Eskom Holdings SOC Limited

ESKOM MINIMUM EMISSION STANDARDS EXEMPTION APPLICATION FOR TUTUKA STATION

December 2024

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Eskom Holdings SOC Limited

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INDEX AND REPORT STRUCTURE

	7.3. Socio-Economic Impacts	66 – 69	Highlights socio-economic impacts.
Ch. 8: Stakeholder Engagement	All	69 – 72	Presents the stakeholder engagement process followed, including methods of notification and meeting dates and venues.
Ch. 9: Assumptions and Limitations	N/A	73	Presents the assumption and limitations applicable to the application.
Appendix A	N/A	N/A	Power station specific Atmospheric Impact Report
Appendix B	N/A	N/A	Cumulative airshed Atmospheric Impact Report
Appendix C	N/A	N/A	Cumulative stack only emissions dispersion modelling results
Appendix D	N/A	N/A	Airshed Health Cost Benefit Analysis

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AEL	Atmospheric Emissions Licence
AOA	Annual Operational Analyses
AP-HRA	Air pollution health risk assessments
APHR-BCA	Air Pollution Health Risk Benefit Cost Analysis
AQMP	Air Quality Management Plan
AQO	Air Quality Offsets
ARM	Air Resource Management
BAT	Best Available Technology
BCA	Benefit-cost analysis
BPFS	Biodiversity Plan Free State Province
BU	Business Units
CAPEX	Capital Expenditure
CRA	Concept Release Approval
CV	Calorific value
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DHP	Dust Handling Plant
DSI	Dry Sorbent Injection
DWS	Department of Water and Sanitation
EAF	Energy Availability Factors
EIA	Environmental Impact Assessment
ERF	Exposure-response functions
ERI	Eskom Rotek Industries
ERP	Emission Reduction Plan
ESA	Ecological Support Area
EWE	Extreme Weather Events
FDDM	Fezile Dabi District Municipality
FEPA	Freshwater Ecosystem Priority Areas
FGD	Flue Gas Desulphurisation
GBV	Gender-Based Violence
GCD	Group Capital Department
GDP	Gross Domestic Product
GHG	Greenhouse Gases

Acronym/Abbreviation	Definition
GHGP	Greenhouse Gas Protocol
GVA	Gross Value Added
HFPS	High Frequency Power Supplies
I&AP	Interested and Affected Parties
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent Power Producers
IRP	Integrated Resource Plan
IVRSv	Integrated Vaal River System
LCOE	Levelised cost of electricity
JET	Just Energy Transition
LNB	Low NO_x burner
LPG	Liquid Petroleum Gas
MES	Minimum Emission Standards
MLM	Metsimaholo Local Municipality
Mt	Megatonnes
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NCCAS	National Climate Change Adaptation Strategy
NCCRP	National Policies such as the Climate Change Response
NDC	Nationally Determined Contribution
NDP	National Development Plan
NECA	National Environmental Consultative and Advisory
NECOM	National Energy Crisis Committee of Ministers
NEMAQUA	National Environmental Management: Air Quality Act
NERSA	National Energy Regulator of South Africa
NGER	National Greenhouse Gas Emission Reporting
NO_x	Nitrogen Oxides
NPV	Net Present Value
NWA	National Water Act (No. 36 of 1998)
OEMs	Original Equipment Manufacturers
OFA	Over-fire Air
OIP	Offset Intervention Plan
Opex	Operating Expenditure
PCD	Pollution Control Dam
PF	Pulverised fuel

Acronym/Abbreviation	Definition
PJFF	Pulse Jet Fabric Filter
PM	Particulate Matter
PMV	Planning, Monitoring and Verification
PPE	Personal Protective Equipment
PV	Photovoltaic
RR	Relative Risk
R&R	Repowering and Repurposing
ROI	Return on investment
SAPS	South African Police Service
SAWS	South African Weather Services
SCR	Selective Catalytic Reduction
SO_2	Sulphur dioxide
SPF	Spray Polyurethane Foam
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compounds
VRESS	Vaal River Eastern Sub-system
VSL	Value of a statistical life
VTAPA	Vaal Triangle Airshed Priority Area
WBCSD	World Business Council for Sustainable Development
WCWDM	Water Conservation and Water Demand Measures
WHO	World Health Organisation
WMO	World Meteorological Organisation
WRI	World Resources Institute
WTP	Willingness to Pay

CONTENTS

TABLES

FIGURES

APPENDICES

APPENDIX A

POWER STATION SPECIFIC ATMOSPHERIC IMPACT REPORT

APPENDIX B

CUMULATIVE ATMOSPHERIC IMPACT REPORT

APPENDIX C

CUMULATIVE STACK ONLY EMISSIONS DISPERSION MODEL

APPENDIX D

HEALTH COST BENEFIT ANALYSIS

EXECUTIVE SUMMARY

Eskom Holdings SOC Ltd (Eskom) is South Africa's public electricity utility, supplying about 95% of the country's electricity with a generation capacity exceeding 35,000 MW. Around 90% of its power comes from coal-fired stations, primarily located in the Mpumalanga Highveld, with others in the Free State and Limpopo provinces.

Coal-fired power stations must comply with strict environmental regulations under the National Environmental Management: Air Quality Act (NEM:AQA). Eskom sought postponements and alternative limits to the Minimum Emission Standards (MES) for oxides of nitrogen (NO_x), sulphur dioxide (SO_2) and particulate matter (PM) between 2018 and 2020. These applications were necessary due to several factors, such as the restrictive legal framework, the advanced age of Eskom's power plant fleet, and the technical challenges of reducing emissions. The high costs of emission reduction technologies, which could significantly impact electricity tariffs and the financial stability of the utility, further underscored the need for a phased approach to compliance.

In October 2021, the Department of Forestry, Fisheries, and the Environment (DFFE) granted conditional postponements for some power stations (Grootvlei, Arnot, Komati, Camden, Hendrina, Acacia, and Port Rex Power Stations), provided partial refusals for others (Majuba, Tutuka, Kendal, and Kriel), and rejected the applications for Lethabo, Matla, Medupi, Matimba, and Duvha.

In December 2021 Eskom initiated an appeal process, engaging with the DFFE, and other governmental departments, on the basis that immediate compliance would lead to the shutdown of about 16,000 MW of coal-fired capacity. Eskom emphasised that this would negatively impact the national grid and delay South Africa's energy transition, that flu gas desulphurisation (FGD) retrofit on "six-pack" power stations was not proven to be technically feasible and would be a world first, and that if funding was available to execute the required compliance projects in time to meet the MES, this would result in an approximate increase of 10% on existing electricity tariffs (Eskom, 2020).

In May 2024, the Minister approved the MES suspensions for the power stations set to shut down by 31 March 2030 (Hendrina, Grootvlei, Arnot, Camden, and Kriel) and, under Section 59 of NEM:AQA, instructed Eskom to apply for MES exemptions for the remaining stations (Lethabo, Kendal, Tutuka, Matla, Duvha, Majuba, Matimba, and Medupi). The Minister would then assess each application based on its merits and supporting information.

This report details the exemption application for Tutuka Power Station, highlighting the specific environmental and operational challenges it faces. While the primary focus is on Tutuka the report also addresses broader issues affecting the entire Eskom Fleet. This holistic approach is necessary as a particular station's circumstances cannot be considered in isolation of the entire Eskom Fleet as station performance, emissions impacts, and financial impacts need to be considered cumulatively. By considering the entire Eskom fleet, the report aims to provide a cohesive strategy for achieving compliance while addressing the unique challenges of each power station

South Africa faces the complex challenge of ensuring energy security, affordability and access, and sustainability, compounded by high unemployment, inequality, unreliable power generation, and reliance on coal. Eskom's Just Energy Transition (JET) Strategy was developed to address these issues. As Eskom's coal plants near the end of their operational life, there is a risk of declining living standards and local community well-being if no action is taken. The JET Strategy aims to develop new energy capacity while ensuring that power station communities benefit from the transition, thus linking the need for new energy sources with socio-economic improvements.

This dual focus forms the core of Eskom's ambition to achieve a just and equitable energy transition. This involves a gradual shift to renewable energy, aligning with South Africa's broader climate goals and global efforts to mitigate climate change. The development of a renewables-dominant power system aims to create jobs and stimulate economic growth, ensuring that communities reliant on coal power plants benefit from the transition. Eskom has identified repowering and repurposing projects as key components of the JET strategy to preserve jobs and utilize existing grid capacity. Prioritizing power stations in Mpumalanga, these projects will leverage existing infrastructure to build new generation capacity, including solar, wind, batteries, and synchronous condensers. Additionally, the plants will be repurposed into new economic centres with training centres, water treatment facilities, manufacturing plants, microgrid assemblies, and aquaponic farms. This approach aims to retain economic activity, create jobs, and generate new economic opportunities for local communities.

Eskom has already commenced with the largest repowering and repurposing project in emerging markets at Komati, expected to have a significant impact by 2030, comprising ~600 direct full-time jobs, ~370MW of renewable generation capacity, and vocational training. Although Tutuka is not currently part of Eskom's repowering and repurposing plans since it will enter the shutdown phase in 2036, a similar approach will be taken to identify suitable projects and plans aligned with the JET strategy.

To address emission reductions in the Eskom Fleet, Eskom developed an Emission Reduction Plan (ERP) in 2015, with this being updated in 2019 (EERP 2019), 2020 and 2022. In May 2024, as part of the Minister's decision, Eskom were required to review the 2022 ERP, with this having been revised by Eskom in 2024.

Eskom currently has abatement technologies to mitigate PM at all power stations since this is historically the pollutant of most concern considering health impacts, and boilers with low NO_x design at Medupi, Kendal, Kusile, and Camden, with SO_2 abatement technology in the form of flue-gas desulphurisation (FGD) installed at Kusile. Further, Eskom is currently taking steps to further reduce emissions at the stations, with several abatement equipment upgrades and refurbishments completed, and currently being undertaken, focusing on projects such as electrostatic precipitator (ESP) refurbishments, high frequency power supply (HFPS) installations, sulphur trioxide (SO_3) plant upgrades, and Dust Handling Plant (DHP) upgrades. Eskom are also planning and/or evaluating the following to reduce emissions:

- Wet flue gas desulphurisation (FGD) at Medupi (included in previous ERPs)
- Kendal (semi-dry FGD) and Majuba (Duct Sorbent Injection (DSI FGD)) SO_2 reduction projects have been identified as potential alternatives, although are being evaluated as part of this process.
- Low NO_x Burner (LNB) technology at Majuba, Tutuka and Lethabo to mitigate NO_x emissions.
- Despatch Prioritisation Strategy at specific power stations, initiated to reduce SO_2 emissions, however also positively impacting PM and NO_x emissions.
- Efficiency improvement projects under the Generation Recovery Programme to optimise the air-to-fuel ratio which should abate some SO_2 emissions and maximise combustion efficiency.
- The progressive shutdown of coal-fired stations will reduce overall Eskom Fleet emissions.
- Although not a method of reducing emissions at source (i.e. the power stations), the cumulative impact on neighbouring communities is reduced through the air quality offset (addressing emission

sources within the community) projects already implemented by Eskom, therefore Eskom are looking to expand this beyond the 35,000 households originally planned.

As noted above, Despatch Prioritisation is an ERP 2024 strategy for implementation to reduce emissions. With the integration of alternative energy sources into the national grid as per the Integrated Resource Plan (IRP), coal-fired power stations are expected to operate in a load-following mode, resulting in lower running load factors as renewable sources are prioritized. Despatch Prioritisation aims to reduce SO_2 emissions, especially in older stations, due to the high costs and complexities of installing SO_2 abatement equipment. The Generation Recovery Programme, initiated in March 2023, has improved fleet reliability, enabling better load management. Eskom plans to limit coal station loads to essential levels, using other energy sources to reduce coal consumption, and therefore emissions. However, this strategy depends on the addition of alternative generation sources to the grid. If these sources are delayed or economic growth increases demand, Eskom may be requested by government to operate stations at higher loads, potentially increasing emissions to maintain grid stability.

Key emissions of concern, and regulated by NEM:AQA, are PM, SO_2, and NO_x. The following discussions provide key highlights for each pollutant, considering details such as current performance, planned projects, Eskom Fleet emission reductions and trajectories, and Eskom's exemption request, where applicable. The Eskom Fleet emission reduction trajectories consider four scenario projections:

- ERP 2024 A (PM and NO_x reduction, Despatch Prioritisation strategy, efficiency improvements, and SO_2 abatement at Medupi and Kusile), representing Eskom's planned projection.
- ERP 2024 B (As per ERP 2024 A plus SO_2 reduction technology installed at Majuba and Kendal), representing a projection, that with additional guarantees and strategic decisions, could be achieved.
- ERP 2024 C (As per ERP 2024 A and B, plus SO_2 reduction technology at Matimba, Lethabo and Tutuka), representing a projection that would require substantial guarantees and considerations of the significant financial impacts, such as on electricity tariffs.
- Eskom's Security of Supply Projection developed using conservative assumptions such as higher electricity demands due to a growing economy, a delay in IPP projects, and a delay in Kusile U6 generating unit coming online.

PARTICULATE MATTER

Presently ambient air quality monitoring shows PM to be non-compliant in the Highveld and Vaal Triangle, with this impacted by multiple sources, such as Eskom power stations, mining, industrial activities, uncontrolled waste burning, veld fires, and domestic fuel burning; importantly, the non-compliant ambient concentrations are not only due to Eskom emissions. Cumulatively the Eskom Fleet shows a significant reduction in PM stack emissions in the coming years due to the various abatement projects being implemented. Eskom's emission trajectories for the options of ERP 2024 A, ERP 2024 B, and ERP 2024 C, show identical trajectories as the same PM abatement projects are planned for each. By FY2030, these show a 65-kilo tonne (kt) reduction from FY2025, representing a 74% decrease, due to PM abatement projects implemented in the fleet and stations entering shutdown phase.

Despite the significant PM emission reduction, and although the dispersion modelling indicated compliant PM_{10} annual average concentrations, non-compliant 24-hour PM_{10} concentrations are predicted, as well as non-compliant annual and 24-hour average $PM_{2.5}$ concentrations; although, the conservative approach to the PM simulations providing an absolute worst-case scenario must be considered. The predicted ambient PM concentrations are predominantly due to the low-level fugitive sources, rather than the stack emissions themselves; the benefit of the stack emissions reductions, as evident in the trajectories, is over-shadowed by the impacts associated with fugitive emissions. This conclusion is supported by the additional dispersion modelling undertaken to assess particulate matter emissions only from the stacks, which showed full compliance with the annual and 24-hour average PM_{10} and $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS), with no exceedances predicted, indicating ground-level impacts associated with stack emissions are well below the NAAQS.

While the abovementioned emission trajectories show significant improvements in the next few years, to offset Eskom PM emissions further, Eskom has introduced an air quality offset (AQO) program, a key component of Eskom's ERP. This program aims to offset PM emissions by implementing interventions that deliver net ambient air quality benefits within communities impacted by Eskom's stations, focusing on PM_{10} and $PM_{2.5}$. Key interventions include the distribution of hybrid stoves, ceilings, electrical rewiring, and LPG heaters to households, as well as cleanup campaigns to remove illegally dumped waste. The program has been implemented in phases, with Phase 1 targeting Kwazamokuhle, Ezamokuhle, and Sharpeville. Preliminary results show significant reductions in PM_{10} and $PM_{2.5}$ concentrations and improvements in indoor air quality in participating households. Eskom plans to expand its AQO program to additional communities and explore new interventions, such as dust suppression on unpaved roads, and veld fire management.

Considering Tutuka, exceedances of the existing plant limit (300mg/Nm^3) have occurred, and to achieve MES compliance, several PM abatement projects are being implemented. Amongst the key projects include ESP upgrades on Unit (U) 1, U2, U3, and U4 (U5 and U6 complete); HFPS installations on U1, U2, and U3 (U4, U5 and U6 are complete); SO_3 flue gas conditioning; and DHP refurbishments on U1 and U2.

Following the completion and optimisation of these projects, Tutuka will achieve MES compliance, although the projects will not be fully complete on all units until 1 April 2027, after the 1 April 2025 deadline. Given this and considering the Eskom Fleet PM emission reductions between FY2025 – FY2028, Tutuka is requesting exemption from the new plant PM MES until completion of the abatement projects (1 April 2027).

NITROGEN DIOXIDE

Ambient nitrogen dioxide (NO_2) concentrations in the Highveld and Vaal Triangle indicate compliance with the annual and hourly NAAQS. Cumulatively, the Eskom Fleet's emission trajectory shows significant decreases, and by FY2030 would have reduced by 292kt (40%), and by a further 574kt (78%) by FY2050. These reductions are predominantly due to the LNB installations at Lethabo, Tutuka, and Majuba, as well as assumed station shutdowns commencing. The dispersion modelling, undertaken to assess each of the trajectories (ERP 2024 A, ERP 2024 B, and ERP 2024 C), shows full compliance with the NAAQS at all receptors. Further, Scenario 1 and Scenario A (of the dispersion modelling scenarios), both of which do not include the LNBs at Lethabo, Tutuka, and Majuba, still predicts full compliance with the NAAQS.

Currently, Tutuka is compliant with the existing plant limit (1,200mg/Nm^3), with no exceedances of this limit; Tutuka will not achieve compliance with the new plant MES (750mg/Nm^3) without the installation of NO_x abatement. LNB installation is scheduled to commence in FY2025, with completion by FY2029, after which Tutuka will comply with the new plant MES. For this reason, Tutuka is requesting exemption from the new plant NO_x MES until 1 April 2029 (Table 0-2). Important considerations in this request include:

- The currently compliant ambient NO_2 concentrations in the Highveld and Vaal areas, recognising Eskom is currently contributing to these concentrations at current emission rates.
- The dispersion modelling predictions indicating concentrations associated with the Eskom Highveld and Vaal Fleet emissions, including Tutuka, remain compliant with the NAAQS under all scenarios.
- The cumulative Eskom Fleet NO_x emission reductions.

SULPHUR DIOXIDE

From 2021 to 2023, SO_2 concentrations in the Highveld and Vaal Triangle complied with the annual NAAQS across all monitoring stations. The Eskom Fleet trajectories show similar emissions until FY2032, when Majuba's DSI is completed, after which ERP 2024 B and ERP 2024 C reduce further. ERP 2024 C emissions are lower than ERP 2024 B in 2036, as ERP 2024 C also includes SO_2 abatement at Lethabo and Tutuka. Considering ERP 2024 A (Eskom planned option), by FY2030, a decrease of 555kt (32%) will be achieved across the fleet, with a further decrease of 165kt (14%) to FY2035. The dispersion modelling, undertaken to assess each of these scenarios, predicted full compliance for ERP 2024 A, ERP 2024 B, and ERP 2024 C, while also showed full compliance for the additional modelling scenarios simulated. Despite the differences in SO_2 abatement between ERP 2024 A (Kusile), ERP 2024 B (addition of Kendal, and Majuba), and ERP 2024 C (addition of Lethabo and Tutuka), all model predictions showed full compliance.

Currently, Tutuka is compliant with the existing plant limit (3,400mg/Nm³), with no exceedances of this during FY2023/24, although to achieve new plant MES compliance, Tutuka would require an FGD, or similar abatement technology. Semi-dry FGD would be the most suitable for Tutuka, however Eskom has consistently motivated in previous applications that an FGD at Tutuka is not feasible and has therefore not commenced with concept and design. Should Tutuka be required to install an FGD, if deemed technically feasible, installation would only commence in 2031, with a best-case completion date of 2035, with Tutuka entering shutdown phase in 2036, well before return on investment is realised. Eskom maintains this position in this application; considering the costs of an FGD (R39 billion nominal Capex and an Opex of R1 billion annually), timeframes until installation is complete, additional water requirements (23% increase on current Tutuka requirements), and the additional waste produced (827kta) requiring a new disposal facility. While CO_2 emissions will also increase due to the FGD, approximately 194kt per month for Tutuka's remaining life, this will have little impact on Eskom's 2031 target for CO_2 emissions from fossil fuel generation.

Since Tutuka is unable to comply with the new plant MES without SO_2 abatement technologies, and it is not considered economically feasible to install these, to reduce SO_2 emissions, although recognising not to MES compliance, Tutuka will reduce emissions through efficiency improvement projects and Despatch Prioritisation.

Tutuka is currently required to comply with an SO_2 daily average emission limit of 3,400mg/Nm³ and required to comply with the new plant emission limit of 1,000mg/Nm³ by 1 April 2025. Since it is not economically feasible to install an FGD at Tutuka, Tutuka is requesting exemption from the new plant MES until shutdown (Table 0-2). Important considerations in this request include:

- The currently compliant ambient SO_2 concentrations in the Highveld and Vaal areas, recognising Eskom is currently contributing to these concentrations at current emission rates.

- The dispersion modelling predictions indicating cumulative concentrations associated with the Eskom Highveld and Vaal Fleet emissions, including Tutuka, remain compliant with the NAAQS. In addition, ERP 2024 A, which assumes only SO_2 abatement at Kusile with all remaining stations emitting at current rates (including Tutuka), still shows full compliance with the NAAQS.
- The cumulative Eskom Fleet SO_2 emission reductions that will be achieved.
- The costs associated with the installation of FGD at Tutuka, with installation completion only occurring one to two years before station shutdown commences.

HEALTH COST BENEFIT ANALYSIS

While the above discussions are pollutant specific, consideration needs to be given to the health cost benefit analysis (CBA) undertaken for the Eskom Highveld and Vaal Triangle Fleet, which considers benefits and costs as a combination of pollutants. The CBA uses exposure-response functions (ERFs) to estimate the health benefits in terms of reduced mortality rates due to lower pollutant levels. The value of a statistical life (VSL) is applied to monetize these health benefits. The CBA assessed the implementation of various emission reduction technologies, evaluating the health benefits and costs associated with the ERP 2024 A, ERP 2024 B, and ERP 2024 C projections. The benefit:cost ratios (BCR) need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health have to be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the cost benefit ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios (Prime Africa Consult, 2024).

The analysis reveals that ERP 2024 A, which includes PM and NO_x reduction and Despatch Prioritisation, has a benefit-cost ratio (BCR) greater than 1, indicating that health benefits exceed costs. ERP 2024 B, which adds SO_2 reduction at Majuba and Kendal, approaches a BCR of 1 in optimistic scenarios but generally shows lower benefits relative to costs. ERP 2024 C, which includes full compliance with MES for SO_2 at Lethabo and Tutuka, has a BCR significantly less than 1, suggesting that the costs far outweigh the health benefits, especially given the short operational period before decommissioning. In summary, greatest benefits relative to costs are evident from ERP 2024 A, which assumes all PM and NO_x reduction projects as planned, with SO_2 abatement only installed at Kusile. The analysis underscores the importance of considering both economic and health impacts in decision-making for emission reduction strategies.

SUMMARY

Table 0-1 summarises key information associated with each ERP scenario, including the health BCR for the Highveld and Vaal Fleet.

Table 0-1 – Eskom Fleet ERP Summaries and Impacts

	ERP 2024 A (Current Plan)	ERP 2024 B (Partial Compliance)	ERP 2024 C (Full MES Compliance)	ERP 2024 A (Current)	ERP 2024 B (Partial Compliance)	ERP 2024 C (Full MES Compliance)
	Eskom Fleet (cumulative)			Tutuka		
SO_2 Abatement	Kusile, Medupi FGD	Kusile, Medupi, Kendal (FGD), Majuba (DSI)	Kusile, Majuba, Kendal Matimba, Medupi, Tutuka, Lethabo (FGD)	-	-	FGD
NO_x Abatement	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	LNB	LNB	LNB
PM Abatement	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Tutuka ESP and DHP upgrades; HFPS installations	Tutuka ESP and DHP upgrades; HFPS installations	Tutuka ESP and DHP upgrades; HFPS installations
CAPEX (nominal)	R77.2 billion	R153.1 billion	R257 billion	R5,6 billion	R5,6 billion	R39 billion
Benefit:Cost Ratio, Central (Highveld Only)	1.74	0.55	0.33	-	-	R1 billion

Eskom is requesting exemption from the new plant MES for PM, NO_x, and SO_2 at Tutuka. While compliance with the PM and NO_x new plant MES will be achieved once abatement equipment installations are complete, compliance with the SO_2 new plant MES cannot be achieved without abatement. As presented, Eskom maintains its position that installation of an FGD, or similar technology, at Tutuka is not feasible, predominantly due to the cost and timeframe of installation, with this only being complete one to two years before Tutuka enters shutdown. Eskom's exemption request is supported by the currently compliant ambient SO_2 concentrations in the area, as well as the dispersion modelling indicating cumulative Eskom contributions to ambient concentrations remain in compliance with the NAAQS. Further to this, the CBA undertaken for this application indicates the costs to achieve full SO_2 MES compliance (ERP 2024 C) far outweigh the health benefits that will be realised from this compliance, while also concluding that most health benefits, relative to costs, will be achieved in ERP 2024 A, which plans for SO_2 abatement only at Kusile.

Strict adherence to the legal framework and regulations (i.e., MES) will require Tutuka generating units to be taken offline, which will reduce available capacity in the grid, resulting in an increased degree of loadshedding. Approximately 3,654 MW at Tutuka will be at risk, and should generating units need to be shutdown, will likely trigger load-shedding, and could significantly affect the economy, employment, standard of living, government revenue, electricity supply and investor confidence.

A balanced approach to energy policy is required, aiming to reduce reliance on coal while expanding renewable and lower-emission energy sources, although the roll-out of these transitions has been slow. Aligning with the National Energy Crisis Committee (NECOM) Energy Action Plan, Eskom aims to address the energy gap with immediate solutions such as demand reduction, accelerating the construction of new generation and storage capacity, improving infrastructure, and enhancing Eskom's operational efficiency.

From an economic/financial perspective a defined minimum load factor/take or pay agreement would ensure that the unit costs are acceptable compared to known alternatives, however if consideration could be given to the extension of the station life the economic/financial viability could improve.

While extension of a station's life may provide improved viability, this would mean an extension of South Africa's reliance on coal generation, potentially impacting South Africa's GHG commitments. A possible alternative to consider, would be that if funding is made available Eskom increases its investments in renewables and grid connection by the same amounts that would have been invested in such SO_2 retrofits; this would result in larger economic value add than FGD retrofits, and would progress South Africa's transition to renewables quicker.

Considering the above, and in summary, Tutuka is requesting exemption from the PM, NO_x, and SO_2 new plant MES, and requests the limits presented in Table 0-2 be applied, and remain applicable to Eskom as emission targets in terms of the Priority Area Plans. To achieve partial MES compliance (PM and NO_x), as requested for Tutuka, a nominal Capex of R5.6 billion will be incurred. To achieve full MES compliance, a nominal Capex of R44.6 billion would be incurred, with an annual Opex of approximately R1 billion required.

Table 0-2 - Emission limits requested for Tutuka

POINT SOURCE CODE	POLLUTANT	MAXIMUM RELEASE RATE*			DURATION OF EMISSIONS
		MG/NM³	AVERAGE PERIOD	DATE TO BE ACHIEVED	
Stack 1 (U1-3) Stack 2 (U4 -6)	SO_2	3,000 mg/Nm³	Daily	Immediate - shutdown	Continuous
	NO_x	1,100 mg/Nm³	Daily	Immediate	Continuous
		750 mg/Nm³	Daily	1 April 2029	Continuous
	PM	300 mg/Nm³	Daily	Immediate	Continuous
		50 mg/Nm³	Daily	1 April 2027	Continuous
*Emission limits requested are for normal operations, so exclude upset, startup, shutdown, or maintenance conditions.					

The public participation phase is complete, which commenced on 6 November 2024 and ended 6 December 2024. The comments received during this process have been responded to, as contained within the Stakeholder Engagement Report. The final Exemption Application reports will be submitted to the Minister of the DFFE to consider the applications. Any further comments can be directed to the Minister.

1 INTRODUCTION

Eskom Holdings SOC Ltd (Eskom) is the public electricity utility company of South Africa, as of 2024, Eskom is responsible for supplying approximately 95% of electricity to South Africa's national grid, with an available generation capacity exceeding 35,000 MW (Eskom, 2024). Eskom's role is to help reduce the cost of doing business in South Africa, supporting economic growth, and ensuring a stable electricity supply by delivering power efficiently and sustainably. This mandate is guided by its vision and mission, which aim to enhance the quality of life for people in South Africa and the surrounding region, while maintaining a clean and healthy environment.

Eskom is responsible for generating, transmitting, and distributing electricity across the country and to neighbouring countries such as Namibia, Botswana, Zambia, Zimbabwe, and Mozambique. Approximately 90% of Eskom's generating capacity comes from coal-fired power stations, most of which are located in the Mpumalanga Highveld, with others such as Lethabo Power Station located in the Fezile Dabi District Municipality of the Free State province, and Matimba and Medupi Power Stations located in Limpopo's Waterberg District (Figure 1-1).

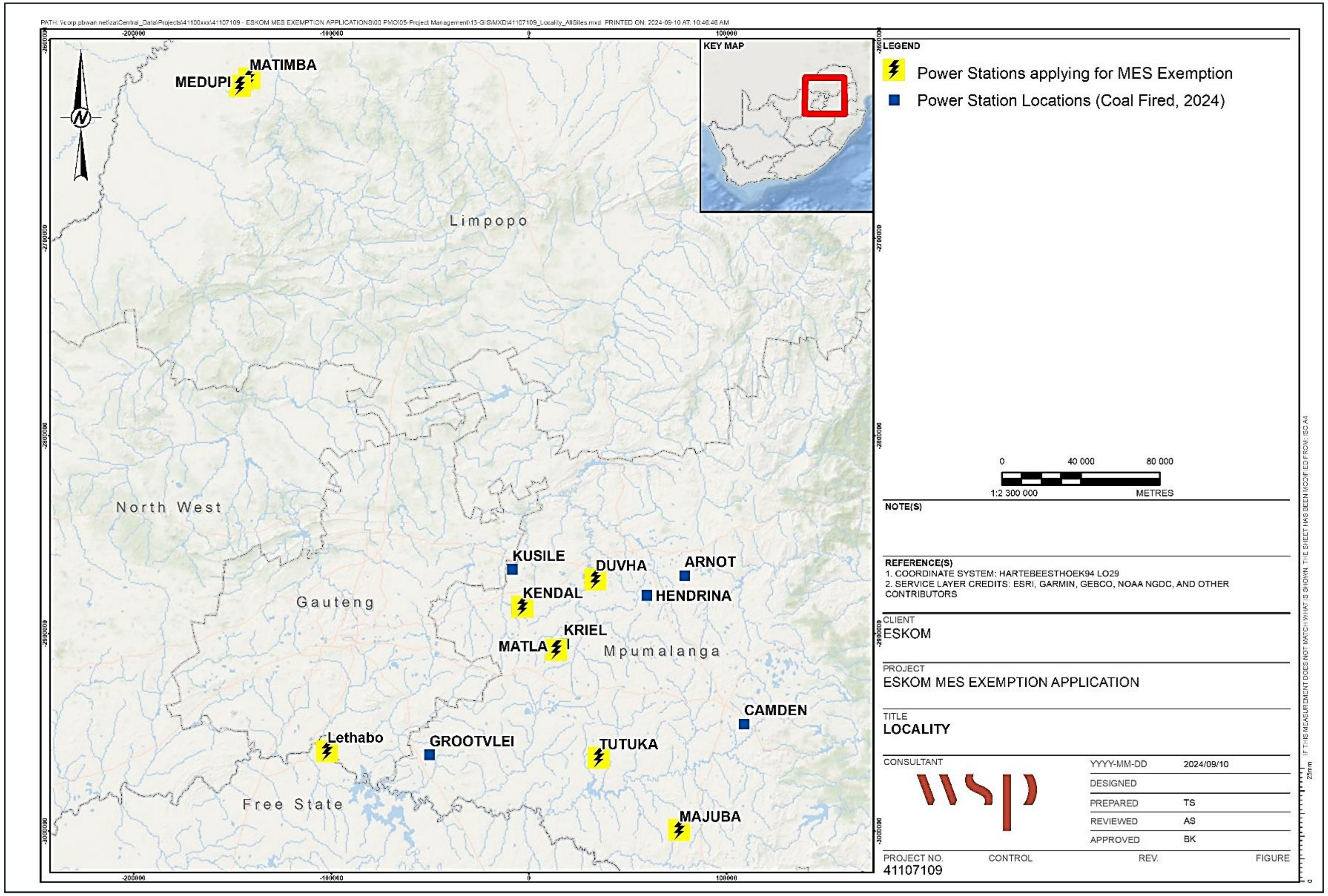


Figure 1-1: Eskom's coal-fired power station distribution

Coal-fired power stations are subject to strict environmental regulations and monitoring due to their emissions. In terms of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA), all coal and liquid fuel-fired power stations are required to meet the minimum emission standards (MES) contained in GNR 893 that was issued on 22 November 2013 (as amended by GNR 1207 on 31 October 2018) and promulgated in terms of Section 21 of the NEM:AQA. GNR 893 (as amended by GNR 1207) also provides for transitional arrangements in respect of the requirement for existing plants to meet the MES and provides that less stringent 'existing plant' limits must be achieved by 1 April 2015 for existing plants, and more stringent 'new plant' limits must be achieved by existing plants by 1 April 2020 unless specific legal indulgences are obtained.

Between 2018 and 2020, Eskom submitted applications for postponement, suspension and/or alternative limits to the MES for several of its power stations to the Department of Environmental Affairs (now the Department of Forestry, Fisheries, and the Environment (DFFE)) as the power utility sought more time to implement necessary pollution control technologies for nitrogen oxides (NO_x), sulphur dioxide (SO_2) and particulate matter (PM) emissions. These applications were necessary due to several factors, such as the restrictive legal framework, the advanced age of Eskom's power plant fleet, and the technical challenges of reducing emissions. Eskom's commitment to a Just Energy Transition (JET) and its broader climate change strategy also influenced this decision. The high costs of emission reduction technologies, which could significantly impact electricity tariffs and the financial stability of the utility, further underscored the need for a phased approach to compliance. Eskom's applications aimed to balance its legal obligations with the need to maintain stable electricity supply in South Africa (Eskom, 2020).

In response to Eskom's applications, the DFFE granted conditional postponements for several Power Stations in October 2021 (Grootvlei, Arnot, Komati, Camden, Hendrina, Acacia, and Port Rex Power Stations) through its National Air Quality Officer (NAQO); while partial refusals were issued for Majuba, Tutuka, Kendal, and Kriel Power Stations. However, the postponement applications for Lethabo, Matla, Medupi, Matimba, and Duvha Power Stations were rejected, citing concerns over the potential health impacts and the long-standing environmental challenges posed by emissions from the coal-fired power stations.

Eskom initiated an appeal process for the partial refusals and rejections on 13 December 2021, engaging with the DFFE and other governmental departments, on the basis that immediate compliance would lead to the shutdown of about 16,000 MW of coal-fired capacity. Eskom emphasised that this would negatively impact the national grid and delay South Africa's energy transition, and that flu gas desulphurisation (FGD) retrofit on "six-pack" power stations was not proven to be technically feasible and would be a world first. Eskom further argued that the cost of full compliance to the MES is estimated at R300 billion; and will not add any additional capacity to the national grid. Eskom added that if funding was available, and if it were possible to execute all the compliance projects in time to meet the requirements, these projects would add at least 10% to the existing electricity tariff.

Subsequently, appeals were lodged in respect of the NAQO's decisions concerning Eskom's Kendal, Tutuka, Majuba, Camden, Hendrina, Arnot, Komati, Grootvlei, and Kriel Power Stations on 9 February 2022. These appeals led to the establishment of the National Environmental Consultative and Advisory (NECA) Forum, in August 2022, by the Minister of Forestry, Fisheries and the Environment (Minister) to provide guidance on MES issues.

On the 23rd of May 2024 the Minister issued its decision on the appeals made by Eskom, and other parties, with regards to the NAQO's decision made in October 2021. The decision prescribed that for power stations scheduled to be shut down by 2030 (Hendrina, Grootvlei, Arnot, Camden, and Kriel Power Stations), Eskom's request to suspend the MES limits was approved, with a further requirement to submit shutdown plans within 12 months to facilitate closure by 31 March 2030. For the remaining power stations, comprising Matla, Duvha, Tutuka, Kendal, Lethabo, Majuba, Matimba, and Medupi, Eskom was instructed to apply for an exemption under Section 59 of the NEM:AQA within 60 days from 23 May 2024. However, thereafter the Minister granted an extension to the 10th of December 2024 to apply for this exemption. The Minister would then assess each application based on its merits and supporting information. As part of this submission, Eskom was directed to notify all relevant stakeholders and provide them an opportunity to comment on the exemption applications, for inclusion in the submission.

Eskom has appointed WSP Group Africa (Pty) Ltd (WSP), as an independent service provider, to support on the exemption applications required in terms of the Minister's decision. This report is specific to the exemption request in terms of Section 59 of the NEM:AQA for the Tutuka Power Station. This report must be read in conjunction with the Eskom fleet approach to the MES.

This report provides a comprehensive overview of the MES exemption application for Tutuka Power Station, detailing its background and the legal framework governing its operations. It outlines the Eskom's JET and repurposing plans, along with Eskom's emission reduction strategies and proposed emission limits. The report also examines the health and environmental impacts associated with the power station and discusses the financial consequences of compliance.

This draft MES exemption application report will be made available for public review to provide interested and affected parties (I&APs) the opportunity to comment on the report. Comments received during the public review period will be acknowledged and recorded in the final exemption application report submitted to the Minister for decision-making.

2 STATION BACKGROUND

Tutuka power station is a coal-fired power plant located 25km away from Standerton, Mpumalanga, South Africa (Figure 2-1). Commissioned in 1985, the station's final unit was synchronized with the national grid in 1991.

With an installed capacity of 3,654MW, comprising six generating units, each with a capacity of approximately 609 MW. These units use tangentially fired, dry-bottom boilers designed for low-quality coal, which is plentiful in the area, and comprise of a boiler, a turbine coupled to a generator-rotor, control and auxiliary support systems.

Coal is sourced from nearby mines, such as the New Denmark Colliery, ensuring a steady and cost-effective supply. The planned shutdown for the station is from FY 2030 to FY2041 with the retirement of its individual units staggered throughout these years. The final shutdown will be subject to obtaining all the necessary governance approvals from the National Energy Regulator of South Africa (NERSA), DFFE, National Treasury, and other relevant authorities.

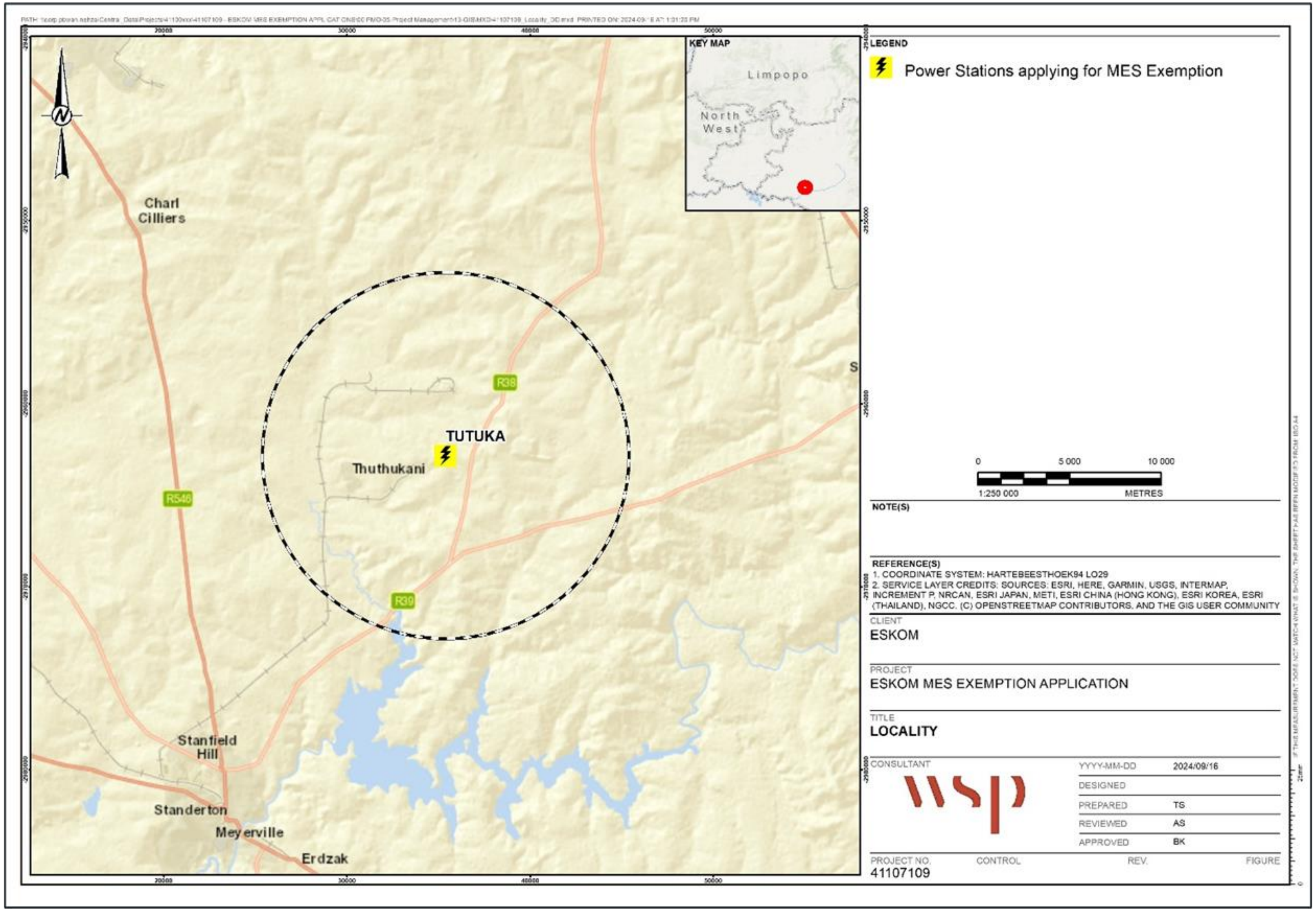


Figure 2-1: Locality Map for Tutuka

The predominant land use surrounding Tutuka is agriculture, as depicted by the cultivated lands and grasslands (Figure 2-2). Mines and quarries are found on the eastern side and the northern side of the power station. A small residential area, Thuthukani is the nearest residential area to Tutuka. Other populated areas include Sakhile, Kosmospark, Flora Park and Meyerville.

Depression, seep and valley-bottom wetlands are located east of the power station. Consequently, Tutuka falls within Critical Biodiversity Area (CBA). CBAs constitute the planning units which if not included in the final portfolio (selection of planning units) will result in the pre-defined targets not being achieved. They are therefore identified based in the irreplaceability output of the Conservation Plan. Together with protected areas, CBAs ensures that a viable representative sample of all ecosystem types and species can persist. Therefore, the surrounding areas around Tutuka are to be to maintain for ecological functions.

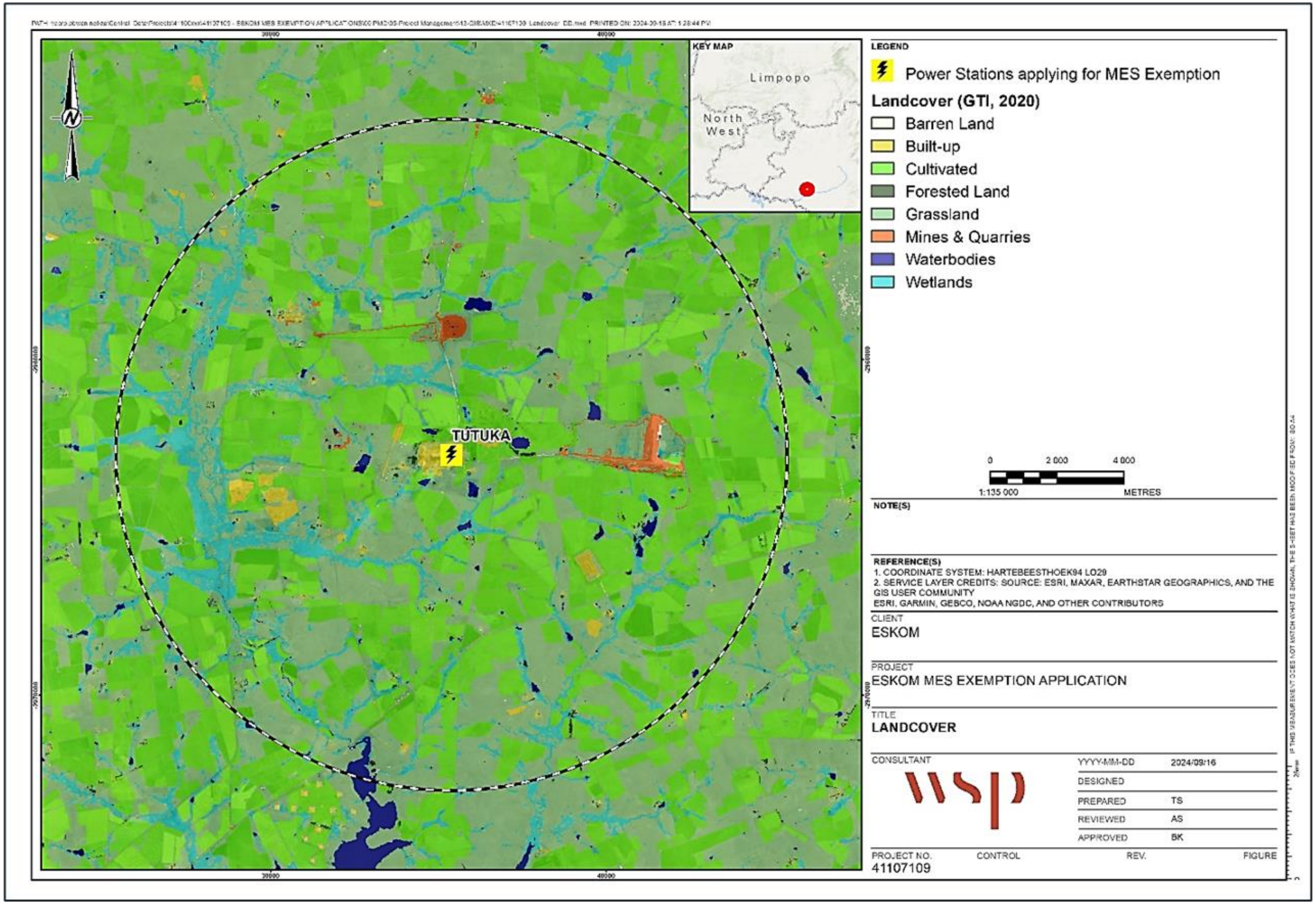


Figure 2-2: Land Cover Map for Tutuka Power Station

3 LEGAL FRAMEWORK

3.1 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT

The overarching piece of legislation that governs air quality management in South Africa is the NEM:AQA, administered and enforced by the DFFE, Metropolitan, District and Local authorities.

The NEM:AQA focuses on the protection of 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".

The NEM:AQA is therefore the key legislative framework for managing and controlling air quality in South Africa, particularly with respect to industrial activities such as coal-fired power stations. The Act plays a critical role in regulating air pollution from these facilities, ensuring that emissions are minimised to protect human health and the environment.

3.1.1 SECTION 21 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT – LISTING OF ACTIVITIES

In terms of Section 21 of the NEM:AQA a list of activities which result in atmospheric emissions and which the Minister or MEC reasonably believes, have or may have a significant detrimental effect on the environment, must be promulgated. Sections 22, 36 to 49, 61 and 62 provide additional information regarding the Atmospheric Emissions Licence (AEL) requirements and processes to be followed.

GNR 893 (22 November 2013), as amended, promulgated in terms of the NEM:AQA, contains a list of activities that would require licensing. The activities applicable to Tutuka Power Station comprise of:

- Subcategory 1.1: Solid Fuel Combustion Installations.
- Subcategory 2.4: Storage and handling of Petroleum Products.
- Subcategory 5.1: Storage and handling of Ore and Coal.

Tutuka Power Station was issued with an AEL (ref. Lekwa/Eskom H SOC Ltd TPS/0013/2019/F03), in April 2019 by the Gert Sibande District Municipality for Subcategory 1.1: Solid fuel combustion installations, 2.4 Storage and handling of petroleum products and 5.1 Storage and handling of Ore and Coal. This AEL expired in April 2024. However, Eskom was advised that the renewal thereof will be undertaken once the Tutuka Power Station exemption application has been finalised.

3.1.2 THE MINIMUM EMISSION STANDARDS

In March 2010, the MES was published in terms of the NEM:AQA. The intent is that by setting these emission limits (known as point source limits), overall air quality at the local or ambient level, as defined by the National Ambient Air Quality Standards (NAAQS), will be maintained. In terms of the NEM:AQA, all of Eskom's coal- and liquid fuel-fired power stations are required to meet the MES contained in GNR 893, and as amended in GNR 1207. The MES also provides transitional arrangements in respect of the requirement for existing plants to meet the MES and provided that less stringent limits had to be achieved by existing plants by 1 April 2015, and more stringent "new plant" limits had to be achieved by existing plants by 1 April 2020. The MES applicable to Tutuka Power Station are listed in Table 3-1 below.

Table 3-1 - Minimum emission standards for Category 1: Combustion installations, sub 1.1: Solid fuel installations

SUBCATEGORY 1.1: SOLID FUEL			
Description:		Solid fuels combustion installations used primarily for steam raising or electricity generation.	
Application:		All installations with design capacity equal to or greater than 50 mw heat input per unit, based on the lower calorific value of the fuel used.	
Substance		Plant status	mg/Nm^3 under normal conditions of 10% 0_2, 273 Kelvin and 101,3 kPa.
Common name	Chemical symbol		
Particulate matter	N/A	Existing	100
		New	50
Sulphur dioxide	SO_2	Existing	3 500
		New	1 000
Nitrogen oxides	NO_x	Existing	1 100
		New	750

3.1.3 POSTPONEMENT OR SUSPENSION OF COMPLIANCE TIMEFRAMES

Section 12 of GNR 893 (as amended by GNR 1207) provides for the postponement or suspension of compliance timeframes with the MES under specific conditions. This means that facilities may apply to the NAQO for a postponement or suspension, for a maximum of 5 years, if they are unable to comply with the set standards by the required date.

The applicant must demonstrate current or future projects aimed at ensuring eventual compliance. They should also include an air quality impact assessment detailing the implications of continued emissions on the environment and health and evidence of consultation with I&APs.

Tutuka Power Station's application for postponement from the MES was rejected by the DFFE in October 2021. This decision was appealed by Eskom in December 2021 and a decision was issued by the Minister in May 2024 which directed Eskom to submit an exemption application in terms of Section 59 of the NEM:AQA.

3.1.4 EXEMPTION FROM MINIMUM EMISSION STANDARDS

Section 59 of the NEM:AQA grants any person, or organ of state, the right to apply for exemption from a provision of the NEM:AQA directly to the Minister of DFFE. These exemptions are typically made where compliance with a provision is considered inappropriate often due to requirements being economically or technically unfeasible and exemption are generally time-bound and subject to review by the Minister. The review frequency can vary but often coincides with specific time frames set in the exemption itself.

Section 59 of the NEM:AQA provides Eskom the opportunity to apply for exemption from certain provisions of the NEM:AQA. In terms of Section 59, Eskom is required to advertise the application in at least two newspapers circulating nationally and give reasons for the application. The approval of an MES exemption application could potentially limit the constitutional rights of South Africans by leading to environmental degradation, posing health risks, and creating economic and social challenges. As such, an approval would likely be issued subject to a range of conditions to limit potential negative impacts.

3.2 THE NATIONAL AMBIENT AIR QUALITY STANDARDS

In terms of Section 9 of the NEM:AQA the Minister identified substances in the ambient air that are believed to present a threat to the health, well-being or the environment and has in respect of those substances, established national standards for ambient air quality. These standards provide the permissible amount or concentration of each of the substances in ambient air. The standards contain the averaging periods, concentrations, frequencies of exceedance, compliance dates and reference methods for select substances.

In 2004, the National Ambient Air Quality Standards (NAAQS) were promulgated to better regulate local air quality. The NAAQS define the acceptable levels of environmental risk associated with human exposure to air pollutants. If an area meets the NAAQS, it is considered to have an air quality that poses a legally acceptable level of risk to the environment and human health in South Africa.

The NAAQS relevant to Tutuka Power Station and this exemption application are Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), and Particulate Matter (PM_{10} and $PM_{2.5}$). The NEM:AQA defines ambient air to exclude air regulated by the Occupational Health and Safety Act (No. 85 of 1993).

3.3 REGULATION FOR IMPLEMENTING AND ENFORCING PRIORITY AIR QUALITY MANAGEMENT PLANS

The Regulation for Implementing and Enforcing Priority Air Quality Management Plans of 26 August 2024 (GNR 5153) is a framework established by the South African government to provide for the implementation and enforcement of a priority area air quality management plans, in terms of sections 19(1)(b) and 19(5) of the NEM:AQA, to strengthen air quality management in identified priority areas with high levels of air pollution. It was published for public comment, allowing stakeholders and the public to provide input before it is finalised. These regulations have coincided with The Vaal Triangle Priority Area air quality management plan (AQMP) Implementation Regulations, published under GNR 614 on 29 May 2009, being repealed.

GNR 5153 is aimed at ensuring that designated priority areas meet national ambient air quality standards. The regulations also establish the mandatory steps for implementing emission reduction and management measures, with the government empowered to monitor their effectiveness and enforce compliance where necessary. They apply to various proponents, including those involved in activities like mining, reclamation, or operating controlled emitters such as power stations. These proponents are required to submit emission reduction and management plans, in terms of the Regulations, within six months of the publication of a priority area AQMP. Once these emission reduction and management plans are approved, they must be implemented within specified timeframes. Additionally, any existing priority area AQMPs, published prior to the commencement of these regulations, must be reviewed by the DFFE within two years to include updated emission reduction targets. These measures ensure that compliance is regularly evaluated and enforced across sectors.

Tutuka Power Station is in the Highveld Priority Area (HPA), one of South Africa's key air quality management zones. The HPA, which includes parts of Mpumalanga and Gauteng provinces, was declared a priority area on 23 November 2007 by the South African government. This declaration was prompted by significant air pollution levels primarily driven by coal-fired power stations, heavy industry, and mining operations in the region, including Tutuka Power Station. This region is therefore subject to the HPA AQMP, published in March 2012, for focused air quality management interventions aimed at reducing industrial emissions and protecting public health. The HPA AQMP is presently under review with finalisation expected in 2025.

The HPA AQMP sought to reduce emissions from industries such as power stations and petrochemical plants, with specific focus on reducing SO_2, NO_x, and PM. These pollutants are linked to heavy industrial activities and high levels of air pollution in the HPA. Specific emission limits, including those tied to MES for industries, are a cornerstone of the HPA AQMP. The HPA AQMP requires industries to meet strict MES values and incorporate Best Available Technology (BAT) for emission reduction. These measures include continuous monitoring and improvements, such as reducing fugitive emissions (unintended releases of pollutants, such as dust or gases from industrial activities). The HPA AQMP also calls for offsets to reduce pollution in other areas as compensation when targets are not immediately achievable. In addition, industries are encouraged to regularly review and update their emission reduction strategies to align with evolving environmental policies. Industries are also expected to take measures to reduce ground-level ozone precursors, such as NO_x and volatile organic compounds (VOCs), which pose risks to both health and agriculture.

Hotspot Zones within priority areas, where intervention efforts are to be concentrated, are identified based on predicted levels of ambient air pollution from key pollutants and the potential for exposure. Prioritisation of sources are then ranked based on impacts rather than the extent of their emissions. Tutuka Power Station is situated in the Standerton Hotspot Zone of the HPA. This zone is prioritised due to its significant industrial activities, including coal-fired power generation, which contribute to high levels of air pollution. As a result, interventions for the HPA were developed and Tutuka Power Station, falling within the power generation sector, is expected to comply with all the applicable listed activities for the MES and reduce fugitive emission to ensure compliance with the NAAQS. However, the implementation of regulations relevant to priority areas by authorities must also be done under the consideration and indulgence of any MES postponements, suspensions and exemptions granted to emitters.

Adherence to the HPA AQMP, as it currently stands, is not a legal requirement. The HPA AQMP outlines guidelines and recommended actions for stakeholders in the region to help meet air quality standards. However, while it sets MES and encourages BAT use, its enforcement has been somewhat limited. Non-compliance primarily results in reputational risks or administrative sanctions but is not uniformly enforced across sectors. In terms of the recently published Priority Areas Regulation (GNR 5153) the HPA AQMP must be reviewed within two years of publication of the regulations to include emission reduction targets. Once HPA is reviewed, stakeholders (such as industries, municipalities, and other entities operating within priority areas) will be required to develop emission reduction and management plans indicating how they will comply with the agreed emission reduction targets. The regulation also provides enforcement mechanisms, including fines or penalties for non-compliance, making adherence to such air quality management plans legally enforceable. Thus, with the new regulation, failure to comply would result in legal consequences, strengthening the overall governance and impact of air quality management in priority areas. The Priority Area regulations and the revision of the HPA Plan has been influenced by recent court rulings in respect of poor air quality in the Highveld.

3.4 POLICIES AND LEGISLATION REGARDING CLIMATE CHANGE

Table 3-2 and Table 3-3 outlines relevant policy, guidance and legislation (i.e., includes both International and National policy, guidance and legislation) that provides the framework within which the greenhouse gas (GHG) and climate change issues relevant to Tutuka Power Station have been considered.

Table 3-2 – Applicable climate change related policies, legislation, guidelines and standards - International

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to provide independent scientific advice on climate change. This first assessment report of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC). . Its main role is to provide policymakers with regular assessments of the scientific basis of climate change, its impacts, and possible adaptation and mitigation strategies. While the IPCC does not have direct regulatory authority, its reports and findings play a crucial role in shaping global climate policies and informing decision-makers on how to address climate change.	The IPCC policy guides climate science, adaptation strategies, and emission reduction targets. Developers are encouraged to align with IPCC assessments to mitigate climate risks, manage water resources, and ensure compliance with environmental regulations. Stakeholder engagement and access to climate finance can benefit from this alignment, enhancing Project credibility. IPCC data aids in risk assessment and long-term planning, informing decisions on infrastructure design and Project sustainability. In summary, the integration of IPCC policies into the operations of developers supports climate resilience and aligns with global climate goals. The IPCC advocates for urgent global actions to mitigate climate change, mainly by reducing GHG emissions.
The Paris Agreement, which was adopted in December 2015, is an international accord within the United Nations Framework Convention on Climate Change (UNFCCC). Its main objective is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees Celsius. To achieve this, the agreement aims to enhance the global response to climate change by strengthening countries' abilities to deal with the impacts of climate change and reducing greenhouse gas emissions (2015)	The Paris Agreement does not single out specific industries, rather it sets a framework for nations to develop and submit their own Nationally Determined Contributions (NDCs). These NDCs are country-specific climate action plans that outline the measures and targets each country will undertake to contribute to the global effort in combating climate change. These targets include reductions in emissions from various sectors, including the energy sector, where coal combustion activities play a role. South Africa's commitments are discussed below. The Paris Agreement also emphasises transparency and accountability. Countries are required to regularly report on their GHG emissions and progress towards their NDCs. The Paris Agreement seeks to limit global temperature increases to below 2°C, striving for 1.5°C, through GHG emission reductions. South Africa's commitments under the Paris Agreement is to reduce national emissions.
Greenhouse Gas Protocol (GHGP)	The GHGP is a joint initiative of the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), which arose out of the need to help countries and companies account for, report, and mitigate emissions, based on a report that identified an action agenda to address climate change that included the need for standardised measurement of GHG emissions. The GHGP provides accounting and reporting standards, sector guidance, calculation tools and training for businesses and local and national governments. It has created a comprehensive, global, standardised framework for measuring and managing emissions from private and public sector operations,

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
	value chains, products, cities and policies to enable GHG reductions across the board. This protocol provides a voluntary global standard for measuring and managing GHG emissions.

Table 3-3 - Applicable policies, legislation, guidelines and standards - National

<table>
<tr><th>POLICY, LEGISLATION, GUIDELINE OR STANDARD</th><th>DESCRIPTION</th></tr>
<tr><td colspan="2">National Policy and Strategy</td></tr>
<tr><td>South Africa’s National Climate Change Response Policy White Paper (NCCRP) (2011)</td><td>The National Climate Change Response Policy is a comprehensive strategy to address both mitigation and adaptation in the short, medium and long term (up to 2050).
Strategies are specified for the following areas:
▪ Carbon Pricing.
▪ Water Agriculture and commercial forestry.
▪ Health.
▪ Biodiversity and ecosystems.
▪ Human settlements.
▪ Disaster risk reduction and management.
The policy has two main objectives: first, to manage inevitable climate change impacts through interventions that build and sustain social, economic and environmental resilience and emergency response capacity. Secondly, to make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere.
The NCCRP outlines South Africa’s vision for transitioning to a low-carbon economy.</td></tr>
<tr><td>National Climate Change Adaptation Strategy (NCCAS) (2020)</td><td>The NCCAS provides a common vision of climate change adaptation and climate resilience for South Africa, and outlines priority areas for achieving this vision. It draws on South Africa's National Climate Change Response Policy (NCCRP) (DEA 2011), the National Development Plan (NDP) (NPC 2011), the adaptation commitments included in its NDC, sector adaptation plans, provincial adaptation plans and local government adaptation plans.
The main objective of the strategy is to provide guidance across all levels of government, sectors, and stakeholders affected by climate variability and change. It should also serve as the country's National Adaptation Plan and fulfils the commitment to its international obligations under the Paris Agreement.
The NCCAS aims to enhance the country’s climate resilience and adaptability.</td></tr>
<tr><td>South Africa’s Nationally Determined Contributions (NDC) (2021)</td><td>South Africa updates and enhances its NDC under the Paris Agreement, meeting its obligation under Article 4.9 to communicate NDCs every five years, and responding to the requests in paragraphs 23 to 25 of decision 1/CP.21. The NDC was updated in 2021 to account for developments and increased ambitions since the first submission.
Climate mitigation targets have been updated to:
<table>
<tr><th>Year</th><th>Target</th><th>Corresponding period of implementation</th></tr>
<tr><td>2025</td><td>South Africa’s annual GHG emissions will be in a range from 398-510 Mt CO_2-eq.</td><td>2021-2025</td></tr>
<tr><td>2030</td><td>South Africa’s annual GHG emissions will be in a range from 350-420 Mt CO_2-eq.</td><td>2026-2030</td></tr>
</table>
The NDC outlines adaptation goals and highlights planned mitigation and adaptation efforts and associated costs. The updated NDC highlights the importance of securing access to large-scale international climate finance
South Africa’s NDC includes emission reduction targets under the Paris Agreement.</td></tr>
</table>

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
South African National Greenhouse Gas Emission Reporting (NGER) Regulations (2017)	The Reporting Regulations adheres to the NEM:AQA. The purpose of the National Greenhouse Gas Emissions Reporting Regulations is to introduce a single national reporting system for the transparent reporting of greenhouse gas emissions, which will be used to maintain a National Greenhouse Gas Inventory, allow South Africa to meet its UNFCCC reporting obligations and to inform the formulation and implementation of legislation and policy. The emission sources and data providers who are covered by the Regulations are set out in Annexure 1 and Regulation 4. Energy is included as a sector. The Regulations also set out the reporting requirements, calculation methodology, verification procedure (to be carried out by the National Inventory Unit) and penalties (which include fines and imprisonment). These regulations mandate reporting of GHG emissions to ensure transparency and accountability.
Declaration of Priority Pollutants and Pollution Prevention Plans (2018)	Under Section 29 of the NEM:AQA, Government Notice 710 of 2017 (Government Gazette 40996), GHGs (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) have been declared as priority pollutants. Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs in excess of 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval in line with NEM:AQA, Government Notice 712 of 2017 (Government gazette 40996). On 22 May 2018, in Government Notice 513 in Government Gazette 41642, the Minster of Environmental Affairs amended the National Pollution Prevention Plan Regulations (published in Notice 712 on 21 July 2017). In terms of this amendment, the first pollution prevention plan was due on or before 21 June 2018. A first pollution prevention plan must cover a period from the date of promulgation of these Regulations up to 31 December 2020 and the subsequent pollution prevention plans must cover periods of five calendar years each. This policy focuses on reducing priority pollutants, including GHGs.
South African Carbon Tax Act (2019)	The Act imposes a tax on carbon dioxide equivalent (CO_2e) GHG emissions. The tax follows the polluter pays principle to ensure that high emitting companies are accountable for their contribution to climate change. The South African Carbon Tax Act, 2019 establishes a framework for calculating and applying carbon tax, but the actual tax liability for an emitter would depend on various elements, including: ▪ Emission Levels ▪ Allowances and Thresholds ▪ Carbon Budgets ▪ Renewable Energy Tax Incentives ▪ Sector-Specific Factors ▪ Compliance and Reporting The specific tax amount paid by the station would be determined through calculations based on these factors and the applicable tax rates specified in the Carbon Tax Act. The Act provides a structure for progressively increasing carbon tax rates over time. The Carbon Tax Act imposes a tax on GHG emissions to encourage reductions and are applicable to Eskom Power Stations.
Draft National Guideline for the Consideration of Climate Change Implications in Applications for Environmental Authorisation, AEL and WML (2021)	On 25 June 2021, the Minister of Forestry, Fisheries and the Environment published a Notice under the National Environmental Management Act (No. 107 of 1998) (NEMA) seeking public comment on a draft National Guideline for the consideration of climate change implications in applications for environmental authorisation, atmospheric emission licences and waste management licences. The draft National Guideline aims to create a consistent approach for the incorporation of climate change considerations in EIAs, WMLs and AELs. The guidelines outline a methodological approach for minimum requirements for consideration when conducting climate change assessments has been considered in compiling this report. This guideline advises integrating climate change considerations into environmental decisions, aiming to ensure that projects minimise their climate impacts.

POLICY, LEGISLATION, GUIDELINE OR STANDARD	DESCRIPTION
South African Climate Change Act (2024)	The Climate Change Bill was signed into law on 18 July 2024 and published as Climate Change Act, 2022 (Act) on 23 July 2024. However, as per section 35 of the Act, it will only come into operation on a fixed date by the President proclamation in the Government Gazette. The Act provides a comprehensive South African legal framework for regulating the climate change impacts with the goal of achieving net-zero by 2050. The Act aims to enable effective development of climate change responses through a long-term transition to a climate-resilient and low-carbon society and economy while considering sustainable development. The Act aims to contribute fairly to global GHG stabilisation and conforms to South African international climate change obligations and commitments to protect and preserve our planet for current and future generations. The Act provides two main mechanisms to reduce the country's GHG emissions: ▪ Section 24 (under Chapter 5) of the Act obliges the Minister to determine a national GHG emissions trajectory. This trajectory must be set in consultation with the Cabinet. The trajectory must specify a national GHG emission reduction objective. This objective must be informed by South Africa's current and projected greenhouse gas emissions and be consistent with South Africa's international obligations. Section 25 (under Chapter 5) of the Act deals with sectoral emissions targets. According to section 25, the Minister must identify GHG-emitting sectors and sub-sectors that should be subject to sectoral emissions targets. The Minister must then set sectoral emissions targets for each sector, in consultation with the relevant Minister responsible for that sector. These targets must align with the national GHG emissions trajectory. The Minister responsible for each sector must then implement each sectoral target through a range of planning instruments, policies, measures, and programmes.

4 JUST ENERGY TRANSITION AND REPURPOSING PLANS

4.1 INTRODUCTION

South Africa is grappling with the energy trilemma: how to simultaneously ensure energy security, affordability and access, and sustainability. At the same time, South Africa's national context of high unemployment and inequality, unreliable performance of the current power generation fleet, and reliance on coal-fired generation in the electricity sector make the energy trilemma uniquely complex.

It was with this context in mind that Eskom's JET Strategy was developed, which is focused on resolving all components of the energy trilemma, by delivering on the 5 "E"s: Energy, Economy, Employment, Equity, and Environment.

As Eskom's existing power plants gradually reach their end of life, the standard of living, quality of life and state of surrounding communities are at risk of decline if no mitigation actions are taken. While developing new energy capacity to resolve the energy trilemma is critical, a considered approach that ensures power station communities share in the benefits of the transition is of equal importance.

For Eskom's JET Strategy, a clear link is seen between the need to build new energy capacity and the importance of ensuring the transition offers a second life to power station communities. The combination of these aims, are not mutually exclusive, form the core of Eskom's JET ambition.

4.2 JET STRATEGY AND ENERGY BROADER POLICY LANDSCAPE

The purpose of the JET Strategy is to provide a consolidated view of the approach that will be taken to build Eskom's future portfolio, optimising for economic growth and development, the reduction of emissions, the creation of jobs, and equitable socio-economic development. These objectives necessitate the gradual, but decisive, development of renewable energy generation, aligned to the 5 Es of Eskom's JET.

Transitioning in a socially and economically responsible manner is aligned to South Africa's broader policy goals in the context of the global effort to mitigate climate change. Given the country's vulnerability to climate change and its commitment to an inclusive energy transition, South Africa chose to be part of the transition to a low-carbon, socially inclusive future, by announcing a revised NDC of ~350-420 megatonnes (Mt) of carbon dioxide equivalent (CO_2e) per annum at COP26 in 2021. The country's stated objectives are in line with the global direction of travel, including for other developing countries.

The revised Eskom JET Strategy is an updated version of the original JET Strategy approved in 2021. The revised JET Strategy adjusts the positioning of the original JET Strategy slightly by acknowledging the context of the ongoing energy crisis and the national generation strategy, as well as the debt relief conditions subsequently announced by National Treasury. The revised strategy details financing and partnership options that are available to support the execution of JET and the socio-economic impact of JET. The original JET Strategy assumed that Eskom would largely execute on JET projects through debt financing. Given the debt relief conditions, the revised strategy indicates that Eskom will not be able to execute on all the projects on the balance sheet and thus external collaboration models must be explored.

The JET Strategy, Generation Strategy and Energy Crisis Management Strategy are interdependent, together contributing to address all components of the energy trilemma. The Energy Crisis Management Programme emanates predominantly from new generation capacity not coming online as anticipated in the Integrated Resource Plan (IRP) 2010 and IRP 2019 and Eskom's lower than expected plant energy availability factors (EAF). However, it should be noted that since the IRP was last updated in 2019, the EAF has improved with the latest state of system briefing held on 26 August 2024 indicating an EAF of 67.02% (July MTD).

A review of the coal plant shutdown schedules, as part of the Generation Strategy was prompted due to low plant EAFs. As these schedules are subject to change going forward, the JET Strategy has been decoupled from the shutdown of coal-fired power stations. Recognising the JET Strategy as separate from shutdown is important, as the focus of the JET on new capacity additions and socio-economic projects for power station communities should proceed regardless of specific shutdown timelines. The JET Strategy, which focuses on Repurposing and Repowering existing power stations and developing new renewable energy capacity, will proceed regardless of any specific shutdown schedule.

The Energy Crisis Strategy and the Eskom JET Strategy overlap on grid access, since a key factor limiting new build is Transmission's current constraints in evacuating additional generating capacity in prime wind and solar regions. The JET Strategy promotes build in Mpumalanga, where there is established grid infrastructure, and where repowering of coal power stations is possible while they are still operational.

The Generation Strategy and JET Strategy overlap where repowering and repurposing (R&R) and other socio-economic initiatives provide a second life to coal power plants and their surrounding communities. In the nexus of all three strategies lies a low-carbon future that contributes to solving all components of the energy trilemma (Figure 4-1).

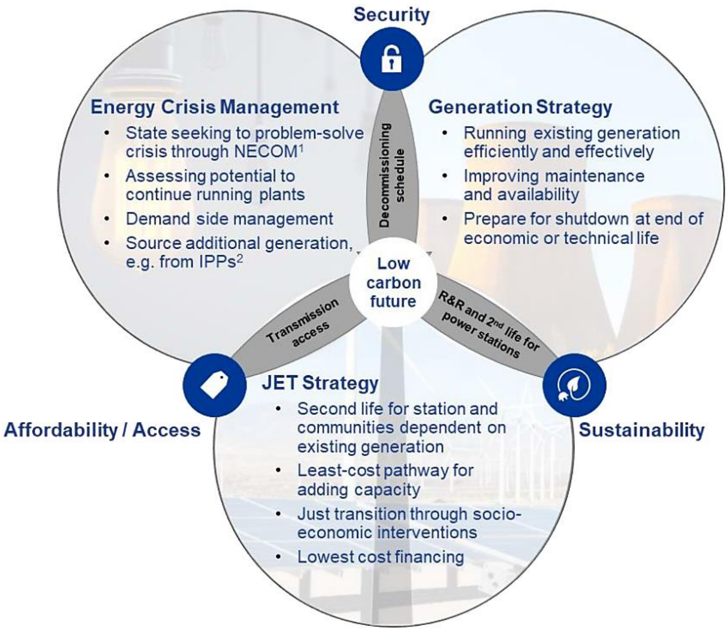


Figure 4-1 - The Energy Crisis Management, Generation and JET strategies are interdependent, but have different areas of focus (Eskom JET, 2023)

The Energy Crisis Management Strategy, amongst other factors, focuses on assessing the potential for the continued operation of coal plants, management of energy demand and sourcing additional generation through Independent Power Producers (IPPs) and/or National Energy Crisis Committee of Ministers (NECOM). The Generation Strategy has different, but overlapping, focal areas: running existing generation efficiently and effectively, improving the maintenance and EAFs of power stations, and preparing for power stations that are reaching the end of their useful lives.

The JET Strategy focuses on offering a second life for coal power stations and the communities that depend on existing generation, figuring a pathway for new build Eskom capacity in alignment with the IRP to enhance energy security, and defining Eskom's planned socio-economic interventions to ensure the energy transition is truly Just.

The main purpose of the IRP is stated as: "*to ensure security of electricity supply necessary by balancing supply with demand, while considering the environment and cost of supply".* With this in mind, Eskom's JET Strategy is in alignment with the IRP and seeks to balance its commitments of electricity demand, environmental obligations and cost of electricity supply to customers.

4.2.1 REPOWERING AND REPURPOSING PLANS

Figure 4-2 - Location and expected R&R for coal power stations with a focus on Mpumalanga

As discussed above, the development of a renewables-dominant power system aims to create jobs and stimulate economic growth. To ensure that communities currently reliant on coal power plants benefit from this transition specifically, Eskom has further identified repowering and repurposing projects to create economic opportunities in these communities. These projects will be a key component of the JET as Eskom seeks to repower and repurpose existing coal plants to preserve jobs and utilise existing grid capacity. Power stations in Mpumalanga, depicted in Figure 4-2, will be prioritised.

As per the plan, coal plants will be repowered by leveraging the existing infrastructure to build new generation capacity including solar, wind, batteries and/or synchronous condensers. The plants will also be repurposed into new centres of economic activity with training centres, water treatment facilities, manufacturing plants, microgrid assemblies and modern aquaponic farms as potential initiatives. Therefore, a Just transition for local communities, through these Repurposing and Repowering activities which will help to retain economic activity, create jobs, and create new economic opportunities.

Eskom has already commenced with the implementation of the largest repowering and repurposing project in emerging markets at the Komati Power Station. The Komati repowering and repurposing projects are expected to have a significant impact by 2030, including the following:

- ~660 estimated direct full-time jobs and ~8700 additional temporary jobs created.
- ~370 MW of renewable generation capacity, replacing remaining ~100 MW of operational capacity at Komati when it was shut down in 2022.
- ~200 people are expected to be trained in different vocations annually.

Approximately $497 million dollars has been secured in funding from the World Bank for this project. Some examples of projects currently underway at Komati that are contributing to the stated impact include a renewable technical training facility, agrivoltaics plants and a containerised microgrid assembly. Komati is the pilot project for the repurposing of a shutdown power plant, with the total cost of repurposing projects estimated at ~R434,5 million.

Potential repowering and repurposing projects were identified through socio-economic impact analyses employed to identify opportunities to offer a second life to power station communities. These initiatives are shortlisted through three filters to ensure the prioritised initiatives have maximum positive impact:

1. **Viability filter** uses on-site resources and findings of socio-economic impact analyses to understand which projects are implementable.
2. **Relevance filter** removes projects that are duplicated or do not have goals aligned with the JET Strategy.
3. **Prioritisation filter** places greatest focus on initiatives that have a meaningful impact on job creation and local economies, unlock other initiatives, and are cost-effective. This process also ensures that projects that are infeasible due to lack of funding, capabilities or regulatory compliance are deprioritised, as well as projects that lack demand for initiative outcomes or have low technological maturity.

The prioritisation filter leverages four stages to identify the optimal socio-economic initiative portfolio for Eskom to implement by itself, partner to implement, or support implementation. The four stages are:

1. **Project attractiveness** considers the sustainable and quality jobs the initiative creates, the capital expenditure (CAPEX) required to implement the initiative, the broader contribution the initiative will have on the economy, and the catalytic effect of the initiative on other initiatives in the area. The outcome of this stage is a ranked list of initiatives based on their attractiveness and relevance to the JET objectives.

2. **Feasibility assessment** considers the allocated or available funding for the initiative, the ease of implementation of the initiative, whether there are any regulatory constraints in Eskom pursuing the initiative, the maturity of the technology associated with the initiative, and whether the implementation of the initiative is dependent on another initiative. The outcome of this stage is the initiatives being categorised into initiatives Eskom to implement by itself, partner to implement, or support implementation based on how feasible the initiative is for Eskom to implement. Only initiatives that Eskom chooses to implement by itself, or partner to implement, will move on to the third stage and have business cases developed.

3. **High-level business case development** for the top 5-10 initiatives from stage two. The high-level business case will include aspects such as net present value (NPV) calculation, profitability, and time to deliver.

4. **Full business case and decision on Eskom's role** considering the value for Eskom based on the portfolio value add and strategic importance of the initiative. The outcome of this stage is the initiatives to be funded by Eskom are submitted for approval.

The current longlist of socio-economic initiatives that are being considered in the prioritisation stage has grown to over 130 projects, and this list will continue to grow as Eskom's JET Strategy is implemented. Socio-economic initiatives are essential in ensuring that communities currently reliant on coal power stations have livelihoods protected and benefit from the energy transition.

Eskom is expected to start the shutdown of generation units at Tutuka Power Station over a period from 2030 to 2041, with the retirement of its individual units staggered throughout these years. Eskom is currently investigating possible repowering, repurposing and alternative projects for multiple sites some of which may be considered of relevance to Tutuka (Eskom, 2024). These include creating new energy generation on-site to replace coal-fired power (Solar photovoltaic, wind, gas peaking, synchronous condenser, battery energy storage). Reusing power station assets for a new use, linked with the repowering option (PV panel assembly, Wind tower manufacturing, Battery assembly, agrivoltaics). Alternative projects may include using a power station asset for a socio-economic benefit unrelated to the repowering option (Ash beneficiation, Water treatment, Microgrids etc).

5 ESKOM EMISSION REDUCTION PLAN

5.1 ESKOM JOURNEY AND OVERVIEW

Coal-fired power stations are subject to strict environmental regulations and monitoring due to their emissions. All coal-fired power stations are required to meet the MES contained in GNR 893 that was issued on 22 November 2013 (as updated by GNR 1207 on 31 October 2018) and promulgated in terms of Section 21 of the NEM: AQA.

Between 2018 and 2020, Eskom submitted applications for postponement, suspension and/or alternative limits to the MES for several of its power stations to the DFFE as the power utility sought more time to implement necessary pollution control technologies for NO_x, SO_2 and PM emissions.

To address emission reductions, Eskom developed an Emission Reduction Plan (ERP) in 2015, with this being updated in 2019 (EERP 2019), 2020 and 2022. In May 2024, as part of the Minister's decision, Eskom were required to review the 2022 ERP, with this having been revised by Eskom in 2024.

Currently installed emission abatement equipment at each station within the Eskom Fleet are presented in Table 5-1.

Table 5-1 – Current installed abatement on Eskom Fleet

STATION	CURRENT INSTALLED ABATEMENT
Lethabo	Electrostatic precipitators (ESPs), sulphur trioxide (SO_3) plant, and high frequency power supplies (HFPS) to mitigate PM emissions.
Medupi	Pulse Jet Fabric Filter (PJFF) to mitigate PM emissions Low NO_x Burner (LNB) to mitigate NO_x emissions
Matla	ESPs, HFPS (Unit (U) 1, U2, U4 and U6), and SO_3 plant to mitigate PM emissions
Duvha	ESPs and SO_3 Plants (U4, U5, U6), fabric filters (U1, U2), HFPS (U5) to mitigate PM emissions
Tutuka	ESPs, HFPS (U4, U5, U6) to mitigate PM emissions
Kendal	ESPs, HFPS and SO_3 plant to mitigate PM emissions. Low NO_x boilers designed to mitigate NO_x emissions
Majuba	PJFF to mitigate PM emissions
Matimba	ESPs and SO_3 plant to mitigate PM emissions Low NO_x boilers designed to mitigate NO_x emissions
Kusile	Wet FGD, PJFFP to mitigate PM emissions Low NO_x Burner (LNB) to mitigate NO_x emissions
Arnot	PJFFP to mitigate PM emissions
Kriel	ESP Upgrade, HFPS installation (in progress) and SO_3 plant to mitigate PM emissions
Camden	PJFFP to mitigate PM emissions, LNB to mitigate NO_x emissions
Hendrina	PJFFP to mitigate PM emissions
Grootvlei	PJFFP to mitigate PM emissions, 4-units offline

Eskom's focus on PM emission reduction is aligned with the ambient monitoring data from the various stations located through the Highveld and Vaal; importantly these stations represent cumulative ambient concentrations with Eskom not being the sole contributor to measured concentrations. Of the Highveld and Vaal monitoring stations reviewed for this exemption application, for the period 2021 – 2023, all monitoring stations indicated non-compliance with the PM_{10} and $PM_{2.5}$ annual average NAAQS at some point, with numerous exceedances of the NAAQS 24-hour standards also recorded.

While PM has been the critical focus, NO_x and SO_2 emission reduction projects have also been considered. However, unlike PM, ambient NO_2 and SO_2 concentrations in the Highveld for 2021 – 2023 remain below the annual SO_2 and NO_2 NAAQS; although exceedances of the short-term averaging periods (10-minute, hourly, 24-hour, as applicable) of the NAAQS were measured, their frequency of occurrence remained below the permitted frequency of exceedance, remaining compliant with relevant standards.

Following Eskom's review of the 2022 ERP, and to ensure continued focus on emission reductions, Eskom developed the 2024 ERP. In addition to the various abatement equipment upgrades and refurbishments currently being undertaken at each station, predominantly addressing PM emissions through ESP refurbishments, HFPS upgrades, SO_3 plant upgrades, and Dust Handling Plant (DHP) upgrades, many of which are already complete, Eskom are also planning and/or evaluating the following to reduce emissions:

- Wet flue gas desulphurisation (FGD) at Medupi (included in previous ERPs)
- Kendal (semi-dry FGD) and Majuba (Duct Sorbent Injection (DSI FGD)) SO_2 reduction projects have been identified as potential alternatives, although are being evaluated as part of this process.
- Low NO_x Burner (LNB) technology at Majuba, Tutuka and Lethabo to mitigate NO_x emissions.
- Despatch Prioritisation Strategy at specific power stations, initiated to reduce SO_2 emissions, however also positively impacting PM and NO_x emissions.
- Efficiency improvement projects under the Generation Recovery Programme to optimise the air-to-fuel ratio which should abate some SO_2 emissions and maximise combustion efficiency.
- The progressive shutdown of coal-fired stations will reduce overall Eskom Fleet emissions.
- Although not a method of reducing emissions at source (i.e. the power stations), the cumulative impact on neighbouring communities is reduced through the air quality offset (addressing emission sources within the community) projects already implemented by Eskom, therefore Eskom are looking to expand this beyond the 35,000 households originally planned.

Figure 5-1 illustrates Eskom's planned or estimated installation dates, linked to the 2024 ERP, for abatement equipment upgrades, retrofits, and new installations. This installation schedule considers:

- Time required to secure funding for each project.
- Lead time required to procure, design, manufacture, and begin installations.
- The outage schedule to allow generating units to be taken offline for upgrades / retrofitting while not impacting grid supply i.e. ensuring sufficient generating capacity remains across the stations to avoid loadshedding.
- To ensure sufficient capacity remains in the grid, generally only a single generating unit at a station can be taken offline at a time, particularly with regards to the long installation timelines of the equipment.

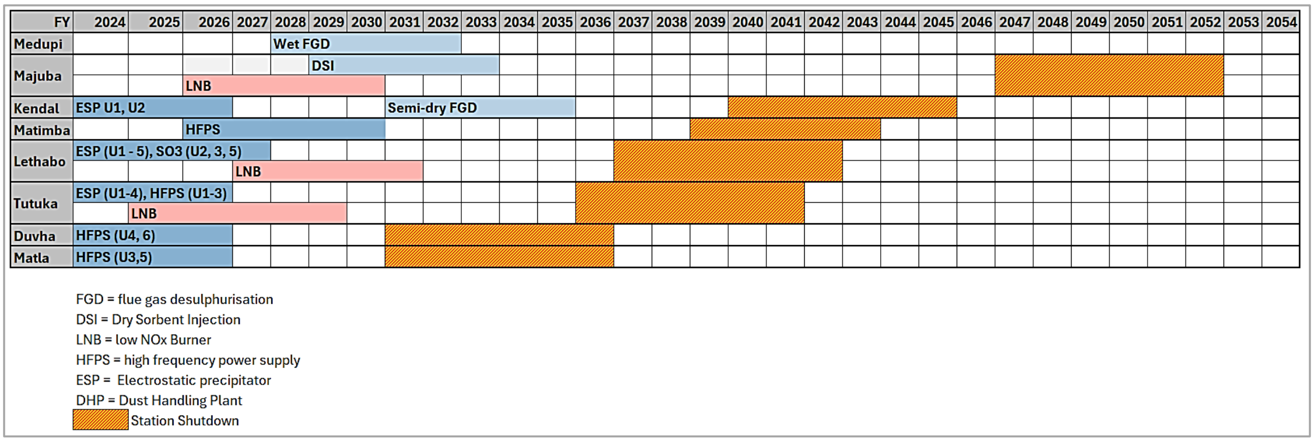


Figure 5-1 - Eskom's abatement equipment installation schedule

Coal beneficiation as a method of reducing SO_2 emissions has been investigated by Eskom and research continues. Investigations to date illustrate the potential for sulphur reduction but various complexities in terms of implementation need to be confirmed and managed such as the energy intensive nature of the process, increased coal mined, and the generation of additional wastewater and coal discards/solid waste. The financial and contractual implications of beneficiation also need to be assessed and shown to be positive for Eskom. Given these uncertainties Eskom has not included any benefit associated with coal beneficiation in the ERP and emission reduction calculations. Any emission reduction identified in this area in future will be considered additional to the 5% improvement in emissions associated with efficiency improvement projects.

Similarly, investigations completed to assess emission reductions using coal with a lower sulphur content confirm that for Eskom to obtain coal with low(er) sulphur content will, in most cases, require sourcing a washed product. This will result in Eskom acquiring coal from the same source pool that services the export market. Purchasing export market coal will result in a significant cost increase for Eskom and this filter though as an increase in electricity prices.

5.1.1 DESPATCH PRIORITISATION STRATEGY

With the addition of alternate energy sources (wind and solar) on to the national grid planned in the draft IRP, the existing coal fired power stations are expected to provide additional flexibility to the system through increased variability in a load following mode of operation, as well as providing back-up to the variable intermittent non-dispatchable renewable technologies, as well as providing ancillary services, inertia etc. which are not provided by the inverter-based renewable technologies. This essentially results in lower running load factors for these stations as the renewable energy sources will be given priority dispatch over the fossil fuelled stations. Furthermore, South Africa's commitments under the Paris Agreement (with the upcoming revision of the NDC) is expected to result in a new GHG emissions target for 2035. Considering an indicative limit of 125-140 Mt CO_2 per annum from fossil fuel generation from 2031, this equates to average load factors of 40-45% for stations operating in 2031 and between 48% to 55% for stations operating beyond 2035, i.e. after Matla and Duvha shutdown. While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

Despatch Prioritisation of renewables reduces SO_2 emissions given the costs associated with SO_2 abatement equipment, complexities of installation, and the age of most stations within the Eskom fleet where return on investment may not be realised. The recent improvement in the reliability of the fleet, allowing Eskom to adopt increased use of Despatch Prioritisation to reduce emissions, is due to a variety of reasons, although most critically the successful implementation of the Generation Recovery Programme. This programme was initiated in March 2023 focusing on specific projects targeting major and minor breakdowns and has improved the generating capacity at stations, allowing improved load management.

To limit emission loads Eskom will not run coal stations at maximum loads but will rather aim to limit the loads to only what is required for system adequacy making maximum use of other available energy sources for generation, resulting in less coal burnt. This reduction in load will result in a reduction in the levels of total emissions from Eskom into the atmosphere. Although the objective is to reduce SO_2 emissions, given the reduced coal burnt, NO_x and PM emissions will also be positively impacted.

Although Despatch Prioritisation will lead to reduced emissions, it is noted this is based on other power generation sources being added to the grid, allowing Eskom to reduce loads overtime. The addition of these alternative generation sources is outside of Eskom's control, and therefore should these not materialise within anticipated timeframes or there is an increase in economic growth, to avoid constraining the economy and ensure continued grid stability and security of supply, in terms of national energy planning Eskom may be required to operate stations at higher loads with increased emissions.

5.2 TUTUKA POWER STATION

The construction of Tutuka began in October 1980, with the first unit commissioned in 1985 and the power station fully commercial by 1991. Tutuka has six units with an installed capacity of 609MW (585MW sent out) and a total installed capacity of 3,654MW (3,510 MW sent out).

In terms of the Integrated Resource Plan and the Eskom Consistent Data Set, coal-fired power stations are generally planned for decommissioning after 50 years although can be subject to review based on plant conditions, financial requirements and security of supply requirements, although for the purposes of this application, a 50-year life is assumed. Tutuka's intended shutdown commences in FY2036, with completion due in FY2041, although this will require NERSA approval. Tutuka receives 40% of its coal supply from the local New Denmark coal mine, while 60% of the coal is brought in from external sources.

5.2.1 CURRENT STATION PERFORMANCE AND EMISSION LEVELS

5.2.1.1 Sulphur Dioxide

Daily average SO_2 emissions between 2019 and 2024 was 2,141mg/Nm^3 (over-estimation as this includes upset conditions) remaining below the existing limit of 3,400mg/Nm^3, with no exceedances of the daily average limit occurring in FY2023/24. Although the recorded average is compliant with the existing limit, this exceeds the new plant MES (1,000mg/Nm^3). To achieve compliance with the MES, Tutuka would require technology to abate SO_2.

5.2.1.2 Nitrogen Oxides

During the period 2019 to 2024, Tutuka had managed a daily average concentration of 818mg/Nm^3 (over-estimation as this includes upset conditions), complying with the existing plant limit of

1,200mg/Nm^3, with no exceedances of the daily average limit occurring in FY2023/24. Although the recorded average is compliant with the existing limit, this exceeds the new plant MES (750mg/Nm^3). To achieve compliance with the MES, Tutuka will require a NO_x upgrade retrofit (LNB).

5.2.1.3 Particulate Matter

During the period 2019 – 2024, Tutuka had managed an average daily concentration of 239mg/Nm^3 (over-estimation as this includes upset conditions), complying with the existing plant limit of 300mg/Nm^3. In 2024 emissions show an improvement with a daily average concentration of 199mg/Nm^3, although 42 exceedances of the existing limit occurred during FY2023/24. No exceedances of the existing plant MES have occurred since April 2024.

During the periods of elevated emissions, the generating units were affected by breakdowns on the DHP which led to high hopper levels and ESP under performance and coal quality constraints. The successful implementation of most of the Generation Recovery Projects has certainly assisted with improving the plant performance, as evident in 2024 emissions, while the improved reliability of the fleet has enabled the execution of the maintenance strategy, which will result in a further improvement in abatement performance, positively impacting emissions.

Tutuka has been challenged with poor coal quality, required to obtain 60% of its coal from external sources, much of which contained stones which impacted the milling plant performance and all downstream activities, including emissions. A feasibility study was undertaken for a destoning plant; however, this was unfeasible due to effectiveness and cost. An alternative considered was to increase the frequency of stone grinding and loading of mill grinding balls, however this also impacted the milling plant performance negatively.

5.2.2 EMISSION REDUCTION PROJECTS AND TIMELINES

5.2.2.1. Sulphur Dioxide

Various investigations were undertaken of the different SO_2 reduction technologies that are operating successfully in the field, all of which were taken through a qualitative technology evaluation undertaken by Eskom. The criteria selected for the evaluation facilitated a process of screening which of the technologies are feasible for recommendation for the Eskom fleet. The basis of the evaluation considered reagent availability in South Africa, the maturity of the technology, technology performance (removal efficiency), and complexity of the retrofit.

Of the technologies investigated, the semi-dry FGD was identified as the most appropriate for Tutuka. However, Eskom has consistently indicated in its postponement applications that given the age of Tutuka and reaching end of life, cost and complexity of implementation, and the general compliance of ambient SO_2 concentrations in the area, that implementation of any SO_2 reduction technology is not feasible and therefore has not undertaken further detailed planning to install SO_2 reduction technology.

Assuming Tutuka was required to implement semi-dry FGD, construction and installation of this could only start in FY2031 as concept and design have not yet commenced, with execution taking five to six years to complete on all generating units. A best-case completion date of FY2035 would be achieved considering the project milestones, with Tutuka entering shutdown phase from FY2036. Given the costs to install and operate an FGD and considering this would only be fully complete one to two years before shutdown phase commences, and therefore well before return on investment (ROI) is realised, Eskom considers it not practically feasible or beneficial to South Africa.

Tutuka cannot reach the new plant SO_2 MES without an FGD, or similar SO_2 abatement, therefore, to reduce SO_2 emissions, although not to MES compliance, Tutuka is planning:

- Despatch Prioritisation Strategy, based on future anticipated loads considering the current IRP and Eskom production plans. This Despatch Prioritisation will also positively impact PM and NO_x emissions.
- Efficiency improvements to optimize the air-to-fuel ratio which should abate some SO_2 emissions and maximize combustion efficiency. This requires in part, ensuring optimal mill firing configuration and design level pulverized fuel (PF) particle size distribution.

Should the anticipated additional capacity projections of the IRP be delayed, on which Eskom has determined future load requirements, resulting in the need for higher loads to meet electricity demand, Eskom's planned Despatch Prioritisation Strategy may not have the anticipated impact on emissions.

5.2.2.1 Nitrogen Oxides

To address NO_x emissions at Tutuka, LNBs will be installed. The LNB installation enquiry went to market in July 2024 and closed at the end of September 2024. The tenders are currently in the evaluation stage. Based on the current timelines, it is envisaged that the contract for the installation of the LNB would be awarded in January 2025, while the contract for the manufacturing of the LNB was awarded on 07 February 2024 and is currently at the Design Stage. It is envisaged to have the manufactured LNB delivered to site in the last quarter of 2024. The first unit should be installed in FY2025 and the rest of the units in their respective subsequent outages, with the final unit installed by FY2029.

5.2.2.2 Particulate Matter

The ESP refurbishment on unit 6 and 5 are complete, with unit 5 being completed in July 2024. The remaining ESP unit refurbishments (1 – 4) are at the final stages of the procurement phase. The awarding of the contract is planned to be completed during the month of November 2024, with expected installation completion by FY2025, which is dependent on available outages and successful commercial finalisation to complete the projects.

The DHP refurbishment projects on units 1 to 4 are at the final stages of the procurement phase, with an expected installation completion date of FY2025, although again dependant on available outages and successful commercial finalisation to complete the projects.

Further to the above projects, the HFPS installations were completed on units 4 and 6 in FY2023/2024. Installation of the HFPS on unit 5 was completed in July 2024. Currently, the expected completion date on all units is October FY2025.

To further enhance abatement effectiveness, Tutuka is investigating flue gas conditioning to increase the ESP collection efficiency by reducing the high fly ash resistivity. Dual flue gas conditioning equipment was installed on unit 6 and testing was initiated. The Dual Flue Gas Conditioning is the combination of SO_3 and ammonia (NH_3). SO_3 enhances fly ash resistivity, and while NH_3 also assists with resistivity, the primary objective was to determine if there are some benefits with fine ash agglomeration. Initial indications were a 5% improvement in emissions when NH_3 and SO_3 were injected, although soon after unit 6 experienced a major breakdown and will only be back online in FY2026, after which testing can continue. The procurement process is underway to make this a semi-permanent installation, with the intention to use SO_3 only, with execution estimated by FY2026.

5.2.3 EMISSION REDUCTION TRAJECTORY

As discussed previously, various initiatives are underway and/or planned to further mitigate emissions at Tutuka. While these initiatives will impact Tutuka emissions positively, they cannot be considered in isolation from the total Eskom Fleet emissions. Given this, and the intent of Eskom to make a fleet exemption application, Eskom considered various emission reduction scenarios (ERP alternatives) based on present planning assumptions considering the various abatement initiatives undertaken, planned or being evaluated, energy demand, station shutdowns, and the positive impact of Despatch Prioritisation. No detailed stochastic energy systems analysis, such as is done for the Integrated Resource Plan (IRP), was completed for this exemption application process given time constraints. The energy projections used for the ERP alternatives were based on presently available planning assumptions and Eskom internal projections. Considering security of supply, a fourth emission projection was included, representing an upper emission limit projection based on more conservative assumptions than the original ERP alternatives with the aim to ensure security of electricity supply in the absence of any stochastic energy system analysis is provided. The trajectories considered comprised:

- ERP 2024 A (PM and NO_x reduction, Despatch Prioritisation strategy, efficiency improvements, and SO_2 abatement at Medupi and Kusile), representing Eskom's planned projection.
- ERP 2024 B (As per ERP 2024 A plus SO_2 reduction technology installed at Majuba and Kendal), representing a projection, that with additional guarantees and strategic decisions, could be achieved.
- ERP 2024 C (As per ERP 2024 A and B, plus SO_2 reduction technology at Matimba, Lethabo and Tutuka), representing a projection that would require substantial guarantees and considerations of the significant financial impacts, such as on electricity tariffs.
- Eskom's Security of Supply Projection developed using conservative assumptions such as higher electricity demands due to a growing economy, a delay in IPP projects, and a delay in Kusile U6 generating unit coming online.

Each ERP alternative emission trajectory considered, as well as the Security of Supply trajectory, and abatement projects linked to each are illustrated and discussed in the following sections. These sections consider a 2025 baseline for comparative purposes which better represents Eskom's current performance in meeting national demand as opposed to 2019, when loadshedding was in place, constraining the economy and reducing demand. For the following sections, it is assumed that the proposed FGD retrofit type (where applicable) on a 'six-pack' power station has proven to be technically feasible, notwithstanding that it would be a world-first.

5.2.3.1 Sulphur Dioxide

As noted previously, scenario ERP 2024 A assumed only the FGD installation at Kusile and Medupi (completion in 2032), with no other stations receiving SO_2 abatement technology. Scenario ERP 2024 B assumed SO_2 abatement installations at Kusile, Medupi, Kendal, and Majuba, representing a potentially practical option with certain considerations, if proven to be technically feasible. Scenario ERP 2024 C assumed SO_2 abatement installed at Kusile, Matimba, Medupi, Kendal, Majuba, Lethabo, and Tutuka (Matla and Duvha were not given FGD as it cannot be practically installed given their shutdown before 2035).

As illustrated in Figure 5-2, all three scenarios remain similar until FY2032, when the Majuba DSI FGD takes effect, followed by the Kendal FGD, resulting in ERP 2024 B and ERP 2024 C having lower emissions than ERP 2024 A. In FY2036, ERP 2024 C reduces further due to a combination of SO_2 abatement technology at Matimba, Lethabo and Tutuka, and assumed completion of the Duvha and Matla shutdowns. While actual emissions show a reduction from ERP 2024 A to ERP 2024 B and C, considering the cumulative Highveld and Vaal dispersion modelling predictions at receptors, ERP 2024 A, which only assumes SO_2 abatement at Kusile, still shows full MES compliance, without abatement at Kendal and Majuba. The modelling predictions show ERP 2024 B, which assumes Kendal and Majuba abatement, have slightly lower ambient concentrations than ERP 2024 A, while these reduce further for ERP 2024 C, although crucially all modelling scenarios predict full MES compliance (discussed further in Chapter 6).

Considering ERP 2024 A, by FY2030, compared to FY2025 (actuals), Eskom Fleet SO_2 emissions are anticipated to have reduced by 555kt, representing a 32% reduction in emissions. In FY2035, compared to FY2030, a further reduction of 165kt (14%) is anticipated, and by FY2040 a further 6% reduction is anticipated. Between FY2025 and FY2050, a total SO_2 emissions reduction of 85% (1.45Mt) is estimated.

Regarding Eskom's Security of Supply projection, representing an upper emissions limit, emissions increase to FY2026, remaining above the ERP 2024 A, B, and C projections, although by FY2030 shows a 482kt (27%) reduction and is more closely aligned with the ERP projections. By FY2035, the Security of Supply projection shows a further reduction of 294kt (23%) and aligns more closely with the ERP projections, and from FY2036 shows closer alignment until FY2050. Crucially, although this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

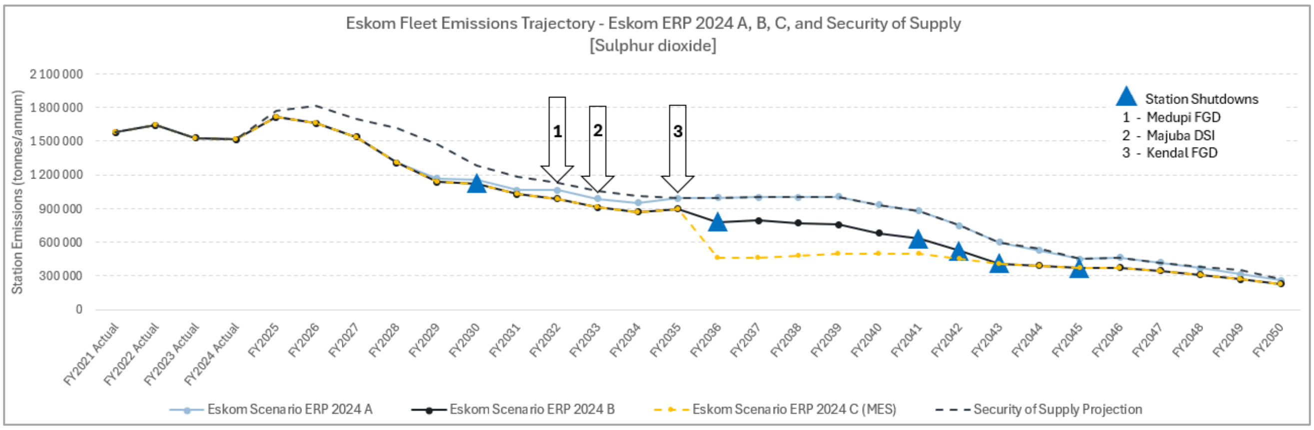


Figure 5-2 –Eskom Fleet sulphur dioxide emission trajectories

5.2.3.2 Oxides of Nitrogen

NO_x emission trajectories associated with ERP 2024 A, ERP 2024 B, ERP 2024 C and the Security of Supply are illustrated in Figure 5-3. All Scenario's ERP 2024 A, ERP 2024 B, and ERP 2024 C assume the same NO_x abatement installed; that is LNBs at Tutuka, Majuba, and Lethabo, therefore the emission trajectory for each is the same, while the Security of Supply includes this abatement this is based on an increased electricity demand.

From FY2025, emissions are anticipated to reduce in the coming years due to the burner efficiency improvement projects, Despatch Prioritisation initiated to address SO_2 emissions, station shutdowns assumed to be complete by FY2030 (Grootvlei, Camden, Hendrina, Arnot, and Kriel), Duvha and

Matla assumed to be entering shutdown phase in FY2031, and the completion of the LNB abatement on Tutuka (FY2029), Majuba (FY2030), and Lethabo (FY2031). By FY2030, compared to FY2025 (actuals), Eskom Fleet NO_x emissions are anticipated to have reduced by 292kt, representing a 40% reduction. Emissions remain stable until FY2041, after which further reductions will occur due to stations entering shutdown. Between FY2025 and FY2050, a total NO_x emissions reduction of 78% (574kt) is estimated.

Considering Eskom's Security of Supply projection, representing an upper emissions limit, emissions increase to FY2026, remaining above the ERP 2024 A, B, and C projections, given the conservativeness of the Security of Supply projection, although by FY2030 shows a 256kt (33%) reduction and is more closely aligned with the ERP projections. By FY2035, a further 151kt (29%) reduction is estimated and aligns more closely with the ERP projections and shows closer alignment until FY2041. As noted, although this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

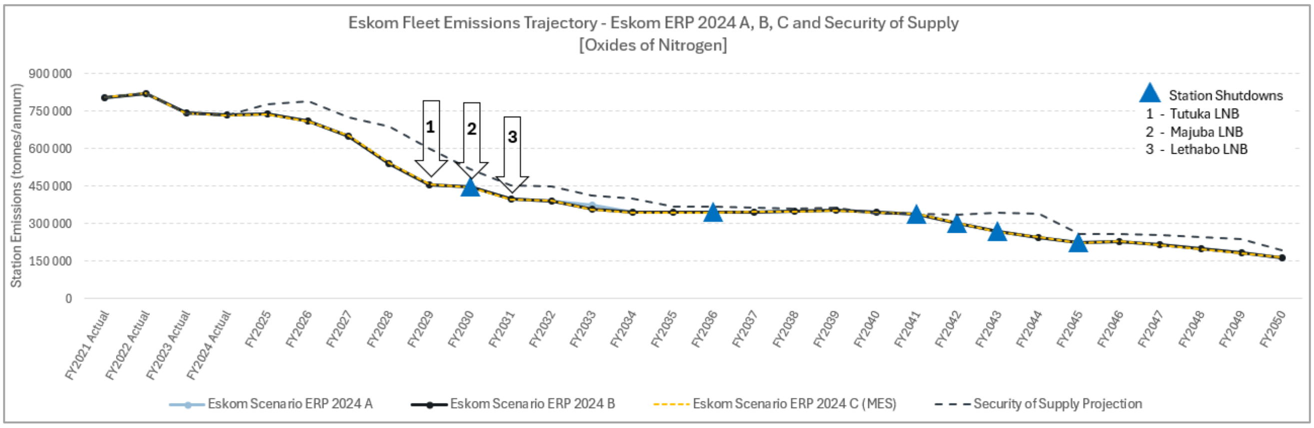


Figure 5-3 –Eskom Fleet oxides of nitrogen emission trajectories

5.2.3.3 Particulate Matter

PM emission trajectories associated with ERP 2024 A, ERP 2024 B, ERP 2024 C and the Security of Supply are illustrated in Figure 5-4. As noted, all alternatives considered the same PM abatement installed at Tutuka, Matla, Duvha, Kendal, Lethabo, and Matimba, so have the same trajectories, while the Security of Supply trajectory includes these projects as well as increased generation to meet demand assumptions.

From FY2025, emissions are anticipated to reduce sharply until FY2028 due to the PM abatement projects at Tutuka, Matla, Duvha, Kendal and Lethabo, as well as the progression of the assumed shutdown phases at Grootvlei, Hendrina, Arnot, Kriel, and Camden. From FY2030, PM emissions remain consistently low, showing further reductions from FY2040 due to stations assumed to be entering shutdown phases. By FY2030, compared to FY2025 (actuals), Eskom Fleet PM emissions are anticipated to have reduced by 65kt, representing a 74% reduction, after which emissions will gradually reduce as stations enter shutdown. Between FY2025 and FY2050, a total PM emissions reduction of 94% (82kt) is estimated.

Considering Eskom's Security of Supply projection, representing an upper emissions limit, emissions show a similar trend to the ERP projections, although are marginally higher between FY2026 to FY2030 due to the conservativeness of this projection. By FY2030, a PM reduction of 64kt (71%) is estimated, with a further reduction by FY2035 of 6.5kt (25%). As noted, this is an upper emissions projection, the same trend of emission reductions year on year is evident from FY2026.

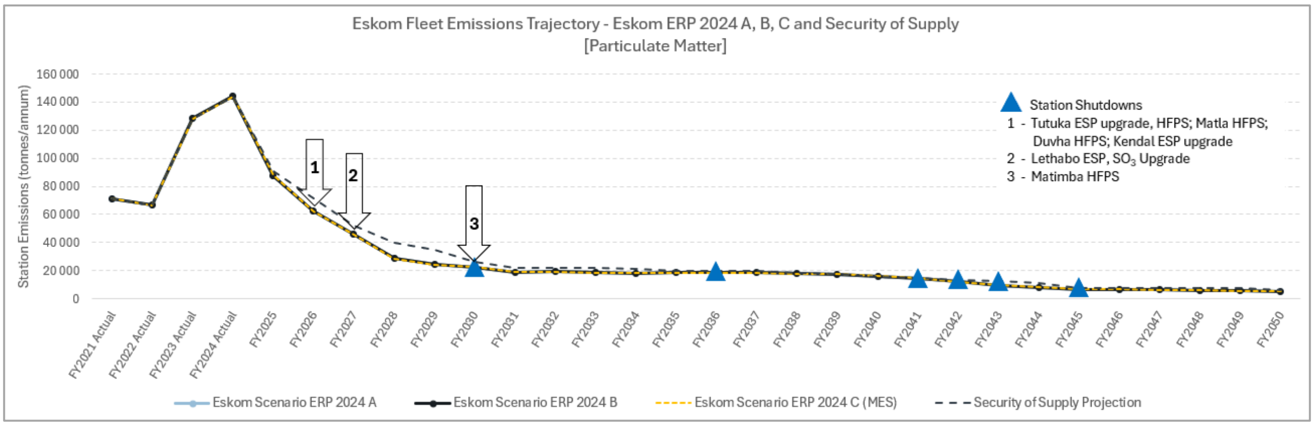


Figure 5-4 –Eskom Fleet particulate matter trajectories

5.2.3.4 Establishment of an Emission Reduction Trajectory

The scenarios described above have referred to emission reduction trajectory in terms of PM, NO_x and SO_2. With scenario ERP 2024 A showing emission reductions by FY2030 for PM (65kt), NO_x (292kt), and SO_2 (555kt), while the Eskom security of supply projection also shows reductions by FY2030 for PM (64kt), NO_x (256kt) and SO_2 (482kt). While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

The Priority Area regulations and priority area plans refer to emission reduction targets, with the draft HPA plan indicating that industry should obtain a 40% reduction in total emissions by 2030 from a 2019 base. The emission reduction projections described above are based on the best available assessment of what Eskom is required to generate from coal stations in terms of the nationally driven IRP process and Eskom planning. Neither of these processes are static and they are influenced by a range of factors including economic growth rates, IPP production and national climate change commitments. If economic growth increases and there are substantive delays in the provision of non-coal-based generation then the Eskom coal fleet may be asked to ensure security of supply which will result in an increase in emissions above the trajectories predicted in this application. As such Eskom believes it would be inappropriate for the setting of specific legally binding emission reduction targets at either a fleet or station level and request exemption from any such requirements where they are enforced through air quality related legal mechanisms.

5.2.4 TUTUKA PROPOSED EMISSION LIMITS

As contained within Tutuka's AEL (ref. no. TPS/0013/2019/F03), Tutuka is required to meet the following MES:

- Particulate matter:
  - 300 mg/Nm^3 current, and 50 mg/Nm^3 post 1 April 2025, although as per Tutuka's postponement application the limit requested is 300 mg/Nm^3.
- Oxides of nitrogen:

- 1,100mg/Nm^3 current, and 750mg/Nm^3 post 1 April 2025

- Sulphur dioxide:
  - 3,400mg/Nm^3 current, and 1,000mg/Nm^3 post 1 April 2025. It is noted the AEL currently indicates 500mg/Nm^3, however according to the MES amendment (GNR 1207, 2018), existing plants are to comply with a new plant MES of 1,000mg/Nm^3.

Considering Tutuka's planned abatement project schedule, and that these projects will not be complete before 1 April 2025 (for PM and NO_x) due to long lead times associated with manufacturing and installations, Tutuka is requesting exemption from the PM and NO_x MES limits until the committed emission abatement projects are complete. Further, since it is not feasible to install FGD at Tutuka, as presented herein, Tutuka is requesting exemption from the new plant SO_2 MES until shutdown.

While Eskom recognise the importance of pollution concentrations in a stack, of equal importance is the total mass of pollutants emitted from a stack which are directly related to environmental impacts. As presented in Section 5.2.3, Eskom's cumulative mass of pollutants emitted show decreases between FY2025 – FY2050. The dispersion model considered Eskom's anticipated loads and associated emissions, on average, so modelled concentrations are lower than the limits requested herein. The limits requested by Eskom will allow for increased loads according to demand, however as indicated in Section 5.2.3. Eskom's total mass of emissions is anticipated to decline year on year.

Table 5-2 presents Tutuka's requested emission limits, applicable to normal operating conditions, so excluding start-up or shutdown, upset conditions and maintenance periods. Key considerations to the requested concentration limits include:

- Particulate matter:
  - Although not solely due to Eskom, Eskom recognises measured ambient PM concentrations in the Highveld/Vaal are non-compliant with the NAAQS, requiring specific focus, Eskom is requesting exemption from immediately complying with the MES. Eskom will reach MES compliance once the PM abatement upgrades are complete.
  - Cumulatively, the Eskom Fleet shows substantial reductions in PM emissions, as presented previously.
  - Although ambient measured concentrations show non-compliance with the NAAQS in the Highveld/Vaal, according to the cumulative dispersion modelling results (discussed in Section 6.1 of this report), the Eskom Fleet's contributions to the PM_{10} annual averages are below the NAAQS at receptors, although annual average $PM_{2.5}$ contributions exceed the annual NAAQS. While non-compliant 24-hour concentrations are predicted, these are predominantly related to the fugitive sources (ash dumps), rather than the stack emissions themselves, as noted in the cumulative AIR.
  - Further, the conservative assumptions made in the modelling simulations also need to be considered.
- Oxides of nitrogen:
  - As noted previously, ambient NO_2 concentrations in the Highveld/Vaal are low, below the NO_2 NAAQS.
  - Cumulatively, the Eskom Fleet shows substantial reductions in NO_x emissions, as presented previously.
  - According to the cumulative dispersion modelling (Section 6.1), ground-level NO_2 concentrations due to the Eskom Fleet emissions, under all modelling scenarios, were extremely

low for both the annual and hourly averages, remaining well below the NAAQS, with no hourly exceedances predicted.
  - Although existing measured ambient NO_2 concentrations are low, and predicted contributions from the Eskom Fleet are also low, Eskom still recognises the importance to reduce NO_2 emissions at Tutuka and will therefore be installing LNBs.
- Sulphur dioxide:
  - Measured ambient SO_2 concentrations comply with the NAAQS in the Highveld/Vaal area.
  - Cumulatively, the Eskom Fleet shows substantial reductions in SO_2 emissions, as presented previously.
  - According to the dispersion modelling (section 6.1), ground-level SO_2 concentrations due to the Eskom Fleet emissions, under all modelling scenarios, were low for both the annual, 24-hour and hourly averages, remaining below the NAAQS at all receptors.
  - Existing ambient SO_2 concentrations and the ground-level concentration contributions from the Eskom Fleet comply with the NAAQS, and since it is not economically feasible to install SO_2 abatement at Tutuka, Tutuka will manage SO_2 emissions through Despatch Prioritisation Strategy and efficiency improvements.

This exemption application, and emission limits requested herein, are presented in **Table 5-2**.

Table 5-2 - Emission limits requested for Tutuka

Point Source Code	Pollutant	maximum release rate*			Duration of Emissions
		mg/Nm³	Average Period	Date To Be Achieved	
Stack 1 (U1-3) Stack 2 (U4 -6)	SO_2	3,000 mg/Nm³	Daily	Immediate - shutdown	Continuous
	NO_x	1,100 mg/Nm³	Daily	Immediate	Continuous
		750 mg/Nm³	Daily	1 April 2029	Continuous
	PM	300 mg/Nm³	Daily	Immediate	Continuous
		50 mg/Nm³	Daily	1 April 2027	Continuous
*Emission limits requested are for normal operations, so exclude upset, startup, shutdown, or maintenance conditions					

5.2.5 COSTS TO REACH MES COMPLIANCE

As noted previously, Eskom finds SO_2 reduction technology infeasible for the aging Tutuka plant due to costs, complexity, and compliance with ambient SO_2 levels. If required to implement semi-dry FGD now, construction could start in FY2031, with completion by FY2035 and shut down by FY2036. Certainty around cost is only reached once the contract has been awarded and will be accurate to within 90%.

Considering only Tutuka, the projects already approved comprise:

- Low NO_x Burners (NO_x compliance):
  - Capex ≈ R1.6 billion
- ESP/HFPS/DHP (PM compliance):

- Capex ≈ R4 billion

Should Tutuka be required to also meet the SO_2 MES, through an FGD installation, an additional Capex of ≈ R39 billion is required, with an associated Opex of ≈ R1,04 billion.

Importantly, although the Despatch Prioritisation does not result in direct incurred costs, this will have a negative revenue implication on Eskom.

5.3 ESKOM AIR QUALITY OFFSETS

According to the Air Quality Offsets Guideline (Government Gazette No. 39833 of March 2016) (hereafter referred to as 'the Air Quality Offsets Guideline'): "In the air quality context, an offset is an intervention, or interventions, specifically implemented to counterbalance the adverse and residual environmental impact of atmospheric emissions in order to deliver a net ambient air quality benefit within, but not limited to, the affected airshed where ambient air quality standards are being or have the potential to be exceeded and whereby opportunities and need for offsetting exist." (Republic of South Africa, Air Quality Offsets Guideline, 2016)

Whilst Eskom continues to persevere in improving ambient air quality through the reduction of emissions at the existing coal-fired fleet, the retrofitting of abatement technology and diversification of the energy fleet is extremely costly. This will impact all of South Africa financially, while also taking a long time to implement. Air quality offsets (AQOs) afford the opportunity to address emission sources directly within vulnerable communities, and to target greater improvement in community-experienced air quality than is achievable from other approaches. Such offsets are more cost-effective and can result in meaningful improvements in air quality within a shorter period.

Eskom embarked on their first AQO programme in 2016, following the National Air Quality Officer's decision that each power station must develop and implement an offset programme targeting particulate matter (PM_{10} and $PM_{2.5}$) concentration reduction in the ambient environment. Eskom's first AQO Plans, initially submitted for the Nkangala District Municipality, Gert Sibande District Municipality, and Lethabo Power Station, were approved by the National Air Quality Officer, together with the relevant Atmospheric Emission Licensing authorities, in September 2016. These were later updated and resubmitted in April 2021, with updates provided annually. Eskom's AQO Plans cover the period April 2016 to March 2025.

5.3.1 ESKOM'S AIR QUALITY OFFSET JOURNEY

Eskom began their first AQO initiative in 2011 with a pre-feasibility study to identify potential strategies to best meet the offset requirements of their Atmospheric Emissions Licenses (AELs). Several initiative implementation trials took place in Kwazamokuhle (a township near Hendrina Power Station, Mpumalanga) from 2013 to 2017, before Eskom's 2016/2017 Offset Implementation Programme was finally formulated. Interventions within the programme target domestic fuel burning for heating and cooking in the Highveld region, particularly Kwazamokuhle and Ezamokuhle, whilst interventions target both domestic fuel burning and domestic waste burning in the Vaal. Presently, the AQO Plans are being executed in stages across various communities in proximity to Eskom coal-fired power stations in both the Highveld and Vaal regions. Table 5-3 outlines the main interventions completed and planned as part of Eskom's AQO Programme (Eskom, 2024).

Table 5-3 - Implemented Air Quality Offset Interventions

Phase	Power station	Settlement	No of Houses	Start	End	Comments
Phase 1	Hendrina	Kwazamokuhle	3700	2021	2024	Completed
	Majuba	Ezamokuhle	2100	2021	2024	Completed
	Lethabo	Sharpeville		2021	2024	Completed
Phase 2a	Tutuka	Sivukile	1160	April 2024	Dec 2025	Contract terminated. Tender to be reissued
	Kendal	Phola	66073	Nov 2024	Oct 2029	In the procurement phase – Contract being negotiated.
Phase 2b	Matla	Emzimnoni	3440	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Duvha	Masakhane	886	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Kriel	Thubelihle	2390	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Arnot	Silobela	2003	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Lethabo	Refengkotso	500	April 2025	Mar 2030	Budget secured. In the procurement phase.
	Lethabo	Boitshepiville	N/A	April 2025	Mar 2030	Budget secured. In the procurement phase.
Phase 2c	Camden	New Ermelo	935	Sept 2025	Aug 2030	Budget approval outstanding
	Grootvlei	Grootvlei village/Ntorwane	2000	Sept 2025	Aug 2030	Budget approval outstanding
	Camden	Nederland	1660	Sept 2025	Aug 2030	Budget approval outstanding
	Duvha	eMalahleni	2000	Sept 2025	Aug 2030	Budget approval outstanding

5.3.2 AIR QUALITY OFFSET IMPACT ASSESSMENT

The effectiveness of Eskom's AQO Programme depends on how well the interventions are planned, monitored and verified. Eskom has established a contract with Air Resource Management (Pty) Ltd The effectiveness of Eskom's AQO Programme depends on how well the interventions are planned, monitored and verified. Eskom has established a Planning, Monitoring and Verification (PMV) contractor, to provide PMV services for Phase 1 of Eskom's AQO Plan at Kwazamokuhle, Ezamokuhle and Sharpeville. Three key indicators will be monitored before, during and after offset implementation, namely the state of ambient air, emissions and quality of life (Air Resource Management (ARM), 2024). Over every monitoring period, the AQO project scenario (as it took place) will be compared to a credible baseline scenario (i.e., the situation that would have been the case if the project were not implemented). The principal indicator of success of the intervention will be related to a change in exposure to air pollution and nett emissions avoided because of Eskom AQO interventions. Various project effectiveness surveys have been completed in Ezamokuhle and Kwazamokuhle to assess the impact of Eskom's AQO interventions, as summarised below.

The calculated the net reduction in emissions associated with the AQO rollout in Kwazamokuhle and Ezamokuhle (approximately 4,255 households), which shows a notable reduction in annual PM10

(132 tons), PM2.5 (123 tons) annually, as well as CO, SO_2, NO_2, VOCs and methane emissions to air (Figure 5-5).

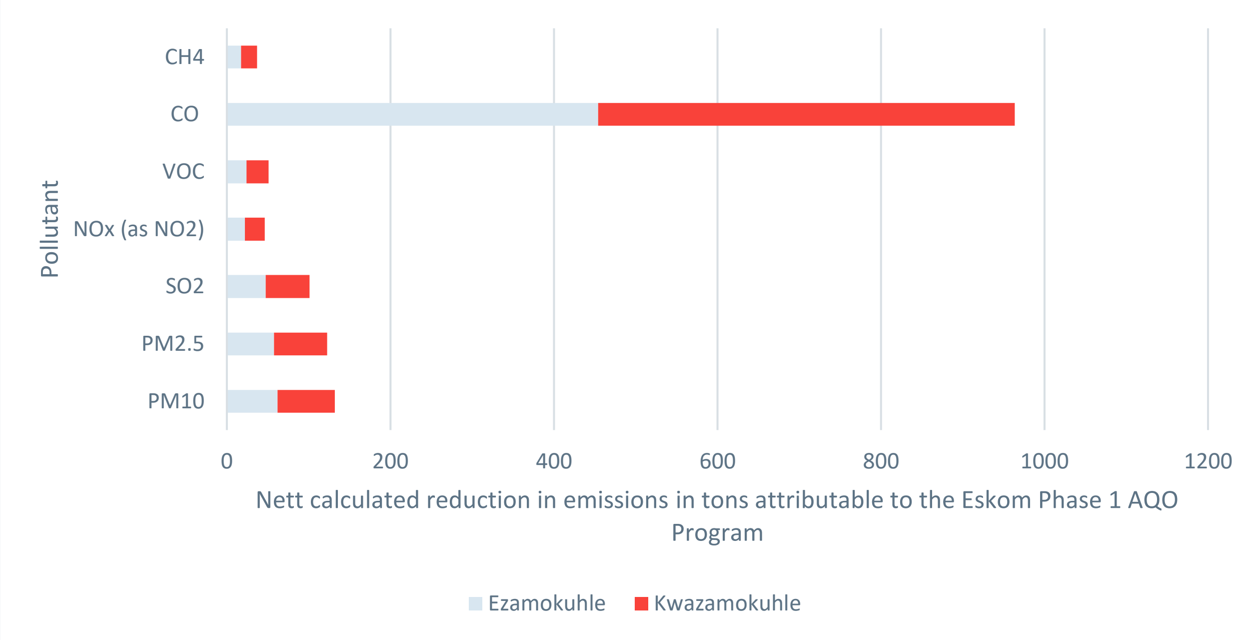


Figure 5-5 - Total net reduction in emissions attributable to Eskom's Phase 1 AQO Project (tons) for Ezamokuhle and Kwazamokuhle (Air Resource Management (ARM), 2024)

Indoor PM_{10} and $PM_{2.5}$ monitoring in participating households in Ezamokuhle showed a notable decrease in indoor pollution concentrations following the AQO interventions (Air Resource Management (ARM), 2024). Furthermore, data collected from questionnaires distributed to Kwazamokuhle's and Ezamokuhle's participating households showed that 84% and 85%, respectively, of respondents were completely satisfied with the intervention, as it improved their quality of life (Air Resource Management (ARM), 2024), (Eskom, Progress Report, March 2024). Post-intervention monitoring and surveys are scheduled for Sharpeville in 2025. However, Eskom have quantified the air quality impact of AQO waste interventions at Sharpeville by calculating the nett emissions avoided and developing an air dispersion model. The net emissions avoided associated with the first three clean-up campaigns show the greatest potential reduction is of PM_{10} (16,01 tons) and $PM_{2.5}$ (15,96 tons), with notable reductions in potential NO_2 (3,32 tons) and SO_2 (0,33 tons) emissions also observed. Results of the dispersion modelling exercise show the potential air quality improvement due to emissions reduction. The predicted short-term maximum ambient air quality improvements across the first three campaigns are provided in Table 5-4.

Table 5-4 - Potential improvement in ambient air quality due to Eskom's Sharpeville Project (Air Resource Management (ARM), 2024)

Model Pollutant Maximum Concentration (µg/m³)							
Pollutant	PM_{10}		$PM_{2.5}$		SO_2		NO_2
Averaging Period	1-hour	24-hour	1-hour	24-hour	1-hour	24-hour	1-hour
Campaign 1	19.1	2.4	19.1	2.3	0.4	0.1	2.1
Campaign 2	33.9	4.4	33.8	4.4	0.6	0.1	3.5
Campaign 3	278.0	28.9	277.5	28.8	5.6	0.6	28.6

5.3.3 TUTUKA'S AIR QUALITY OFFSETS PROGRAMME

Eskom's AQO implementation plan for the Gert Sibande District Municipality aims to improve ambient air quality in several communities around four of Eskom's coal-fired power stations in the district. These include: Majuba, Tutuka, Camden, and Grootvlei power stations, all of which fall within the Highveld Priority Area (HPA).

In the past three years, ambient pollutant concentrations recorded at Eskom's air quality monitoring station at Sivukile village (near to Tutuka power station) have shown non-compliance of PM_{10} with the National Ambient Air Quality Standards (NAAQS) (Eskom, Monitoring Data). According to the *Consultation on the Draft Second-Generation Highveld Priority Area Air Quality Management Plan* published in Government Gazette No. 50985 of July 2024 (hereafter referred to as 'the HPA AQMP'), industry and wind-blown dust are the highest contributors to PM emissions. However, domestic fuel burning is also recognised as a significant source of particulate emissions, contributing approximately 7% and 15% to total PM_{10} and $PM_{2.5}$, respectively (Republic of South Africa, Government Gazette 50985, Air Quality Act, (2024)). Indeed, studies have also indicated that within low-income settlements that PM is mainly generated within the community from sources such as indoor fuel use for cooking and heating (Adesina, J. A. et al, 2022).

Table 5-5 demonstrates the indicative number of households for offset interventions based on Eskom's assumption that 75% of households in Sivukile and Thuthukani use coal or wood as their main fuel source, and of that 90% of households would choose to participate in the programme. The number of households identified in table 5 is a revision of previous numbers to reflect recently completed work on possible addition households which could be included in the programme. Based on a recent review of sites, a further 16,241 households have been identified as available for potential AQO interventions in the surrounding communities as a part of the potential expansion of Eskom's AQO Programme (Air Resource Management (ARM), 2024). The recent investigation indicates the existing programme could be expanded from the present target of 36 000 households to 96 000 and work to assess this on-going.

Table 5-5 – Selected areas and associated Air Quality Offset Interventions (ARM, 2024)

Area	Opportunity for Offset Intervention	Proposed Number of Households for Offsets	Potential households for expansion (ARM 2024)	Implementation Phase	Timeline (Eskom, Air Quality Offset Project, 2024)
Sivukile	Domestic Fuel Burning	1,160	NA	Phase 2	April 2024 – December 2025
Thuthukani	Domestic Fuel Burning	400	199	Phase 3	TBC
Neighbouring farms	Domestic Fuel Burning	TBC	No data	Phase 3	TBC
Standerton	Domestic Fuel Burning	No data	8,004	TBC	TBC
Sakhile	Domestic Fuel Burning	No data	8,038	TBC	TBC

Projects in development**:** Given the potential role that offset play in improving air quality Eskom has undertaken a review of its present interventions with the objective of optimising for increased air quality improvements and impact The recent literature reviews and high-level desktop feasibility analyses conducted by ARM, there is evidence to support the current suite of AQO interventions currently proposed and being rolled out by Eskom. As such, it is recommended that Eskom continue with the current AQO interventions for both domestic fuel burning and domestic waste burning although a few improvements to the current rollout were suggested which will be evaluated by Eskom.

Furthermore, additional AQO opportunities for Eskom to consider, should the outcomes of the relevant feasibility studies show that they can be effectively and affordably realised in practice were identified which include:

- "Implementing dust suppression/solutions of unpaved roads in low-income settlements;
- Implementing veld fire management solutions;
- Eskom evaluates the feasibility of mini and micro grids in appropriate locations; and
- Eskom in conjunction with local municipalities assess the potential for biogas generation from Waste and Sewage treatment plants"

Since this AQO Plan extends over several years, the proposed interventions cannot remain static but should evolve with changing technologies and community circumstances. A critical aspect of the AQO Plan is that offsets should address ambient air quality non-compliance, particularly non-compliance of the same pollutant that is emitted by the targeted opportunity for offset intervention. Several settlements identified based on Power Station impact are in semi-rural to rural areas. Eskom's existing AQO interventions have not been shown as practical for such areas and further investigation of options is underway (Eskom, March, 2021).

5.4 NATIONAL ELECTRICITY SUPPLY ISSUES

South Africa's electricity system has been strained over the past 10-12 years and was not able to provide sufficient power to meet demand due to breakdowns causing reduced capacity, and recurrent loadshedding had to be implemented to protect the system. The electricity crisis has been severely damaging to the South African economy, with no sectors untouched by these impacts. Mining and industry were severely impacted, with outputs reduced, resulting in a loss in investor confidence leading to postponed or cancelled investments into South Africa. Further, power outages led to impacts on quality of medical care, cold food chain storage facilities, failure of equipment in sanitation, bulk water, and sewerage facilities, to name a few. Outside of this, South African citizens experienced day to day difficulties, such as extended commutes to work due to power failures, increased crime due to lighting outages and lack of communications, and difficulties to prepare food.

The eventual objective of the energy policy is to reduce reliance on coal and to expand electricity generation through renewable and/or lower emission options, the reality of this unfortunately, is that the roll-out of these projects is not at the desired rate, with the South African power generation system remaining insecure. Importantly, and adding to the challenges of transitioning to renewables, is that 1GW of coal produces far more energy than 1GW of wind or solar PV. Therefore, much more solar or wind capacity is needed to produce the same amount of energy as coal combustion. To ensure adequate energy margin in the grid, to either start reducing the amount of coal burnt and/or allowing for the upgrading and retrofitting of abatement technologies, various initiatives will be required to ensure energy security is not jeopardized.

Eskom intends to align with the National Energy Crisis Committee (NECOM) Energy Action Plan of combining immediate solutions to address the energy gap, such as demand reduction, accelerating the building of generation and storage capacity, expanding and improving infrastructure, and ‘fixing’ Eskom. The sourcing of power (Independent Power Producers-IPP), an externality that Eskom has no control over but certainly welcomes, is a longer-term strategy that will aid in fast tracking the decommissioning of power plants reaching end of life. Since these processes are complex, involving multiple parties and stakeholders, the time for them to take effect is difficult to determine and plan.

The amount of electricity Eskom is required to supply is defined through the Integrated Resource Plan (IRP). A draft IRP was published on 4 January 2024 and an update of this plan is expected. For the modelling work undertaken for this application Eskom was informed by the draft IRP 2023 and its own production plan projections over the periods until 2030 and then beyond. Due to time constraints no specific energy system modelling exercise was completed for this application.

As indicated above there are a range of factors which impact on energy demand and security of supply nationally and in terms of what Eskom is required to deliver. Changes in these factors and the assumptions they create will impact on the requirement for Eskom generation and some of the impacts and assessments presented in this application. A review of this application in light of revision of the IRP is recommended.

6 HEALTH & ENVIRONMENTAL IMPACTS

6.1 AIR QUALITY IMPACTS

6.1.1 BASELINE AMBIENT AIR QUALITY MONITORING DATA

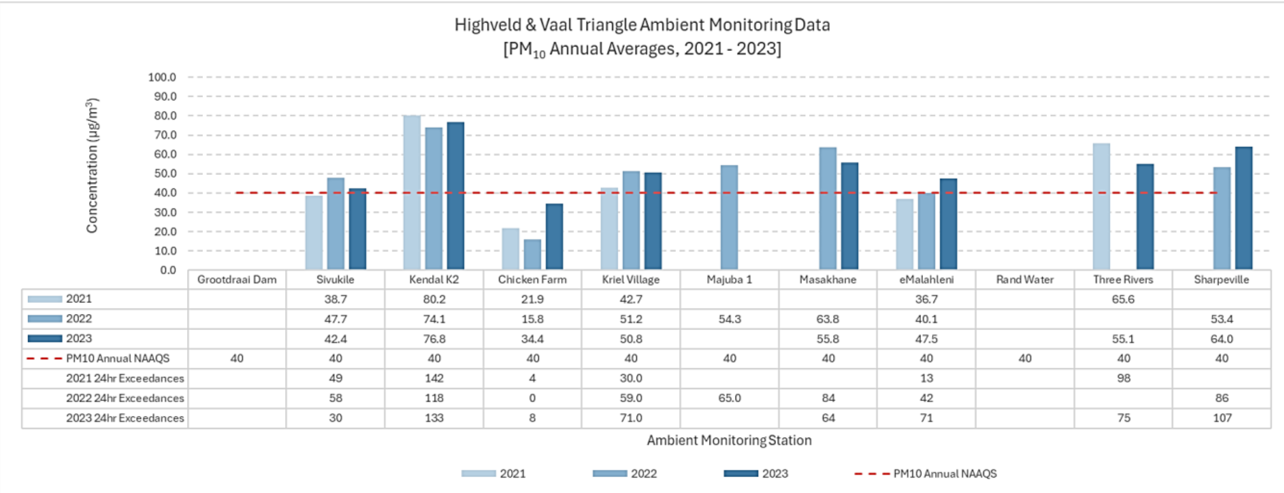
Ambient air quality monitoring stations in the Highveld and Vaal areas considered in this exemption application comprised Eskom owned stations and South African Weather Services (SAWS) stations, for the period 2021 - 2023. Although a minimum data recovery of 90% is required, as stipulated by the SANAS TR 07-03 (SANAS, 2012), for the purposes of this report, data recovery of 50% and greater were considered. Given the great distance that Eskom stack emissions are likely to disperse, and the cumulative impact this will have across the selected monitoring stations, all stations selected for the Highveld and Vaal areas are discussed, although station selection was based on proximity to each power station, as follows:

- Duvha – Masakhane (Eskom) and eMalahleni (SAWS);
- Kendal – Kendal K2 (research station) and Chicken Farm (both Eskom);
- Lethabo – Rand Water (Eskom), Sharpeville and Three Rivers (SAWS);
- Matla – Kriel Village (Eskom);
- Majuba – Majuba 1 (Eskom); and
- Tutuka – Sivukile and Grootdraai Dam (both Eskom).

Figure 6-1 illustrates annual average PM_{10} concentrations and exceedances of the 24-hour average NAAQS measured in 2021 – 2023; no data was recovered at the Grootdraai Dam and Rand Water monitoring stations. As is evident, except for the annual average at Chicken Farm which remained compliant, ambient PM_{10} concentrations are non-compliant at all stations with both the annual and 24-hour NAAQS, with the frequency of 24-hour exceedances exceeding the permitted frequency of exceedances per calendar year (four exceedances are permitted per calendar year). Highest concentrations were measured at Kendal K2 (research station located at maximum point of impact for Kendal emissions), Three Rivers, Sharpeville and Kriel Village, with the highest occurrence of 24-hour average exceedances at Kendal K2.

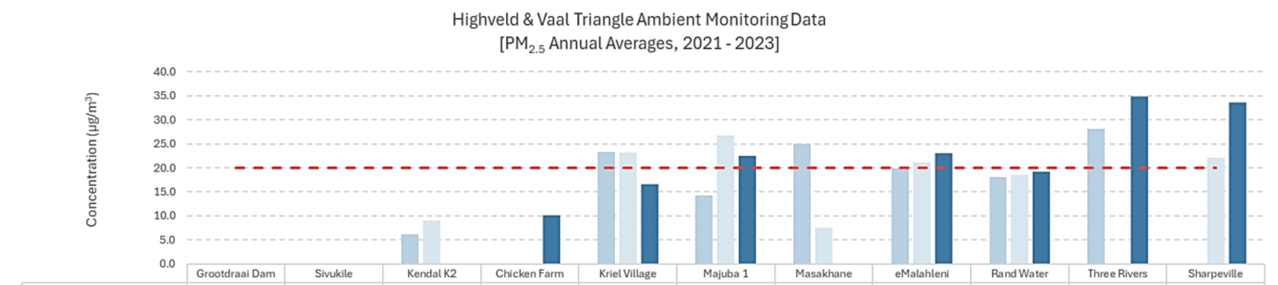
Considering $PM_{2.5}$ concentrations, as illustrated in Figure 6-2, similar to PM_{10}, non-compliance with the annual NAAQS is evident at the Kriel Village, Majuba 1, Masakhane, eMalahleni, Sharpeville and Three Rivers stations, with Kendal K2, Chicken Farm, and Rand Water showing compliance with the annual $PM_{2.5}$ NAAQS. All stations measured frequent exceedances of the 24-hour NAAQS, while Rand Water, which was compliant with the annual NAAQS, showed non-compliance with the 24-hour NAAQS given the frequency of exceedances. Highest $PM_{2.5}$ concentrations were measured at Three Rivers and Sharpeville, with no data recorded at Grootdraai Dam and Sivukile.

Given the elevated PM_{10} and $PM_{2.5}$ concentrations throughout the Highveld and Vaal Triangle areas, the PM_{10} and $PM_{2.5}$ NAAQS should be considered saturated, with these contributing emission sources requiring focus. Key sources of emissions in the area comprise mining, industrial activities, the Eskom power stations, vehicle emissions, uncontrolled waste burning, and domestic fuel burning.



	Grootdraai Dam	Sivukile	Kendal K2	Chicken Farm	Kriel Village	Majuba 1	Masakhane	eMalahleni	Rand Water	Three Rivers	Sharpeville
2021		38.7	80.2	21.9	42.7			36.7		65.6	
2022		47.7	74.1	15.8	51.2	54.3	63.8	40.1			53.4
2023		42.4	76.8	34.4	50.8		55.8	47.5		55.1	64.0
PM10 Annual NAAQS	40	40	40	40	40	40	40	40	40	40	40
2021 24hr Exceedances		49	142	4	30.0			13		98	
2022 24hr Exceedances		58	118	0	59.0	65.0	84	42			86
2023 24hr Exceedances		30	133	8	71.0		64	71		75	107

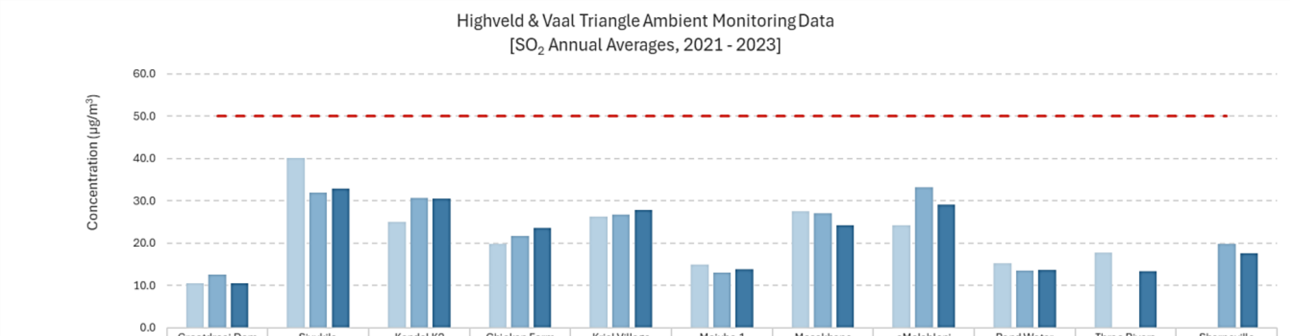
Figure 6-1 - Highveld and Vaal Triangle ambient PM_{10} concentrations, 2021 – 2023



	Grootdraai Dam	Sivukile	Kendal K2	Chicken Farm	Kriel Village	Majuba 1	Masakhane	eMalahleni	Rand Water	Three Rivers	Sharpeville
2021			6.1		23.3	14.3	24.9	19.8	18.0	28.1	
2022			9.1		23.2	26.8	7.5	21.2	18.5		22.1
2023				10.1	16.6	22.5		23.1	19.1	34.9	33.6
PM2.5 Annual NAAQS	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2021 24hr Exceedances			0		25.0	2.0	53	32	5	45	
2022 24hr Exceedances			4		25.0	81.0	0	25	4		67
2023 24hr Exceedances				1	8.0	35.0		48	9	113	97

Figure 6-2 - Highveld and Vaal Triangle ambient $PM_{2.5}$ concentrations, 2021 – 2023

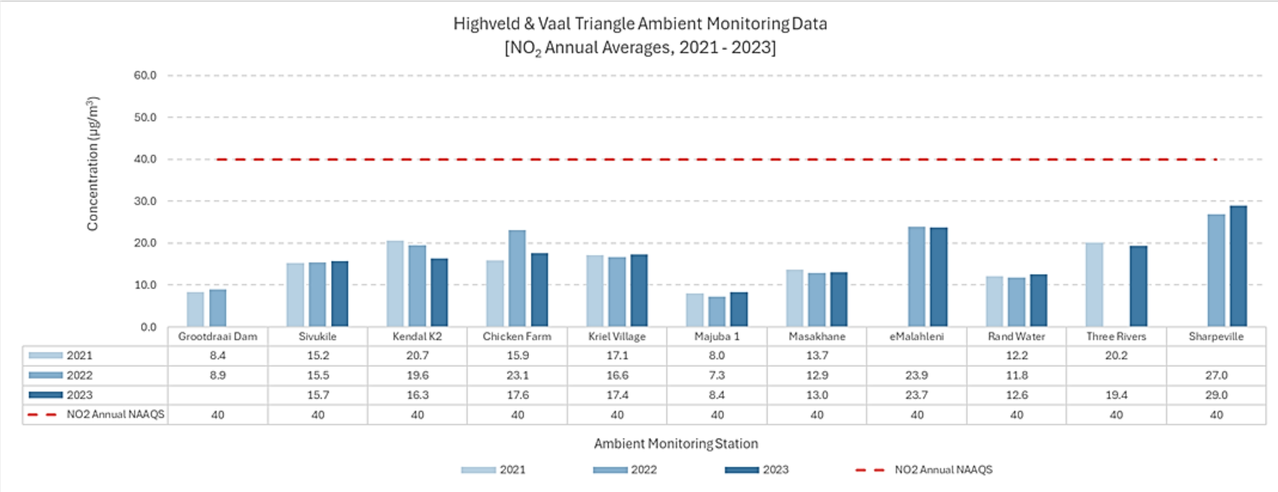
SO_2 measured concentrations in the Highveld and Vaal Triangle for the period 2021 – 2023 are presented in Figure 6-3. Annual average concentrations across the ambient monitoring network indicate compliance with the annual NAAQS, with no stations exceeding the NAAQS in any year. Highest concentrations were typically measured at Sivukile, Kendal K2, and eMalahleni. Although not presented in Figure 6-3, exceedances of the short-term NAAQS (10-minute, hourly and 24-hour) were recorded at most stations, although importantly these remained below the permitted frequency of exceedances. Of these, Kendal K2 recorded the most short-term exceedances, with 199 10-minute, 49 hourly, and three 24-hour exceedances recorded in 2023. Importantly, these exceedances remain below the permitted exceedances, with 526 10-minute, 88 hourly, and four 24-hour average exceedances permitted per calendar year.



	Grootdraai Dam	Sivukile	Kendal K2	Chicken Farm	Kriel Village	Majuba 1	Masakhane	eMalahleni	Rand Water	Three Rivers	Sharpeville
2021	10.4	40.1	25.1	19.8	26.3	14.9	27.5	24.2	15.2	17.8	
2022	12.5	31.9	30.6	21.7	26.7	13.1	27.1	33.1	13.5		19.8
2023	10.5	32.9	30.4	23.5	27.8	13.9	24.2	29.1	13.7	13.3	17.5
SO2 Annual NAAQS	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0

Figure 6-3 - Highveld and Vaal Triangle ambient SO_2 concentrations, 2021 – 2023

Nitrogen dioxide (NO_2) measured concentrations in the Highveld and Vaal Triangle for the period 2021 – 2023 are presented in Figure 6-4. Annual average concentrations across the ambient monitoring network indicate compliance with the annual NAAQS, with no stations exceeding the NAAQS in any year. Highest concentrations were typically measured at Sharpeville, Chicken Farm, Kendal K2, and eMalahleni. Although not presented in Figure 6-4, exceedances of the hourly NAAQS were recorded at Chicken Farm, although importantly these remained well below the permitted frequency of exceedances, with 15 exceedances recorded and 88 permitted.



	Grootdraai Dam	Sivukile	Kendal K2	Chicken Farm	Kriel Village	Majuba 1	Masakhane	eMalahleni	Rand Water	Three Rivers	Sharpeville
2021	8.4	15.2	20.7	15.9	17.1	8.0	13.7		12.2	20.2	
2022	8.9	15.5	19.6	23.1	16.6	7.3	12.9	23.9	11.8		27.0
2023		15.7	16.3	17.6	17.4	8.4	13.0	23.7	12.6	19.4	29.0
NO2 Annual NAAQS	40	40	40	40	40	40	40	40	40	40	40

Figure 6-4 - Highveld and Vaal Triangle ambient NO_2 concentrations, 2021 – 2023

6.1.2 HIGHVELD AND VAAL TRIANGLE CUMULATIVE AIR QUALITY IMPACTS

CALPUFF dispersion modelling was undertaken by uMoya-NILU Consulting (Pty) Ltd, as contained within the Cumulative Highveld and Vaal AIR (report uMN220-24, 2024) to assess various operational scenarios anticipated by Eskom for the Highveld and Vaal Fleet, comprising Komati, Arnot, Camden, Kriel, Grootvlei, Hendrina, Duvha, Matla, Kendal, Lethabo, Tutuka, Majuba, and Kusile in the coming years for SO_2, NO_x, and PM (PM_{10} and $PM_{2.5}$), namely:

- **Scenario 1 (Current)**: The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the ash dump.
- **Scenario A (2025)**: Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the ash dumps and stockpiles. This includes the shutdown of Komati; the completion of PM abatement projects at Kendal, Lethabo, Tutuka, Duvha, and Matla; and the FGD at Kusile.
- **Scenario B (2031) / ERP 2024 A**: Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the ash dumps and stockpiles. This includes completion of shutdowns at Arnot, Kriel, Hendrina, Camden, and Grootvlei, including their fugitive sources, with Matla and Duvha also entering shutdown phase; FGD at Kusile and reduced SO_2 emissions achieved through Despatch Prioritisation and efficiency improvement projects; and NO_x abatement (LNB) at Majuba, Lethabo, and Tutuka.
- **Scenario C (2036) / ERP 2024 B**: Representing an alternative scenario for anticipated station performance from 2036 onwards, including fugitive emissions from the ash dumps and stockpiles. This includes the complete shutdown of Matla and Duvha; shutdowns of Tutuka, Lethabo, and Kendal, including their fugitive sources, with Majuba entering shutdown phase in FY2047; SO_2 abatement installed at Kusile (Wet FGD), Majuba (DSI FGD), and Kendal (Semi-dry FGD); as well as reduced SO_2 emissions achieved through Despatch Prioritisation and efficiency improvement projects.

- **Scenario D (MES) / ERP 2024 C**: MES compliance, inclusive of the ash dumps and stockpiles, where relevant (i.e. not for the stations shutdown), and in addition to the abatement included in above scenarios, FGD installations at Tutuka and Lethabo. (Additional NO_x and FGD technology not installed at Duvha and Matla given the shutdown of these stations by 2035).

Table 6-1 presents maximum ground level concentrations predicted at sensitive receptors and monitoring stations (only the highest concentration and predicted exceedances presented) associated with each operational scenario. While the focus of the assessment is on stack emissions, and SO_2 particularly, the inclusion of fugitive PM emissions provides a holistic understanding of the Highveld/ Vaal Fleet contributions to ambient PM_{10} and $PM_{2.5}$ concentrations. Key findings from this AIR comprised:

- For SO_2:
  - Predicted concentrations are attributed only to the stack emissions.
  - Maximum predicted annual concentrations at all receptors remain below the annual NAAQS in all scenarios.
  - No exceedances of the short-term NAAQS (24-hour and hourly) are predicted at receptors in all scenarios.
  - Considering Scenario D (full MES compliance) and Scenario C (Eskom planned), concentration predictions show an improvement in Scenario D. However, critically, Scenario C and B, inclusive of the abatement planned by Eskom, does not show any exceedances of the NAAQS. This is also evident in Eskom's current operational scenarios (Scenario 1 and A) where abatement has not yet taken effect, although improvements in emissions due to Despatch Prioritisation and efficiency improvements are considered.
- For NO_2:
  - Predicted concentrations are attributed only to the stack emissions.
  - Maximum predicted concentrations remain well below all averaging periods of the NAAQS at all receptors for the five scenarios.
  - No short-term exceedances (hourly) are predicted to occur.
- For PM_{10} and $PM_{2.5}$:
  - Predicted concentrations are attributed to stack emissions and low-level fugitive sources (ash dumps and stockpiles).
    - The inclusion of the fugitive sources was done assuming most the area is exposed and available for entrainment, while in reality only a small portion of the modelled area would be exposed to entrainment due to the vegetated sides and wet areas of the dumps. This approach should be considered an over-estimate.
  - The PM emissions from stacks and fugitive sources are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$, considered environmentally conservative.
  - Maximum PM_{10} annual concentrations predicted at sensitive receptors, inclusive of the ambient monitoring stations, are predicted to remain below the annual NAAQS in all scenarios, with a maximum annual average concentration of 28.1µg/m^3 predicted to occur at a receptor.
    - Exceedances of the 24-hour PM_{10} NAAQS are predicted in Scenarios 1, A, and B, exceeding the permitted frequency of exceedance in a three-year period (12 in a three-year period, as modelled). Predicted concentrations decrease in Scenario's C and D, with no 24-hour

exceedances predicted, predominantly due to station shutdowns, inclusive of their fugitive sources which are assumed to be rehabilitated, which are the main contributing sources.

- Maximum annual average $PM_{2.5}$ concentrations are predicted to exceed the annual NAAQS in Scenario's 1, A, and B, while 24-hour exceedances are also predicted, exceeding the permitted frequency of exceedance. While the annual averages in Scenario C and D are below the more stringent $PM_{2.5}$ standard coming into effect in 2030, 24-hour exceedances are still predicted, above the permitted frequency.
  - $PM_{2.5}$ predictions must be viewed in light of the conservative assumptions (over-estimate) applied in the dispersion models, as discussed previously.
- Further, considering the areas of predicted non-compliances and their proximity to each power station, as noted in the uMoya-Nilu AIR (report uMN220-24, 2024), the elevated PM can mostly be attributed to the low-level fugitive sources, which have poor buoyancy and disperse poorly, as opposed to the stack emissions which are released at a much higher height above ground-level, with considerable buoyancy, and so disperse well.

- Given the conservative approach to the fugitive emission source simulations, and that this provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom undertook an additional cumulative modelling scenario, assessing only PM, SO_2, and NO_X stack emissions from the Highveld and Vaal Triangle Fleet. NO_X and SO_2 emissions were included to ensure secondary particulate formation is accounted for. Key findings from this include:

  - Predicted PM_{10} and $PM_{2.5}$ concentrations, including secondary particulate formation, indicated full compliance with the NAAQS, with no 24-hour exceedances predicted within the modelling domain.
  - The maximum PM_{10} annual and 24-hour average predicted was 4.7µg/m^3 and 36.5µg/m^3, respectively, predicted in Scenario A, remaining well below the NAAQS.
  - The maximum $PM_{2.5}$ annual and 24-hour average predicted was 4.2µg/m^3 and 31.3µg/m^3, respectively, predicted in Scenario A, remaining well below the NAAQS.
  - This additional modelling confirms ground-level concentrations due to Eskom stack emissions remain well below the NAAQS, with the elevated concentrations originally predicted being influenced by the low-level fugitive sources, rather than the stack emissions.

  - In comparison to measured ambient annual average SO_2, NO_x, PM_{10} and $PM_{2.5}$ concentrations, the modelling scenario representing Eskom current emissions (Scenario 1) predicted lower annual averages compared to the measured data, to be expected as Eskom is not the sole contributor to measured ambient concentrations.

Table 6-1 - Predicted maximum annual and short-term ground level concentrations occurring at selected receptors and ambient monitoring stations for each operational scenario (uMoya-NILU, report uMN220-24, 2024)

Pollutant			
Predicted maximum SO_2	**Annual**	**24-hour (P99)**	**1-hour (P99)**
Scenario 1 (Current)	11.4	81.3 (0)	150.8 (0)
Scenario A (2025)	23.0	121.1 (0)	344.0 (0)
Scenario B (2031)	17.2	95.8 (0)	289.2 (0)
Scenario C (2036)	13.3	79.7 (0)	241.0 (0)
Scenario D (MES)	5.4	31.8 (0)	105.2 (0)
NAAQS limit value	**50**	**125 (12)***	**350 (264)***
Predicted maximum NO_2	**Annual**	**-**	**1-hour (P99)**
Scenario 1 (Current)	5.1	-	89.4 (0)
Scenario A (2025)	6.7	-	107.8 (0)
Scenario B (2031)	3.9	-	75.3 (0)
Scenario C (2036)	3.9	-	79.0 (0)
Scenario D (MES)	3.9	-	79 (0)
NAAQS limit value	**40**	**-**	**200 (264)***
Predicted maximum PM_{10}	**Annual**	**24-hour (P99)**	**-**
Scenario 1 (Current)	27.7	205.8 (96)	-
Scenario A (2025)	28.1	209.4 (95)	-
Scenario B (2031)	18.7	135.3 (27)	-
Scenario C (2036)	10.4	62.3 (0)	-
Scenario D (MES)	10.2	59.9 (0)	-
NAAQS limit value	**40**	**75 (12)***	**-**
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour (P99)**	**-**
Scenario 1 (Current)	27.7	205.8 (222)	-
Scenario A (2025)	28.1	209.4 (218)	-
Scenario B (2031)	18.7	135.3 (278)	-
Scenario C (2036)	10.4	62.3 (98)	-
Scenario D (MES)	10.2	59.9 (98)	-
NAAQS limit value	**20**	**40 (12)***	Up to 31 Dec 2029
	15	**25 (12)***	From 01 Jan 2030

Note: Red represent non-compliances, with exceedance counts in brackets
*Regulations provide for permitted frequency of exceedance per calendar year; 4 exceedances per year of a 24-hour standard, and 88 exceedances per year of an hourly standard. Since the model simulated three years, these permissible exceedance counts represent a three-year period.

6.2 HEALTH IMPACTS

A coal-fired power station releases impurities into the air during coal combustion in the boiler. These pollutants are released through stacks, where they are diluted and endure chemical transformations before ultimately reaching the surface. Here, they may be inhaled or impact the physical environment. The pollutants include SO_2, NO_x, polycyclic aromatic hydrocarbons, and trace substances such as mercury.

The effects of coal combustion-associated air pollution on health are recognised worldwide. The sensitive receptors mainly consist of schools, hospitals, and other locations where children, the elderly, and the infirm might reside. While many factors impact air quality, air pollution exposure in communities near coal-fired power stations is significantly higher than areas without these facilities.

Air emissions are responsible for a variety of detrimental health effects. Examples of these effects include respiratory diseases, lung cancer, cardiovascular diseases, and neurodevelopmental disorders. Potential health impacts as a result of emissions from Tutuka Power Station are outlined below:

- Sulphur dioxide that potentially contributes to respiratory illnesses (chronic bronchitis, nasal, throat and lung irritations, asthma attacks) and cardiovascular disease.
- $PM_{2.5}$ is the air pollutant responsible for the most significant health issues and premature mortality. $PM_{2.5}$ is more likely to penetrate and accumulate on the surface of the deeper lung regions. Furthermore:
  - Short-term exposure to $PM_{2.5}$ is linked to premature mortality, acute and chronic bronchitis, asthma attacks, and other respiratory symptoms, as well as heart or lung distress. Infants, children, and older individuals who have preexisting cardiac or lung diseases are more likely to experience these adverse health effects.
  - Long-term exposure to $PM_{2.5}$ (months to years) has been associated with reduced lung function growth in children and premature death, particularly in those with chronic heart or lung diseases.
- PM_{10} contributes to adverse health effects as it is more likely to deposit on the surfaces of the larger airways of the upper lung region, inducing tissue damage and lung inflammation.
  - There is evidence of the adverse effects of short-term exposure on respiratory health.
  - The consequences of prolonged exposure to PM_{10} are less certain, although studies indicate a correlation between respiratory mortality and long-term PM_{10} exposure.
- Nitrogen oxides contribute to respiratory illnesses (e.g., respiratory infection, asthma, chronic bronchitis) and smog.
- Mercury and other heavy metals have been associated with neurological and developmental impairment in humans.

Noting the above issues, the NAAQS described in section 3.2 above were established to protect air quality and public health. Compliance with the standard in an area implies that the area is exposed to an acceptable level of risk from air quality impacts and air quality related health issues. This does not imply that there is no risk associated with lower levels of pollutants in the atmosphere but there is arguably no acceptable risk to some pollutants and the NAAQS thus represent what is considered acceptable in the South African context. The benefit-cost analysis discussed below attempts to put a financial cost on these health impacts.

The extent to which the HPA complies with NAAQS and the predicted impact of Tutuka Power Station on this ambient air quality standards, and by default acceptable public health risks is described above.

In reviewing this it is important to note that Tutuka is only one of many facilities and activities in the HPA which impact on air quality and ensuring improvement in air quality in the area and public health requires a targeted, practical and integrated approach to emissions management in the area.

It can also be noted that unplanned electricity outages through load shedding can also result in health impacts due to challenges with the availability of medical facilities, water provision and food storage challenges for example.

6.3 WATER

6.3.1 WATER DEMAND OF FGD SYSTEM

FGD systems are used to remove SO_2 from exhaust flue gases of fossil-fuel power plants and other industrial processes. FGD technology includes wet, dry and semi-dry processes. Wet FGD technology is planned at Medupi, with semi-dry FGD technology proposed for Kendal and DSI FGD is proposed for Majuba. Should the MES be enforced on the remaining Eskom power stations, Matimba, Lethabo, and Tutuka would receive semi-dry FGDs.

Wet FGD while having higher efficiency in SO_2 removal (up to 98%), has higher operational complexity and environmental impact due to its high-water usage. Semi-dry processes have a lower water requirement and a smaller footprint, with no wastewater production, simplifying water management but also requiring an increase in water usage. However, SO_2 removal has a slightly lower efficiency than wet FGD.

Dry FGD processes produce less waste and use less water, reducing the need for extensive water treatment facilities. However, it may produce more solid waste, requiring adequate disposal solutions. The dry FGD process has a slightly lower efficiency (up to 90%) but simpler operation and lower environmental impact in terms of water usage. The lower water usage makes dry FGD systems more suitable for regions with limited water resources (such as South Africa).

The Eskom Emission Reduction Plan includes the implementation of wet and semi-dry FGD technology options due to the higher efficiencies that would be required to reduce SO_2 emissions to levels compliant with the MES. This will result in an increase in water demand across the fleet. This additional water demand is not necessarily available over the short-term specifically in the catchments of operation of the power stations, such as the Integrated Vaal River System (IVRS). Very limited water supply development potential exists, which requires that any water increases be addressed by an appropriate mix of supply and demand side measures. While power generation is a strategic water use in terms of the National Water Act (No. 36 of 1998), and as such receives water at an assurance level of supply of 99.5% due to the importance of electricity for the socio-economic growth of this country, water supply is not necessarily available to meet an increase in water requirements. Water security is thus at risk.

6.3.2 WATER SUPPLY

The raw water supply to the Eskom power stations is sourced directly from two water resource supply systems, *namely:*

- Mokolo River system for supply to the Medupi and Matimba power stations\
- Integrated Vaal River System (Vaal, Thukela and Usutu catchments) for supply to Matla, Majuba, Duvha, Tutuka, Kendal and Lethabo power stations.

Power generation is identified as a strategic water use in terms of the National Water Act (Act No. 36 of 1998) and is provided with the highest assurance of supply (99.5 %) in the operation of all water resource systems in the country (National Water Resources Strategy -3 (NWRS-3), DWS 2023). However, a key goal of the NWRS-3 is reducing water demand, and while water supply for electricity generation is afforded priority it is not unlimited and has to be balanced with other strategic objectives of the NWRS-3. The NWRS-3 does refer to the disadvantage of the proposed FGD technology with its high-water usage, and due to water scarcity in the country, recommends further research on alternative technologies and options to meet the future Eskom water demand (DWS, NWRS-3, 2023). Future allocations to meet the increased water supply, should FGD's be installed, to Eskom can thus not be guaranteed, if it's not aligned with the strategic goals of the NWRS-3 and imperatives to reduce water demand, increase water conservation and improve water use efficiency.

6.3.3 TUTUKA POWER STATION

Tutuka is in the Leeuspruit catchment (C11K) of the Grootdraai Dam catchment in the Upper Vaal catchment area. Water uses have been authorised until 2033 in terms of the NWA (Act No. 36 of 1998) for power generation activity. Water requirements to the power station is supplied from the integrated Vaal River system, via the Usutu Vaal water scheme (Eastern subsystem supply). Tutuka is authorised to abstract 11.15 million m^3/a from the sources in the Upper Olifants catchment. Waste slurry waste products generated through the operation are stored in ash dams on site, while treated sewage wastewater is discharged into the Leeuspruit.

Should full MES compliance be enforced, a semi-dry FGD would be the most practical option for Tutuka. The summary of the current allocation and potential changes to the water requirements are shown in Table 6-2. Achieving full MES compliance will require an approximate 23% (5.15 million m^3/a) increase in water required, with this requiring an increase to the water allocation to Tutuka from the VRESS. The increase in water usage will have a marginal impact on the water balance of Tutuka and will necessitate additional abstraction and waste disposal capacity on site. As the water use is consumptive, with a dry byproduct there will however be minimal wastewater generation. It is expected that the additional water requirement for Tutuka Power station will be met through the current allocation from the VRESS, as the power station has shown a decline in its water usage due to low load factors (Eskom, 2024).

Table 6-2 – Summary of water changes with a semi-dry FGD

VARIABLE	UNIT	
Water allocation (VRESS, 2023)	million m^3/a	22.11
Additional water requirement	million m^3/a	5.148
	%	23

As FGD implementation is only expected beyond 2030, the risk to the water supply from the VRESS will be alleviated/low with the LHWP-Phase 2 expected to be on-line at that stage to meet the projected water requirements of the users of the Vaal River System and associated catchments. The cost of water will however be higher, and the DWS may need to be balance water allocations with competing users. Water security will however be a risk should the LHWP-Phase 2 be delayed. If this is the case, restrictions to users will be implemented, which will impact the allocated and future increased water supply to Tutuka, and on the ability to implement the FGD process.

The implications of the semi-dry FGD technology at Tutuka will impact the longer-term sustainability of the water resources and the receiving environment. As opposed to Eskom's commitment to

Environmental, Social, Governance (ESG) principles of reducing water consumption, increasing WCWDM, and reducing waste generation thereby alleviating the strain on water availability and usage, the FGD will necessitate increased water usage and more waste generation.

6.4 WASTE

Flue Gas Desulfurization (FGD) is a process used to reduce SO_2 emissions from coal-fired power plants by capturing sulphur compounds in the flue gas. While FGD significantly improves air quality and helps meet environmental regulations, it also introduces new waste management challenges. The FGD process typically produces a byproduct known as calcium sulphates (gypsum in the case of wet FGDs), which, based on DFFE waste management requirements, must be managed and stored separately from existing waste streams like ash. Implementing FGD increases both the volume of waste generated and the complexity of waste handling infrastructure. Since co-disposal is not permitted by DFFE, stations will be required to design and construct new facilities to accommodate the gypsum, which requires additional approvals, water management, operational adjustments, and new handling infrastructure. This added waste stream, combined with the increased water use needed for the FGD process, can substantially impact the overall environmental footprint of the facility, making waste management a critical aspect of FGD implementation.

While Eskom does not intend to install FGD technology at Tutuka, should compliance with the SO_2 MES be enforced, requiring FGD technology, the process will result in the production of Gypsum (by-product) that will require storage on a waste facility, depending on the materials waste classification.

At Tutuka, due to FGD, approximately 827 kt per annum (ktpa) of gypsum will be produced in addition to the ash production of approximately 3.5 Mtpa. Starting in 2031, the first year will see 137 kt of gypsum produced, followed by 257 kt in the second year, continuing to increase annually until the full 827 ktpa is reached, beginning to decrease annually with the start of the Tutuka shutdown phase in 2036.

The existing ash disposal facility was originally designed to handle ash residue and particulate matter collected through current abatement processes. The introduction of gypsum from the FGD process, however, will significantly affect the way waste streams are managed. Ash and gypsum differ in particle size, and density, which could challenge the existing infrastructure. Since DFFE does not permit co-disposal, Eskom will need to specifically construct a disposal facility for gypsum. Water management, specifically, will be impacted, as gypsum handling introduces different moisture retention and drainage requirements compared to ash. Currently, water from ash disposal is managed with established runoff and containment systems, but the addition of gypsum will necessitate more rigorous water controls to prevent contamination, requiring additional infrastructure and permitting. Addressing water impacts will be critical, as water management often presents the greatest challenge in waste handling.

As noted previously, the existing storage facilities will not be used for storage (co-disposal) of gypsum that will be produced. As such, the need for design, approval and construction of new disposal facilities will be triggered. The design and regulatory approvals for new facilities will require extensive planning and budget allocations.

Based on WSP's high-level review and assessment of the information provided by Eskom, the following concluding remarks are made:

- The implementation of semi-dry FGD technology at Tutuka will be a challenging exercise for waste management, particularly the safe and effective disposal of the gypsum by-product.
- Should co-disposal, albeit not recommended by WSP, not be applicable, safe handling of the gypsum by-product will necessitate the constructing a new (lined) storage facility.
- Design, regulatory approvals and permits, construction and start-up safe operation of a new storage facility for gypsum will incur significant capital expenditure and timeframes.
- WSP has not assessed the capacity of the current ash handling equipment (conveyors), and it is not clear whether the increase of waste would be managed by existing infrastructure, which would require detailed investigation.
- Separating the waste streams to different facilities will necessitate the handling of ash and gypsum on separate conveyors. Installation of an additional conveyor system to handle the gypsum will therefore lead to a substantial increase in CAPEX and OPEX.
- From a high-level assessment, it appears that the CAPEX and Opex associated with the required waste handling infrastructure may outweigh the potential benefits of implementing FGD. This suggests it might be financially inappropriate for a station with a limited remaining operational life.

6.5 CLIMATE CHANGE

Eskom has identified the contribution of their operations on global climate change in terms Greenhouse Gases (GHGs) emitted as carbon dioxide emissions as a significant issue. Due to this, the organisation has identified the need for a Climate Change Policy as well as the Generation Division Adaptation to Climate Change Plan. Both the plan and policy are developed to combat Eskom's vulnerability to acute and chronic effects that climate change may have on Eskom's infrastructure and systems and its plan to reduce its contribution to global climate change.

The Eskom Climate Change Policy applies all of Eskom's Divisions and subsidiaries. This Policy is in line with South Africa's National Policies such as the Climate Change Response (NCCRP) White Paper, 2011; the National Development Plan (NDP), 2030; South Africa's updated Nationally Determined Contribution (NDC), which has been submitted to the secretariat of the UNFCCC; the Paris Agreement; and the recently implemented Climate Change Act (2024), which will provide for a coordinated and integrated national response to climate change and its impacts.

The Eskom Climate Change Policy is supported by the approved Eskom JET Strategy, which demonstrates how Eskom will transition away from coal-fired power to more sustainable, lower emitting electricity sources. Eskom sees the JET as a pivotal point in Eskom's future which supports the national goals to decrease GHG emissions, promote job creation through reskilling and stimulate economic growth. The overall monitoring protocols will also be guided by the Climate Change Act (2024) and all other relevant climate change regulations and strategies.

As emphasised in the Eskom policy, South Africa's revised NDC will significantly impact Eskom, as most mitigation in the updated NDC target needs to come from the electricity sector which now accounts for approximately 41% of South Africa's GHG emissions. Eskom will need to decommission multiple coal-fired power stations over the next decade for South Africa to align to the objectives of international climate agreements. This means that coal-fired power stations would need to be supplemented with generation capacity from renewable and lower carbon technologies to meet South Africa's climate change commitments while maintaining security of supply. Preliminary analysis by the department shows that greenhouse gases from fossil fuel power generation will need to be limited to 125 – 140Mt CO_2 per annum in 2030 for South Africa to remain within the upper end of the NDC for

2030. While a new NDC is still being developed for 2035, the range (125 – 140 Mt CO_2 per annum) is maintained in the modelling from 2031.

GHG emissions from carbon dioxide are presented for the Eskom's Generation Business Unit, inclusive of all coal-fired power stations, in Figure 6-5. While the MES and climate change regulatory process are legally separate it is useful to note both ERP 2024 A and the security of supply projection are aligned with Eskom's current pollution prevention plan running to December 2025. Future CO_2 trajectories will be based on the updated pollution prevention plan and IRP, NDC, and Sectorial Emission Targets (SET).

This illustrates the anticipated CO_2 emissions trajectory, based on Eskom's anticipated loads, for the 2025 to 2050 operational period. Eskom's anticipated coal-fired load, in turn, assumes a time and full roll out of new electricity generation capacity to meet growing demand. Eskom's CO_2 emissions trajectory, without the enforcement of full MES compliance, shows a decreasing trend over time, predominantly driven by stations decommissioning and reduced loads at other stations. CO_2 emissions are anticipated to reduce from approximately 192Mt in 2025 to 63Mt in 2050, representing an approximate decrease of 67%. This is aligned with Eskom's and Government's aspirations in terms of climate change.

Should compliance with the MES be enforced, specifically with the new plant SO_2 MES, requiring the need to install FGDs at Lethabo, Tutuka, and Matimba, in addition to the already planned FGDs at Medupi and Kendal, CO_2 emissions would increase. This increase is predominantly due to the increase in the auxiliary power requirements to supply the FGD, considering Eskom's Scope 1 emissions. Although these are the emissions Eskom would be responsible for (i.e. in accordance with direct accounting and reporting of carbon emissions), other considerations due to the installation of FGDs with regards to CO_2 emissions are manufacturing, transportation, construction, and installation of the FGD itself, potential increase in mining activities due to the additional limestone (sorbent) required, emissions associated with the transport of limestone, most likely from the Northern Cape and emissions due to the end of life decommissioning of the FGD unit.

Figure 6-5 also illustrates the anticipated increase in CO_2 emissions with the addition of the abovementioned FGDs. Although seemingly insignificant, the addition of the FGDs would result in an approximate increase in CO_2 emissions of 25Mt between 2025 and 2050 across the coal-fired fleet, representing a 0,9% increase in Eskom's estimated emissions. This estimate only considers the auxiliary power requirements of the FGD, and although not responsible for Eskom to report, also the estimated CO_2 emissions due to sorbent transport from the Northern Cape. Further, the estimated 25Mt increase represents an approximate annual contribution to South Africa's 2030 Nationally Determined Contributions (NDC) budget of 0.4% (on average from 2030 – 2050), with a peak CO_2 contribution anticipated in 2026/27 of approximately 2Mt due to the FGD installations, representing a 0.6% contribution to SA's 2030 NDC budget[1].

[1] The contribution of the SA NDC lower emissions target is based on CO_2e, whereas the emissions from the FDG are based only on CO_2. It is understood that CO_2 is the largest GHG contributor for the project.

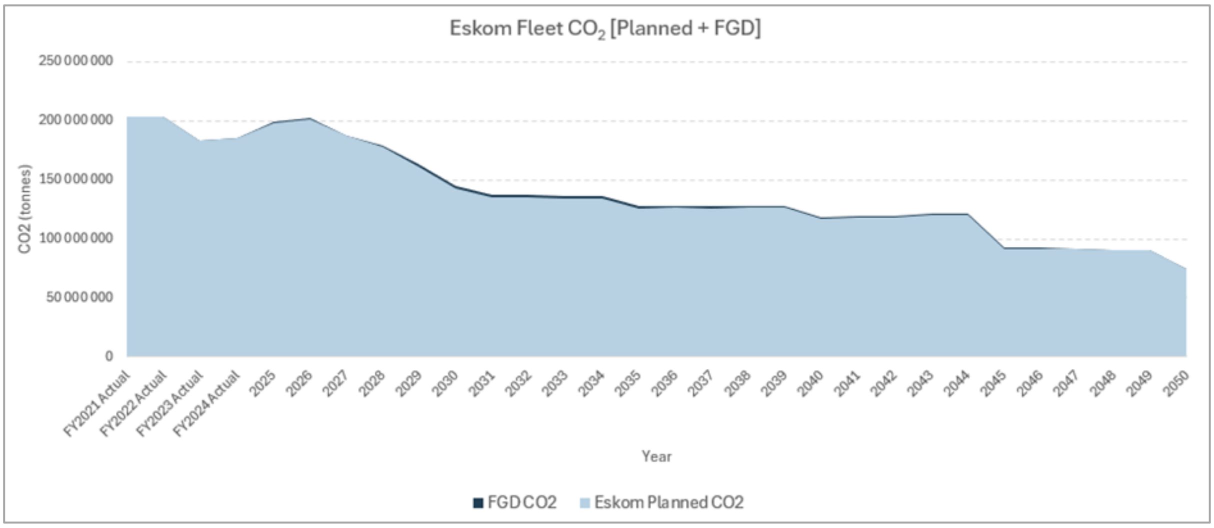


Figure 6-5 – Eskom coal-fired fleet CO_2 emission trajectory and contribution from FGDs

7 FINANCIAL CONSEQUENCES

7.1 FINANCIAL COSTS

Previous assessments completed as part of the MES and NECA process have shown that attempting to install the technology required to meet new plant SO_2 limits (wet-FGD) at stations by 2025 was unfeasible from a technical, economic and project-implementation perspective, apart from Medupi that was designed for a FGD retrofit, the other plants were not (Eskom 2021). Given the previous analysis and the time and other constraints influencing the present exemption applications only the two most potentially viable SO_2 reduction implementations (Majuba and Kendal) were assessed as part of this exemption application.

The assessments completed previously, included an analysis of the Levelised Cost of Electricity (LCOE) to compare the viability of FGD investments at stations with other options like gas or renewables. They also used stochastic electricity systems modelling to understand the full impact of FGD implementations. The studies indicated that retrofitting the plants with FGD would increase the cost of electricity produced due to the high capital and operating cost of FGD and the limited remaining life of the plants. (Eskom, 2020). Full implementation might have resulted in an increase in the average electricity tariff of around 10%, whereas the partial implementation scenarios would have a lesser impact – depending on the scenario. Studies also showed that the shutdown of multiple stations to enable the rapid implementation of FGD would result in significant security of supply issues which would result in massive levels of load shedding and a resultant destruction of the economy.

With an average age of the coal fleet being almost 40 years old, the long lead time to implement retrofits results in a limited economic life remaining post retrofit of the FGD. Assuming it was technically feasible to retrofit (which is a significant risk), and ignoring the unserved energy and load shedding, even with the increased cost, in the short term the plants would be cost competitive, relative to the comparable alternatives which could be deployed in the same time frames. These alternatives included that of running the OCGTs at 20% p.a. load factor and load shedding of the remaining demand in the earlier years. In the latter years with the increased cost due to the FGD, the plants would need to run at guaranteed higher load factors i.e. have a higher output, to remain competitive with comparable alternatives.

Two years have passed since the last detailed analysis, which now further limits the remaining useful life over which to recover any financial investment.

Eskom has maintained in all previous applications, that the costs associated with retrofitting FGD to any of its plant outweighs the benefits. This has been rejected by the NAQO, and partially by the NECA panel advising the Minister and in the Ministers Appeal decision. Although, in the case of Medupi, the report by the NECA indicated that FGD was very costly and would require Medupi to be offline for 80 additional days per year for six years, increasing load shedding risks (DFFE, 2024).

From a national strategic and risk perspective, if it is considered necessary for Eskom to implement a SO_2 abatement project at an Eskom station beyond Kusile and Medupi, and if it is proven to be technically feasible, it would be necessary to source funding against the background of guaranteed cost -reflective tariffs. From an economic/financial perspective a defined minimum load factor/take or pay agreement would ensure that the units costs are acceptable compared to known alternatives however if consideration could be given to the extension of the station life the economic/financial viability could improve. Given the quantum of the requirement investment, it is probable that Eskom would require fiscal support in order to raise funding for additional abatement projects beyond Kusile and Medupi. There might also be implications regarding possible carbon tax and carbon budget allocation target adjustments with the increase in load factor and extended plant life.

With the current uncertainties in the context of the pre-concept phase of planning and not yet having performed the thorough stochastic systems modelling process (based on any updated IRP), factoring in the range of possible outcomes on all the key input variables, it would be reckless for Eskom to make unconditional commitments to any SO_2 reduction implementation. Any commitments must be subject to completion of the mentioned systems modelling process as well as the completion of a detailed technical implementation feasibility study/ pilot. If retrofit proves technically unfeasible, a relief from obligations and commitments should be obtained. This might include SO_2 exemption for relevant stations, depending on the system's alternatives and the potential requirement for the stations to continue operating, as established through the stochastic systems modelling process.

Any Eskom commitments or authority decision should also incorporate an economic viability threshold. The market tendering processes should indicate that if costs exceed the estimates made for purposes of these commitments by a defined degree (which could be linked to budgets, operational cost caps etc), the decision will need to be revisited. Such thresholds should not just be defined in terms of project costs but rather in terms of economic/financial viability, factoring in the likely system alternatives in the event of these power plants not continuing to be operated.

The decision on any SO_2 reduction implementation must consider the benefit of SO_2 reduction from the power stations, against the opportunity cost of such SO_2 reduction. A possible alternative solution is that if funding is available Eskom increases its investments in renewables and grid connection by the same amounts that would have been invested in such SO_2 retrofits, this would result in larger economic value add than FGD retrofits.

7.1.1 COST ANALYSIS FOR MES COMPLIANCE AT KENDAL

Kendal has a lower operating cost and higher load factor than most stations, however it has a relatively short useful life post retrofit to recover the high FGD retrofit cost, resulting in marginal financial and economic viability. Kendal will need to sustain higher load factors than presently planned, to remain competitive with alternative options in an unconstrained power system context, where these alternatives would potentially be the lowest-cost Risk Mitigation Independent Power Producer Program (RMIPPPP) type of projects (The RMIPPP program called for dispatchable technologies including a combination of wind, solar, gas, diesel etc). Like Majuba, if the power system continues to be highly constrained, where the alternatives include OCGTs and the cost of inadequate supply (load shedding/ unserved energy etc) then Kendal could be much cheaper thus economically and financially very viable even at very low load factors, and with the cost of the retrofit included and assuming technical feasibility is proven.

It should however be noted that 9.5 years post retrofit for a significant investment is very short. Kendal will be approximately 40 years old by the time the retrofit is complete and will only operate for a full 5 years with all 6 units running with the retrofit, assuming it is delivered on time. In the context of such a short remaining life, consistently higher load factors of a minimum 40% are required to sustain viability within the future market competing with alternative options of potentially the lowest-cost RMIPPPP type of projects. The assumption of a longer remaining life could improve Kendal's competitiveness and make it viable at lower load factors, from a purely economic/financial perspective.

The capital expenditure (Capex) required to ensure SO_2 compliance at Kendal is estimated at R44,4 billion, while the annual Opex is estimated at R1,04 billion. Additionally, the costs associated with Kendal achieving its proposed maximum daily limits for PM is R1,43 billion.

7.1.2 COST ANALYSIS FOR MES COMPLIANCE AT MAJUBA

Despite Majuba having a longer remaining life than Kendal (17 years post retrofit) and DSI FGD being lower in cost (and technically less efficient relative to the Wet and Semi-dry FGDs), Majuba's high operating cost, even before considering the additional capex, makes the economic and financial viability of the DSI FGD investment challenging.

At low load factors e.g., below 50%, the LCOE for Majuba will probably not be competitive with alternative options in an unconstrained power system, where these alternatives would potentially be the lowest-cost RMIPPP program type of projects. Under a constrained power system scenario, where the alternatives include OCGTs and the cost of load shedding/unserved energy, then Majuba with DSI FGD could have a lower cost and be economically and financially viable even at low load factors (assuming it is technically feasible).

With the identified implementation risks, a sensitivity was performed assuming the implementation of DSI FGD is delayed by three years. The LCOE increased i.e. the option became more expensive. For it to remain competitive with alternative options, a minimum load factor of approximately 60% is required.

Which technology to deploy and Majuba's likely range of load factors results in uncertainty, which could only be established and quantified trough the stochastic systems modelling process. Depending on the outcome of such modelling process it might also be appropriate to justify the continued operation of Majuba (with or without the retrofit) based on strategic risk considerations.

The Capex required to ensure SO_2 compliance at Majuba is estimated at R13,1 billion, while the annual Opex is estimated at R1,04 billion. Additionally, the costs associated with Majuba achieving its proposed maximum daily limits for NO_x is R1,1 billion.

7.1.3 ERP NOMINAL COSTS AND TARIFF IMPACTS

Table 7-1 presents estimated nominal costs associated with each ERP option. The total nominal cost of all Eskom ERP scenarios has been estimated by Eskom at a Class 2 accuracy, implying a variance between -15% and +20%. Increases in Eskom capital costs impact on the electricity tariff paid by consumers. The extent of any tariff increases is influenced by multiple factors including the extent and timing of funding and projected energy sales. Implementation of the ERP scenarios with additional SO_2 reduction requirements could increase the electricity tariff by between 3 and 10% from current levels. Work to confirm the extent of increases utilising Eskom NERSA applicable methodologies will be undertaken.

Table 7-1 – Eskom Fleet ERP financial summary

	ERP 2024 A	ERP 2024 B	ERP 2024 C
	ESKOM FLEET (CUMULATIVE)		
SO_2 Abatement	Kusile, Medupi FGD	Kusile, Medupi, Kendal (FGD), Majuba (DSI)	Kusile, Matimba, Medupi, Tutuka, Kendal, Lethabo (FGD), and Majuba (DSI)
NO_x Abatement	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB	Majuba, Lethabo, Tutuka LNB
PM Abatement	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects	Kendal, Matimba, Lethabo, Tutuka, Duvha, Matla PM Projects
Capex (nominal)	R77.2 billion	R134.6 billion	R256.9 billion
Opex (real, pa)	R2.1 billion	R4.2 billion	R6.3 billion

7.2 HEALTH BENEFIT COST ANALYSIS

The combustion of fossil fuels by power stations results in the emission of several atmospheric pollutants, that include PM, NO_2, and SO_2. Atmospheric pollutants have numerous negative effects on human health and may increase the risk of premature mortality.

Technologies exist to reduce these emissions and therefore also their negative health effects. Abatement technologies for power stations include FGD and Direct Sorbent Injection (DSI), for SO_2 reduction; installation of HFPS to improve ESP efficiency to reduce PM emissions; and Low NO_x Burners (LNB) for NO_2 reduction.

A benefit-cost analysis (BCA) allows for trade-offs between different scenarios to be compared to support decision making.

The aim of the cost-benefit study was to estimate the incremental health benefits associated with abatement technology options as well as plant decommissioning, to achieve or move towards compliance with the new MES of the DFFE.

7.2.1 METHODOLOGY

An integrated Air Pollution Health Risk Benefit Cost Analysis (APHR-BCA) model was developed to model the impacts of three different abatement scenarios as developed by Eskom. The APHR-BCA was developed following the General Principles of the World Health Organisation, WHO (WHO, 2016a), for performing air pollution health risk assessments (AP-HRA). The detailed methodology and assumptions are set out in Section 2 below. In summary, the methodology proceeded through several steps, as set out in Figure 7-1.

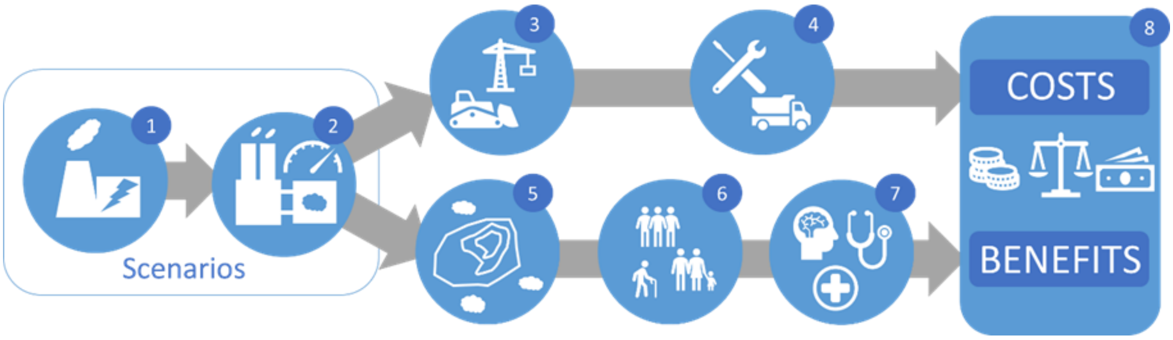


Figure 7-1 – APHR-BCA Methodology

7.2.2 HEALTH BENEFITS RESULTING FROM AIR POLLUTION ABATEMENT

The WHO (2016a) recommends that the health risk in a population, associated with air pollution, is to be estimated using exposure-response functions (ERFs). ERFs are based on Relative Risk (RR) estimates derived from primary epidemiological studies. These RR functions estimate the likelihood of health outcomes occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level. RR is usually expressed as the proportional increase in the assessed health outcome risk incidence associated with a given increase in pollutant concentrations, measured in µg/m^3.

The WHO (2016a) notes that "*the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.*"

Ideally, ERF studies and their RRs should be determined based on primary epidemiological studies focussing on the exposed population. In the absence of such studies, as in the case of South Africa, the WHO (2016a) recommends using ERFs from other countries.

The health outcomes were selected based on the latest WHO systematic reviews from 2020 and 2021 that were conducted for the update of the WHO Global Air Quality guidelines. The health outcome that was considered in this study is all-cause mortality. Morbidity was not considered in this study as comprehensive data on morbidity studies is not widely available. Additionally, there are issues relating the transferability of data from one population to another in terms of country and culture as populations have different sensitivities to pollutant exposure (WHO 2000).

Pollution levels, chemical composition and health care systems are typically very different in other settings, and this would affect the accuracy of the ERFs. It is important to understand at what level interval the ERFs would result in significant differences in health outcome incidences. As a result, the WHO (2016a) advises performing an assessment of the uncertainty of the analysis; in this case therefore this requires an assessment related to a lack of knowledge about one or more components of the integrated Health BCA Model. Section 2.5 discusses each source of uncertainty and related limitations. Variation resulting from relevant uncertainty factors was assessed through performing sensitivity analysis in the BCA (refer to Section 2.4).

Interpretation of the risk of premature mortality must be done with care. It is to be noted firstly that these numbers are indicators of health risk at a population level. The relative risk estimate inherent in the ERF is a metric of the likelihood of an adverse health outcome, and it cannot be attributed to an individual person. It can thus be used to quantify risk to a defined population (and not to an individual), (WHO 2016a) and how this risk would vary between various mitigation scenarios.

In this study, the ERFs obtained from the latest WHO systematic reviews, focussed exclusively on mortality and thus a monetary measure of mortality was required in order to perform benefit-cost analyses. In air pollution benefit-cost analyses, the concept of value of a statistical life (VSL) is commonly used to monetise mortality related benefits of air pollution reduction. The concept of a VSL is frequently misunderstood. It does not measure the intrinsic value of a human life, and neither does it value the economic productivity of a human. Rather, VSL is estimated by dividing an individual's willingness to pay (WTP) to reduce health risk, by the likelihood of risk reduction. Robinson and Hammitt (2009) defines VSL to represent the rate at which an individual is willing to exchange their own income for a small reduction in their own mortality risk over a particular time period. VSL is not the value that a person, society or the government would place on reducing mortality rates with certainty, but it is rather a representation of the rate at which a person views a change in the money available for spending as equivalent to a small change in their own mortality risk (Robinson et al., 2018).

Primary WTP studies for mortality risk reductions have not been done in South Africa. The VSL for South Africa in the BCA was determined by using the methodology as advised by Viscusi and Masterman (2017) and Robinson et al. (2018) with a base VSL from the U.S, GNI per capita for income measures and adjusted by income elasticity. As advised by Robinson et al. (2018), a sensitivity analysis is conducted to explore various VSL estimates.

7.2.3 SCENARIO ASSESSMENT

The three scenarios proposed by Eskom and evaluated in the BCA study were:

- Scenario ERP 2024 A (PM and NO_x reduction, generating load capped, air quality offsets and SO_2 reduction at Kusile).
- Scenario ERP 2024 B (As per ERP 2024 A plus SO_2 reduction technology installed at Majuba and Kendal).
- Scenario ERP 2024 C (Full compliance with MES for PM, NO_x and SO_2 for Kusile, Majuba, Kendal, Lethabo and Tutuka).

A key difference in the scenarios is the number of stations which are installed with SO_2 reduction technology in the form of wet-FGD, semi-dry FGD, or Direct Sorbent Injection (DSI). The focus on SO_2 reduction is important given the extent which it is anticipated to impact on air quality and public health and the very significant cost of SO_2 reduction cost.

Health benefits associated with each scenario were calculated against the baseline that took into account the anticipated changes in loads in the coming years from 2025 and assumed no additional abatement technologies installed, and all stations would continue to emit air pollution at their current rates until decommissioning. The baseline also includes the health benefits derived from subsequent decrease in load as stations shutdown as new alternate energy source capacity becomes available.

- The health benefits of ERP 2024 A deliver immediate impact from 2024. The benefits associated with this scenario start tapering off from 2030 onwards as Duvha and Matla decommission between 2031 and 2036, and the associated health benefits from the HFPS and LNB technologies reduces accordingly. Tutuka, Lethabo and Kendal decommission from 2036, 2037 and 2040 respectively.

The Electrostatic Precipitators (ESP) plus High Frequency Power Supplies (ESP+HFPS) and Low NO_x Burners (LNB) technologies at these stations continue to provide health benefits until 2045. Majuba decommissioning starts in 2047 and the health benefits from the LNG technology continue until final closure. ERP 2024 A includes wet FGD at Kusile but the costs and benefits of this fall outside of the scope of this scenario assessment.

- The health benefits of ERP 2024 B include those as discussed for ERP 2024 A above. In addition, efficiency and coal improvement projects reduce total sulphur and carbon emissions by 5% for Kendal, Lethabo, Tutuka and Majuba contributing to the increase in health benefits in ERP 2024 B. In addition to the Kusile wet FGD (but the costs and benefits of this fall outside of the scope of this scenario assessment), at Majuba DSI is commissioned from 2029 – 2033. Kendal is equipped with semi-dry FGD which is implemented from 2036, and this increases health benefits for a short period to 2040 whereafter Kendal decommissioning starts.
- The health benefits of ERP 2024 C include those as discussed for ERP 2024 A and B above. All planned PM emission reduction projects are completed (by 2028), and stations operate at PM=50 mg/Nm^3. NO_x projects are completed at all stations (completed by 2032), and stations operate at NO_x = 750 mg/Nm^3. In addition to the SO_2 reduction at Kendal and Majuba (and Kusile – however these effects are not part of the scenario assessment), semi-dry FGDs are installed at Tutuka and Lethabo by 2035, however, these stations start decommissioning from 2036 and 2037 respectively, thus effectively negating the health benefits from the FGD technologies.

With respect to the abatement costs associated with each scenario:

- The total Capex and Opex costs of abatement are identical to 2025.
- ERP 2024 B implementation starts in 2026 and 2027 with Majuba and Lethabo's LNB technology. From 2029 DSI installation starts at Majuba and in 2031 FGD starts at Kendal.
- ERP 2024 C builds on ERP 2024 B with implementation of SO_2 reduction technology starting in 2031 for both Lethabo and Tutuka.

The BCA ratios need to be interpreted with care. They are meant only to provide a perspective on and inform the decision-making process underlying the scenarios. They are not meant to be interpreted as a definitive answer to making abatement decisions. Decisions involving human health have to be informed by non-economic criteria as well. In addition, with uncertainty inherent in the analysis, the benefit cost ratio should thus not be viewed as absolute, but rather as a relative value from which to compare scenarios.

Benefits from station closure are included within the baseline so are not visible in the BCA directly. The shutdown of stations does however generally result in less pollution being emitted with increased health benefits compared to the baseline.

The BCA results are provided in Table 7-2. In the upper estimates the lower costs and higher VSL are used and in the lower estimates the higher costs and lower VSL are used as recommended by Robinson et al. 2018.

- The BCA central ratio in ERP 2024 A is more than 1 (1.74), showing a very clear benefit and the health benefits exceed the costs of abatement, implying that this is a sound abatement option for Eskom to pursue. This scenario has a total nominal cost of R18,500 million.

- The central BCA ratio of ERP 2024 B (SO_2 reduction at Majuba and Kendal) is less than 1 although it approaches 1 in the most optimistic (upper) parameters of the sensitivity analysis. The key reason for this is the implementation of the Kendal semi-dry FGD which is implemented from 2036, but only increases health benefits for a brief period to 2040 whereafter Kendal decommissioning starts. In this scenario the total nominal cost increases to R75,970 million (which adds to ERP A the additional cost of SO_2 reduction at Majuba and Kendal).
- The BCA central ratio of ERP 2024 C (SO_2 reduction at Majuba, Kendal, Lethabo and Tutuka) is less than 1 (0.33) and remains below 1 even in the most optimistic (upper) parameters of the sensitivity analysis. The key reason for this is the implementation of FGDs at Tutuka and Lethabo by 2035, followed by immediate decommissioning from 2036 and 2037 respectively, thus effectively negating the health benefits from the FGD technologies. In this scenario the total nominal cost increases to R155,320 million (which adds to the ERP 2024 A and B costs the additional costs of SO_2 reduction at Lethabo and Tutuka).
- Evaluation of the BCA ratios at a social discount rate of 2% delivers similar results, with ERP 2024 A above 1 and ERP 2024 B and C both less than 1. This is because of the limited health benefits achieved post 2036.

Table 7-2 - BCA ratios (lower and upper ranges) for each scenario (discounted at Eskom WACC)

	ERP 2024 A		**ERP 2024 B**		**ERP 2024 C**	
Million Rands	***Lower***	***Upper***	***Lower***	***Upper***	***Lower***	*Upper*
NPV of Costs	-10,479	-7,423	-33,909	-24,019	-56,964	-40,349
NPV of Benefits	3,575	23,341	3,651	23,831	3,732	24,357
NPV of Benefits minus Costs	-6,904	15,918	-30,258	-188	-53,232	-15,993
Benefit:Cost Ratio (range)	0.34	3.14	0.11	0.99	0.07	0.60
Benefit:Cost Ratio (central)	1.74		0.55		0.33	

In the analyses above the benefits from station closure form part of the baseline.

The power stations planned shutdown schedule results in health benefits without associated abatement costs. These benefits are dependent on timing of the shutdown schedule. These benefits have been assumed to form part of the BCA baseline and have therefore not been quantified directly in the BCA.

7.3 SOCIO-ECONOMIC IMPACTS

The following section of the report discusses importance of Tutuka Power Station to the local economy of the region and the potential socio-economic impacts of not obtaining MES exemption for Tutuka Power Station. Such a scenario may result in a shutdown or load-shedding.

7.3.1 ECONOMIC CONTRIBUTION

The GVA (Gross Value Added) of LLM was valued at R23,2 billion in 2023 (constant prices), which accounts for around 11.0% of the district economy's GVA and 3.4% of Mpumalanga's economy. The finance and business sectors are the largest economic sectors by contribution and account for 18.9% of the local economy.

The manufacturing sector (152%) and the trade sector (16.6%) are the next biggest economic contributors to the local economy. The agricultural sector currently contributes around 11% to the local economy. These sectors show a diversified economy that is not reliant on one or two specific sectors for economic growth.

The utilities sector (Electricity, Gas and Water) contributes roughly R0,9 billion to the local economy. However, the reliance of the manufacturing industry and other economic sectors on the utility sector makes it vital within the regional and local economy.

Over the last decade, the LLM economy had an average growth rate of 0.01%, stagnant over the past 10 years. The significant global challenges experienced over the last decade, specifically COVID-19, have contributed to the stagnant growth.

If the station is required to shut down due to a negative MES decision this outcome would lead to a variety of economic impacts.

Tutuka Power Station supplies electricity to the national grid. Should the station be required to shut down and there is no adequate alternative supply, the loss of this generation capacity on the national grid could result in the reintroduction of load-shedding. Maintaining a stable energy supply ensures the economy remains robust and productive.

Maintaining a stable national energy supply supports the national and local economy, including employment and associated livelihood requirements. The operation of Tutuka Power Station contributes to this. Goods and services providers, among others, benefit from the power station's consistent supply and operational stability. Amongst others, the agriculture sector feeds into the agro-processing industry, which utilises electricity for manufacturing. Both these sectors contribute significantly to job creation and economic growth.

Maintaining a reliable power supply is crucial for economic growth. Avoiding load-shedding helps prevent economic downturns and supports growth trajectories. Reliable operations also bolster investor confidence, attracting investment to the area and the country.

7.3.2 IMPACT ON EMPLOYMENT

The Lekwa Local Municipality (LLM) population increased by 4,007 between 2011 and 2022 to 119,669, representing an increase of 20.5% over the 11 years. The municipality's population is estimated to increase to 152,280 in 2030, 165,403 in 2040, and 171,314 in 2045. People between 15 and 64 years old represent 69.8% of the population. The young represent 24.4%, and the elderly 5.9% (Stats SA, 2022).

In 2023, the unemployment rate of (LLM) was 24.8%. This rate is slightly lower than the national unemployment rate of 33.0% (Quantec Easydata, 2024). There are 44,437 employed people in the municipality, while 14,651 are classified as unemployed. The non-economically active population amounts to 25,425 people. A large percentage of the population is classified as non-economically active. This aspect translates to a growing youthful population that will enter the workforce over the coming years, thus emphasising the need for job creation within the local municipality. The unemployment rate needs to be addressed to alleviate poverty and improve the living conditions of the local communities.

The Tutuka Power Station employed an estimated 712 Eskom employees and 1 443 contractors in 2024, while the nominal capacity is an estimated 3510 MW, according to Eskom (Eskom, 2024).

Therefore, sustaining these employment opportunities at Tutuka Power Station is crucial. Other Key employment opportunities rely on the power station's operations, including off-site suppliers, original equipment manufacturers (OEMs), and indirect employment opportunities.

Granting Tutuka Power Station the exemption requested in this application will allow the facility to be operational at the current staffing levels. Maintaining staffing levels will secure the income of the surrounding communities, and local businesses and services will be able to continue operating.

Social impacts of potential job losses as a result of changed operations due an adverse MES decision can include:

- Increase in the unemployment rate within the area. The loss of jobs at the power station will increase the amount of people of working age who are unemployed.
- A sudden loss of income can result in drastic changes in lifestyle and the inability to meet necessities.
- Unemployment creates additional stress in families, resulting in tensions and possible disintegration.
- Being unemployed can result in alienation, shame and stigma.
- Increase in crime, including Gender Based Violence (GBV). The impacts associated with job losses can result in social disintegration, which may increase crime and GBV levels.
- Skilled workers are more likely to seek and find employment outside the area, resulting in an exodus of skills.
- With a decrease in disposable income, the standard of living is often reduced.

7.3.3 IMPACT ON THE STANDARD OF LIVING

As discussed, Tutuka Power Station is responsible for many employment/job opportunities within the local communities and municipalities and supports off-site suppliers, OEMs, and indirect employment opportunities. All these employees earn a salary to support their families and increase direct spending in these areas.

The household earnings are used for housing, transportation, food, medical expenses, school fees, etc. With these earnings, the families continue their standard of living. However, should the Tutuka Power Station be shut down, the standard of living of some individuals in the local communities will be reduced due to lost employment.

Should security of supply be impacted and load-shedding return, the standard of living will be impacted as access to electricity is reduced, and households will have to rely on other energy sources such as household solar or burning carbon fuels. These energy sources have financial and health impacts, lowering the standard of living.

7.3.4 IMPACT ON GOVERNMENT REVENUE

The Tutuka Power Station is o responsible for water revenues to the municipality and the Department of Water Affairs. The continued operation of the power plant will allow for the collection of these rates, taxes and revenues.

7.3.5 IMPACT ON ELECTRICITY SUPPLY TO THE NATIONAL GRID

Tutuka Power Station currently has a nominal capacity of 3510 MW, which amounts to around 7.5% of the national grid capacity and thus is key to the sustainability of the national grid (Eskom, 2024). Grid security is crucial for economic growth and investor confidence. The loss of this generation capacity on the national grid without the availability of replacement capacity would be significant and could impact on the national security supply resulting in the reintroduction of load-shedding, resulting in a decline in economic activity and growth in the local and regional economies. The impact on capacity if the station is removed from the grid is discussed in more detail in the introduction and section 5.2 of this report.

The socio-economic impacts should be considered in the context of the impact of compliance on security of energy supply. As was shown through scenario modelling in 2021/22, full compliance (whether immediate of even over a period of several years) could potentially limit the constitutional rights of South Africans by leading to severe energy deficits, at minimum constraining GDP growth and economic recovery, at worst causing total catastrophic economic collapse. Even at the minimum impact it would increase unemployment, reduce job creation, reduce government tax revenue, increase poverty and the associated malnutrition and health implications, with (even at this minimum impact level) a far greater health consequence than a delayed and more prolonged phase-out of carbon emissions.

8 STAKEHOLDER ENGAGEMENT

The Ministers Decision issued in May 2024 requires that: "Eskom must ensure that all relevant organs of state, I&APs are notified of its applications for exemption and provided with an opportunity to comment thereon."

Based on this requirement, a public participation process based on the requirements of the EIA Regulations have been undertaken. Public participation is understood to be a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the decision-making process.

8.1 PUBLIC PARTICIPATION

8.1.1 IDENTIFICATION OF KEY STAKEHOLDERS

The stakeholder engagement commenced with the compilation of a stakeholder database to include relevant stakeholders, such as Commenting Authorities, State Owned Enterprises, business landowners/users, and Ward Councillors, as well as any other I&APs who may be interested or affected by the project.

Relevant authorities (organs of state) have been automatically registered as I&APs. In accordance with the EIA Regulations, 2014 all other persons must request in writing to be placed on the register, submit written comments, or attend meetings to be registered as stakeholders and included in future communication regarding the application.

Section 41 of the EIA Regulations, 2014 states that written notices must be given to identified stakeholders as outlined in the table below.

Table 8-1 - I&AP Identification

NEMA REQUIREMENT	DISCUSSION
(i) the owner or person in control of that land if the applicant is not the owner or person in control of the land	The applicant is the landowner.
(ii) the occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken	The applicant is the landowner and occupant.
(iii) owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken	The landowners and occupant of adjacent properties will be notified of the proposed application by newspaper advert, site notices placed around the proposed site and also emails and SMS for those already registered in the database.
(iv) the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area	The Ward Councillor has been included in the stakeholder database and will be notified by newspaper, received personal email and SMS notifications.
(v) the municipality which has jurisdiction in the area	The District Municipality as well as the Local Municipality have been included in the stakeholder database and will be notified by newspaper, received email and SMS notifications.
(vi) any organ of state having jurisdiction in respect of any aspect of the activity	The organs of state will be notified by newspaper, email and SMS notifications.
(vii) any other party as required by the competent authority.	All tiers of government, namely, national, provincial, local government and parastatals have been included on the stakeholder database and were notified by newspaper, received email and SMS notifications. Inclusive of: DFFE Department of Energy Department of Water and Sanitation

8.1.2 MES EXEMPTION APPLICATIONS ANNOUNCEMENT

The exemption application process will be announced for public comment for a period of 30 days from **06 November 2024 to 06 December 2024**. Additionally, the technical report along with an electronic version of the comment sheet will be placed on the WSP Group Africa (Pty) Ltd (WSP) website as well as the WSP Datafree website to be accessed by the public at the following links: https://www.wsp.com/en-ZA/services/public-documents and https://wsp-engage.com/.

8.1.2.1 DIRECT NOTIFICATION

8.1.2.1.1 Email notifications

Notification of the exemption application will be issued to registered I&APs and stakeholders, via email on **06 November 2024**. The purpose of the notification was to offer registered I&APs and stakeholders the opportunity to comment on the application process. A total of 830 registered stakeholders were notified via email.

8.1.2.1.2 SMS

Notification of the exemption application will be issued to registered I&APs and stakeholders, via SMS on **06 November 2024**. The purpose of the notification was to offer registered I&APs and stakeholders the opportunity to comment on the application process. A total of 1,321 registered stakeholders were notified via sms.

8.1.2.1.3 Site notices

The EIA Regulations, 2014 require that site notices be fixed at places conspicuous to the public at the boundary or on the fence of the site where the activity (to which the application relates) is to be undertaken, as well as at any alternative sites. Posters (in English, Afrikaans and isiZulu), conforming to the size specifications as per the EIA Regulations, 2014 were placed on **06 November 2024**. Six posters in each language (where relevant) were placed for each power station.

8.1.3 AVAILABILITY OF TECHNICAL REPORTS

The exemption reports will be made available for public comment at the public places outlined in Table 8-2.

Table 8-2 - Public Availability of Exemption Report

LOCATION	ADDRESS
Tutuka Power Station	Thuthukani, Standerton 9 26°46'42.02"S; 29°20'49.16"E0
Standerton Public Library	Mbonani Mayisela St, Standerton
Stanwest Public Library	103 Sydney de Lange St, Standerton
Ga Nala Public Library	c/o Quintin & Heinrich St, Ga-Nala
EMalahleni Main Library	28 Hofmeyer St, eMalahleni
Thubelihle Public library	Thubelihle, Ga-Nala (26°13'1.68"S; 29°17'26.50"E)
Lynville Public Library	Vector Road, Lynville, eMalahleni
WSP Website	https://www.wsp.com/en-ZA/services/public-documents
Data-free Website	https://wsp-engage.com/

8.1.4 ADVERTISEMENT

Notification of the exemption application as well as opportunity to comment on the application process was issued to the general public via advertisements published in the newspapers outlined in Table 8-3, in **October and November 2024**, in English in all national newspapers and one other language in local newspapers. As mentioned above, the purpose of the advertisement was to notify the general public of the application, inform the public about the public meetings, and provide an opportunity to register on the project database and provide input into the process.

Table 8-3 - Placement of Adverts

LOCATION	DATE OF PUBLICATION
City Press (Regional Newspaper)	Sunday 3 November 2024
Sunday Times (National Newspaper)	Sunday 3 November 2024
Beeld (National Newspaper)	Sunday 3 November 2024
Star (National Newspaper)	Sunday 3 November 2024
Mpumalanga News	Wednesday 6 November 2024
Standerton Advertiser	Thursday 1 November 2024
Mpumalanga Lowvelder	Thursday 1 November 2024
Ridge Times	Thursday 1 November 2024
Witbank News	Thursday 1 November 2024

Middelburg Observer	Thursday 1 November 2024

8.1.5 PUBLIC MEETINGS

Public meetings will be convened for the project team to present the application to stakeholders as well as gather feedback from them. These meetings offer the stakeholders an opportunity to participate in the decision-making process and ensures that their voices are heard. Meetings will be convened at the locations outlined in Table 8-4 translation services will be available at the meetings and hard copy summaries of key documents will be made available at the physical meetings.

Table 8-4 - Date, venue and time of public meetings

VENUE	ADDRESS	DATE	TIME
Secunda Community Hall	Walter Sisulu Road, Cnr Fisant Street - Lilian Ngoyi Centre Building	14 November 2024	18:00
Standerton Community Hall	81 Tamarisk St, Standerton	20 November 2024	18:00
Eskom Academy of Learning	Dale Road, Midrand	26 November 2024	10:00
Online Meeting	Microsoft Teams Meeting Meeting ID: 334 202 077 604 Passcode: 8PwGGQ	29 November 2024	13:00
Middelburg Civic Centre	Eastdene Hall - Boncker Street (Verdoeran Street)	03 December	12:00

8.1.6 COMMENTS AND RESPONSES

Following the receipt of comments from I&APs, a Comments and Response Report ("CRR") will be prepared and submitted to the Minster.

Proof of stakeholder engagement undertaken will be included in the submission to the Minister.

9 ASSUMPTIONS AND LIMITATIONS

The following assumptions, limitations and exclusions are applicable to this application:

- A 50-year operational life for the power stations has been assumed for this application.
- It is assumed the emission trajectories for scenario options of ERP 2024 A, ERP 2024 B, and ERP 2024 C, as provided by Eskom, are accurate and representative of reality and future anticipated plans.
- It is assumed current emissions data, as provided by Eskom, used to assess compliance to emission limits, and used as input to the dispersion models, are accurate and representative of existing operations.
- It is assumed abatement projects, as proposed by Eskom, will be undertaken as presented within the timeframe commitments, to the best of Eskom's ability i.e. should outage schedules and grid capacity allow.
- Operational challenges identified at the stations, and confirmed by Eskom, are assumed to be accurate of current operational conditions at the stations.
- Results from the dispersion modelling, discussed herein, are assumed to accurately represent emissions data provided.
- Due to time constraints, the Security of Supply emission projection could not be assessed in the dispersion modelling.
- Ambient monitoring data, as contained herein, is assumed to accurately represent existing ambient air quality within the various airsheds.
- Qualitative technology evaluations, particularly relating to SO_2 abatement technologies, were undertaken by Eskom. This application assumes these evaluations, and the preferred technologies from these, accurately reflect the most appropriate technology for a particular station. WSP's involvement in this application, and high-level understanding of Eskom stations, does indicate the technologies selected are most suitable, considering all aspects, such as costs, timeframes to commission, water requirements, retrofitting complexities, waste management, and emission reduction efficiencies. Despite this, WSP cannot be held responsible should more appropriate technologies be identified in the future.
- Shutdown dates provided by Eskom are not within Eskom's legal mandate to decide, but require prior approval from NERSA, which may not necessarily be granted should security of supply be jeopardised.

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Appendix A

POWER STATION SPECIFIC ATMOSPHERIC IMPACT REPORT

ATMOSPHERIC IMPACT REPORT IN SUPPORT OF THE APPLICATION FOR EXEMPTION FROM THE MINIMUM EMISSION STANDARDS FOR TUTUKA POWER STATION

Final
30 November 2024

uMOYA-NILU

Report issued by:

uMoya-NILU Consulting (Pty) Ltd
P O Box 20622
Durban North, 4016
South Africa

Report issued to:

WSP Group Africa (Pty) Ltd
Building 1, Maxwell Office Park
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South Africa

Report Details

Client:	WSP Group Africa (Pty) Ltd
Report title:	Atmospheric Impact Report in Support of the Application for Exemption from the Minimum Emission Standards for Tutuka Power Station
Project:	uMN920-24
Report number:	uMN217-24
Version:	Final 30 November 2024
Prepared by:	uMoya-NILU Consulting (Pty) Ltd, P O Box 20622, Durban North 4016, South Africa
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Front page picture credit: https://www.eskom.co.za/eskom-divisions/gx/coal-fired-power-stations/

EXECUTIVE SUMMARY

Eskom operates a fleet of 14 coal-fired power stations, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). Eskom holds Atmospheric Emission Licenses (AELs) for the respective power plants and is obligated to operate these plants according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants, however existing activities had to comply with the MES for new plants by 30 April 2020.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue. The Minister ruled on the Eskom appeals on 22 May 2024 and granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations up to 31 March 2030, namely Arnot, Camden, Grootvlei, Hendrina and Kriel. The Minister further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. These are Duvha, Kendal, Lethabo, Majuba, Matimba, Matla, Medupi and Tutuka.

In terms of the Minister's ruling, Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) (DEA, 2013a) to support these applications.

The stack emissions currently meet the MES for existing plants for oxides of nitrogen (NO_X) and complies with stations Atmospheric Emission Licence limits for particulate matter. Projects to bring the station into compliance with the MES new plans for NOx and PM will be completed by 2030. The station does not comply with the sulphur dioxide (SO_2) new plant MES. This AIR for Tutuka supports Eskom's application for exemption from the MES for new plants for SO_2 until shutdown and for additional time to complete the PM and NOx projects.

Tutuka Power Station is located in the Highveld Priority Area, approximately 21 km northeast of Standerton and 26 km west of Morgenzon in the Mpumalanga Province. It has a base load generation capacity of 3 654 MW. Tutuka operates three Listed Activities in terms of the AEL issued by Gert Sibande District Municipality. These are listed in Table E-1. The AEL expired on 25 April 2024. The renewal process is on hold for a decision regarding the exemption application. The emission limits that apply to Tutuka are listed in Table E-2. Shutdown of Tutuka is planned from 2036 to 2041.

Table E-1: Current authorisations related to air quality

Atmospheric Emission License	Date of Certificate	Listed Activity Category	Sub-category	Listed Activity Process Description
Lekwa/Eskom H SOC Ltd TPS/0013/2019/F03	Issue: 25/04/2019 Renewal: 25/04/2024	1 2 5	1.1 2.4 5.1	Solid Fuel Combustion Installations Storage and Handling of Petroleum Products Storage and Handling of Ore and Coal

Table E-2: Minimum Emission Standards in mg/Nm³ for existing plants and for new plants in brackets

Substance or mixture of substances		Subcategory 1.1
Common name	Chemical symbol	MES under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Particulate matter	N/A	100 (50)
Oxides of nitrogen[a]	NO_X	1 100 (750)
Sulphur dioxide	SO_2	3 500 (1 000)[b]

(a): Expressed as NO_2
(b): Gazette 43174, GN421 of 27 March 2020

Shutdown of Tutuka is planned from 2036 to 2041. In the meantime Eskom intends to improve PM reduction efficiency. This entails Electrostatic Precipitators and Dust Handling Plants refurbishment on Units 1 to 4. It is planned to install low NOx burners at Tutuka from 2025. In respect of SO_2, Eskom is considering multiple factors including costs and benefits and does not intend to install SO_2 reduction technology, but rather reduce its emission impact by improving operational efficiencies.

Five emission scenarios capture these reduction plans and are assessed for Eskom's application for exemption of the MES for Tutuka. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stockyard and ash dump.

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stockyard and ash dump.

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stockyard and ash dump.

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stockyard and ash dump.

Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyard and ash dump.

The annual average emissions for the five scenarios are presented in Table E-3.

Table E-3: Annual emissions from the Tutuka Power Station in tonnes/year

Scenario	Stack	Emission rate (tonnes/annum)			Emission concentration @ 10% O_2 and average load (mg/Nm³)		
		NO_x	SO_2	PM	NO_x	SO_2	PM
1[a]	Stack 1	24 217	45 512	7 692	244	458	77
	Stack 2	24 217	45 512	7 692	244	458	77
A	Stack 1	28 989	59 187	7 006	600	1 225	145
	Stack 2	28 989	59 187	7 006	600	1 225	145
B	Stack 1	4 945	15 654	597	290	918	35
	Stack 2	4 945	15 654	597	290	918	35
C	Stack 1	17 621	55 242	1 982	400	1 254	45
	Stack 2	17 621	55 242	1 982	400	1 254	45
D	Stack 1	17 621	16 573	1 982	400	376	45
	Stack 2	17 621	16 573	1 982	400	376	45
MES					750	1000	50

(a): Average from actual monthly emissions (Note that these averages may appear lower than those reported in the AEL reports)

The CALPUFF dispersion model is used to predict ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ resulting from Tutuka stack emissions and fugitive emissions of PM from the coal stockyard and the ash dump for the five scenarios. While the focus of the assessment is on the stack emissions, the inclusion of fugitive PM emissions provides a holistic understanding of Tutuka's contribution to ambient PM_{10} and $PM_{2.5}$ concentrations. Modelling is done according to the modelling regulations and 3-years of hourly surface and upper air meteorological data is used.

In the body of the report the predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented as isopleth maps over the modelling domain. In this executive summary the maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile concentration of the 24-hour and 1-hour predicted concentrations are presented in Table E-4.

For SO_2 and NO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted concentrations for the 5 scenarios are low relative to the limit values of the respective National Ambient Air Quality Standards (NAAQS). The highest of these predictions occurs for Scenario A (2025) and Scenario C (2036).

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. Included in the predicted concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions. Together, this represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$. The stack emissions generally have an effect some distance from the source, while low-level emission have an effect close to the source.

Table E-4: Maximum predicted ambient annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations in µg/m^3 and the predicted 99th percentile concentrations for 24-hour and 1-hour averaging periods, with the South African NAAQS

Pollutant	SO_2		
Predicted maximum SO_2	**Annual**	**24-hour**	**1-hour**
Scenario 1 (Current)	2.5	46.9	67.1
Scenario A (2025)	5.9	90.2	164.7
Scenario B (2031)	3.2	39.6	83.3
Scenario C (2036)	5.9	86.0	161.2
Scenario D (MES)	1.8	25.8	48.3
NAAQS	**50**	**125**	**350**
Predicted maximum NO_2	**Annual**		**1-hour**
Scenario 1 (Current)	1.0		27.4
Scenario A (2025)	2.2		62.4
Scenario B (2031)	0.7		20.3
Scenario C (2036)	1.4		39.7
Scenario D (MES)	1.4		39.7
NAAQS	**40**		**200**
Predicted maximum PM_{10}	**Annual**	**24-hour**	
Scenario 1 (Current)	**71.2**	**309.1**	
Scenario A (2025)	**71.6**	**310.5**	
Scenario B (2031)	**70.9**	**308.1**	
Scenario C (2036)	**71.1**	**310.2**	
Scenario D (MES)	**71.0**	**308.2**	
NAAQS	**40**	**75**	
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**	
Scenario 1 (Current)	**71.2**	**309.1**	
Scenario A (2025)	**71.6**	**310.5**	
Scenario B (2031)	**70.9**	**308.1**	
Scenario C (2036)	**71.1**	**310.2**	
Scenario D (MES)	**71.0**	**308.2**	
NAAQS	**20**	**40**	Up to 31 Dec 2029
	15	**25**	From 01 Jan 2030

At all of the sensitive receptors, the predicted ambient SO_2 and NO_2 concentrations are well below the limit values of the respective NAAQS. As discussed for the predicted maximum concentrations, the highest predicted concentrations occur in Scenario A (2025) and Scenario C (2036) at all receptor points.

For PM_{10} and $PM_{2.5}$, it must be remembered that the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stockyard and ash dump). Furthermore, the particulate emissions are not speciated into PM_{10} and $PM_{2.5}$, but rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In addition, the predicted PM_{10} and $PM_{2.5}$ concentrations include the formation of secondary particulates from SO_2 and NO_2 stack emissions. This is a very conservative approach.

For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations are below the limit values of the NAAQS at all sensitive receptor points in all five scenarios. For PM_{10}, the predicted 99th percentile of the 24-hour concentrations are low and below the limit value of the

NAAQS at the sensitive receptor points in all five scenarios. For $PM_{2.5}$, the predicted 99th percentile of the 24-hour concentrations are low and below the limit value of the NAAQS at the sensitive receptor points in all five scenarios, except at the Amalumgelo Primary School. This receptor is located 10.6 km east-northeast of Tutuka where the 24-hour $PM_{2.5}$ limit value is exceeded in all five scenarios.

Noteworthy findings from the modelling results for SO_2 and NO_2 may be summarised as follows:

i) For NO_X actual emissions and Eskom's proposed emission scenarios the predicted ambient NO_2 concentrations comply with the NAAQS.

ii) For SO_2 actual emissions and Eskom's proposed emission scenarios the predicted ambient SO_2 concentrations comply with the NAAQS.

iii) For PM_{10} and $PM_{2.5}$ exceedances of the NAAQS are predicted close to Tutuka as a result of the low-level fugitive sources from the coal stockyard and ash dump. Beyond this area there is general compliance with the NAAQS for the current and proposed emission scenarios.

Noteworthy findings from the modelling results for PM_{10} and $PM_{2.5}$ may be summarised as follows:

i) Ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to stack emissions and the low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emissions have an effect close to the source.

ii) In the modelling, the conservative assumption is made firstly that the total PM emission is PM_{10}, and secondly, the total PM emission is $PM_{2.5}$.

iii) The predicted PM_{10} and $PM_{2.5}$ concentrations are high relatively close to the power station, otherwise they are low and comply with the NAAQS throughout the modelling domain, except at one sensitive receptor point west-northwest of Tutuka.

The AIR for Eskom's MES exemption application for Tutuka (uMoya-NILU, 2018) considered stack emissions only, i.e. fugitive sources were excluded. This AIR therefore provides insights into the contribution of stack emission to ground-level concentrations.

In that AIR, the actual PM emissions of 8 581 tonnes/annum from each of the two stacks was simulated. The maximum predicted ambient PM_{10} concentration was 0.6 µg/m^3, approximately 8 km east of Tutuka. The 99th percentile of the 24-hour predicted PM_{10} concentrations was 6.4 µg/m^3 and occurred approximately 5 km to the east of Tutuka.

In this AIR, the PM emission for Scenario 1 (Current) is 11% lower than the 2018 AIR, i.e. 7 692 tonnes/annum for each stack. By comparison, the predicted annual PM_{10} concentrations 8 km east of Tutuka are between 10 and 20 µg/m^3. The predicted 24-hour PM_{10} concentrations 5 km east of Tutuka are greater than 75 µg/m^3. The decrease in PM emissions from the 2018 AIR to the current AIR is not evident as the ambient concentrations in the current AIR are higher and emphasizes the contribution made by the low-level fugitive sources.

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO2, and NOx stack emissions. NOx and SO2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

ACKNOWLEDGEMENT

Jared Lodder, Yakeen Kowlas and Lehlohonolo Sello from WSP Group Africa (Pty) Ltd are acknowledged for processing the ambient air quality and wind data for the baseline assessment.

GLOSSARY OF TERMS AND ACRONYMS

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
g/s	Grams per second
kPa	Kilo Pascal
MES	Minimum Emission Standards
mg/Nm^3	Milligrams per normal cubic meter refers to emission concentration, i.e. mass per volume at normal temperature and pressure, defined as air at 20^{o}C (293.15 K) and 1 atm (101.325 kPa)
NAAQS	National Ambient Air Quality Standards
NAQO	National Air Quality Officer
NECA	National Environmental Consultative and Advisory
NEM-AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
USEPA	United States Environmental Protection Agency
µm	Micro meter (1 µm = 10^{-6} m)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Eskom operates a fleet of 14 coal-fired power stations, collectively generating more than 39 000 MW of electricity. The combustion of coal to generate steam for the generation of electricity is a Listed Activity in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). Eskom holds Atmospheric Emission Licenses (AELs) for the respective power plants and is obligated to operate these plants according to conditions specified in the respective AELs. Minimum Emission Standards (MES) for Listed Activities were published in 2010 (DEA, 2010) including compliance timeframes for existing and new plants, however existing activities had to comply with the MES for new plants by 30 April 2020.

Between 2018 and 2020, Eskom submitted applications to the Department of Forestry, Fisheries and the Environment (DFFE) based on an internally approved Emission Reduction Plan, which defined which power stations in the fleet would have emission reduction technology installed and when. The National Air Quality Officer (NAQO) made decisions on these applications in 2019, which were not in favour of Eskom. Eskom appealed the NAQO's decision, and the Minister established the National Environmental Consultative and Advisory (NECA) Forum to advise her on the issue.

The Minister ruled on the Eskom appeals on 22 May 2024. The Minister granted the suspension of the Minimum Emission Standards (MES) at five (5) power stations up to 31 March 2030. The Minister further directed Eskom to submit an application in terms of Section 59 of the National Environmental Management: Air Quality Act for the exemption of the MES for eight (8) power stations that will continue to operate post 2030. The five power stations that will close by 2030 are Arnot, Camden, Grootvlei, Hendrina and Kriel. The eight power stations that will operate post 2030 are Duvha, Kendal, Lethabo, Majuba, Matimba, Matla, Medupi and Tutuka.

In terms the Minister's ruling, Eskom Holdings SOC Ltd appointed WSP Group Africa (Pty) Ltd to prepare the necessary applications. WSP Group Africa (Pty) Ltd sub-contracted uMoya-NILU Consulting (Pty) Ltd to prepare the associated Atmospheric Impact Reports (AIRs) (DEA, 2013a) to support these applications.

Tutuka Power Station (hereafter referred to as Tutuka) is located in the Highveld Priority Area, approximately 21 km northeast of Standerton and 26 km west of Morgenzon in the Mpumalanga Province. It has a base load generation capacity of 3 654 MW. Tutuka operates three Listed Activities in terms of the AEL issued by Gert Sibande District Municipality. The AEL expired on 25 April 2024. The renewal process is on hold for a decision regarding the exemption application. This AIR for Tutuka supports Eskom's application for exemption from the MES until shutdown.

2. ENTERPRISE DETAILS

2.1 Enterprise Details

The details of Tutuka are summarised in Table 2-1.

Table 2-1: Enterprise details

Entity Name:	Eskom Holdings SOC Limited
Trading as:	Tutuka Power Station
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.:	State Owned Company
Company/Close Corporation/Trust Registration Number (Registration Numbers if Joint Venture):	2002/015527/30
Registered Address:	Megawatt Park, Maxwell Drive, Sunninghill, Sandton
Postal Address:	P. O. Box 1091, Johannesburg, 2000
Telephone Number (General):	+27 11 800 3861
Fax Number (General):	
Company Website:	www.eskom.co.za
Industry Type/Nature of Trade:	Electricity Generation
Land Use Zoning as per Town Planning Scheme:	Agricultural/Heavy industry
Land Use Rights if outside Town Planning Scheme:	Not applicable
Responsible Person:	Bruce Moyo
Emissions Control Officer:	Rendani Nematshema
Telephone Number:	017 749 9548
Cell Phone Number:	079 263 1774
Fax Number:	086 536 5960
Email Address:	nematsr@eskom.co.za/MokgawMM@eskom.co.za
After Hours Contact Details:	0849675116

2.2 Location and extent of the power station

Tutuka is located in the Highveld Priority Area, approximately 21 km northeast of Standerton and 26 km west of Morgenzon in the Mpumalanga Province. The relevant site information is provided in Table 2-2. Its relative location is illustrated in Figure 2-1 and Figure 7-1.

Table 2-2: Site information

Physical Address of the Licensed Premises:	Tutuka Power Station, Bethal Road, Standerton, 2430
Description of Site:	Tutuka Power Station, Bethal Road, Standerton, 2430
Property Registration Number (Surveyor-General Code):	N/A
Coordinates (latitude, longitude) Centre of Operations (Decimal Degrees):	Latitude: 26.776195°S Longitude: 29.352044°E
Coordinates (UTM) Centre of Operations (UTM 35S):	Northing: 7036189.53 m S Easting: 733857.97 m E
Extent (km²):	20
Elevation Above Mean Sea Level (m):	1 620
Province:	Mpumalanga Province
District/Metropolitan Municipality:	Gert Sibande District Municipality
Local Municipality:	Lekwa Local Municipality
Designated Priority Area (if applicable):	Highveld Priority Area

2.3 Description of surrounding land use

The Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa (DEA, 2014a) recommends the Land Use Procedure as sufficient for determining the urban/rural status of a modelling domain. The classification of the study area as urban or rural is based on the Auer method (Auer, 1978), as specified in the US EPA guideline on air dispersion models (US EPA, 2005). From the Auer's method, areas typically defined as rural include residences with grass lawns and trees, large estates, metropolitan parks and golf courses, agricultural areas, undeveloped land and water surfaces. An area is defined as urban if it has less than 35% vegetation coverage or it falls into one of the use types in Table 2-3.

Table 2-3: Land types, use and structures and vegetation cover

Type	Use and Structures	Vegetation
I1	Heavy industrial	Less than 5 %
I2	Light/moderate industrial	Less than 5 %
C1	Commercial	Less than 15 %
R2	Dense single / multi-family	Less than 30 %
R3	Multi-family, two-story	Less than 35 %

Tutuka is located adjacent to the R38, approximately 21 km northeast of Standerton and 26 km west of Morgenzon in the Mpumalanga Province. It lies within the declared Highveld Priority Area, which is an airshed associated with poor air quality, where elevated concentrations of criteria pollutants occur due to the presence of industrial and non-industrial sources. The surrounding land use includes coal mining and agriculture. Figure 2-1 shows the relative location of Tutuka and a circle of 5 km radius around the power station.

Figure 2-1: Relative location of Tutuka, showing a 5 km radius from the centre of the site (Google Earth, 2024)

The US Environmental Protection Agency (USEPA, 2024a) recognise Sensitive Receptors as areas which include, but are not limited to hospitals, schools, daycare facilities, elderly housing and convalescent facilities or specialised healthcare facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides and other pollutants. The California Air Resources Board (CARB, 2024) identify Sensitive Receptors as children, elderly, asthmatics and others who are at a heightened risk of negative health outcomes due to exposure to air pollution.

The locations where these sensitive receptors congregate are considered sensitive receptor locations and therefore include hospitals, schools and day care centres, and other such locations. Three ambient air quality monitoring stations (AQMS) and 52 sensitive receptors were identified within 30 km of Tutuka as shown in Table 2-4.

Table 2-4: Sensitive receptors within 30 km of Tutuka

Receptor	UTMx	UTMy
Grootdraai Dam - Monitoring Station	729.225	7023.458
Secunda - Monitoring Station	707.218	7061.881
Sivukile AQMS - Monitoring Station	759.477	7039.486
Morgenzon Landbou Akademie	760.692	7038.669
Nqobangolwazi Secondary School	760.099	7039.834
Siqondekhaya Pre Primary School	759.041	7040.348
Sizakhele Primary School	759.348	7040.317
Phezukwentaba Primary School (south of Morgenzon)	763.781	7032.155
Kwaggalaagte Primary School (north of Morgenzon)	752.175	7057.414
Sizakhele Clinic/Hospital	759.466	7040.190
Kleuterskool Haas Das	723.219	7017.721
Standerton Primary School	723.424	7018.061
Laerskool Jeugkrag	722.195	7020.007
Laerskool Standerton	723.305	7017.250
Laerskool Kalie De Haas	723.806	7014.865
Hoerskool Standerton	723.420	7018.066
Standerton Provincial Government Hospital	722.909	7018.172
Mar-Peh Medicare Private Hospital	722.853	7017.103
Standerton Retirement Home	722.814	7016.839
Standerton Ouetehuis/Old Age Home	723.532	7016.875
Holmdene Secondary School	705.494	7027.950
Cathuza Primary School (SE of town)	739.934	7012.164
Sizanani Pre Primary School	720.264	7015.440
Hlobisa Primary School	718.977	7014.209
Shukuma Primary School	719.624	7013.256
Retsebile Primary School	718.116	7015.885
Thuto-Thebe Secondary School	720.396	7017.497
Jandrell Secondary School	719.087	7014.999
Thobelani Secondary School	719.020	7015.502
Standerton Tb Hospital	720.296	7014.163
Thuthukani Pre Primary School	729.019	7035.188
Ulwazi Primary School	728.770	7035.231
Zikhetheleni Secondary School	728.765	7035.041

Receptor	UTMx	UTMy
Joubertsvlei Primary School (north of Tutuka)	730.197	7049.457
Amalumgelo Primary School (NE of Tutuka)	744.069	7040.768
Grootdraaidam Primary School	727.701	7022.696
Laerskool Secunda	718.641	7066.034
Laerskool Kruinpark	721.793	7064.897
Laerskool Oranjegloed Primary	719.533	7064.703
Curro Castle Combined School	718.390	7064.519
Hoërskool Oosterland	720.727	7065.345
Mediclinic Secunda (Hospital)	717.499	7066.254
Mediclinic Highveld (Hospital_Trichardt, Secunda)	722.529	7067.888
Daviescourt/Davieshof Old Age Home	719.131	7065.819
Highveld Park High School	720.102	7065.886
Hoerskool Secunda	718.704	7065.665
Basizeni Special School	707.156	7063.935
Maphala-Gulube Primary School	709.078	7059.414
Shapeve Primary School	708.293	7063.744
Thomas Nhlabathi Secondary School	706.362	7062.494
Embalenhle Hospital /Clinic	707.222	7061.722
Vukuzithathe Primary School	707.502	7059.755
K I Twala Secondary	706.684	7059.460
Allan Makunga Primary School	707.954	7063.116
Sakhisizwe Primary School (Emzinoni)	741.947	7067.507

2.4 Emission Control Officer

Tutuka’s Emission Control Officer (ECO) is Bruce Moya. See Table 2-1 for contact details.

2.5 Atmospheric Emission License (AEL) and Other Authorisations

The Atmospheric Emissions Licence (AEL) (Lekwa/Eskom H SOC Ltd TPS/0013/2019/F03) held by Tutuka was issued by the Gert Sibande District Municipality on 25 April 2019. The AEL is in respect of three Listed Activities (Table 2-5) and specifies permissible stack emission concentrations for particulate matter (PM), sulphur dioxide (SO_2) and oxides of nitrogen (NO_X). The AEL expired on 25 April 2024. The renewal process is on hold until a decision is made concerning the exemption application.

Table 2-5: Current authorisations related to air quality

Atmospheric Emission License	Dates	Listed Activity Category	Sub-category	Listed Activity Process Description
Lekwa/Eskom H SOC Ltd TPS/0013/2019/F03	Issue: 25/04/2019 Renewal: 25/04/2024	1 2 5	1.1 2.4 5.1	Solid Fuel Combustion Installations Storage and Handling of Petroleum Products Storage and Handling of Ore and Coal

2.6 Modelling contractor

The dispersion modelling for this AIR is conducted by:

Company: uMoya-NILU Consulting (Pty) Ltd
Modellers: Dr Mark Zunckel, Atham Raghunandan, Nopasika Xulu
Contact details: Tel: 031 262 3265
Cell: 083 690 2728
email: mark@umoya-nilu.co.za
atham@umoya-nilu.co.za
nopasika@umoya-nilu.co.za

See Annexure 2 for abridged CV’s

2.7 Terms of Reference

The Terms of Reference are to prepare an Atmospheric Impact Report (AIR) according to regulations prescribing the format of an AIR (DEA, 2013a) to support the application for exemption of the MES for Tutuka Power Station. In so doing, five emission scenarios are assessed for Eskom’s application for exemption of the MES for Tutuka.

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stock stockyard and ash dump.

Scenario A (2025): Eskom’s planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario B (2031): Eskom’s planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario C (2036): Eskom’s planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario D (MES): Full compliance with the MES including fugitive emissions from the coal stockyard and ash dump.

2.8 Assumptions

The following assumptions are relevant to this AIR:

a) No ambient monitoring is done in this assessment, rather available ambient air quality data is used.
b) The assessment of potential human health impacts is based on predicted (modelled) ambient concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ and the health-based National Ambient Air Quality Standards (NAAQS).
c) Emissions data used in this AIR have been provided by Eskom and are deemed to be accurate and representative of operating conditions in the respective scenarios.
d) The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. This represents a worse-case emission scenario for PM_{10} and $PM_{2.5}$.
e) Assumptions regarding emissions from the ash dump are included in Section 5.4.

3. NATURE OF THE PROCESS

3.1 Listed Activity or Activities

As a measure to reduce emissions from industrial sources and to improve ambient air quality, Listed Activities and associated Minimum Emission Standards (MES) were initially published in 2010 in Government Notice 248 (DEA, 2010) with the most recent revision applicable in 2010 (Government Notice 421, DEA, 2020). The Listed Activities relevant to Tutuka Power Station are listed in Table 3-1.

Table 3-1: Details of the Listed Activity for Tutuka Power Station according to GN 248 (DEA, 2010) and its revisions (DEA, 2013b, 2019,2020)

Category of Listed Activities	Sub-category of Listed Activity	Description of Listed Activity	Description and Application of the Listed Activity
1: Combustion Installations	1.1: Solid Fuel Combustion Installations	Solid fuels combustion installations used primarily for steam raising or electricity generation.	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.
2: Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass	2.4: Storage and handling of petroleum products	Petroleum products storage tanks and product transfer facilities.	All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1 000 cubic metres.

Category of Listed Activities	Sub-category of Listed Activity	Description of Listed Activity	Description and Application of the Listed Activity
5: Mineral Processing, Storage and Handling	5.1: Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996.	Locations designed to hold more than 100 000 tons.

3.2 Process Description

Eskom Holdings SOC Limited is a South African utility that generates, transmits and distributes electricity. The bulk of that electricity is generated by large coal-fired power stations that are situated close to the sources of coal. Tutuka is one such station. Tutuka has a base load generation capacity of 3 654 MW, generated in 6 units, each with an installed capacity of approximately 686 MW. Electricity is generated from the conversion of fuel energy stored in the coal.

Tutuka receives coal from nearby mines. The coal is conveyed to the coal stockstockyard on site where it is milled to pulverised fuel and fed to the six boilers. Combustion of the coal in the boilers heats water to superheated steam, which drives the turbines. In turn, the turbines drive the generators which generate electricity.

3.3 Air pollutants resulting from the process

3.3.1 Air pollutants

Atmospheric emissions depend on the fuel composition and rate of consumption, boiler design and operation, and the efficacy of pollution control devices. Emissions from the boilers are emitted via two stacks and include sulphur dioxide (SO_2), oxides of nitrogen ($NO + NO_2 = NO_X$) and particulate matter (PM).

SO_2 is produced from the combustion of sulphur bound in coal. The stoichiometric ratio of SO_2 to sulphur dictates that 2 kg of SO_2 are produced from every kilogram of sulphur combusted. The coal used by the Tutuka Power Station has a sulphur content (wt %) of less than 1 %. NO_X is produced from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the coal. The quantity of NO_X produced is directly proportional to the temperature of the flame.

The non-combustible portion of the fuel remains as solid waste. The coarser, heavier waste is called 'bottom ash' and is extracted from the boiler, and the lighter, finer portion is 'fly ash' and is usually suspended in the flue gas, and in the absence of any emission control would be emitted as PM through the stack. The coal used at Tutuka has an ash content of between 30 and 40%.

3.3.2 National Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) (DEA, 2009, 2012) apply to the pollutants emitted by Tutuka. The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. The NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ are presented in Table 3-2.

Table 3-2: NAAQS for pollutants relevant to Tutuka

Pollutant	Averaging period	Limit value (µg/m^3)	Tolerance
SO_2	1 hour	350	88
	24 hour	125	4
	1 year	50	0
NO_2	1 hour	200	88
	1 year	40	0
PM_{10}	24 hour	75	4
	1 year	40	0
$PM_{2.5}$	24 hour	40 (25[a])	4
	1 year	20 (15 [a])	0

(a): Applicable from 01 January 2030

3.4 Unit Processes

A summary of the different unit process at Tutuka is provided in Table 3-3. The relative location of these at Tutuka is shown in Figure 3-1.

Table 3-3: Unit processes at Tutuka

Unit Process	Function of Unit Process	Batch or Continuous Process
Boiler Unit 1	Generation of electricity from coal	Continuous
Boiler Unit 2	Generation of electricity from coal	Continuous
Boiler Unit 3	Generation of electricity from coal	Continuous
Boiler Unit 4	Generation of electricity from coal	Continuous
Boiler Unit 5	Generation of electricity from coal	Continuous
Boiler Unit 6	Generation of electricity from coal	Continuous
Coal stockstockyard	Storage of coal	Continuous
Fuel oil storage tanks	Storage of fuel oil	Continuous
Ashing facility	Storage of ash	Continuous

Figure 3-1: Relative location of the different process units at Tutuka

4. TECHNICAL INFORMATION

4.1 Raw materials used

The permitted raw materials consumption rate, the permitted production rates and the energy sources at Tutuka are listed in Table 4-1 to Table 4-3 according to the AEL.

Table 4-1: Raw Materials Used

Type	Maximum Permitted Consumption Rate	Design Consumption Rate	Actual Average Consumption Rate	Unit
Coal	1 200 000	1 200 000	365 297	Tonnes/month
Fuel oil	10 000	10 000	5 290	Tonnes/ month

Table 4-2: Production and by-products rates at Tutuka

Product/by-product	Maximum Production capacity permitted (volume)	Units (quantity/period)
Electricity	3 654	MW

Table 4-3: Materials used in energy sources

Raw Material	Maximum Permitted Consumption Rate	Unit	Material Characteristics (Monthly Average)
Coal	1 200 000	tonnes per month	Sulfur content: < 1% Ash content: 33 - 40 %
Fuel oil	1 000	tonnes per month	Sulfur content: 3.5 max% Ash content: 0.1 %

4.2 Appliances and Abatement Equipment Control Technology

Shutdown of Tutuka is planned from 2036 to 2041. In the meantime Eskom intends to improve PM reduction efficiency. This entails Electrostatic Precipitators and Dust Handling Plants refurbishment on Units 1 to 4. It is planned to install low NOx burners at Tutuka from 2025. In respect of SO_2, Eskom is considering multiple factors including costs and benefits and does not intend to install SO_2 reduction technology, but rather reduce its emission impact by improving operational efficiencies.

Table 4-4: Appliance and abatement equipment control technology at Tutuka Power Station

Appliance Name	Appliance Type/ Description	Appliance Function / Purpose
Electrostatic Precipitators (ESPs) – Stack 2 (units 4-6)	Electrostatic Precipitator (ESPs)	An ESP removes particles from the flue stream using the force of an induced electrostatic charge on the ash particle that is then attracted to and held on a plate. The Efficiency of ESPs is dependent on the electrical resistivity of the ash particles (and the particle size).

5. ATMOSPHERIC EMISSIONS

5.1 Point Source Parameters

The physical stack parameters and emission parameters for stacks at Tutuka are listed in Table 5-1 and Table 5-2 respectively.

Table 5-1: Tutuka stack parameters

Stack ID	Point Source Code	Source Name	Stack Orientation	UTMx	UTMy	Height of Release (m)		Diameter at Stack Tip (m) [a]
						Above Ground	Above nearest building	
Stack 1	Boiler unit 1-3	SV Unit 1-3	Vertical	733.759	7036.088	275	125	12.3
Stack 2	Boiler unit 4-6	SV Unit 4-6	Vertical	733.999	7036.106	275	125	12.3

(a) Individual boiler flues result in a combined stack diameter of 12.3 m.

Table 5-2: Tutuka stack emission parameters

Scenario	Stack ID	Actual Gas Exit Temp (K)	Actual Gas Volumetric Flow (Am^3/s)	Normal Gas Volumetric Flow (Nm^3/s)[a]	Actual Gas Exit Velocity (m/s)[b]
Scenario 1 (Current)	Stack 1	408	4 159	2 307	35
	Stack 2	408	4 159	2 307	35
Scenario A (2025)	Stack 1	408	2 020	1 121	17
	Stack 2	408	2 020	1 121	17
Scenario B (2031)	Stack 1	408	713	396	6
	Stack 2	408	713	396	6
Scenario C (2036)	Stack 1	408	1 842	1 022	15.5
	Stack 2	408	1 842	1 022	15.5
Scenario D (MES)	Stack 1	408	1 842	1 022	15.5
	Stack 2	408	1 842	1 022	15.5

(a): Normal flow corrected to 10% O_2, 101 kPa and 273.15K

(b): The average of the actual gas exit velocity was used in the simulations

5.2 Point Source Emission Rates (Emission scenarios)

Five emission scenarios are assessed for Eskom's application for exemption of MES for Tutuka. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stock stockyard and ash dump.

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario D (MES): Full compliance with the MES, including fugitive emissions from the coal stockyard and ash dump.

The estimated emission rates and equivalent emission concentrations that are used in the dispersion modelling for the two stacks are shown in Table 5-3. The maximum anticipated emissions during each period are used for simulation in the model. The boiler units are assumed to operate continuously, i.e. 24 hours a day. Since each future scenario is a snapshot of period of operation (e.g. Scenario A = 2025 to 2030), the maximum anticipated emissions during that period, in a single year was selected for simulation in the model.

Table 5-3: Stack emission rates and equivalent concentrations for this assessment

Scenario	Stack	Emission rate (tonnes/annum)			Emission concentration @ 10% O_2 and average load (mg/Nm^3)		
		NO_x	SO_2	PM	NO_x	SO_2	PM
1[a]	Stack 1	24 217	45 512	7 692	244	458	77
	Stack 2	24 217	45 512	7 692	244	458	77
A	Stack 1	28 989	59 187	7 006	600	1 225	145
	Stack 2	28 989	59 187	7 006	600	1 225	145
B	Stack 1	4 945	15 654	597	290	918	35
	Stack 2	4 945	15 654	597	290	918	35
C	Stack 1	17 621	55 242	1 982	400	1 254	45
	Stack 2	17 621	55 242	1 982	400	1 254	45
D	Stack 1	17 621	16 573	1 982	400	376	45
	Stack 2	17 621	16 573	1 982	400	376	45
MES					750	1000	50

(a): Average from actual monthly emissions

5.3 Point Source Maximum Emission Rates (Start Up, Shut-Down, Upset and Maintenance Conditions)

Tutuka is required to conduct continuous emission measurements. Maximum emissions during start-up, shut-down, maintenance or upset conditions are accounted for in the actual monthly emissions provided to the modelling team. These conditions are therefore incorporated into the simulations for Scenario 1 (Current).

5.4 Fugitive Emissions

The methodology to estimate emission rates of particulates from the coal stock stockyard and ash dumping activities for the power station is described in this section.

A general equation for emission estimation is: E = A x EF x (1-ER/100)

where: E = emissions;

A = activity rate;

EF = emission factor; and

ER = overall emission reduction efficiency (%)

An emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kg of particulate emitted per tonne of coal crushed). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (USEPA, 2024b).

The emission factors used for the calculation of particulates in this study are the most recent factors published in the United States Environmental Protection Agency (US EPA), AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 13: Section 13.2.4 Aggregate Handling and Storage Piles; Section 13.2.5 Industrial Wind Erosion (USEPA, 2024b).

Wind entrainment of dust and PM_{10} from the coal stockpile and ash dump is a function of the physical size of the facility and the nature of the exposed surface, i.e. the moisture content, silt content, amount of vegetation cover, size of the particles on the surface and wind speed. Characteristics of the coal stockpile and ash dump at the power station is shown in Table 5-4.

Table 5-4: Characteristics of the coal stockpile and ash dump at the Power Station

Parameter	Coal stockpile	Ash dump
Quantity of material stored (tonnes/year)	12 481 644	1 003 232
Moisture content (%)	4.5	27
Silt content (%)	2.2	80
Exposed surface area (m^2)	371 828	897 827
Height (m)	9	36
Dry area (%)	100	80
Dust abatement method	Wetting - Water	Spraying of dust using water tankers during operation, topsoil and vegetation coverage at incremental heights
Material transfer method and ashing system	Conveyors (front end loaders in case of emergency)	Dry (delivered by trucks)

As a mitigation measure, water is sprayed onto the coal stockpiles occasionally to reduce dust generation. In this assessment, the coal stockpile is assessed under worst case conditions (e.g. drought conditions), where it is assumed that no water will be sprayed onto the coal stockpile and 100% of the area is exposed to wind erosion.

The ash dump, by nature, is generally in a damp state depending on rainfall conditions, and if the ash is pumped onto the ash dump in a fluid state or trucked in. Rising green walls will provide vegetation cover on the sides and it is expected that most of the ash dump area exposed at the top will include a wet beach area. These initiatives, together with occasional wetting will reduce the amount of dust entrainment from the ash dump.

In this assessment, the ash dump is modelled under worst case conditions (e.g. drought conditions), where it is assumed that it is mostly dry and 80% of the surface area is exposed to wind erosion, providing a worst-case (environmentally conservative) scenario. The annual emission rates for the coal stockpiles and ash dump are shown in Table 5-5.

Table 5-5: Fugitive sources at Tutuka Power Station

Source name	Emission (tonnes/year)		
	TSP	PM_{10}	$PM_{2.5}$
Coal stockpile	69.1	34.2	12.3
Ash Dump	5 013.0	2 506.5	1 002.6

5.5 Emergency Incidents

A record is maintained for all emergency incidents occurring at Eskom Power Stations reported in terms of Section 30 of the National Environmental Management Act. No emergency incidents were reported at Tutuka in the 2022/23 financial year. One incident was reported in March 2024.

6. BASELINE CONDITIONS

The description of the baseline conditions of the area provide an understanding on the receiving atmospheric environment so that changes as a result of the application for exemption of the MES can be assessed. The baseline description therefore includes an overview of the climatology and meteorology of the area, and an assessment of ambient air quality over the last three years measured at monitoring stations in the area. Other sources of air pollution in the area are also discussed.

6.1 Climate and meteorology

6.1.1 Temperature and rainfall

The climate of a given location is affected by its latitude, terrain and altitude, as well as nearby water bodies and their currents. Climates are classified according to the average and typical ranges of different variables, most commonly temperature and precipitation.

The Mpumalanga Highveld is located in temperate latitudes between 25° S and 26° S and 28° E to 29° E, and approximately 1 600 m above sea level. As a result, it experiences a temperate climate with summer rainfall and dry winters according to the Köppen Climate Classification system. Temperature and rainfall over the central parts of the Mpumalanga Highveld are well illustrated by climate data at Standerton (Figure 6-1). Summer days are generally warm with maximum temperatures sometimes reaching 30 °C, and summer nights are mild. Winter days are mild and nights are cold. The area receives an average of 762 mm of rainfall annually, with more than 85% of the rainfall occurring in the summer months between October and March (Figure 6-1). Rainfall occurs occasionally in winter.

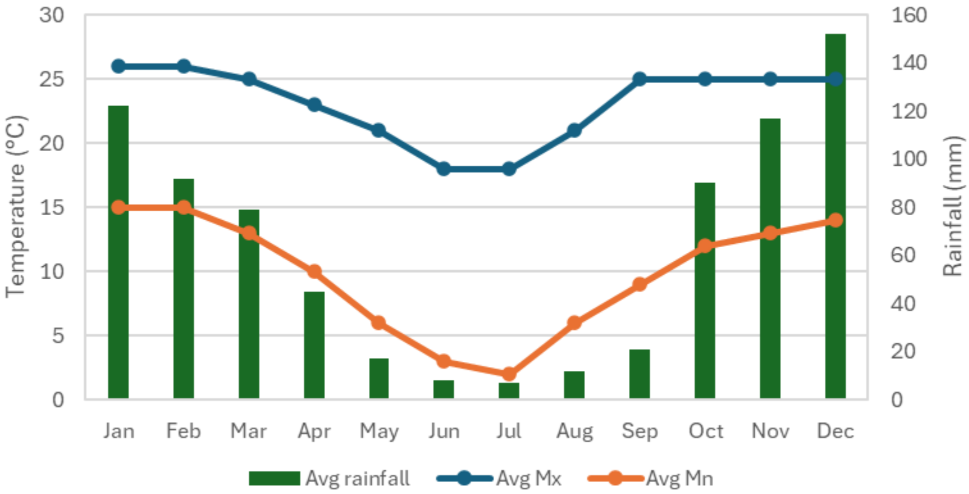

Figure 6-1: Average monthly maximum and minimum temperature, and average monthly rainfall at Standerton https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/standerton_south-africa_952747

6.1.2 Wind

Windroses illustrate the frequency of hourly wind from the 16 cardinal wind directions, with wind indicated from the direction it blows, i.e. easterly winds blow from the east. It also illustrates the frequency of average hourly wind speed in six wind speed classes.

The annual windrose at the Grootdraai Dam, 13 km south-southwest of Tutuka, is presented in Figure 6-2 for the 3-year period, 2021 to 2023. The wind is generally light with wind speeds mostly less than 6 m/s (Figure 6-2). There is a higher frequency of calm winds at night (Figure 6-3). Stronger winds exceeding 8 m/s do occur throughout the year. The wind is mostly from the sector easterly to northeasterly and generally from the west in the sector northwest to southwest, and (Figure 6-3). The stronger winds occur in the winter and into spring and mostly during the day.

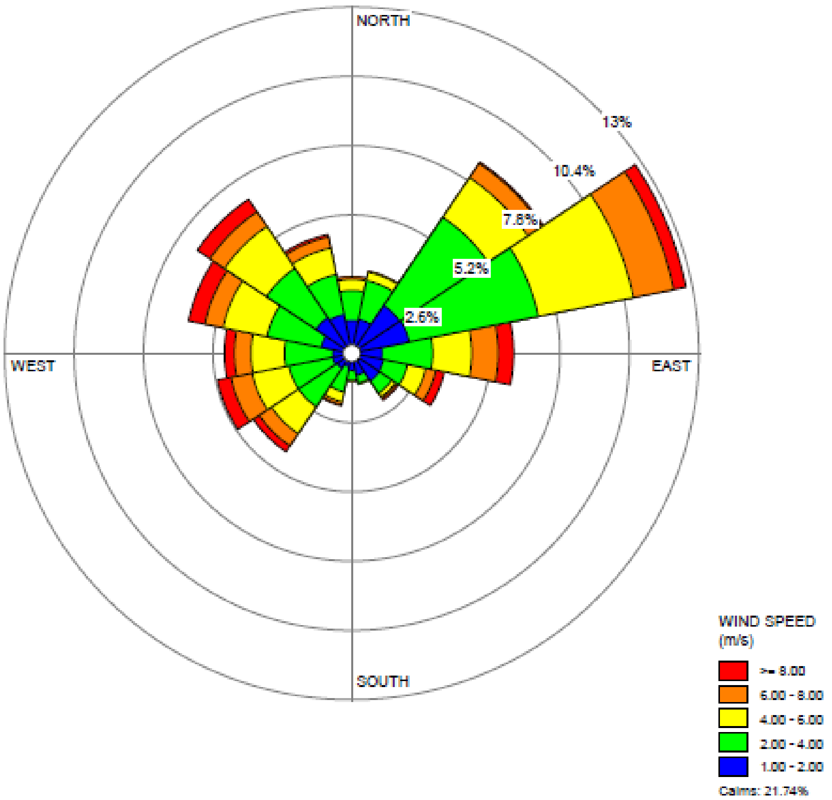

Figure 6-2: Annual windrose at the Grootdraai Dam AQMS

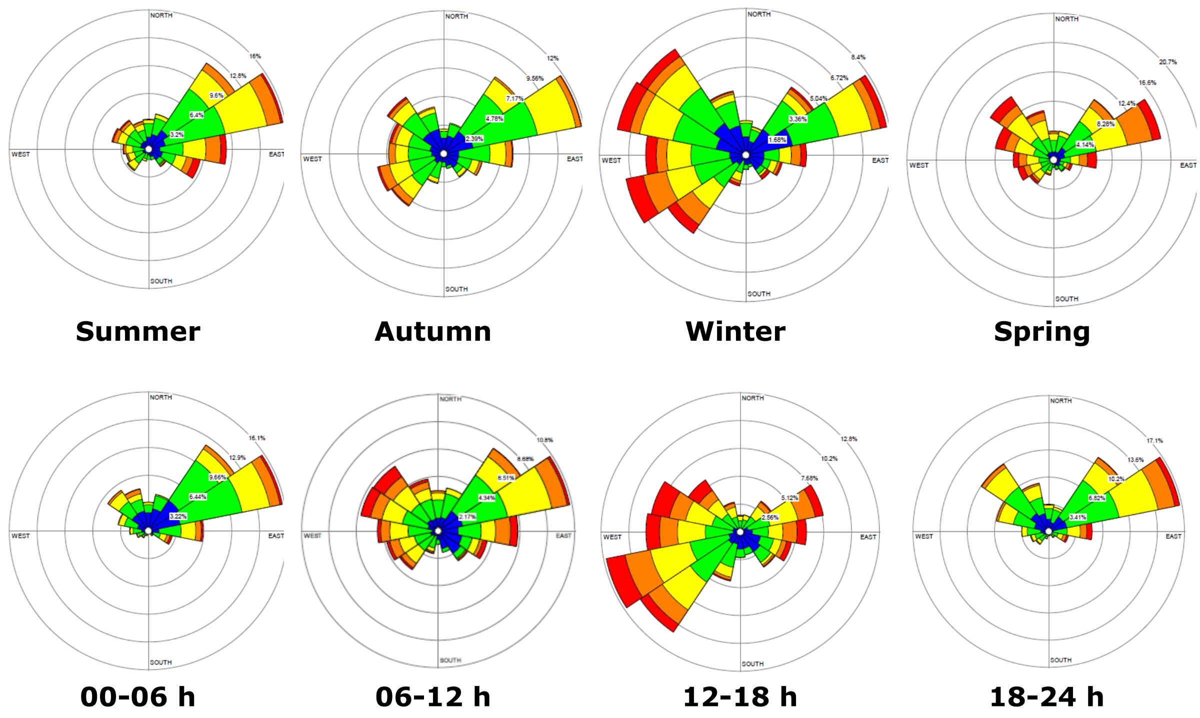

Figure 6-3: Seasonal (top) and diurnal (bottom) windroses at the Grootdraai Dam AQMS

6.1.3 Air Pollution Dispersion Potential

The air pollution dispersion of an area refers to the ability of atmospheric processes, or meteorological mechanisms, to disperse and remove pollutants from the atmosphere. Dispersion comprises both vertical and horizontal components of motion. The vertical component is defined by the stability of the atmosphere and the depth of the surface mixing layer. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field and atmospheric stability. The wind speed determines the rate of downwind transport and wind direction and the variability in wind direction determines the general path of the pollutant. Atmospheric stability, or instability, determines the ability of the atmosphere to mix and dilute pollutants. Stability is a function of solar radiation (thermal turbulence) and wind speed and surface roughness, which induce mechanical turbulence. The dispersion potential of an area therefore experiences diurnal and seasonal changes.

By day, with strong insolation (in-coming solar radiation) and stronger winds, the dispersion potential is generally efficient through vertical dilution and horizontal dispersion. The dispersion potential is generally better on summer days than winter days. At night, as the surface temperature inversion develops, the lowest layer of the atmosphere becomes more stable, reaching a maximum at sunrise. As a result, the dispersion potential typically becomes less efficient during the night and the poorest conditions generally occur at sunrise. Thermal turbulence disappears when the sun sets, and mechanical turbulence decreases as the wind speeds drops at night. Pollutants tend to accumulate near the point of release under these conditions, particularly if these are released close to ground level. The dispersion potential is generally poorer on winter nights than summer nights.

In the Tutuka study area the dispersion potential is expected to be relatively good during the day in summer and winter as a result of daytime temperatures and a relatively high frequency of moderate winds. Summer rainfall is an important removal mechanism for air pollutants. Night-time surface temperature inversions are prevalent in winter and tend to trap pollutants that are released at or near ground level. Generally, there is better air pollution dispersion in summer when air pollutants disperse easily, compared with winter when pollutants can accumulate in stable night-time conditions.

6.2 Ambient Air Quality

Sources of air pollution in the vicinity of Tutuka include agricultural activities, domestic fuel and waste burning, motor vehicle emissions, mining and the power station. The Thuthukani residential area is located approximately 4.7 km west-southwest of Tutuka. New Denmark Colliery is located approximately 6.1 km northwest of the power station.

There are no air quality monitoring stations (AQMS) close to Tutuka. The closest are the Sivukile and Grootdraai AQMS, located approximately 25.2 km east-northeast and approximately 13.3 km south-southwest respectively of Tutuka. There is no mining or industrial activities within a 5 km radius of the Sivukile and Grootdraai AQMSs. The pollutant airshed at these stations is therefore likely to be different to that of Tutuka. Nevertheless, pollutant concentrations measured at Sivukile and Grootdraai for 2021 to 2023 are presented here and are referenced against the respective NAAQS which appear in Table 3-2. The pollutants include SO_2, NO_2 and PM_{10}. Notably $PM_{2.5}$ is not measured at either of the AQMSs.

6.2.1 Data recovery

Data recovery for the Sivukile AQMS was above the minimum requirement of 90% for NO_2 (2023) and PM_{10} (2023), stipulated by the SANAS TR 07-03 (SANAS, 2012). Data recovery for all remaining pollutants in the remaining years was between 50% and 89.9%, which is below the minimum requirement. While discussed here, the data must be viewed with caution.

Data recovery for the Grootdraai AQMS was below the minimum requirement of 90% for all pollutants during all years. Data recovery for SO_2 (2021 to 2023), and NO_2 (2021 and 2022) was between 50% and 89.9%. While discussed here, the data must be viewed with caution.

Pollutants with a data recovery below 50% in a single year were not considered in this baseline discussion and are highlighted in bold in Table 6-1.

Table 6-1: Data recovery at the Sivukile and Grootdraai AQMS from 2021 to 2023

Year	Data recovery (%)		
	SO_2	NO_2	PM_{10}
Sivukile AQMS			
2021	73.7	60.0	80.1
2022	89.3	83.1	89.5
2023	80.2	99.1	93.6
Grootdraai AQMS			
2021	85.5	82.1	**34.3**
2022	79.9	66.5	**17.7**
2023	85.3	**9.6**	**3.0**
Note:	Data recovery for Sivukile and Grootdraai AQMS based on 10-minute average data.		

6.2.2 Sulphur Dioxide (SO_2)

Sivukile AQMS

- The 10-min average (Figure 6-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2021 (114 times), 2022 (22 times) and 2023 (one time), however remaining compliant as 526 exceedances of the 10-min NAAQS are permitted per calendar year.
- The 1-hour average (Figure 6-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS during 2021 (47 times) and 2022 (ten times); thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year. The 1-hour average SO_2 concentrations remained below the 1-hour (350 µg/m³) NAAQS during 2023 with no exceedances recorded, thus remaining compliant.
- The 24-hour average (Figure 6-6) SO_2 concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2021 (two times) and 2022 (three times), thus compliant with the respective NAAQS as four exceedances of the 24-hour NAAQS are permitted per calendar year. The 24-hour average (Figure 6-6) SO_2 concentrations remained below the 24-hour (125 µg/m³) NAAQS during 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average SO_2 concentrations for 2021 (40.1 µg/m³), 2022 (31.9 µg/m³) and 2023 (32.9 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Grootdraaai AQMS

- The 10-min average (Figure 6-4) SO_2 concentrations exceeded the 10-min (500 µg/m³) NAAQS in 2022 (one time), thus compliant with the respective NAAQS as 526 exceedances of the 10-min NAAQS are permitted per calendar year. The 10-min average SO_2 concentrations remained below the 10-min (500 µg/m³) NAAQS in 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The 1-hour average (Figure 6-5) SO_2 concentrations exceeded the 1-hour (350 µg/m³) NAAQS in 2022 (one time); however, thus compliant with the respective NAAQS as 88 exceedances of the 1-hour NAAQS are permitted per calendar year. The 1-hour average SO_2 concentrations remained below the 1-hour (350 µg/m³) NAAQS in 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The 24-hour average (Figure 6-6) SO_2 concentrations remained below the 24-hour (125 µg/m³) NAAQS between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.

- The annual average SO_2 concentrations for 2021 (10.4 µg/m³), 2022 (12.5 µg/m³) and 2023 (10.5 µg/m³) remained below the annual average NAAQS (50 µg/m³) thus compliant with the respective NAAQS.

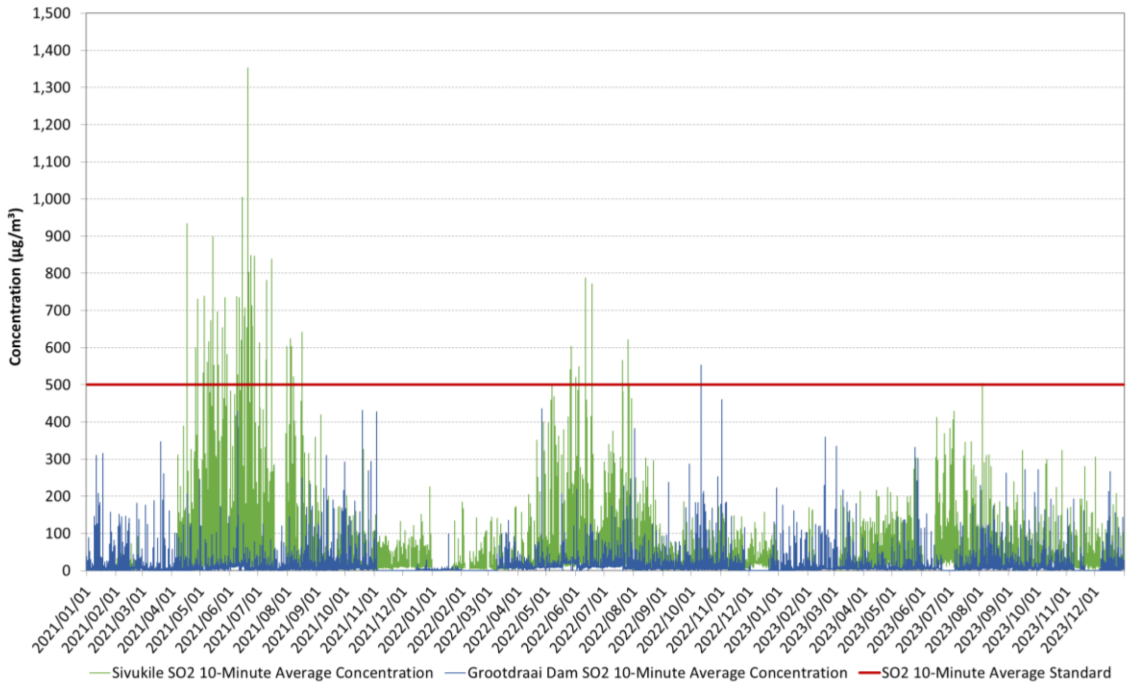

Figure 6-4: 10-minute average SO_2 concentrations at the Sivukile and Grootdraai AQMS from 2021 to 2023

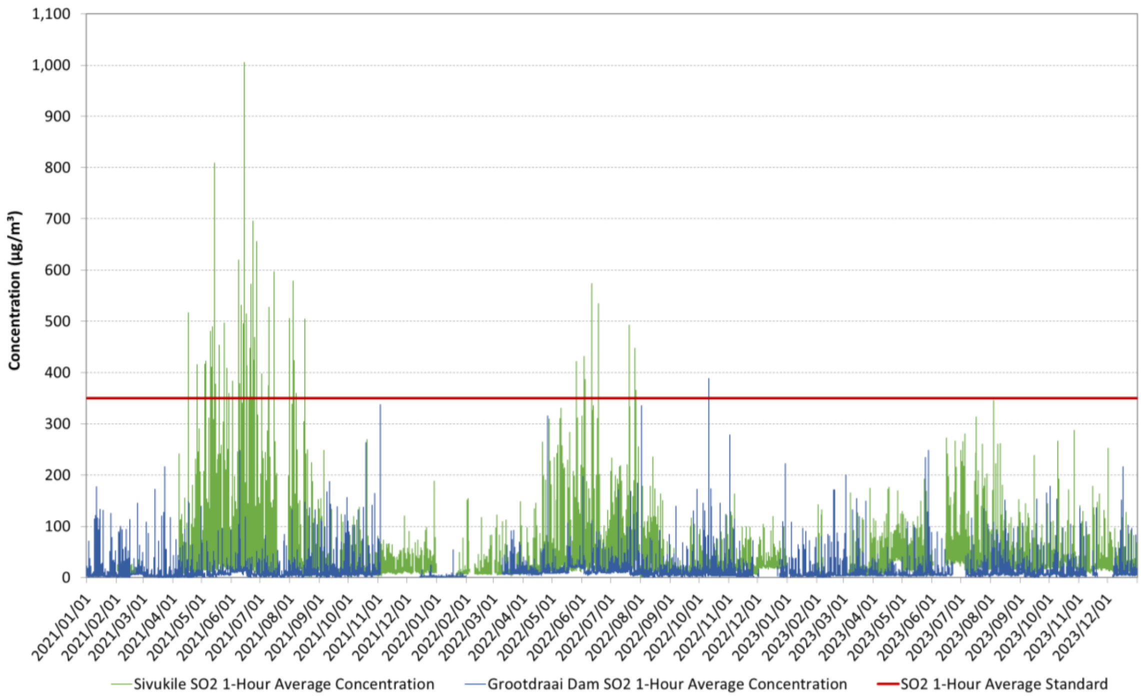

Figure 6-5: 1-hour average SO_2 concentrations at the Sivukile and Grootdraai AQMS from 2021 to 2023

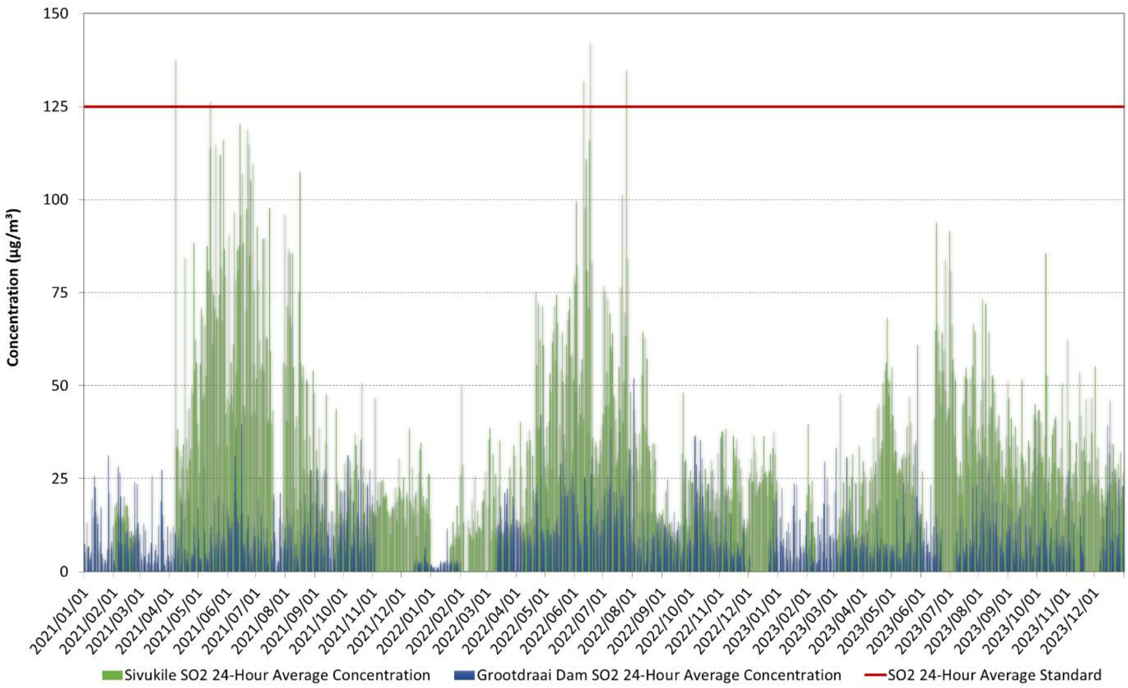

Figure 6-6: 24-hour average SO_2 concentrations at the Sivukile and Grootdraai AQMS from 2021 to 2023

6.2.3 Nitrogen Dioxide (NO_2)

Sivukile AQMS

- The 1-hour average (Figure 6-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) between 2021 and 2023, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (8.1 µg/m³), 2022 (8.3 µg/m³) and 2023 (8.4 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

Grootdraai AQMS

- The 1-hour average (Figure 6-7) NO_2 concentrations remained below the 1-hour NAAQS (200 µg/m³) for 2021 and 2022, with no exceedances recorded, thus compliant with the respective NAAQS.
- The annual average NO_2 concentrations for 2021 (4.4 µg/m³) and 2022 (4.8 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus compliant with the respective NAAQS.

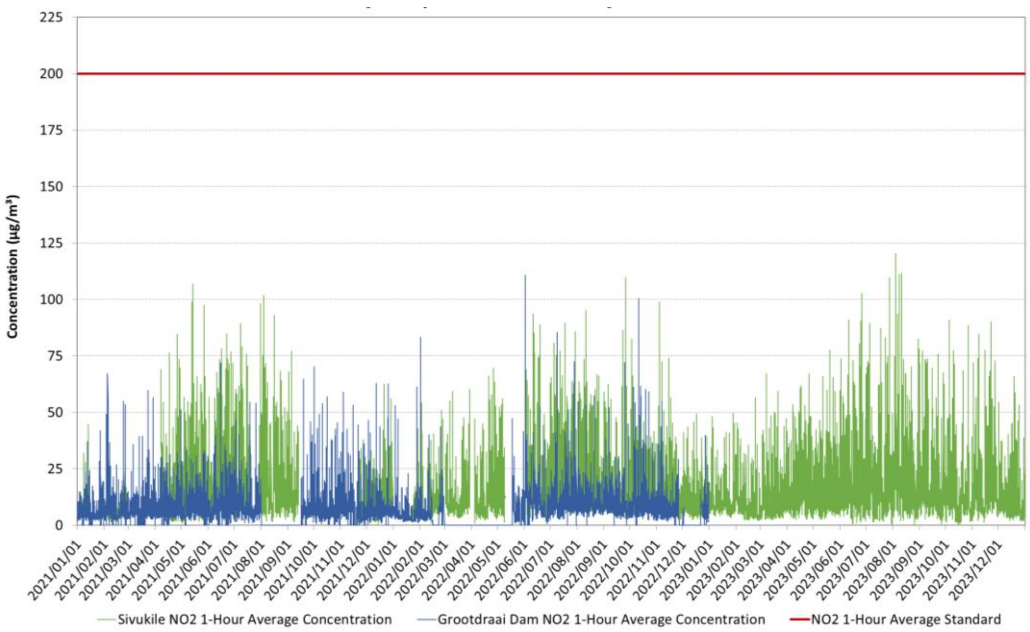

Figure 6-7: 1-hour average NO_2 concentrations at the Sivukile and Grootdraai AQMS from 2021 to 2023

6.2.4 Particulates (PM_{10})

Sivukile AQMS

- The 24-hour average (Figure 6-8) PM_{10} concentrations exceeded the 24-hour average NAAQS (75 µg/m³) in 2021 (59 times), 2022 (48 times) and 2023 (30 times), thus are non-compliant with the respective NAAQS as four exceedances per year are permitted.
- The annual average PM_{10} concentrations for 2021 (38.7 µg/m³) remained below the annual average NAAQS (40 µg/m³), thus remaining compliant. The annual average PM_{10} concentrations for 2022 (47.7 µg/m³) and 2023 (42.3 µg/m³) exceeded the annual average NAAQS (40 µg/m³), thus are non-compliant with the respective NAAQS.

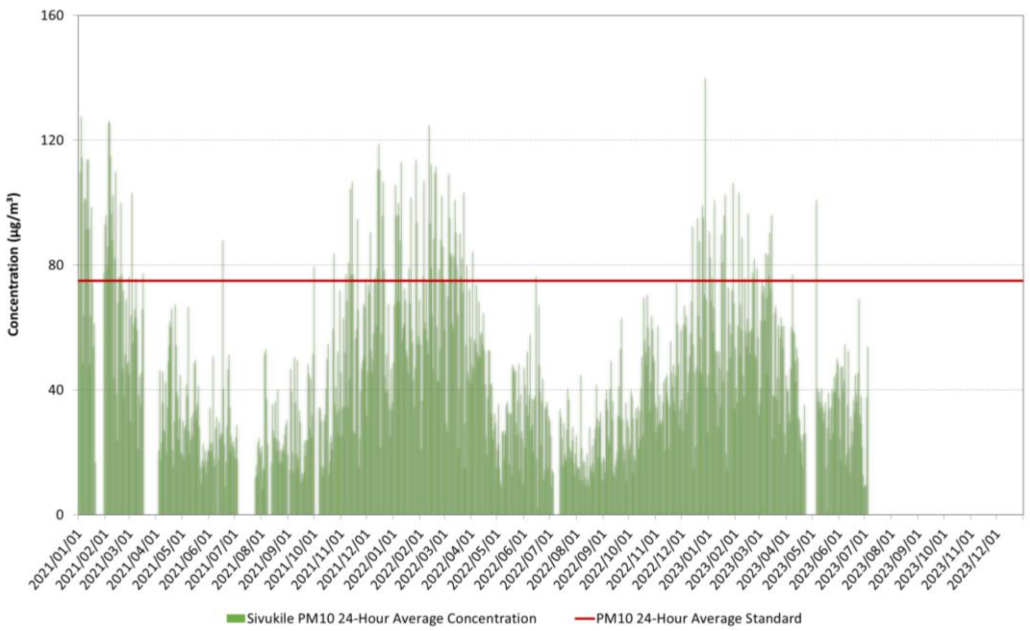

Figure 6-8: 24-hour average PM_{10} concentrations at the Sivukile AQMS for 2021 to 2023

6.2.5 Ambient pollutant summary

A summary of exceedances of the limit value of the NAAQS for all pollutants is presented in (Table 6-2).

Despite the proximity of several sources of SO_2 and NO_2 to the two monitoring sites, no exceedances of the NAAQS for SO_2 and NO_2 were recorded during the period 2021 to 2023.

The key pollutant of concern however, is PM_{10}. During the period 2021 to 2023 numerous exceedances of the NAAQS limit value for both the 24-hour and annual average were recorded at Sivukile. The exceedances are attributed to the proximity of major sources of particulates to these monitoring sites, such as domestic fuel burning, wind and vehicle entrained dust, and mining activities.

Table 6-2: Pollutant exceedance summary at the Sivukile and Grootdraai AQMS from 2021 to 2023

Pollutant	Averaging Period	Concentration	Permitted Number of Exceedances	2021	2022	2023
Sivukile AQMS						
SO_2	10-min	500 µg/m³	526	114	22	1
	1-hour	350 µg/m³	88	47	10	0
	24-hour	125 µg/m³	4	2	3	0
	1-year	50 µg/m³	0	0	0	0
NO_2	1-hour	200 µg/m³	88	0	0	- (1)
	1-year	40 µg/m³	0	0	0	- (1)
PM_{10}	24-hour	75 µg/m³	4	**48**	**59**	**30**
	1-year	40 µg/m³	0	0	**1**	**1**
Grootdraai AQMS						
SO_2	10-min	500 µg/m³	526	0	1	0
	1-hour	350 µg/m³	88	0	1	0
	24-hour	125 µg/m³	4	0	0	0
	1-year	50 µg/m³	0	0	0	0
NO_2	1-hour	200 µg/m³	88	0	0	- (1)
	1-year	40 µg/m³	0	0	0	- (1)
PM_{10}	24-hour	75 µg/m³	4	- (1)	- (1)	- (1)
	1-year	40 µg/m³	0	- (1)	- (1)	- (1)
Notes:	(1) Data recovery below 50%; thus, exceedances are not presented. Values in red indicate non-compliance against the respective standard.					

7. IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

7.1 Dispersion Modelling

7.1.1 Models used

A Level 3 air quality assessment must be conducted in situations where the purpose of the assessment requires a detailed understanding of the air quality impacts (time and space variation of the concentrations) and when it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types and chemical transformations (DEA, 2014a). A Level 3 assessment may be used in situations where there is a need to evaluate air quality consequences under a permitting or environmental assessment process for large industrial developments that have considerable social, economic and potential environmental consequences. Under these circumstances, the assessment for Tutuka clearly demonstrates the need for a Level 3 assessment.

The CALPUFF suite of models are approved by the USEPA (http://www.src.com/calpuff/calpuff1.htm) and by the DEA for Level 3 assessments (DEA, 2014a). It consists of a meteorological pre-processor, CALMET, the dispersion model, CALPUFF, and the post-processor, CALPOST. It is an appropriate air dispersion model for the purpose of this assessment as it is well suited to simulate dispersion from several sources. It also has capability to simulate dispersion in the atmosphere's complex land-sea interface. More information about the model can be found in the User's Guide for the CALPUFF Dispersion Model (USEPA, 1995).

The Air Pollution Model (TAPM) (Hurley, 2000; Hurley et al., 2001; Hurley et al., 2002) is used to model surface and upper air metrological data for the study domain. TAPM uses global gridded synoptic-scale meteorological data with observed surface data to simulate surface and upper air meteorology at given locations in the domain, taking the underlying topography and land cover into account. The global gridded data sets that are used are developed from surface and upper air data that are submitted routinely by all meteorological observing stations to the Global Telecommunication System of the World Meteorological Organisation. TAPM has been used successfully in Australia where it was developed (Hurley, 2000; Hurley et al., 2001; Hurley et al., 2002). It is an ideal tool for modelling applications where meteorological data does not adequately meet requirements for dispersion modelling. TAPM modelled output data is therefore used to augment the site-specific surface meteorological data for input to CALPUFF.

7.1.2 TAPM and CALPUFF parameterisation

The TAPM diagnostic meteorological model is used to generate a 3-dimensional temporally and spatially continuous meteorological field for 2021, 2022 and 2023 in hourly increments for the modelling domain.

TAPM is set-up in a nested configuration of three domains, centred on Tutuka. The outer domain is 600 km by 600 km at a 24 km grid resolution, the middle domain is 300 km by 300 km at a 12 km grid resolution and the inner domain is 75 km by 75 km at a 3 km grid resolution (Figure 7-1). The nesting configuration ensures that topographical effects on meteorology are captured and that meteorology is well resolved and characterised across the boundaries of the inner domain. Twenty-seven vertical levels are modelled in each nest from 10 m to 5 000 m, with a finer resolution in the lowest 1 000 m. The subset of the entire TAPM model output in the form of pre-processed gridded surface meteorological data fields is input into the dispersion model.

The 3-dimensional TAPM meteorological output on the inner grid includes hourly wind speed and direction, temperature, relative humidity, total solar radiation, net radiation, sensible heat flux, evaporative heat flux, convective velocity scale, precipitation, mixing height, friction velocity and Obukhov length. The spatially and temporally resolved TAPM surface and upper air meteorological data is used as input to the CALPUFF meteorological pre-processor, CALMET.

The CALPUFF modelling domain covers an area of 4 356 km^2, where the domain extends 66 km (west-east) by 66 km (north-south) (Figure 7-1). It consists of a uniformly spaced receptor grid with 0.5 km spacing, giving 17 424 grid cells (132 x 132 grid cells).

The topographical and land use for the respective modelling domains is obtained from the dataset accompanying the Commonwealth Scientific and Industrial Research Organisation (CSIRO) The Air Pollution Model (TAPM) modelling package (CSIRO, 2008). This dataset includes global terrain elevation and land use classification data on a longitude/latitude grid at 30-second grid spacing from the US Geological Survey, Earth Resources Observation Systems (EROS) Data Center.

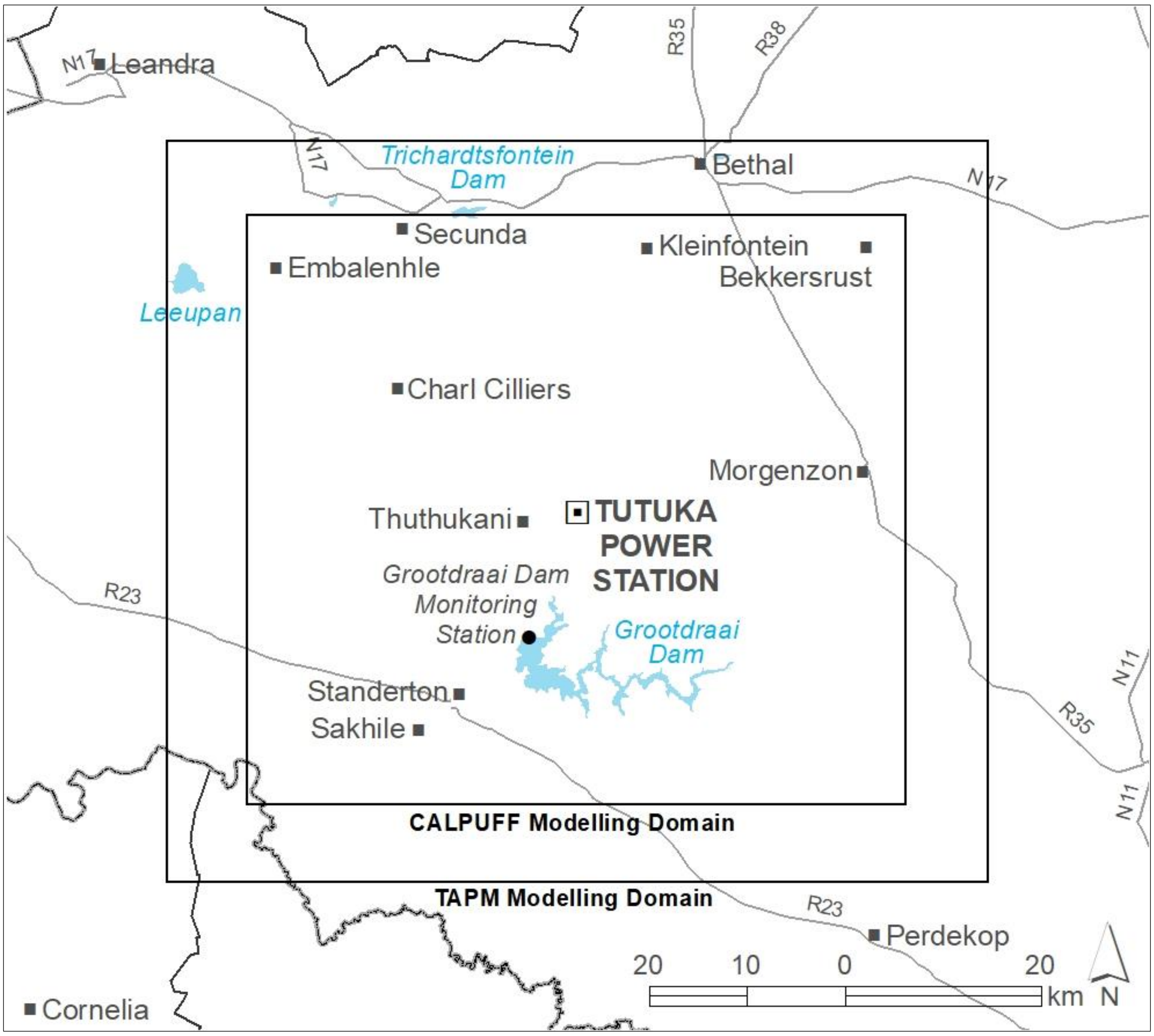

Figure 7-1: TAPM and CALPUFF modelling domain centred on Tutuka

The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X emissions to secondary particulates. The predicted PM_{10} and $PM_{2.5}$ concentrations in this AIR include direct emissions of PM plus secondary particulates formed from Eskom's emissions.

The parameterisation of key variables that will apply in CALMET and CALPUFF are indicated in Table 7-1 and Table 7-2 respectively.

Table 7-1: Parameterisation of key variables for CALMET

Parameter	Model value
12 vertical cell face heights (m)	0, 20, 40, 80, 160, 320, 640, 1000, 1500, 2000, 2500, 3000, 4000
Coriolis parameter (per second)	0.0001
Empirical constants for mixing height equation	Neutral, mechanical: 1.41 Convective: 0.15 Stable: 2400 Overwater, mechanical: 0.12
Minimum potential temperature lapse rate (K/m)	0.001
Depth of layer above convective mixing height through which lapse rate is computed (m)	200
Wind field model	Diagnostic wind module
Surface wind extrapolation	Similarity theory
Restrictions on extrapolation of surface data	No extrapolation as modelled upper air data field is applied
Radius of influence of terrain features (km)	5
Radius of influence of surface stations (km)	Not used as continuous surface data field is applied

Table 7-2: Parameterisation of key variables for CALPUFF

Parameter	Model value
Chemical transformation	Default NO_2 conversion factor is applied
Wind speed profile	Rural
Calm conditions	Wind speed < 0.5 m/s
Plume rise	Transitional plume rise, stack tip downwash, and partial plume penetration is modelled
Dispersion	CALPUFF used in PUFF mode
Dispersion option	Pasquill-Gifford coefficients are used for rural and McElroy-Pooler coefficients are used for urban
Terrain adjustment method	Partial plume path adjustment

7.1.3 Model accuracy

Air quality models attempt to predict ambient concentrations based on "known" or measured parameters, such as wind speed, temperature profiles, solar radiation and emissions. There are however, variations in the parameters that are not measured, the so-called "unknown" parameters as well as unresolved details of atmospheric turbulent flow. Variations in these "unknown" parameters can result in deviations of the predicted concentrations of the same event, even though the "known" parameters are fixed.

There are also "reducible" uncertainties that result from inaccuracies in the model, errors in input values and errors in the measured concentrations. These might include poor quality or unrepresentative meteorological, geophysical and source emission data, errors in the measured concentrations that are used to compare with model predictions and inadequate model physics and formulation used to predict the concentrations. "Reducible" uncertainties can be controlled or minimised. This is done by using accurate input data, preparing the input files correctly, checking and re-checking for errors, correcting for odd model behaviour, ensuring that the errors in the measured data are minimised and applying appropriate model physics.

Models recommended in the DEA dispersion modelling guideline (DEA, 2014a) have been evaluated using a range of modelling test kits (http://www.epa.gov./scram001). CALPUFF is one of the models that have been evaluated and it is therefore not mandatory to perform any modelling evaluations. Rather the accuracy of the modelling in this assessment is enhanced by every effort to minimise the "reducible" uncertainties in input data and model parameterisation.

7.1.4 Assessment scenarios

Five emission scenarios are assessed for Eskom's application for exemption of MES for Tutuka. These are:

Scenario 1 (Current): The baseline scenario using actual monthly stack emissions for 2021-2023 and fugitive emissions from the coal stock and ash dump.

Scenario A (2025): Eskom's planned 2025 stack emissions, representing anticipated station performance between 2025 – 2030, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario B (2031): Eskom's planned 2031 stack emissions, representing anticipated station performance between 2031 – 2035, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario C (2036): Eskom's planned 2036 stack emissions, representing anticipated station performance from 2036 onwards, including fugitive emissions from the coal stock stockyard and ash dump.

Scenario D (MES): Full compliance with the MES, , including fugitive emissions from the coal stock stockyard and ash dump.

7.2 Dispersion Modelling Results

The dispersion modelling results are compared with the NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ (Table 3-2). It is not possible to apportion the PM_{10} and $PM_{2.5}$ portion of the total PM emitted from the Tutuka stacks, so the PM emission is conservatively modelled as PM_{10} and $PM_{2.5}$. The CALPUFF modelling suite provides for the chemical conversion of SO_2 and NO_X to secondary particulates, i.e. sulphate and nitrate in the modelling results. The predicted PM_{10} and $PM_{2.5}$ concentrations presented here include direct emissions of PM plus secondary particulates formed from Tutuka's emissions.

The 99th percentile predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations from the dispersion modelling for Tutuka for the five scenarios are presented as isopleth maps over the modelling domain. The DEA (2012c) recommend the 99th percentile concentrations for short-term assessment with the NAAQS since the highest predicted ground-level concentrations can be considered outliers due to complex variability of meteorological processes. In addition, the limit value in the NAAQS is the 99th percentile.

7.2.1 Maximum predicted ambient concentrations

The maximum predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations are discussed here and are listed in Table 7-3 for the 5 scenarios. Exceedances of the limit value of the NAAQS are shown in red font.

For SO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS. The highest of these predictions occurs for Scenario A (2025), and then systematically decrease with progressive years and the corresponding stack emission reductions.

For NO_2, the predicted concentrations are attributed only to the stack emissions. The maximum predicted concentrations for the 5 scenarios are low relative to the limit values of the respective NAAQS. The highest of these predictions occurs for Scenario A (2025), and then systematically decrease in progressive years with the corresponding stack emission reductions.

For PM_{10} and $PM_{2.5}$, the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stock stockyard and ash dump). The PM emissions are not speciated into PM_{10} and $PM_{2.5}$, rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In other words, PM = PM_{10} = $PM_{2.5}$. This is a worst-case environmental assumption that overestimates the ambient PM_{10} and $PM_{2.5}$ concentrations. Included in the predicted PM_{10} and $PM_{2.5}$ concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions.

Close to the power station the low-level fugitive sources have the greatest influence on predicted PM_{10} and $PM_{2.5}$ ambient concentrations, while the stack emissions have an influence further from the power station. Included in the predicted concentrations is the formation of secondary particulates from SO_2 and NO_2 stack emissions.

For PM_{10} and $PM_{2.5}$, the maximum predicted concentrations exceed the limit values of the respective NAAQS. The predicted concentrations are similar for all of the scenarios as these occur close to the power station and primarily a result of the fugitive sources which are the same for all scenarios (see Table 5-5). The assumptions made in estimating the fugitive emissions are detailed in Section 5.4

Table 7-3: Maximum predicted ambient annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations in µg/m³ and the predicted 99th percentile concentrations for 24-hour and 1-hour averaging periods, with the South African NAAQS

Pollutant	SO_2		
Predicted maximum SO_2	**Annual**	**24-hour**	**1-hour**
Scenario 1 (Current)	2.5	46.9	67.1
Scenario A (2025)	5.9	90.2	164.7
Scenario B (2031)	3.2	39.6	83.3
Scenario C (2036)	5.9	86.0	161.2
Scenario D (MES)	1.8	25.8	48.3
NAAQS	**50**	**125**	**350**
Predicted maximum NO_2	**Annual**		**1-hour**
Scenario 1 (Current)	1.0		27.4
Scenario A (2025)	2.2		62.4
Scenario B (2031)	0.7		20.3
Scenario C (2036)	1.4		39.7
Scenario D (MES)	1.4		39.7
NAAQS	**40**		**200**
Predicted maximum PM_{10}	**Annual**	**24-hour**	
Scenario 1 (Current)	**71.2**	**309.1**	
Scenario A (2025)	**71.6**	**310.5**	
Scenario B (2031)	**70.9**	**308.1**	
Scenario C (2036)	**71.1**	**310.2**	
Scenario D (MES)	**71.0**	**308.2**	
NAAQS	**40**	**75**	
Predicted maximum $PM_{2.5}$	**Annual**	**24-hour**	
Scenario 1 (Current)	**71.2**	**309.1**	
Scenario A (2025)	**71.6**	**310.5**	
Scenario B (2031)	**70.9**	**308.1**	
Scenario C (2036)	**71.1**	**310.2**	
Scenario D (MES)	**71.0**	**308.2**	
NAAQS	**20**	**40**	Up to 31 Dec 2029
	15	**25**	From 01 Jan 2030

7.2.2 Predicted concentrations at AQMS and sensitive receptors

The predicted annual SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations and the 99th percentile of the 24-hour and 1-hour predicted concentrations at AQMS and the sensitive receptor points in the modelling area are presented in Table 7-4 to Table 7-9. Exceedances of the limit value of the NAAQS are shown in red font.

A comparison of the predicted annual averages from Scenario 1 (Current) with the annual average monitored concentrations is shown in Table 7-4 at the Sivukile and Grootdraai AQMS. For all pollutants the predicted ambient concentrations are lower than the monitored concentrations. This is to be expected since the emissions in the model are limited to the power station sources only, while the AQMS are exposed to all sources. The predicted concentrations provide an indication of the contribution of the power station sources at these points.

Table 7-4: Measured annual average concentration at the Sivukile and Grootdraai AQMS compared with predicted concentrations in µg/m³

AQMS	Pollutant	2021	2022	2023	Predicted
Sivukile	SO_2	40.1	31.9	32.9	1.3
Grootdraai		10.4	12.5	10.5	0.9
Sivukile	NO_2	15.2	15.5	15.7	0.4
Grootdraai		8.4	8.9	-	0.3
Sivukile	PM_{10}	-	-	-	0.8
Grootdraai		-	47.7	42.4	1.2

At all of the sensitive receptors, the predicted ambient SO_2 and NO_2 concentrations are well below the limit values of the respective NAAQS. As discussed for the predicted maximum concentrations, the highest predicted concentrations occur in Scenario A (2025) at all receptor points.

For PM_{10} and $PM_{2.5}$, it must be remembered that the predicted concentrations are attributed to stack emissions and the low-level fugitive sources (coal stock stockyard and ash dump). Furthermore, the particulate emissions are not speciated into PM_{10} and $PM_{2.5}$, but rather all PM emitted is assumed to be PM_{10}, and all PM emitted is assumed to be $PM_{2.5}$. In addition, the predicted PM_{10} and $PM_{2.5}$ concentrations account for the formation of secondary particulates from SO_2 and NO_2 stack emissions. This is a very conservative approach.

For PM_{10} and $PM_{2.5}$, the predicted annual average concentrations are below the limit values of the NAAQS at all of the sensitive receptor points in all five scenarios.

For PM_{10}, the predicted 99th percentile of the 24-hour concentrations are below the limit value of the NAAQS at all of the sensitive receptor points in all five scenarios.

For $PM_{2.5}$, the predicted 99th percentile of the 24-hour concentrations are low and below the limit value of the NAAQS at of the sensitive receptor points in all five scenarios, except at the Amalumgelo Primary School. This receptor is located 10.6 km east-northeast of Tutuka where the 24-hour $PM_{2.5}$ limit value is exceeded in all five scenarios. The NAAQS provides for 4 exceedances of the limit value per year, implying that 12 exceedances are permitted for the 3-year modelling period. In both Scenario 1 (Current) and Scenario A (2025) there are 3 predicted exceedances at the Amalumgelo Primary School which complies with the NAAQS. With the more stringent limit value from 01 January 2030 the 16 predicted exceedances each in Scenario B (2031), Scenario C (2036) and Scenario D (MES) do not comply with the NAAQS.

Table 7-5: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario 1 (Current) with the limit value of the NAAQS. The number of exceedances is shown in brackets

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**40**	**20**
Morgenzon Landbou Akademie	36.0	12.8	1.3	12.3	0.4	7.4	0.8	7.4	0.8
Nqobangolwazi Secondary School	36.1	12.2	1.3	12.5	0.4	7.4	0.8	7.4	0.8
Siqondekhaya Pre Primary School	37.3	12.6	1.3	12.9	0.4	9.2	0.8	9.2	0.8
Sizakhele Primary School	37.0	12.2	1.3	12.9	0.4	8.7	0.8	8.7	0.8
Phezukwentaba Primary School (south of Morgenzon)	31.5	9.9	1.2	11.2	0.4	8.1	0.8	8.1	0.8
Kwaggalaagte Primary School (north of Morgenzon)	23.1	11.7	0.7	6.6	0.2	5.8	0.4	5.8	0.4
Sizakhele Clinic/Hospital	37.1	12.4	1.3	12.8	0.4	8.0	0.8	8.0	0.8
Kleuterskool Haas Das	21.7	13.7	0.7	6.1	0.2	8.6	0.8	8.6	0.8
Standerton Primary School	21.6	14.2	0.7	6.1	0.2	8.7	0.8	8.7	0.8
Laerskool Jeugkrag	21.4	15.6	0.7	6.3	0.2	9.7	0.9	9.7	0.9
Laerskool Standerton	21.8	13.9	0.7	6.1	0.2	8.5	0.8	8.5	0.8
Laerskool Kalie De Haas	22.0	12.3	0.7	6.2	0.2	7.7	0.7	7.7	0.7
Hoerskool Standerton	21.6	14.2	0.7	6.1	0.2	8.7	0.8	8.7	0.8
Standerton Provincial Government Hospital	21.4	14.5	0.7	6.2	0.2	8.8	0.8	8.8	0.8
Mar-Peh Medicare Private Hospital	21.3	13.1	0.7	6.2	0.2	8.1	0.7	8.1	0.7
Standerton Retirement Home	21.4	12.7	0.7	6.2	0.2	8.0	0.7	8.0	0.7
Standerton Ouetehuis/Old Age Home	22.2	13.5	0.7	6.1	0.2	8.4	0.8	8.4	0.8
Holmdene Secondary School	15.3	11.6	0.5	3.8	0.1	6.5	0.6	6.5	0.6
Cathuza Primary School (SE of town)	24.1	11.1	0.8	7.0	0.2	11.0	1.0	11.0	1.0
Sizanani Pre Primary School	21.5	12.7	0.7	5.8	0.2	7.3	0.7	7.3	0.7
Hlobisa Primary School	19.5	12.0	0.6	5.5	0.2	6.8	0.6	6.8	0.6
Shukuma Primary School	20.8	11.6	0.6	5.8	0.2	6.3	0.6	6.3	0.6
Retsebile Primary School	19.8	11.4	0.6	5.5	0.2	7.5	0.7	7.5	0.7

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**40**	**20**
Thuto-Thebe Secondary School	21.0	12.8	0.7	5.8	0.2	8.1	0.8	8.1	0.8
Jandrell Secondary School	20.1	12.2	0.6	5.6	0.2	7.1	0.7	7.1	0.7
Thobelani Secondary School	20.0	12.5	0.6	5.6	0.2	7.1	0.7	7.1	0.7
Standerton Tb Hospital	21.5	11.8	0.7	6.1	0.2	6.8	0.6	6.8	0.6
Thuthukani Pre Primary School	15.3	19.7	0.8	4.2	0.3	23.4	2.3	23.4	2.3
Ulwazi Primary School	15.6	21.1	0.8	4.3	0.3	22.8	2.2	22.8	2.2
Zikhetheleni Secondary School	16.8	19.4	0.8	4.4	0.3	21.9	2.2	21.9	2.2
Joubertsvlei Primary School (north of Tutuka)	23.2	17.0	0.8	7.2	0.3	8.3	0.7	8.3	0.7
Amalumgelo Primary School (NE of Tutuka)	55.9	22.8	1.8	20.7	0.7	51.1	3.1	**51.1 (3)**	3.1
Grootdraaidam Primary School	23.6	16.1	0.8	7.0	0.3	11.8	1.2	11.8	1.2
Laerskool Secunda	9.2	7.2	0.3	2.0	0.1	3.1	0.2	3.1	0.2
Laerskool Kruinpark	10.8	8.1	0.4	2.5	0.1	3.6	0.2	3.6	0.2
Laerskool Oranjegloed Primary	10.0	8.4	0.4	2.3	0.1	3.5	0.2	3.5	0.2
Curro Castle Combined School	9.6	8.0	0.4	2.2	0.1	3.5	0.2	3.5	0.2
Hoërskool Oosterland	10.2	8.0	0.4	2.3	0.1	3.5	0.2	3.5	0.2
Mediclinic Secunda (Hospital)	8.7	7.2	0.3	1.9	0.1	3.1	0.2	3.1	0.2
Mediclinic Highveld (Hospital_Trichardt, Secunda)	8.7	6.7	0.3	1.8	0.1	3.0	0.2	3.0	0.2
Daviescourt/Davieshof Old Age Home	9.4	7.5	0.3	2.1	0.1	3.2	0.2	3.2	0.2
Highveld Park High School	9.7	7.7	0.4	2.2	0.1	3.4	0.2	3.4	0.2
Hoerskool Secunda	9.6	7.5	0.3	2.0	0.1	3.2	0.2	3.2	0.2
Basizeni Special School	6.5	6.6	0.3	1.4	0.1	3.0	0.2	3.0	0.2
Maphala-Gulube Primary School	8.7	9.0	0.4	1.8	0.1	3.8	0.2	3.8	0.2
Shapeve Primary School	6.9	7.0	0.3	1.5	0.1	3.1	0.2	3.1	0.2
Thomas Nhlabathi Secondary School	7.0	6.8	0.3	1.5	0.1	3.0	0.2	3.0	0.2

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**40**	**20**
Embalenhle Hospital /Clinic	7.7	7.5	0.3	1.6	0.1	3.2	0.2	3.2	0.2
Vukuzithathe Primary School	8.3	8.6	0.4	1.6	0.1	3.6	0.2	3.6	0.2
K I Twala Secondary	8.3	8.2	0.3	1.7	0.1	3.5	0.2	3.5	0.2
Allan Makunga Primary School	7.2	7.5	0.3	1.5	0.1	3.2	0.2	3.2	0.2
Sakhisizwe Primary School (Emzinoni)	12.9	7.1	0.4	3.2	0.1	3.5	0.2	3.5	0.2

Table 7-6: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario A (2025) with the limit value of the NAAQS. The number of exceedances is shown in brackets

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	350	125	50	200	40	75	40	40	20
Morgenzon Landbou Akademie	58.6	18.8	2.3	19.7	0.7	8.3	0.9	8.3	0.9
Nqobangolwazi Secondary School	58.3	19.6	2.2	19.2	0.7	8.1	0.9	8.1	0.9
Siqondekhaya Pre Primary School	60.8	21.9	2.2	19.8	0.7	9.9	0.9	9.9	0.9
Sizakhele Primary School	59.8	21.3	2.2	19.4	0.7	9.5	0.9	9.5	0.9
Phezukwentaba Primary School (south of Morgenzon)	52.0	16.0	2.2	17.8	0.7	8.8	0.9	8.8	0.9
Kwaggalaagte Primary School (north of Morgenzon)	38.3	14.1	1.1	10.7	0.3	6.4	0.5	6.4	0.5
Sizakhele Clinic/Hospital	59.4	20.6	2.2	19.5	0.7	8.9	0.9	8.9	0.9
Kleuterskool Haas Das	42.9	21.1	1.2	11.3	0.4	9.4	0.9	9.4	0.9
Standerton Primary School	43.6	21.3	1.3	11.7	0.4	9.6	0.9	9.6	0.9
Laerskool Jeugkrag	41.4	23.7	1.2	11.6	0.4	11.6	1.0	11.6	1.0
Laerskool Standerton	41.0	20.7	1.2	11.5	0.4	9.1	0.9	9.1	0.9
Laerskool Kalie De Haas	40.6	19.9	1.2	11.6	0.3	8.3	0.8	8.3	0.8
Hoerskool Standerton	43.6	21.3	1.3	11.7	0.4	9.7	0.9	9.7	0.9
Standerton Provincial Government Hospital	41.1	20.5	1.3	11.7	0.4	9.8	0.9	9.8	0.9
Mar-Peh Medicare Private Hospital	40.6	20.4	1.2	11.1	0.4	8.8	0.8	8.8	0.8
Standerton Retirement Home	40.4	20.4	1.2	11.1	0.4	8.7	0.8	8.7	0.8
Standerton Ouetehuis/Old Age Home	40.6	20.3	1.2	11.8	0.4	9.1	0.8	9.1	0.8
Holmdene Secondary School	26.0	16.1	0.8	7.1	0.2	6.8	0.6	6.8	0.6
Cathuza Primary School (SE of town)	44.0	15.7	1.4	13.3	0.4	11.7	1.1	11.7	1.1
Sizanani Pre Primary School	37.7	19.2	1.1	10.3	0.3	8.0	0.8	8.0	0.8
Hlobisa Primary School	35.4	18.1	1.0	9.5	0.3	7.2	0.7	7.2	0.7
Shukuma Primary School	35.4	17.4	1.1	9.5	0.3	7.0	0.7	7.0	0.7
Retsebile Primary School	34.7	19.9	1.0	9.3	0.3	8.4	0.8	8.4	0.8

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**40**	**20**
Thuto-Thebe Secondary School	38.3	21.8	1.1	10.4	0.3	9.2	0.8	9.2	0.8
Jandrell Secondary School	35.0	17.9	1.1	9.5	0.3	7.8	0.7	7.8	0.7
Thobelani Secondary School	35.6	19.9	1.1	9.6	0.3	8.3	0.8	8.3	0.8
Standerton Tb Hospital	36.3	17.9	1.1	10.0	0.3	7.4	0.7	7.4	0.7
Thuthukani Pre Primary School	51.0	38.5	2.0	17.0	0.7	25.7	2.5	25.7	2.5
Ulwazi Primary School	53.0	39.2	2.0	17.7	0.7	26.0	2.4	26.0	2.4
Zikhetheleni Secondary School	51.0	40.1	2.0	17.5	0.7	24.6	2.4	24.6	2.4
Joubertsvlei Primary School (north of Tutuka)	43.9	23.8	1.3	12.0	0.4	9.4	0.8	9.4	0.8
Amalumgelo Primary School (NE of Tutuka)	110.7	37.4	3.6	40.3	1.3	52.5	3.3	**52.5 (3)**	3.3
Grootdraaidam Primary School	51.9	24.8	1.6	15.1	0.5	13.2	1.3	13.2	1.3
Laerskool Secunda	15.7	9.2	0.5	3.7	0.1	3.5	0.2	3.5	0.2
Laerskool Kruinpark	19.7	11.5	0.6	4.4	0.2	4.1	0.3	4.1	0.3
Laerskool Oranjegloed Primary	17.5	10.2	0.6	4.2	0.2	3.8	0.3	3.8	0.3
Curro Castle Combined School	17.2	10.7	0.5	3.9	0.1	3.9	0.2	3.9	0.2
Hoërskool Oosterland	18.2	10.9	0.6	4.2	0.2	3.8	0.3	3.8	0.3
Mediclinic Secunda (Hospital)	14.8	9.3	0.5	3.5	0.1	3.4	0.2	3.4	0.2
Mediclinic Highveld (Hospital_Trichardt, Secunda)	16.0	9.2	0.5	3.7	0.1	3.6	0.2	3.6	0.2
Daviescourt/Davieshof Old Age Home	16.2	9.2	0.5	3.8	0.1	3.5	0.2	3.5	0.2
Highveld Park High School	16.9	9.5	0.5	3.8	0.1	3.6	0.2	3.6	0.2
Hoerskool Secunda	16.3	9.5	0.5	3.8	0.1	3.6	0.2	3.6	0.2
Basizeni Special School	11.8	9.6	0.4	2.5	0.1	3.5	0.2	3.5	0.2
Maphala-Gulube Primary School	16.1	12.6	0.6	3.3	0.1	4.2	0.3	4.2	0.3
Shapeve Primary School	12.9	9.8	0.4	2.7	0.1	3.6	0.2	3.6	0.2
Thomas Nhlabathi Secondary School	12.4	10.2	0.4	2.5	0.1	3.5	0.2	3.5	0.2

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	**24-hour**	**Annual**	**1-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**40**	**20**
Embalenhle Hospital /Clinic	14.1	11.1	0.5	2.8	0.1	3.7	0.2	3.7	0.2
Vukuzithathe Primary School	15.0	11.6	0.5	3.1	0.1	3.8	0.3	3.8	0.3
K I Twala Secondary	14.1	11.5	0.5	3.2	0.1	3.7	0.2	3.7	0.2
Allan Makunga Primary School	13.2	10.4	0.5	2.8	0.1	3.6	0.2	3.6	0.2
Sakhisizwe Primary School (Emzinoni)	19.4	8.7	0.6	4.4	0.2	4.0	0.3	4.0	0.3

Table 7-7: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario B (2031) with the limit value of the NAAQS. The number of exceedances is shown in brackets

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Morgenzon Landbou Akademie	18.3	6.0	0.8	3.6	0.1	6.5	0.6	6.5	0.6
Nqobangolwazi Secondary School	18.4	6.6	0.7	3.5	0.1	5.3	0.5	5.3	0.5
Siqondekhaya Pre Primary School	19.5	6.5	0.7	3.6	0.1	7.9	0.6	7.9	0.6
Sizakhele Primary School	19.1	6.5	0.7	3.6	0.1	7.4	0.5	7.4	0.5
Phezukwentaba Primary School (south of Morgenzon)	17.0	5.4	0.8	3.5	0.1	6.3	0.6	6.3	0.6
Kwaggalaagte Primary School (north of Morgenzon)	13.2	4.9	0.4	2.1	0.1	4.4	0.3	4.4	0.3
Sizakhele Clinic/Hospital	19.1	6.8	0.7	3.6	0.1	6.9	0.5	6.9	0.5
Kleuterskool Haas Das	15.1	8.1	0.5	2.3	0.1	6.6	0.6	6.6	0.6
Standerton Primary School	15.6	8.0	0.5	2.3	0.1	6.9	0.7	6.9	0.7
Laerskool Jeugkrag	16.3	8.0	0.5	2.7	0.1	8.2	0.7	8.2	0.7
Laerskool Standerton	14.7	8.0	0.5	2.2	0.1	6.5	0.6	6.5	0.6
Laerskool Kalie De Haas	14.3	7.3	0.4	2.2	0.1	6.5	0.6	6.5	0.6
Hoerskool Standerton	15.5	8.0	0.5	2.3	0.1	6.9	0.7	6.9	0.7
Standerton Provincial Government Hospital	15.5	8.1	0.5	2.3	0.1	6.9	0.7	6.9	0.7
Mar-Peh Medicare Private Hospital	14.9	7.7	0.5	2.1	0.1	6.3	0.6	6.3	0.6
Standerton Retirement Home	14.5	7.7	0.5	2.1	0.1	6.1	0.6	6.1	0.6
Standerton Ouetehuis/Old Age Home	14.7	7.6	0.5	2.2	0.1	6.7	0.6	6.7	0.6
Holmdene Secondary School	10.8	5.9	0.3	1.7	0.1	4.6	0.5	4.6	0.5
Cathuza Primary School (SE of town)	16.1	5.7	0.5	2.8	0.1	9.2	0.9	9.2	0.9
Sizanani Pre Primary School	13.4	7.0	0.4	1.9	0.1	5.7	0.5	5.7	0.5
Hlobisa Primary School	12.3	6.4	0.4	1.8	0.1	5.1	0.5	5.1	0.5
Shukuma Primary School	11.9	6.4	0.4	1.8	0.1	5.0	0.5	5.0	0.5
Retsebile Primary School	12.6	6.2	0.4	1.9	0.1	6.4	0.6	6.4	0.6

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Thuto-Thebe Secondary School	14.1	7.0	0.4	2.2	0.1	6.6	0.6	6.6	0.6
Jandrell Secondary School	12.8	6.4	0.4	1.9	0.1	5.5	0.5	5.5	0.5
Thobelani Secondary School	13.0	6.6	0.4	1.9	0.1	5.8	0.6	5.8	0.6
Standerton Tb Hospital	12.3	6.7	0.4	1.8	0.1	5.2	0.5	5.2	0.5
Thuthukani Pre Primary School	41.6	25.3	1.2	9.9	0.3	21.5	2.2	21.5	2.2
Ulwazi Primary School	43.8	25.1	1.2	10.3	0.3	21.2	2.1	21.2	2.1
Zikhetheleni Secondary School	42.6	24.6	1.2	9.9	0.3	21.1	2.1	21.1	2.1
Joubertsvlei Primary School (north of Tutuka)	14.9	7.3	0.5	2.5	0.1	7.3	0.5	7.3	0.5
Amalumgelo Primary School (NE of Tutuka)	43.2	13.3	1.4	9.5	0.3	50.0	2.8	**50.0 (16)**	2.8
Grootdraaidam Primary School	22.6	11.0	0.6	3.9	0.1	11.0	1.0	11.0	1.0
Laerskool Secunda	5.8	3.3	0.2	0.6	0.0	1.9	0.1	1.9	0.1
Laerskool Kruinpark	6.7	4.0	0.2	0.7	0.0	2.3	0.1	2.3	0.1
Laerskool Oranjegloed Primary	6.2	3.6	0.2	0.8	0.0	2.1	0.1	2.1	0.1
Curro Castle Combined School	6.3	3.4	0.2	0.7	0.0	2.1	0.1	2.1	0.1
Hoërskool Oosterland	6.4	3.5	0.2	0.7	0.0	2.1	0.1	2.1	0.1
Mediclinic Secunda (Hospital)	5.6	3.1	0.2	0.6	0.0	1.9	0.1	1.9	0.1
Mediclinic Highveld (Hospital_Trichardt, Secunda)	5.1	2.9	0.2	0.6	0.0	1.9	0.1	1.9	0.1
Daviescourt/Davieshof Old Age Home	6.0	3.4	0.2	0.7	0.0	1.9	0.1	1.9	0.1
Highveld Park High School	6.2	3.4	0.2	0.7	0.0	2.0	0.1	2.0	0.1
Hoerskool Secunda	6.0	3.3	0.2	0.7	0.0	1.9	0.1	1.9	0.1
Basizeni Special School	4.5	3.4	0.1	0.5	0.0	2.0	0.1	2.0	0.1
Maphala-Gulube Primary School	6.1	4.3	0.2	0.7	0.0	2.3	0.2	2.3	0.2
Shapeve Primary School	4.7	3.5	0.1	0.5	0.0	2.0	0.1	2.0	0.1
Thomas Nhlabathi Secondary School	4.6	3.5	0.2	0.5	0.0	2.0	0.1	2.0	0.1

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	**24-hour**	**Annual**	**1-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Embalenhle Hospital /Clinic	5.0	3.8	0.2	0.6	0.0	2.0	0.1	2.0	0.1
Vukuzithathe Primary School	5.6	3.6	0.2	0.7	0.0	2.1	0.1	2.1	0.1
K I Twala Secondary	5.5	3.2	0.2	0.6	0.0	2.0	0.1	2.0	0.1
Allan Makunga Primary School	4.9	3.7	0.2	0.6	0.0	2.1	0.1	2.1	0.1
Sakhisizwe Primary School (Emzinoni)	6.5	3.1	0.2	0.8	0.0	2.4	0.1	2.4	0.1

Table 7-8: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario C (2036) with the limit value of the NAAQS. The number of exceedances is shown in brackets

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	350	125	50	200	40	75	40	25	15
Morgenzon Landbou Akademie	56.0	18.2	2.2	11.9	0.4	7.7	0.7	7.7	0.7
Nqobangolwazi Secondary School	55.6	19.8	2.1	11.4	0.4	6.9	0.7	6.9	0.7
Siqondekhaya Pre Primary School	57.4	21.3	2.1	11.9	0.4	9.5	0.7	9.5	0.7
Sizakhele Primary School	57.0	20.8	2.1	11.6	0.4	9.0	0.7	9.0	0.7
Phezukwentaba Primary School (south of Morgenzon)	49.3	15.2	2.1	10.8	0.4	7.8	0.7	7.8	0.7
Kwaggalaagte Primary School (north of Morgenzon)	36.1	13.3	1.0	6.2	0.2	5.7	0.4	5.7	0.4
Sizakhele Clinic/Hospital	57.0	20.4	2.1	11.7	0.4	8.4	0.7	8.4	0.7
Kleuterskool Haas Das	40.9	20.4	1.2	6.9	0.2	8.6	0.8	8.6	0.8
Standerton Primary School	41.4	20.5	1.2	7.0	0.2	8.7	0.8	8.7	0.8
Laerskool Jeugkrag	39.7	23.4	1.2	6.9	0.2	10.1	0.8	10.1	0.8
Laerskool Standerton	40.6	19.7	1.2	7.2	0.2	8.2	0.7	8.2	0.7
Laerskool Kalie De Haas	39.3	19.3	1.1	6.8	0.2	7.9	0.7	7.9	0.7
Hoerskool Standerton	41.3	20.5	1.2	7.0	0.2	8.7	0.8	8.7	0.8
Standerton Provincial Government Hospital	40.7	20.2	1.2	7.2	0.2	8.6	0.8	8.6	0.8
Mar-Peh Medicare Private Hospital	39.7	20.0	1.2	7.0	0.2	8.2	0.7	8.2	0.7
Standerton Retirement Home	39.9	19.9	1.2	6.9	0.2	7.9	0.7	7.9	0.7
Standerton Ouetehuis/Old Age Home	40.7	19.7	1.2	7.0	0.2	8.4	0.7	8.4	0.7
Holmdene Secondary School	25.5	15.4	0.8	4.4	0.1	6.0	0.6	6.0	0.6
Cathuza Primary School (SE of town)	42.7	15.1	1.3	8.2	0.2	11.0	1.0	11.0	1.0
Sizanani Pre Primary School	36.3	18.4	1.1	6.3	0.2	7.5	0.6	7.5	0.6
Hlobisa Primary School	34.1	17.5	1.0	5.7	0.2	6.7	0.6	6.7	0.6
Shukuma Primary School	35.2	16.7	1.0	5.8	0.2	6.6	0.6	6.6	0.6
Retsebile Primary School	33.0	18.7	1.0	5.6	0.2	7.9	0.7	7.9	0.7

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Thuto-Thebe Secondary School	36.8	19.5	1.1	6.2	0.2	8.5	0.7	8.5	0.7
Jandrell Secondary School	35.3	17.4	1.0	5.8	0.2	7.1	0.6	7.1	0.6
Thobelani Secondary School	34.5	18.2	1.0	5.6	0.2	7.5	0.7	7.5	0.7
Standerton Tb Hospital	35.2	17.7	1.1	6.0	0.2	6.9	0.6	6.9	0.6
Thuthukani Pre Primary School	54.7	40.0	2.0	11.6	0.4	23.6	2.3	23.6	2.3
Ulwazi Primary School	56.5	39.2	2.0	12.6	0.4	23.7	2.2	23.7	2.2
Zikhetheleni Secondary School	54.0	39.6	2.0	11.9	0.4	22.8	2.2	22.8	2.2
Joubertsvlei Primary School (north of Tutuka)	42.3	23.2	1.3	7.8	0.3	8.7	0.6	8.7	0.6
Amalumgelo Primary School (NE of Tutuka)	107.0	35.4	3.5	25.4	0.8	51.9	3.0	**51.9 (16)**	3.0
Grootdraaidam Primary School	51.1	25.1	1.5	9.3	0.3	12.7	1.1	12.7	1.1
Laerskool Secunda	15.2	8.9	0.5	2.2	0.1	2.9	0.2	2.9	0.2
Laerskool Kruinpark	19.1	11.3	0.6	2.7	0.1	3.3	0.2	3.3	0.2
Laerskool Oranjegloed Primary	17.1	9.8	0.6	2.5	0.1	3.1	0.2	3.1	0.2
Curro Castle Combined School	16.6	10.0	0.5	2.3	0.1	3.3	0.2	3.3	0.2
Hoërskool Oosterland	17.2	10.9	0.6	2.5	0.1	3.0	0.2	3.0	0.2
Mediclinic Secunda (Hospital)	13.9	8.7	0.5	2.0	0.1	2.8	0.2	2.8	0.2
Mediclinic Highveld (Hospital_Trichardt, Secunda)	15.7	8.7	0.5	2.1	0.1	2.7	0.2	2.7	0.2
Daviescourt/Davieshof Old Age Home	15.7	8.7	0.5	2.4	0.1	2.8	0.2	2.8	0.2
Highveld Park High School	16.7	9.1	0.5	2.4	0.1	2.9	0.2	2.9	0.2
Hoerskool Secunda	15.5	8.9	0.5	2.2	0.1	2.9	0.2	2.9	0.2
Basizeni Special School	11.2	9.1	0.4	1.5	0.1	2.9	0.2	2.9	0.2
Maphala-Gulube Primary School	15.8	12.0	0.5	1.9	0.1	3.3	0.2	3.3	0.2
Shapeve Primary School	12.4	8.9	0.4	1.5	0.1	2.9	0.2	2.9	0.2
Thomas Nhlabathi Secondary School	12.2	9.7	0.4	1.4	0.1	2.9	0.2	2.9	0.2

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Embalenhle Hospital /Clinic	13.5	10.3	0.5	1.6	0.1	2.9	0.2	2.9	0.2
Vukuzithathe Primary School	14.9	11.0	0.5	1.9	0.1	3.3	0.2	3.3	0.2
K I Twala Secondary	13.8	10.8	0.5	1.9	0.1	3.1	0.2	3.1	0.2
Allan Makunga Primary School	12.3	9.5	0.4	1.6	0.1	3.1	0.2	3.1	0.2
Sakhisizwe Primary School (Emzinoni)	18.7	8.3	0.6	2.7	0.1	3.5	0.2	3.5	0.2

Table 7-9: Predicted concentrations in µg/m³ at the sensitive receptors for Scenario D (MES) with the limit value of the NAAQS. The number of exceedances is shown in brackets

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Morgenzon Landbou Akademie	16.8	5.5	0.7	11.9	0.4	6.6	0.6	6.6	0.6
Nqobangolwazi Secondary School	16.7	5.9	0.6	11.4	0.4	5.6	0.6	5.6	0.6
Siqondekhaya Pre Primary School	17.2	6.4	0.6	11.9	0.4	8.1	0.6	8.1	0.6
Sizakhele Primary School	17.1	6.2	0.6	11.6	0.4	7.7	0.6	7.7	0.6
Phezukwentaba Primary School (south of Morgenzon)	14.8	4.6	0.6	10.8	0.4	6.7	0.6	6.7	0.6
Kwaggalaagte Primary School (north of Morgenzon)	10.8	4.0	0.3	6.2	0.2	4.5	0.3	4.5	0.3
Sizakhele Clinic/Hospital	17.1	6.1	0.6	11.7	0.4	7.1	0.6	7.1	0.6
Kleuterskool Haas Das	12.3	6.1	0.4	6.9	0.2	7.1	0.7	7.1	0.7
Standerton Primary School	12.4	6.2	0.4	7.0	0.2	7.1	0.7	7.1	0.7
Laerskool Jeugkrag	11.9	7.0	0.4	6.9	0.2	8.4	0.8	8.4	0.8
Laerskool Standerton	12.2	5.9	0.4	7.2	0.2	6.6	0.7	6.6	0.7
Laerskool Kalie De Haas	11.8	5.8	0.3	6.8	0.2	6.6	0.6	6.6	0.6
Hoerskool Standerton	12.4	6.2	0.4	7.0	0.2	7.1	0.7	7.1	0.7
Standerton Provincial Government Hospital	12.2	6.1	0.4	7.2	0.2	7.0	0.7	7.0	0.7
Mar-Peh Medicare Private Hospital	11.9	6.0	0.4	7.0	0.2	6.6	0.6	6.6	0.6
Standerton Retirement Home	12.0	6.0	0.4	6.9	0.2	6.3	0.6	6.3	0.6
Standerton Ouetehuis/Old Age Home	12.2	5.9	0.4	7.0	0.2	7.0	0.6	7.0	0.6
Holmdene Secondary School	7.6	4.6	0.2	4.4	0.1	4.9	0.5	4.9	0.5
Cathuza Primary School (SE of town)	12.8	4.5	0.4	8.2	0.2	9.7	0.9	9.7	0.9
Sizanani Pre Primary School	10.9	5.5	0.3	6.3	0.2	5.9	0.6	5.9	0.6
Hlobisa Primary School	10.2	5.2	0.3	5.7	0.2	5.2	0.5	5.2	0.5
Shukuma Primary School	10.5	5.0	0.3	5.8	0.2	5.2	0.5	5.2	0.5
Retsebile Primary School	9.9	5.6	0.3	5.6	0.2	6.4	0.6	6.4	0.6

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Thuto-Thebe Secondary School	11.1	5.8	0.3	6.2	0.2	6.9	0.6	6.9	0.6
Jandrell Secondary School	10.6	5.2	0.3	5.8	0.2	5.6	0.5	5.6	0.5
Thobelani Secondary School	10.4	5.4	0.3	5.6	0.2	5.9	0.6	5.9	0.6
Standerton Tb Hospital	10.6	5.3	0.3	6.0	0.2	5.4	0.5	5.4	0.5
Thuthukani Pre Primary School	16.4	12.0	0.6	11.6	0.4	21.8	2.2	21.8	2.2
Ulwazi Primary School	16.9	11.8	0.6	12.6	0.4	21.7	2.1	21.7	2.1
Zikhetheleni Secondary School	16.2	11.9	0.6	11.9	0.4	21.0	2.1	21.0	2.1
Joubertsvlei Primary School (north of Tutuka)	12.7	6.9	0.4	7.8	0.3	7.4	0.6	7.4	0.6
Amalumgelo Primary School (NE of Tutuka)	32.1	10.6	1.1	25.4	0.8	50.1	2.9	**50.1 (16)**	2.9
Grootdraaidam Primary School	15.3	7.5	0.5	9.3	0.3	11.0	1.0	11.0	1.0
Laerskool Secunda	4.6	2.7	0.1	2.2	0.1	2.0	0.1	2.0	0.1
Laerskool Kruinpark	5.7	3.4	0.2	2.7	0.1	2.4	0.2	2.4	0.2
Laerskool Oranjegloed Primary	5.1	3.0	0.2	2.5	0.1	2.2	0.2	2.2	0.2
Curro Castle Combined School	5.0	3.0	0.2	2.3	0.1	2.3	0.2	2.3	0.2
Hoërskool Oosterland	5.2	3.3	0.2	2.5	0.1	2.2	0.2	2.2	0.2
Mediclinic Secunda (Hospital)	4.2	2.6	0.1	2.0	0.1	2.0	0.1	2.0	0.1
Mediclinic Highveld (Hospital_Trichardt, Secunda)	4.7	2.6	0.1	2.1	0.1	2.0	0.1	2.0	0.1
Daviescourt/Davieshof Old Age Home	4.7	2.6	0.2	2.4	0.1	2.0	0.1	2.0	0.1
Highveld Park High School	5.0	2.7	0.2	2.4	0.1	2.1	0.1	2.1	0.1
Hoerskool Secunda	4.6	2.7	0.2	2.2	0.1	2.1	0.1	2.1	0.1
Basizeni Special School	3.3	2.7	0.1	1.5	0.1	2.2	0.1	2.2	0.1
Maphala-Gulube Primary School	4.7	3.6	0.2	1.9	0.1	2.4	0.2	2.4	0.2
Shapeve Primary School	3.7	2.7	0.1	1.5	0.1	2.2	0.1	2.2	0.1
Thomas Nhlabathi Secondary School	3.7	2.9	0.1	1.4	0.1	2.1	0.1	2.1	0.1

Receptor	SO_2			NO_2		PM_{10} Total		$PM_{2.5}$ Total	
	1-hour	24-hour	Annual	1-hour	Annual	24-hour	Annual	24-hour	Annual
NAAQS limit value	**350**	**125**	**50**	**200**	**40**	**75**	**40**	**25**	**15**
Embalenhle Hospital /Clinic	4.0	3.1	0.1	1.6	0.1	2.1	0.1	2.1	0.1
Vukuzithathe Primary School	4.5	3.3	0.1	1.9	0.1	2.5	0.2	2.5	0.2
K I Twala Secondary	4.2	3.3	0.1	1.9	0.1	2.3	0.2	2.3	0.2
Allan Makunga Primary School	3.7	2.9	0.1	1.6	0.1	2.3	0.1	2.3	0.1
Sakhisizwe Primary School (Emzinoni)	5.6	2.5	0.2	2.7	0.1	2.7	0.2	2.7	0.2

7.2.3 Isopleth maps

Isopleth maps of predicted ambient SO_2, NO_2, PM_{10} and $PM_{2.5}$ concentrations are presented in the following sections. The predicted concentrations are shown as isopleths, lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths are depicted as coloured lines on the various maps, corresponding to a particular predicted ambient concentration. Areas within red isopleths indicate an area where exceedances of the respective NAAQS limit value are predicted to occur. Sensitive receptors are represented by green squares and AQMS are represented by white dots.

The South African NAAQS permits 4 exceedances of the 24-hour or daily limit value per annum, implying 12 permitted exceedances in a three-year modelling period. For the 24-hour or daily isopleth maps, areas within burgundy isopleths indicate areas where more than 12 exceedances of the limit value is predicted over a 3-year period. The predicted 24-hour concentrations in these areas do not comply with the NAAQS.

The South African NAAQS also permits 88 exceedances of the 1-hour or hourly limit value per annum, implying 264 permitted exceedances in a three-year modelling period. For the 1-hour or hourly isopleth maps, areas within burgundy isopleths indicate areas where more than 264 exceedances of the limit value is predicted over a 3-year period. The predicted 1-hour concentrations in these areas do not comply with the NAAQS.

7.2.3.1 Sulphur dioxide (SO_2)

The isopleth maps showing the predicted annual average SO_2 concentrations clearly demonstrate the effect of the predominant north-westerly winds, with dispersion generally to the southeast of the power plant. In all scenarios the highest predicted annual average concentrations occur between 10 and 20 km of the power station and to the southeast.

The increase in SO_2 emission and a reduction in stack exit velocity from Scenario 1 (Current) to Scenario A (2025) is seen by an increase in the predicted concentrations. Similarly, the reduction in emissions in Scenario B (2031) shows a reduced affected area, increasing again in Scenario C (2036) with the increase in emissions. The predicted annual ambient concentrations are low and well below the NAAQS in all scenarios throughout the modelling domain.

The predicted 24-hour and 1-hour SO_2 concentrations show the same trend between scenarios as the annual predictions with the change in the emissions. The predicted 24-hour and 1-hour ambient concentrations are low and well below the NAAQS in all scenarios throughout the modelling domain.

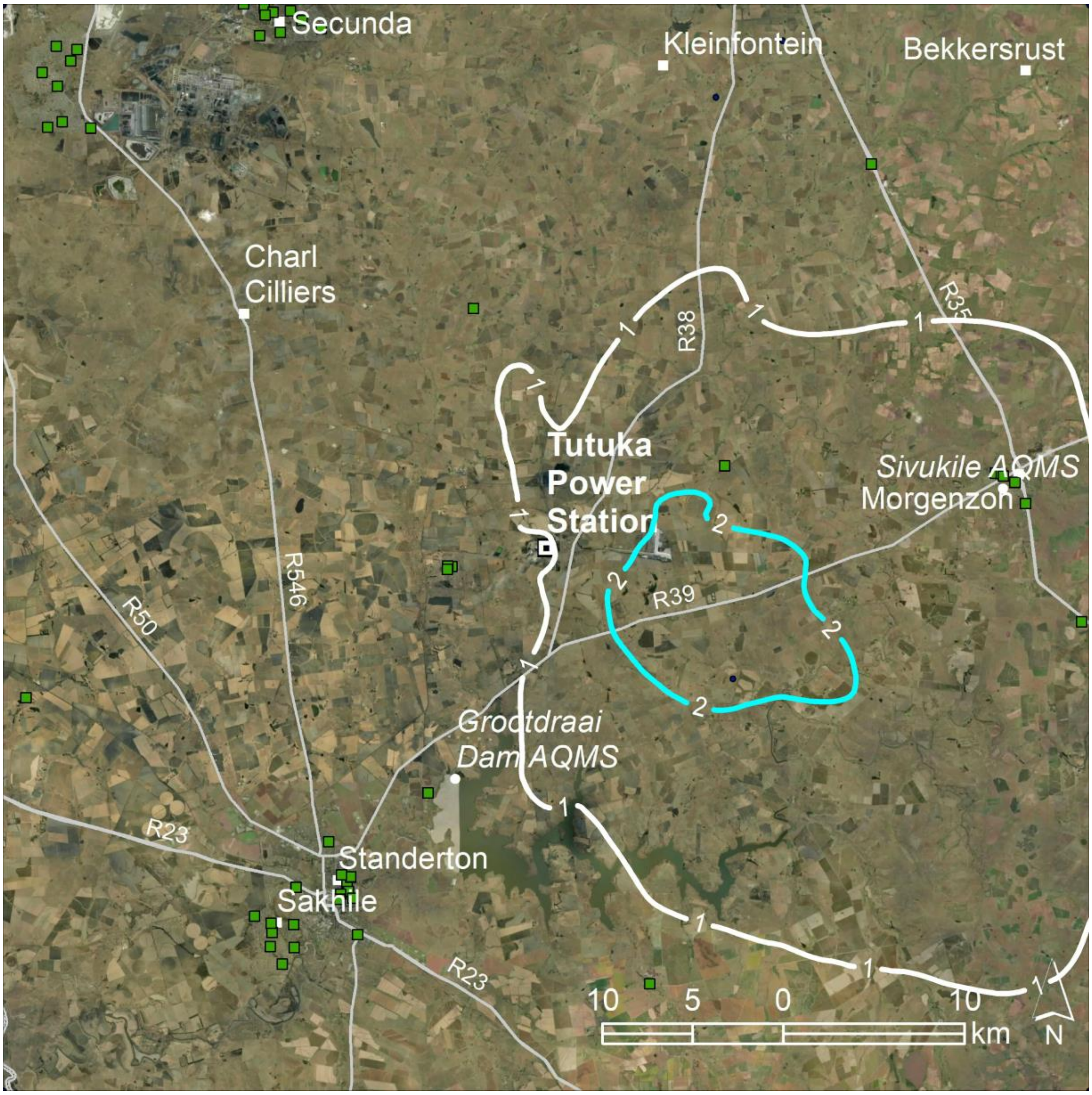

Figure 7-2: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current)(NAAQS limit 50 µg/m³)

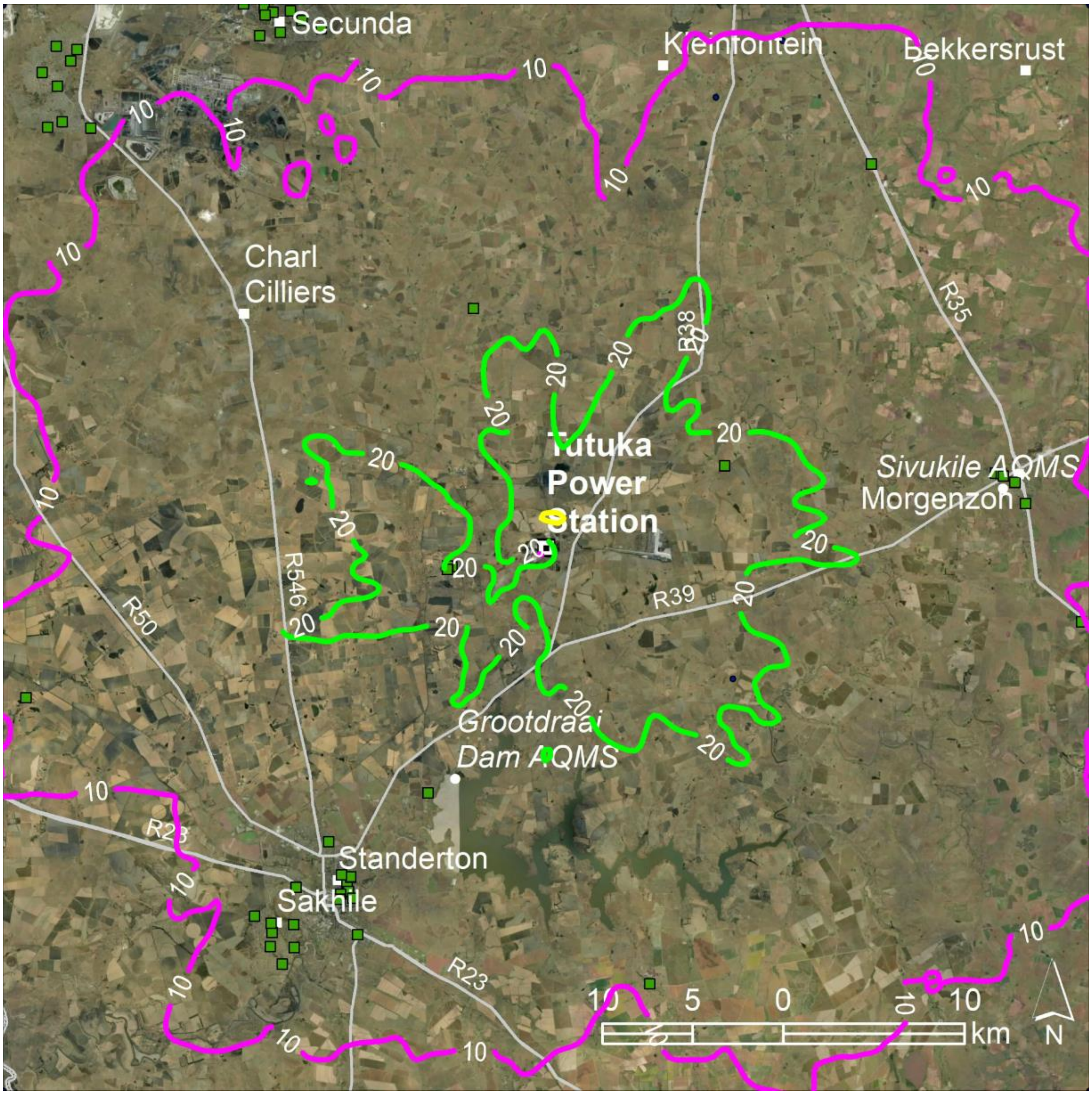

Figure 7-3: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (Current)(NAAQS limit 125 µg/m³)

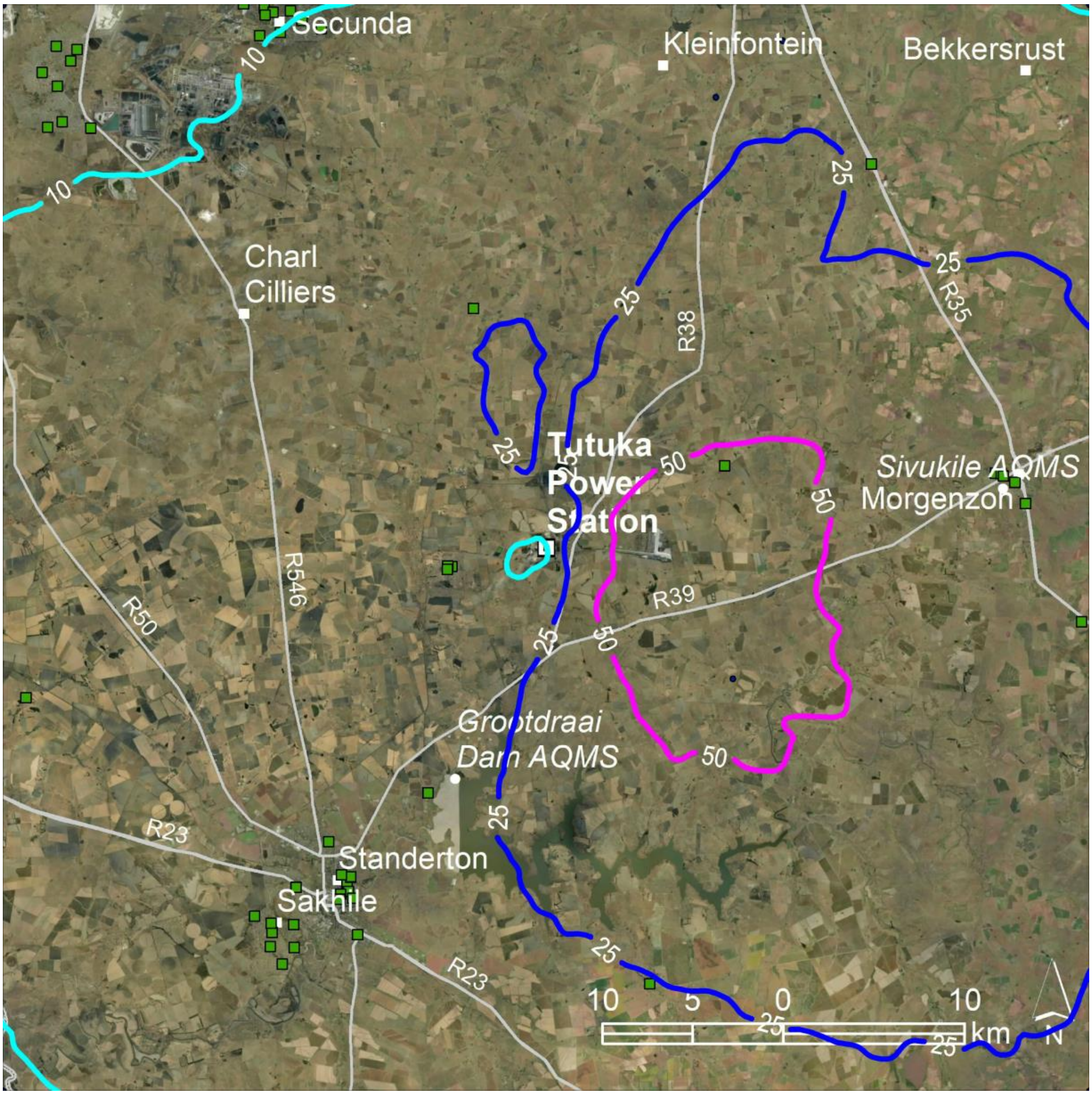

Figure 7-4: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (Current)(NAAQS limit 350 µg/m³)

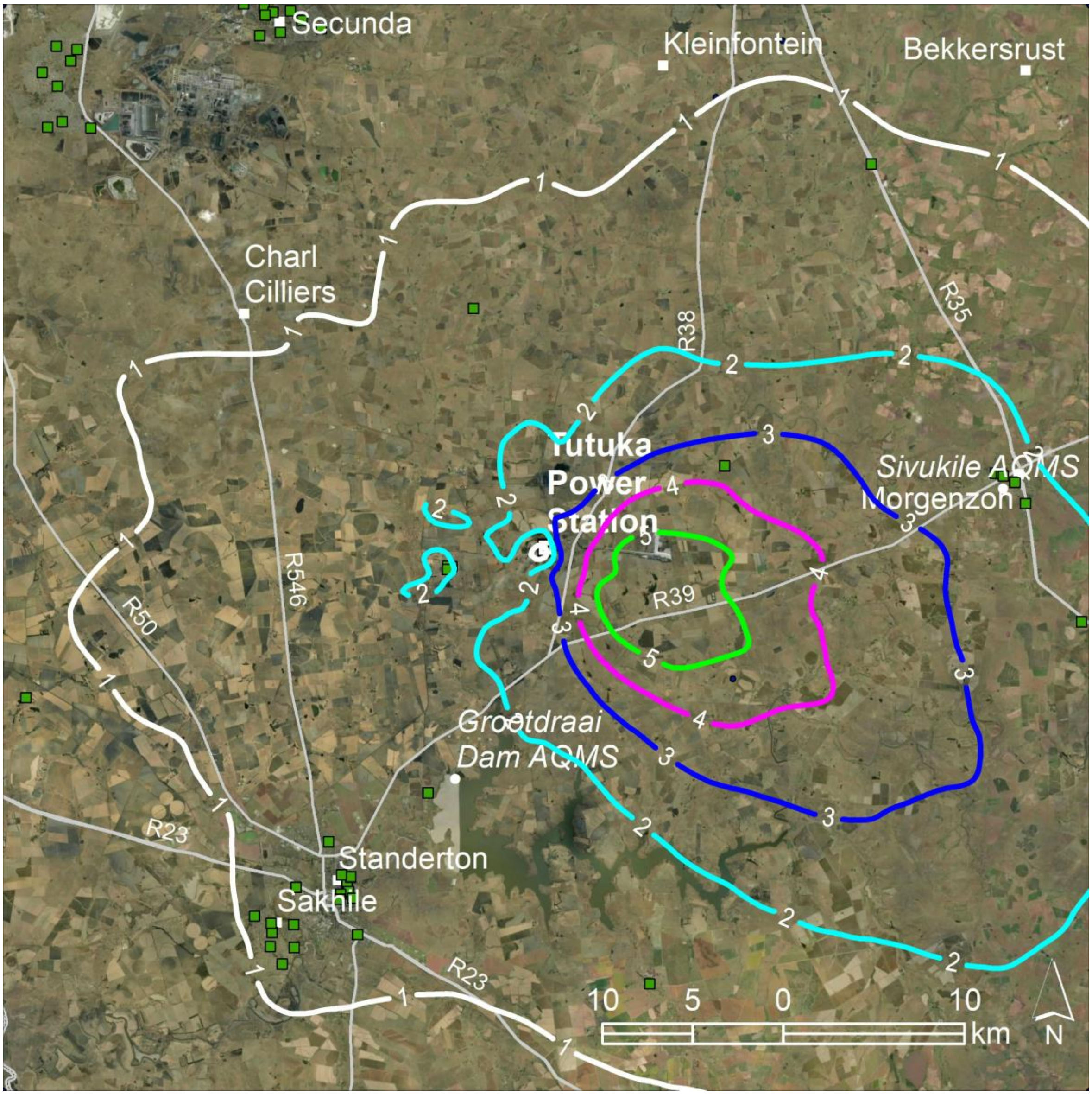

Figure 7-5: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (Current)(NAAQS limit 50 µg/m³)

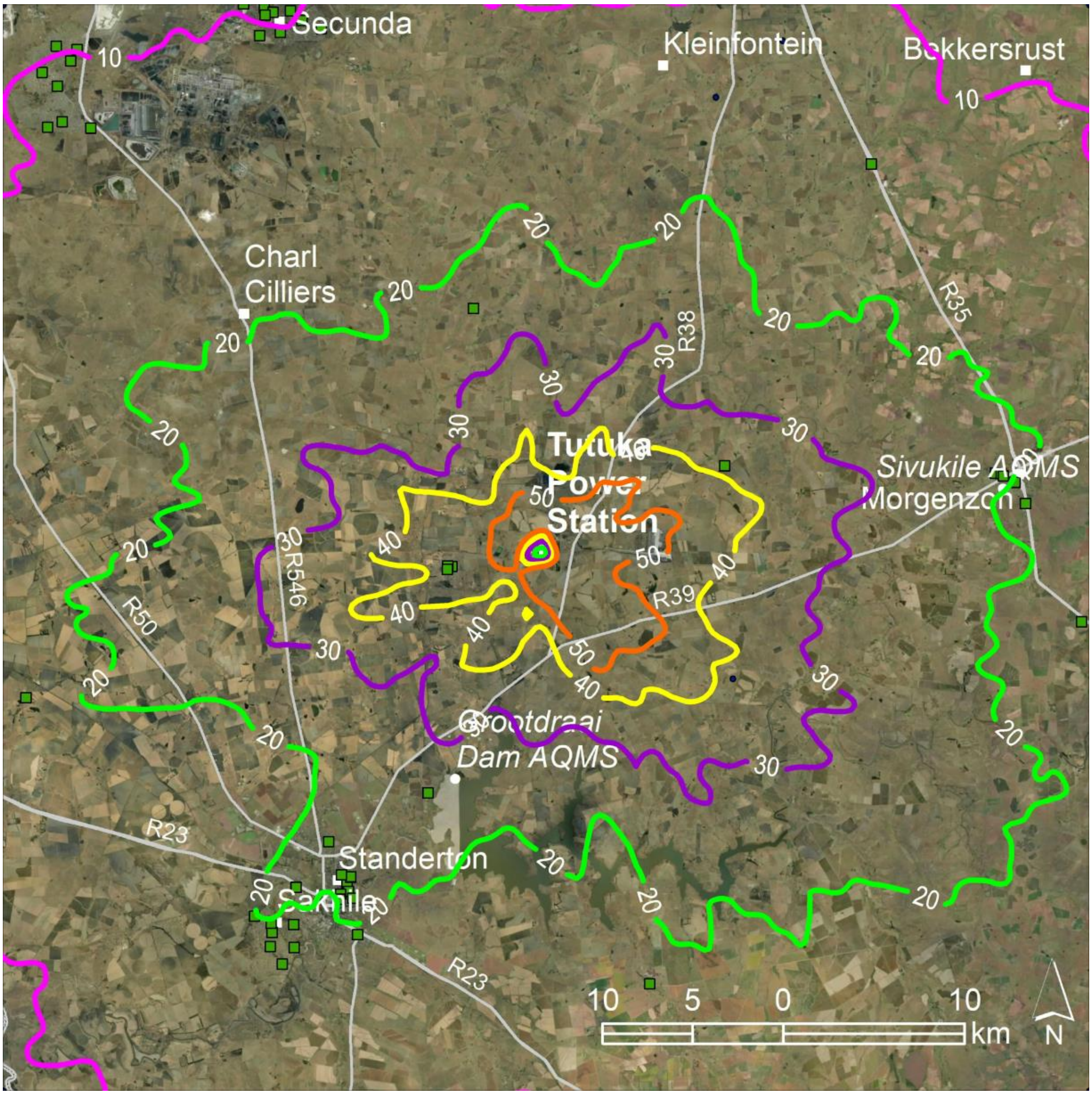

Figure 7-6: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (Current)(NAAQS limit 125 µg/m³)

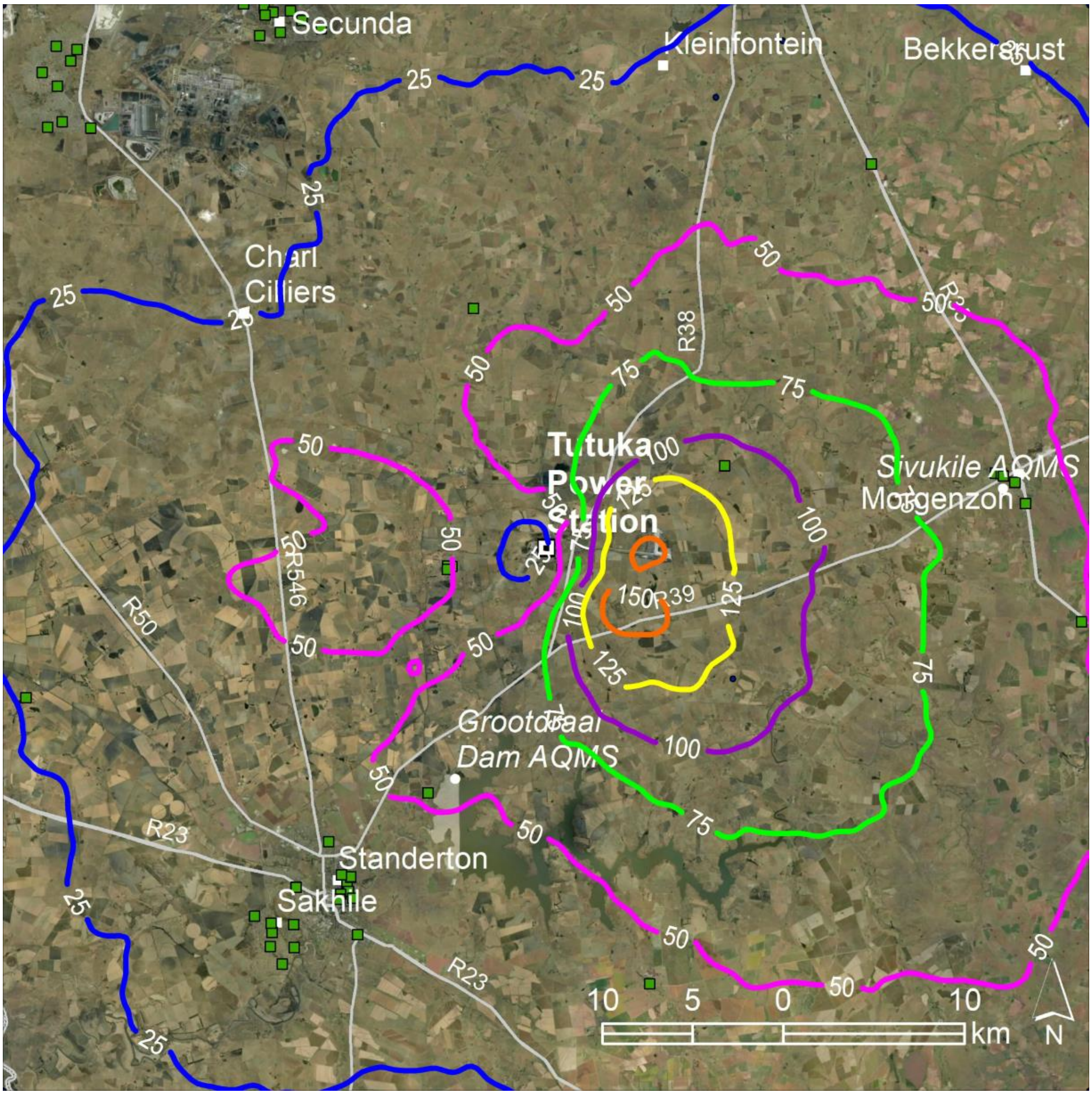

Figure 7-7: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m^3 resulting from emissions from Tutuka: Scenario A (2025) (Current)(NAAQS limit 350 µg/m^3)

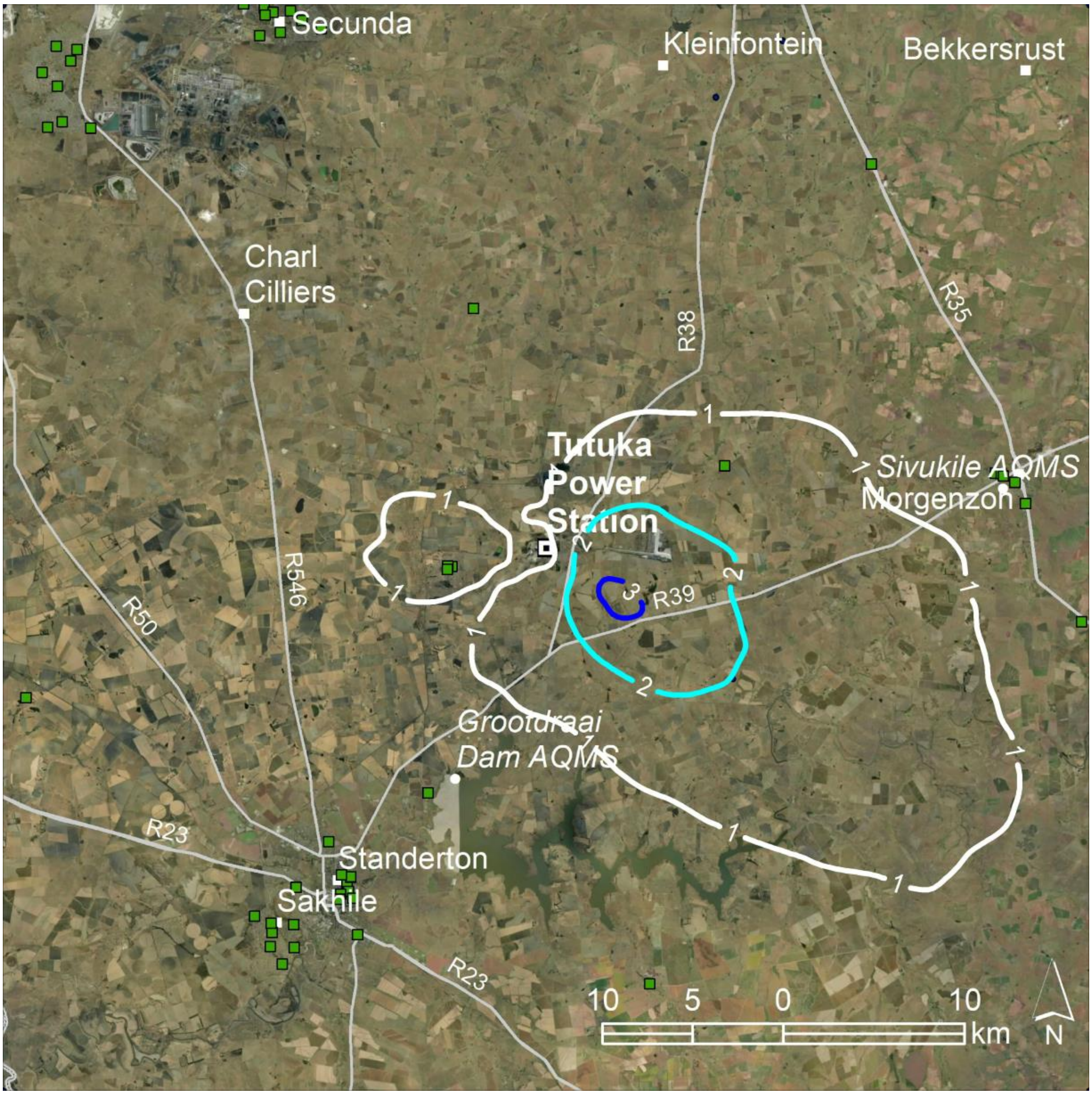

Figure 7-8: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (Current)(NAAQS limit 50 µg/m³)

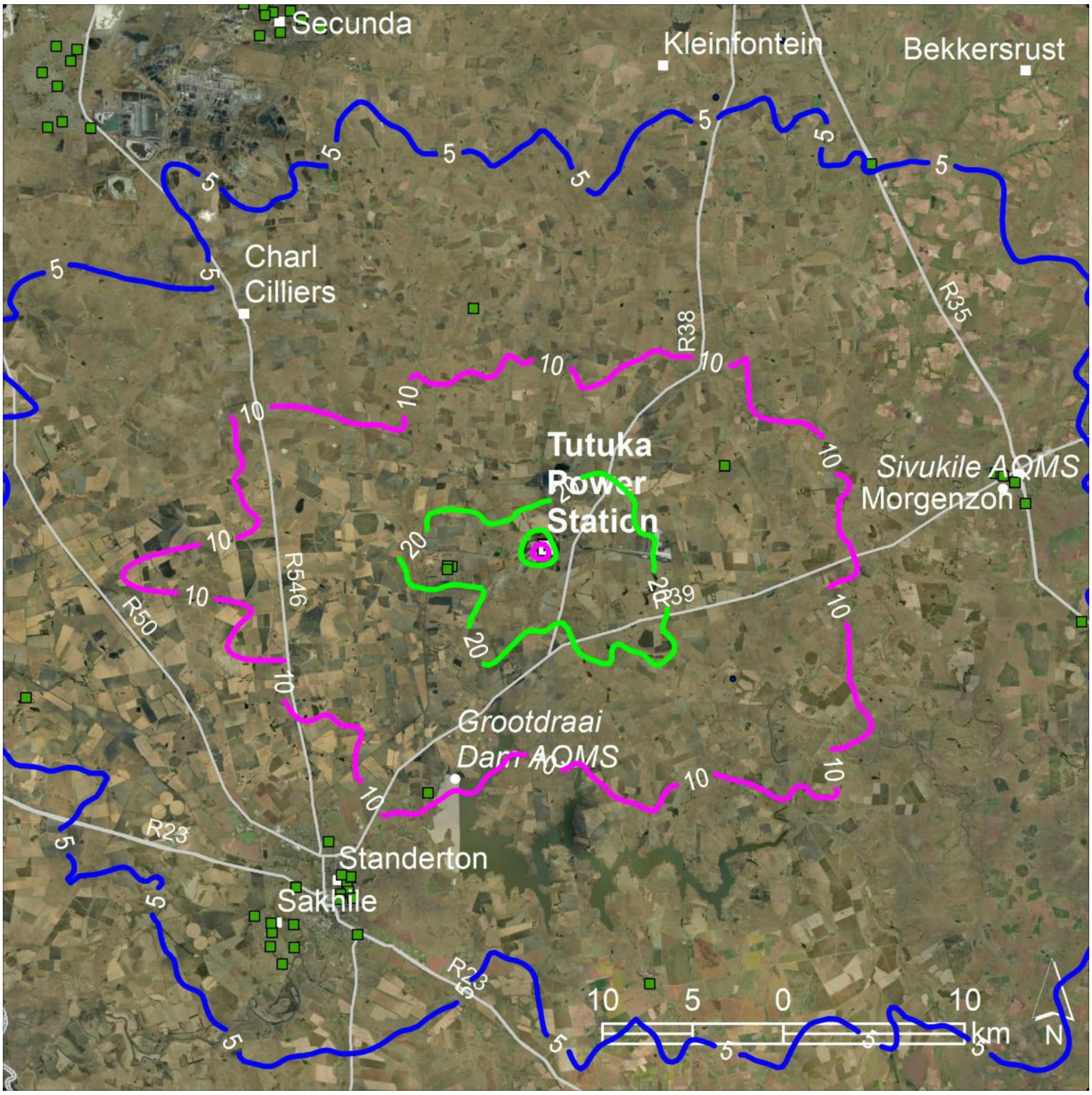

Figure 7-9: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (Current)(NAAQS limit 125 µg/m³)

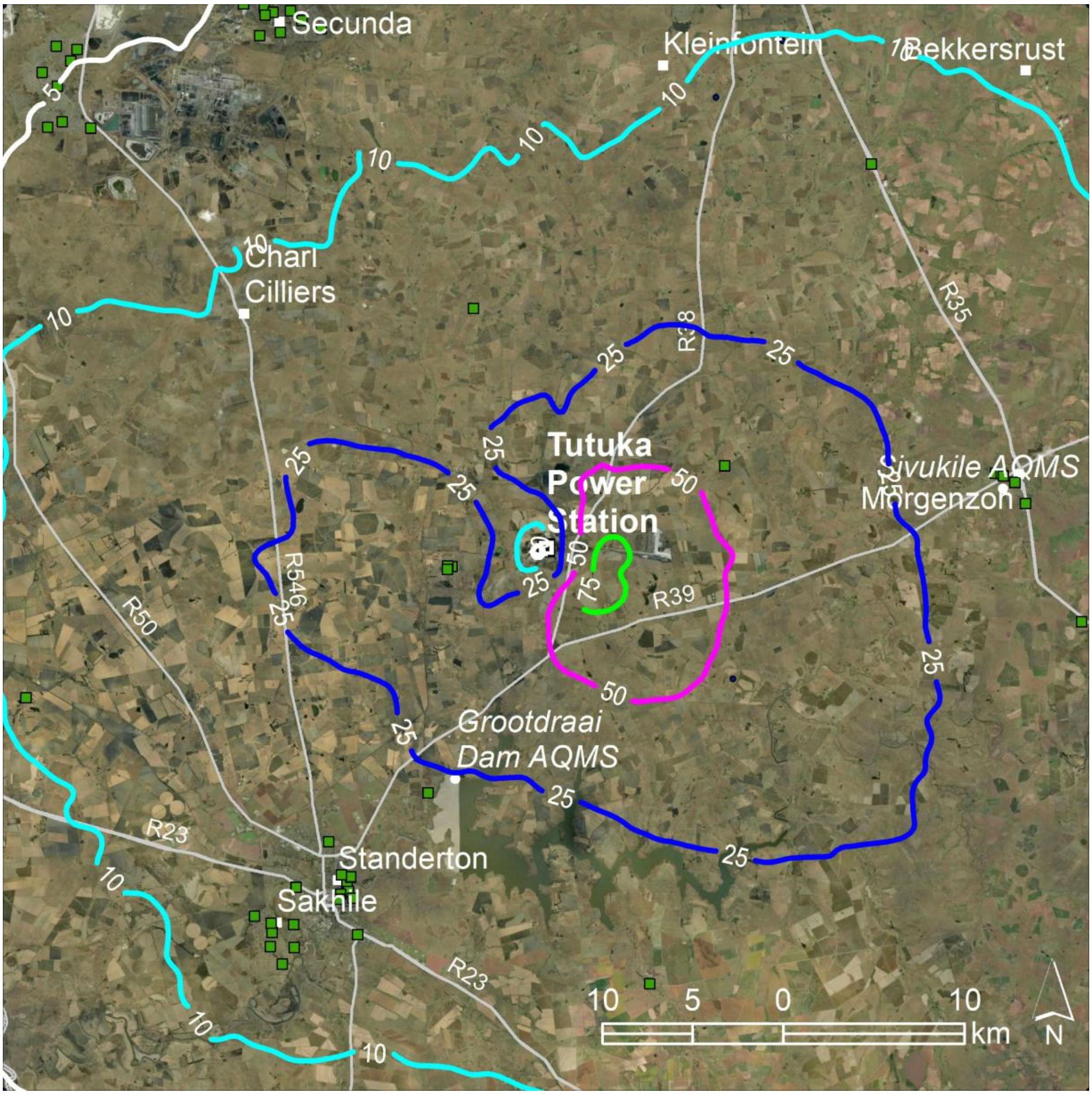

Figure 7-10: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (Current)(NAAQS limit 350 µg/m³)

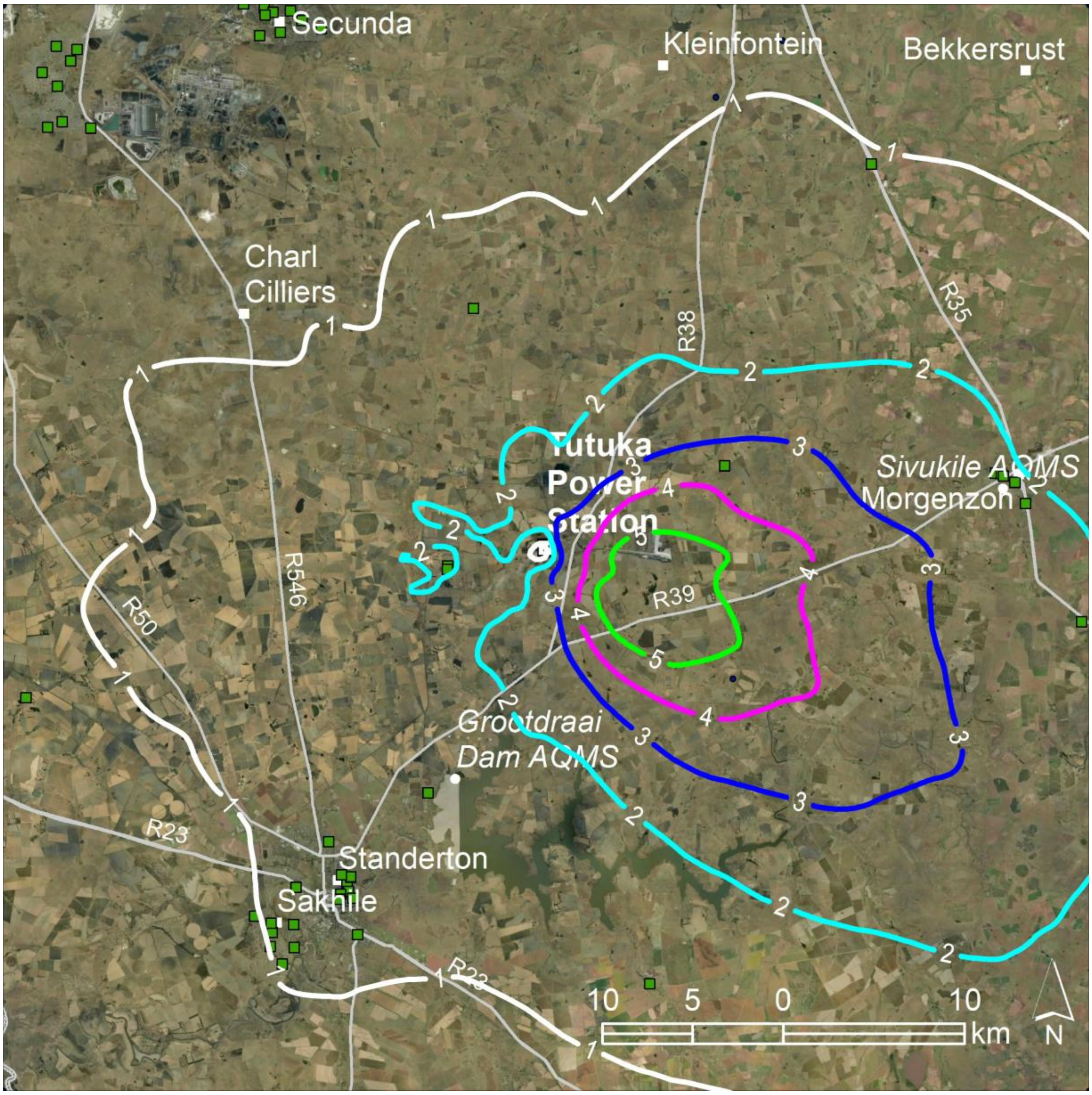

Figure 7-11: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (Current)(NAAQS limit 50 µg/m³)

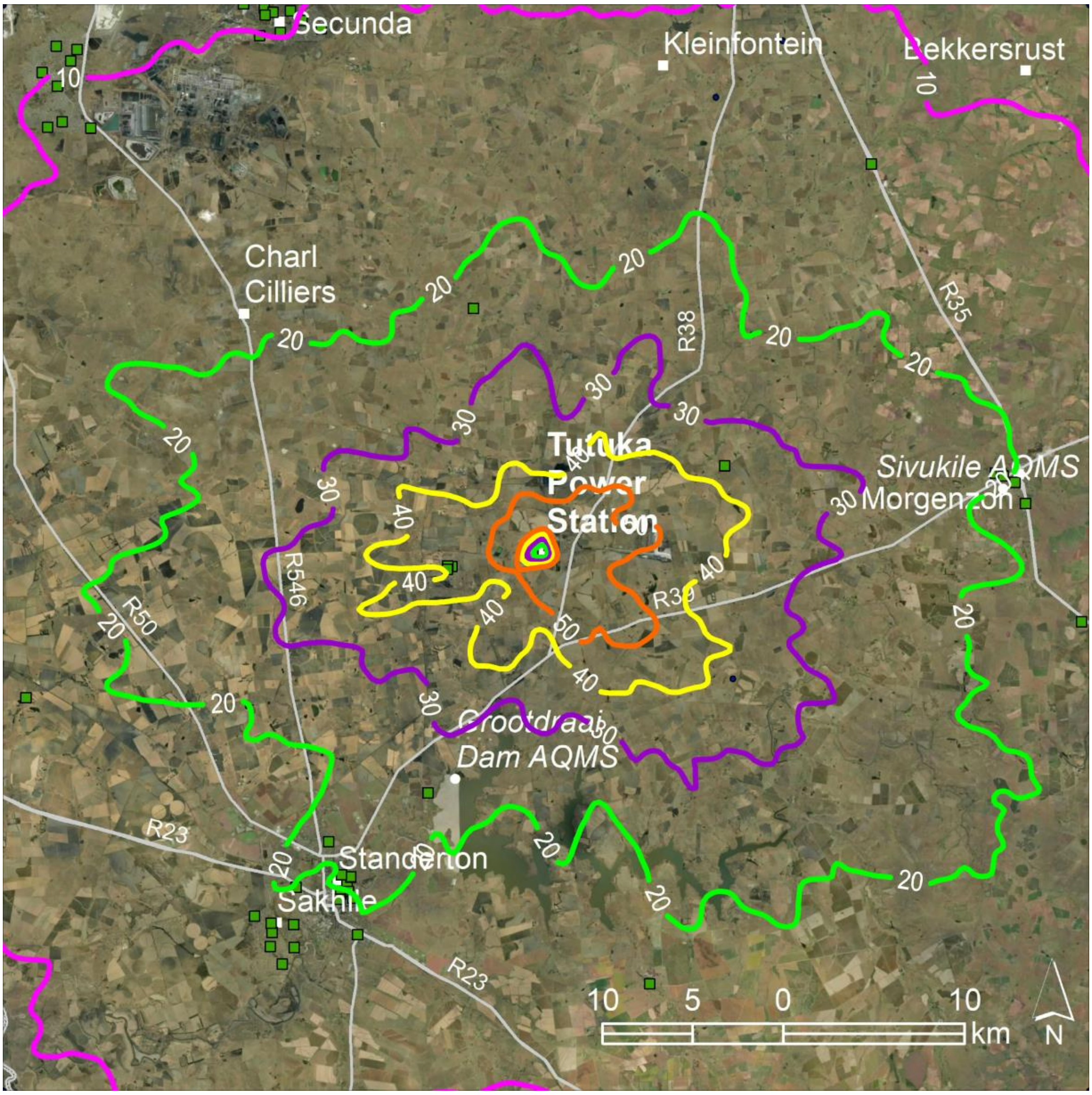

Figure 7-12: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (Current)(NAAQS limit 125 µg/m³)

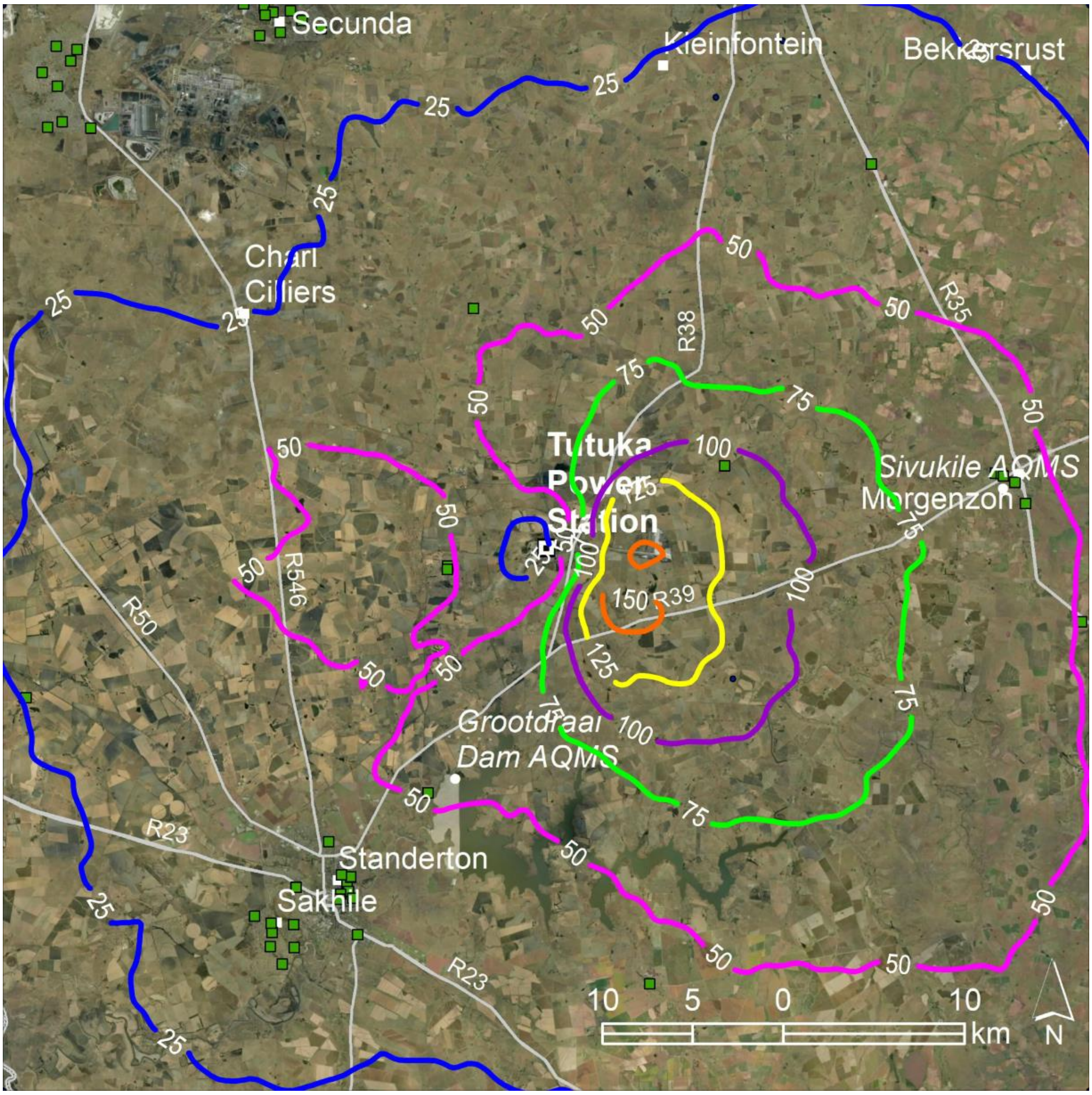

Figure 7-13: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (Current)(NAAQS limit 350 µg/m³)

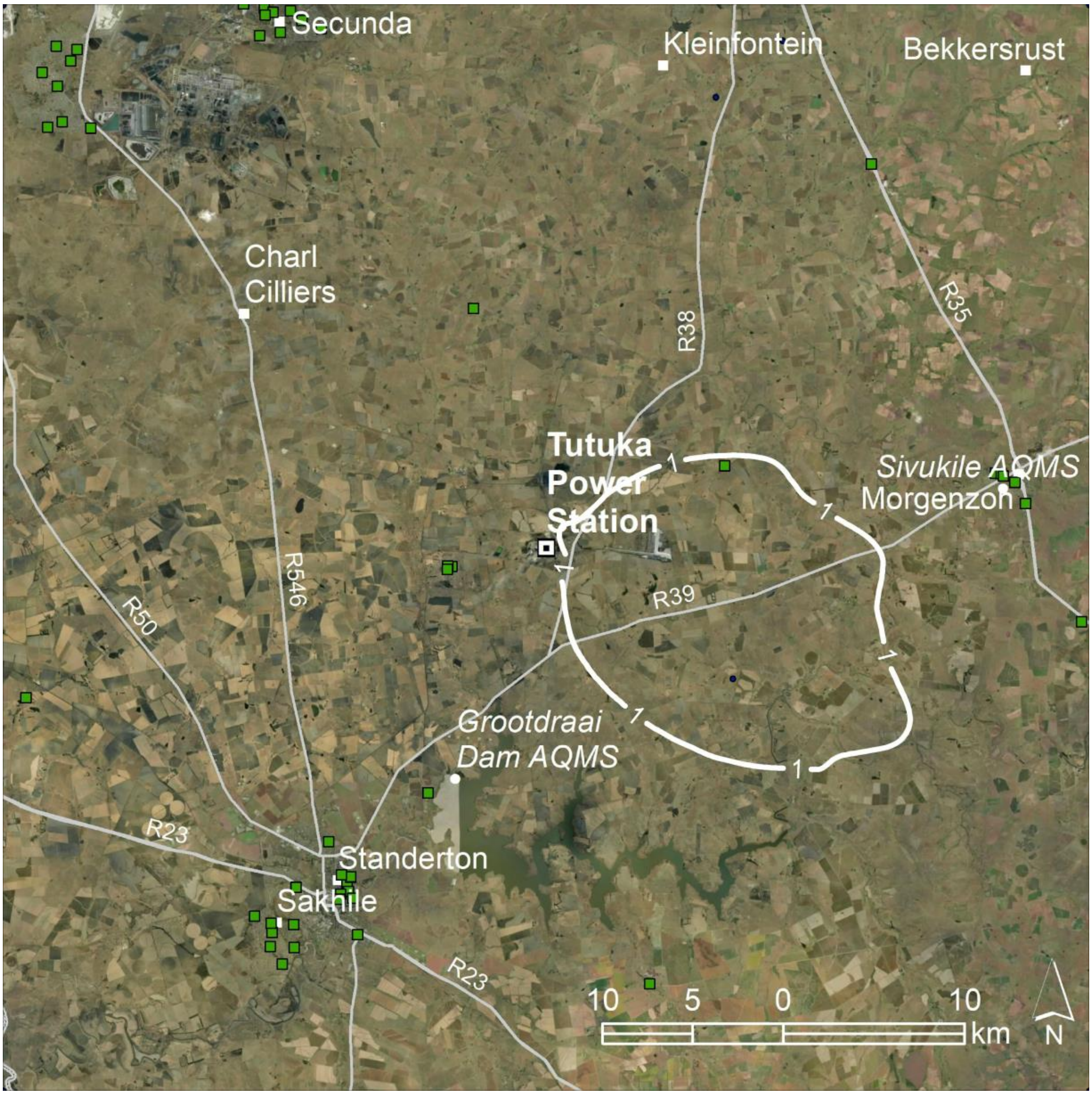

Figure 7-14: Predicted annual average SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (Current)(NAAQS limit 50 µg/m³)

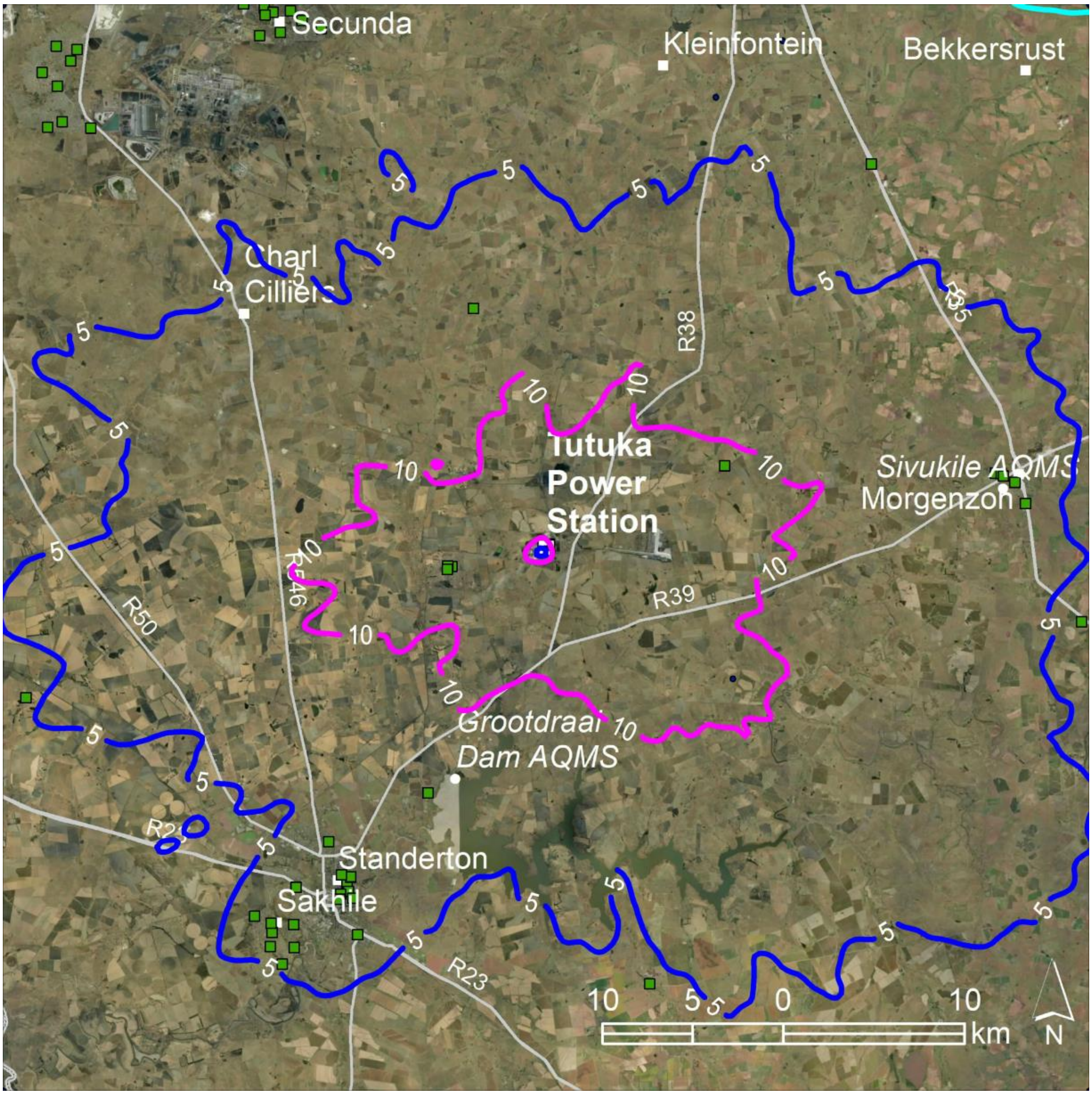

Figure 7-15: Predicted 99th percentile 24-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (Current)(NAAQS limit 125 µg/m³)

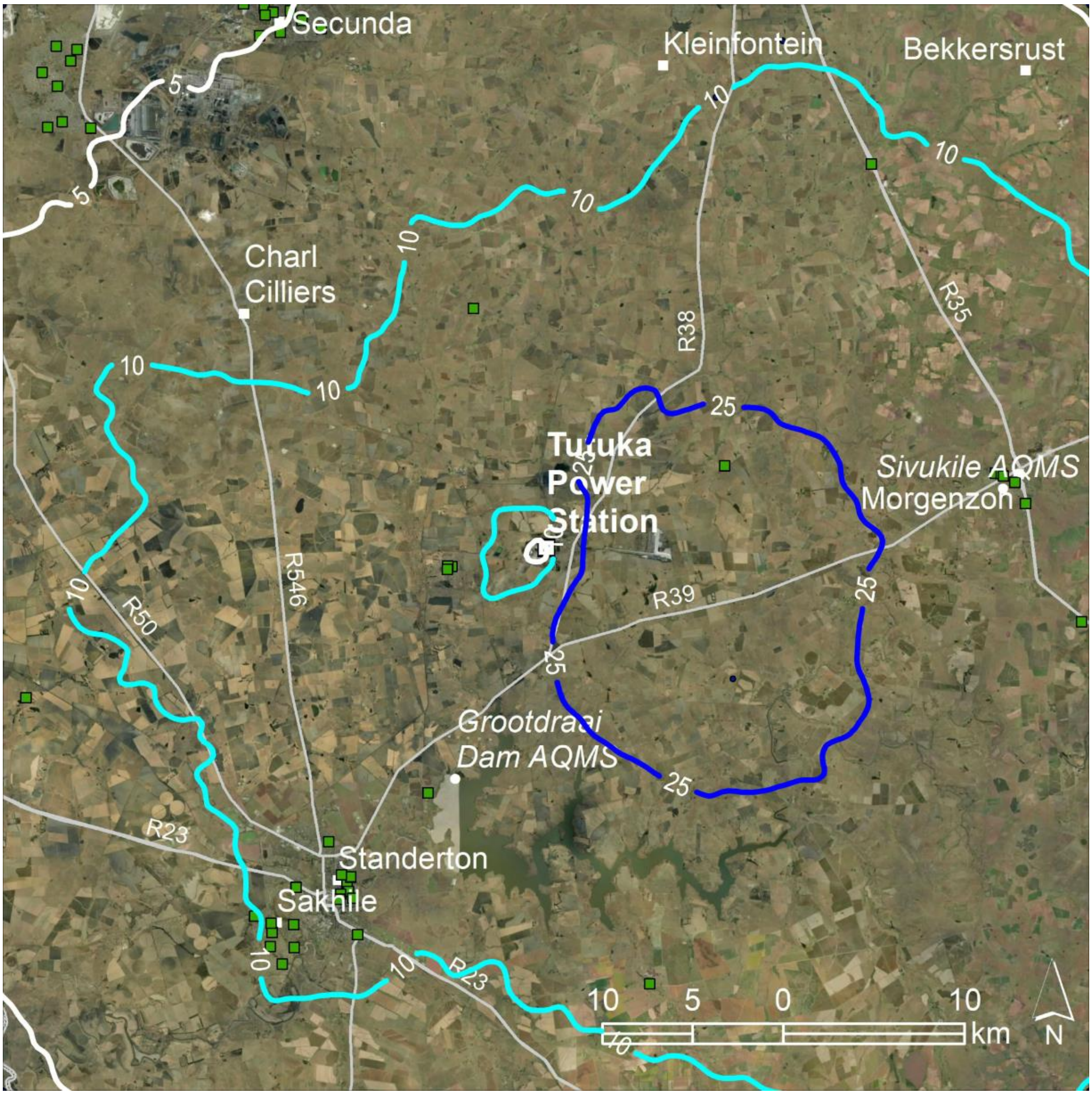

Figure 7-16: Predicted 99th percentile 1-hour SO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (Current)(NAAQS limit 350 µg/m³)

7.2.3.2 Nitrogen dioxide (NO_2)

The isopleth maps showing the predicted annual average NO_2 concentrations clearly demonstrate the effect of the predominant north-westerly winds, with dispersion generally to the southeast of the power plant. In all scenarios the highest predicted annual average concentrations occur between 10 and 20 km of the power station and to the southeast. The predicted annual ambient concentrations are low and well below the NAAQS in all scenarios throughout the modelling domain.

The predicted 1-hour ambient concentrations are relatively low and are well below the NAAQS in all scenarios throughout the modelling domain.

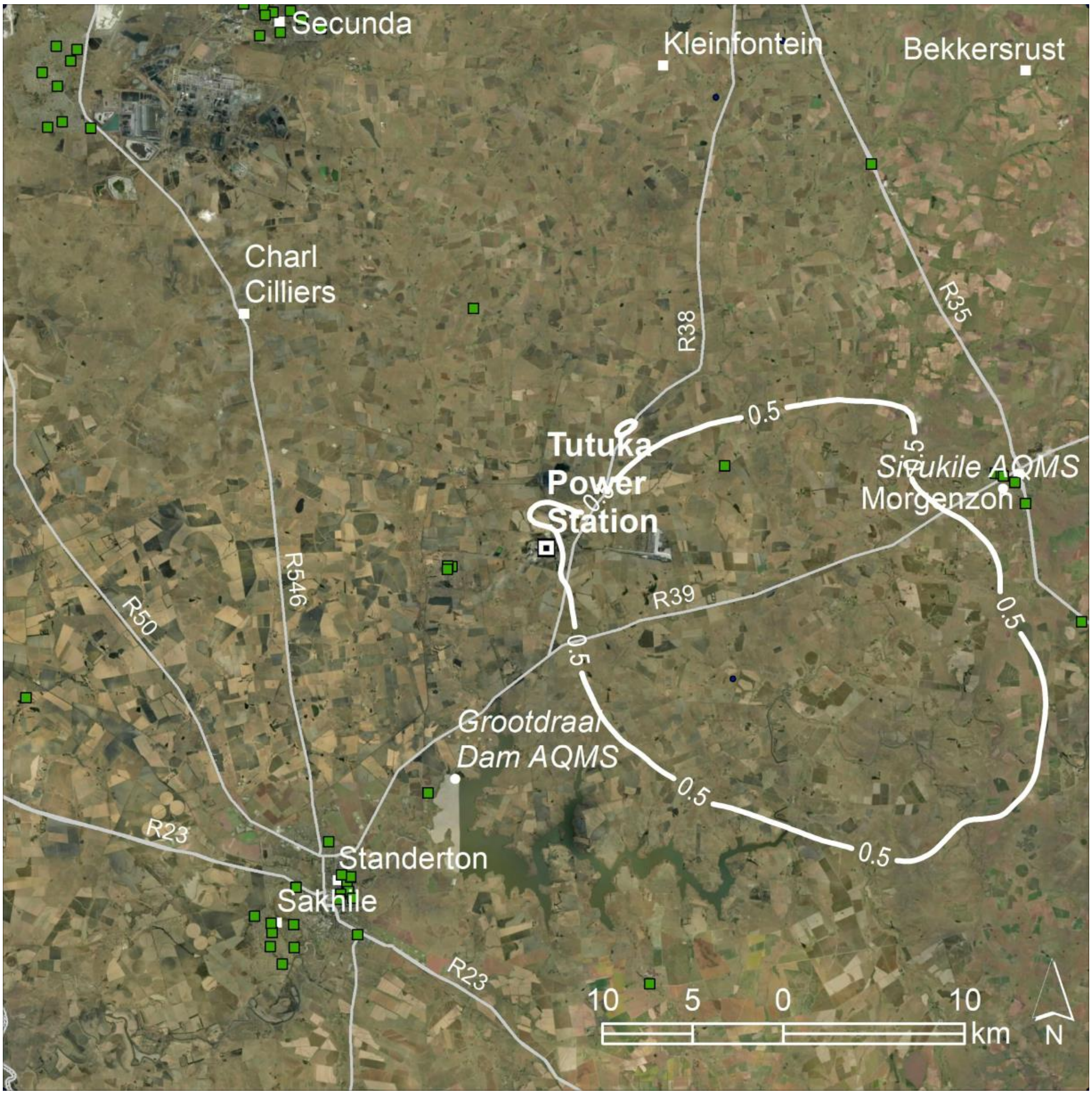

Figure 7-17: Predicted annual average NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (Current)(NAAQS limit 40 µg/m³)

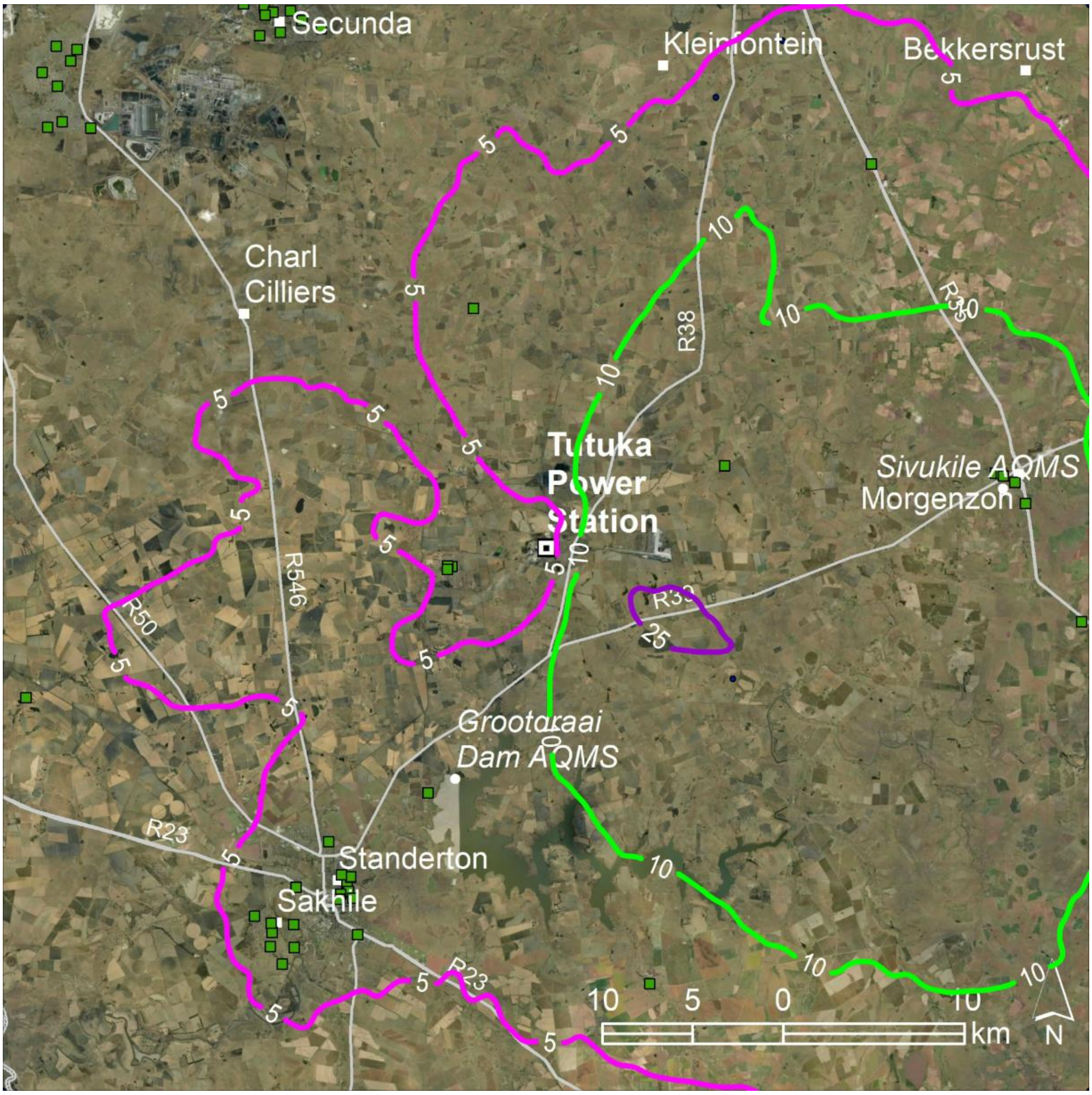

Figure 7-18: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (NAAQS limit 200 µg/m³)

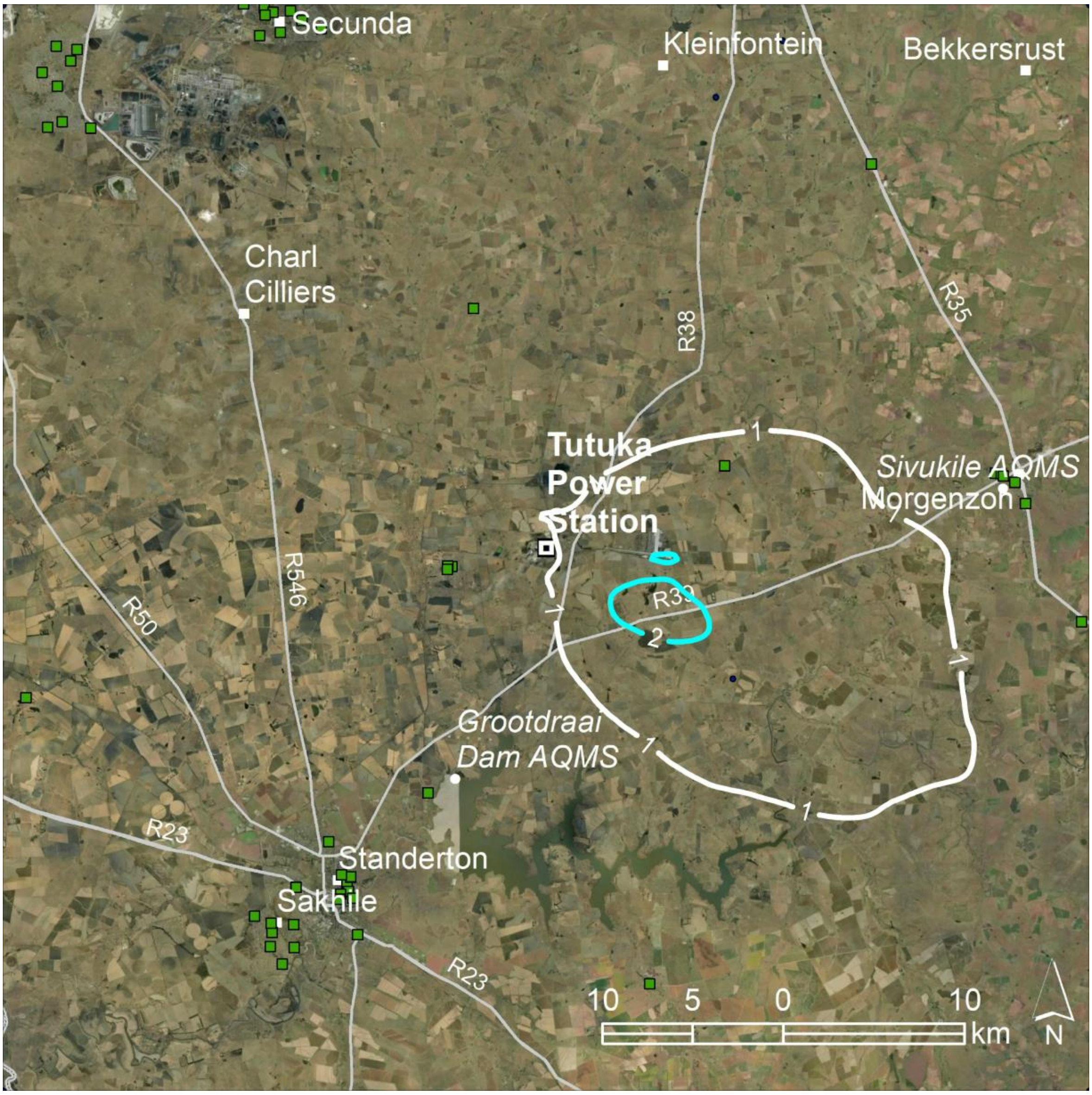

Figure 7-19: Predicted annual average NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 40 µg/m³)

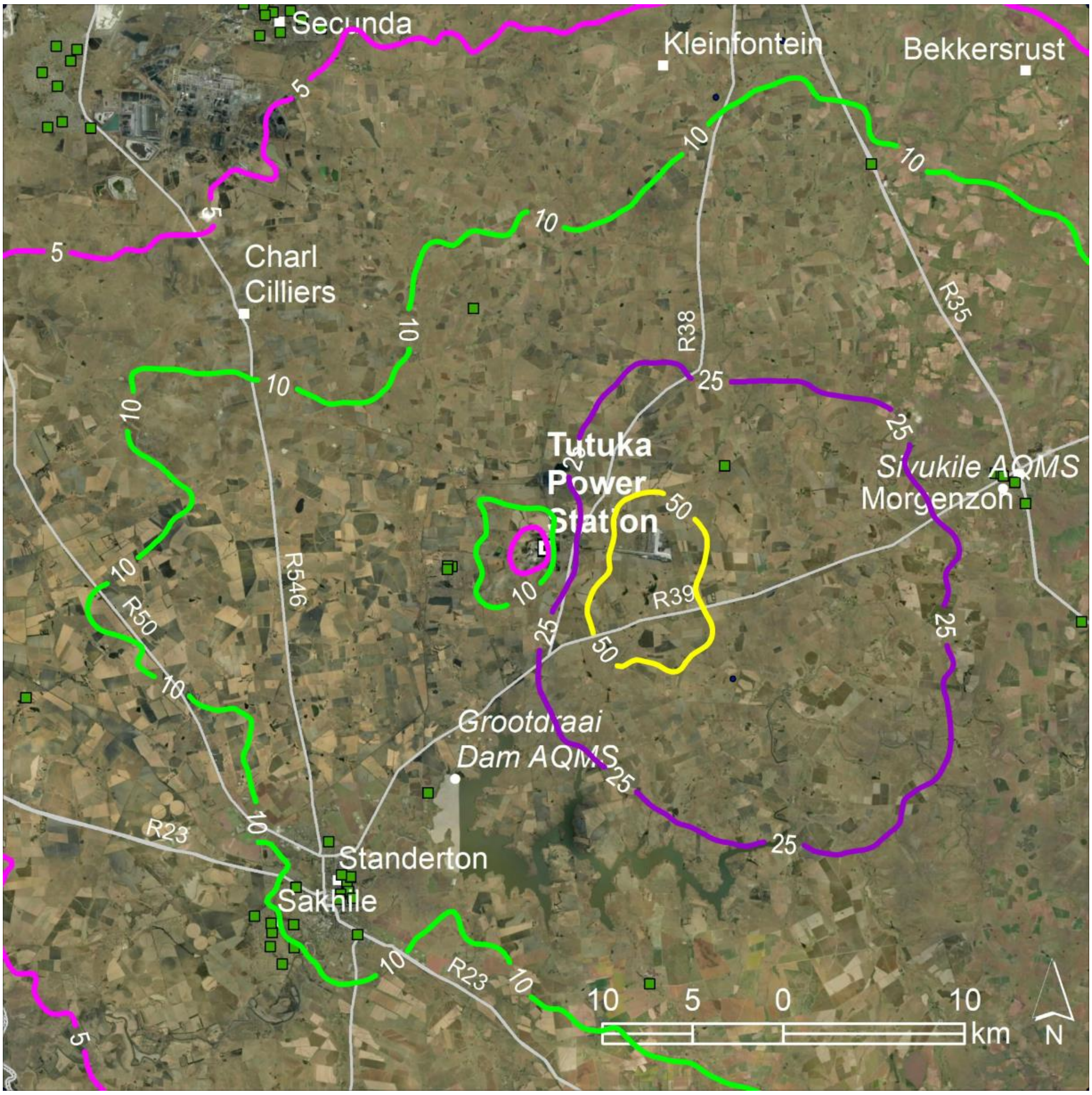

Figure 7-20: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 200 µg/m³)

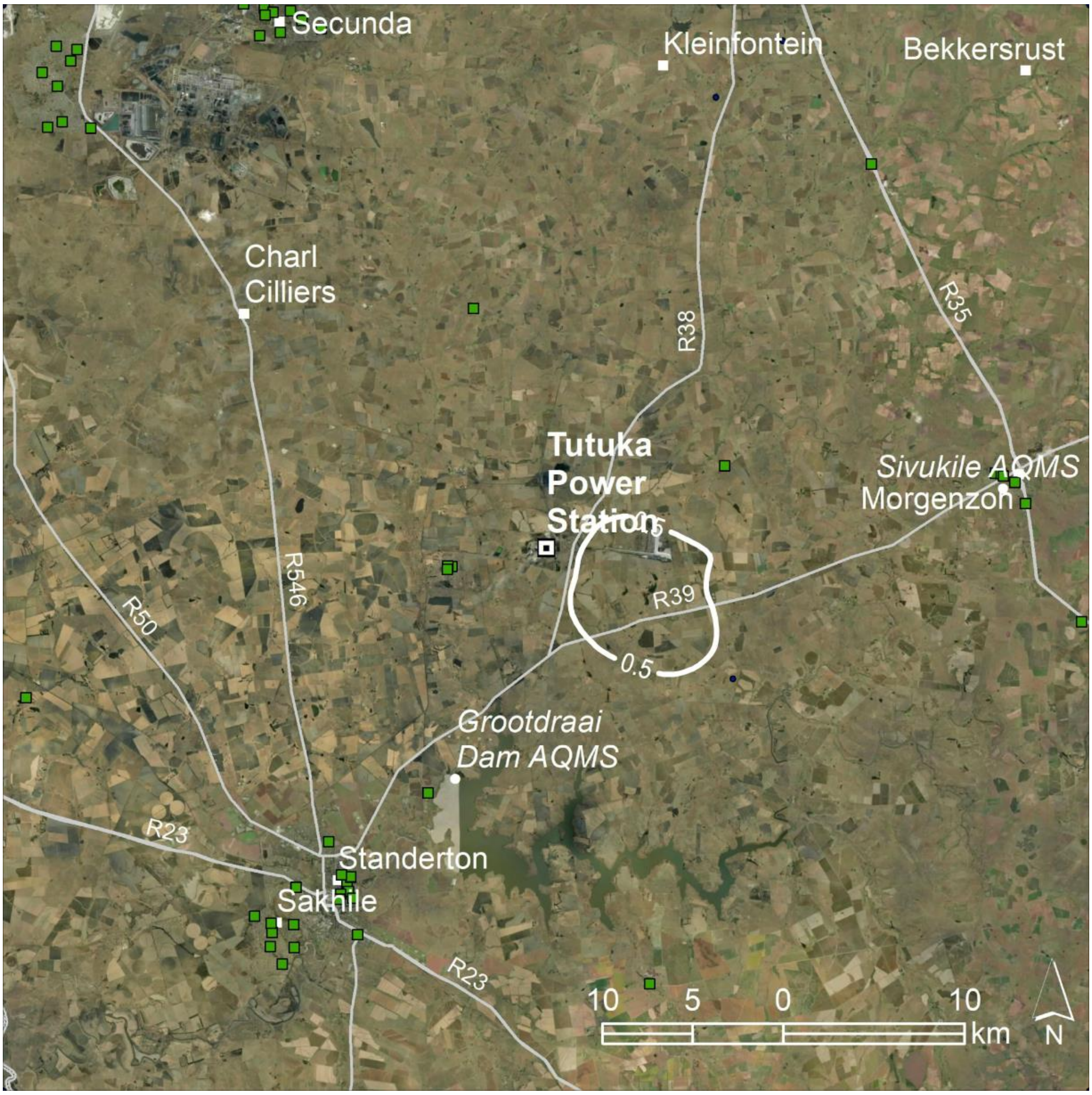

Figure 7-21: Predicted annual average NO_2 concentrations in μg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 40 μg/m³)

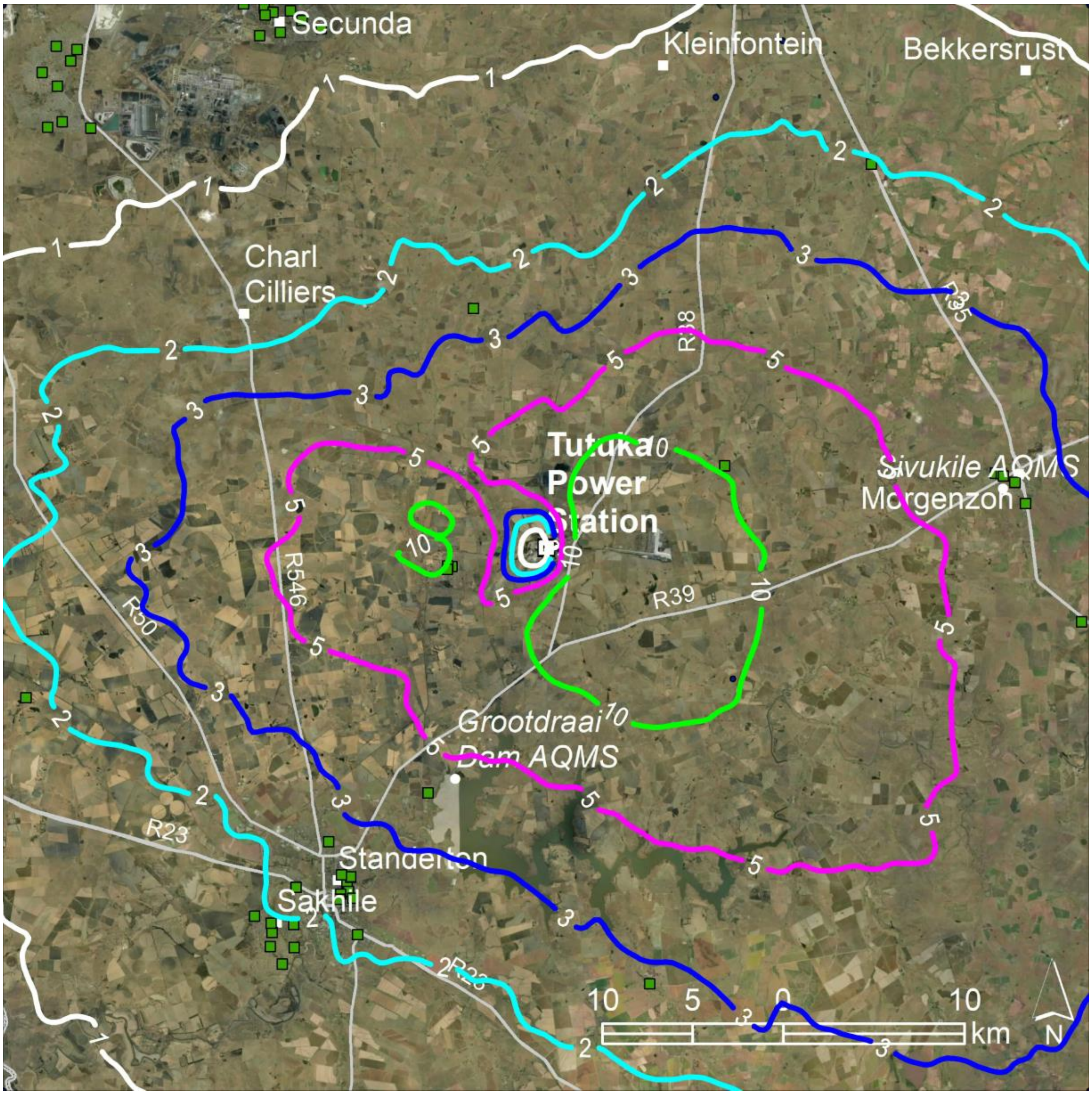

Figure 7-22: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 200 µg/m³)

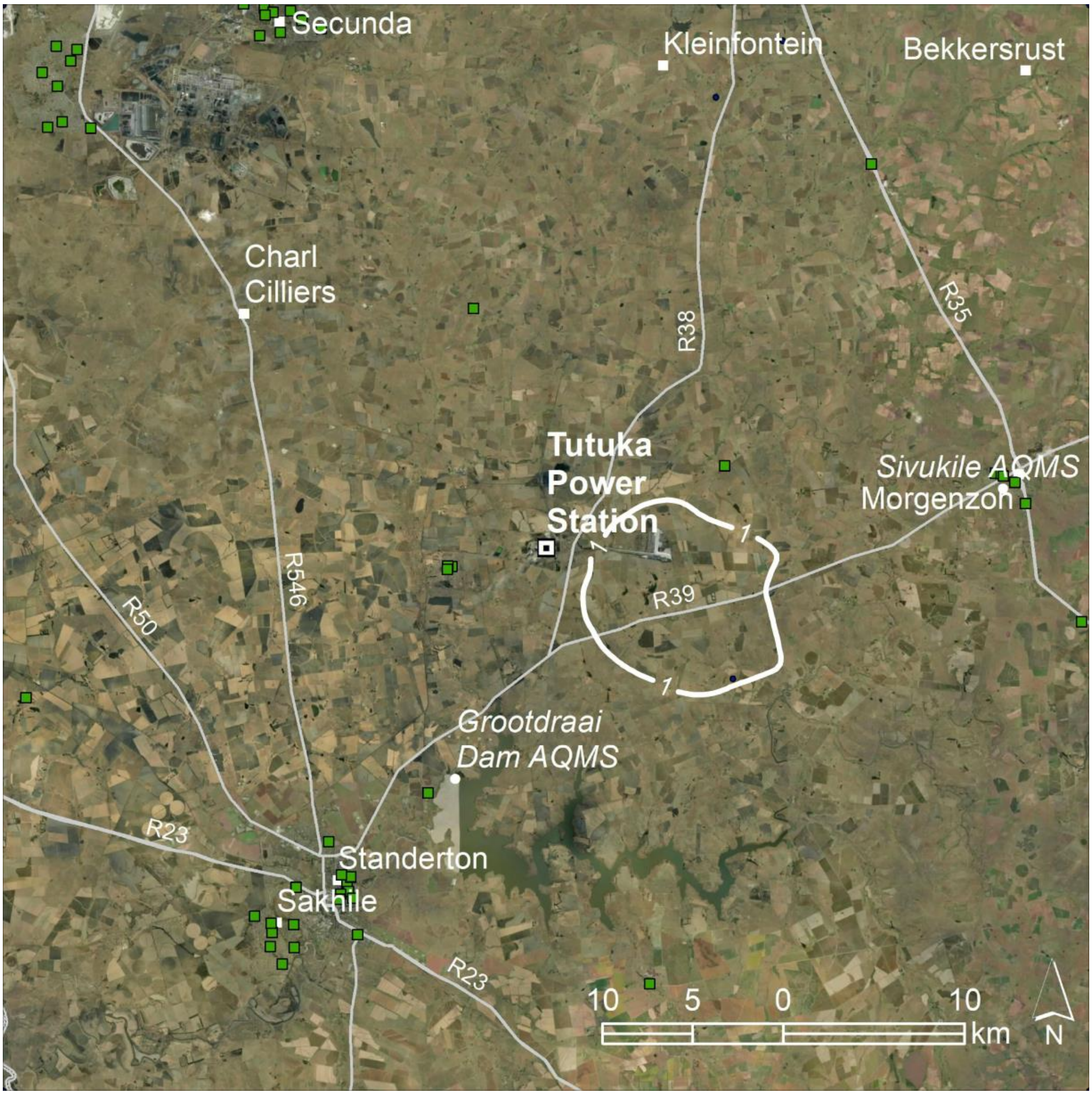

Figure 7-23: Predicted annual average NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 40 µg/m³)

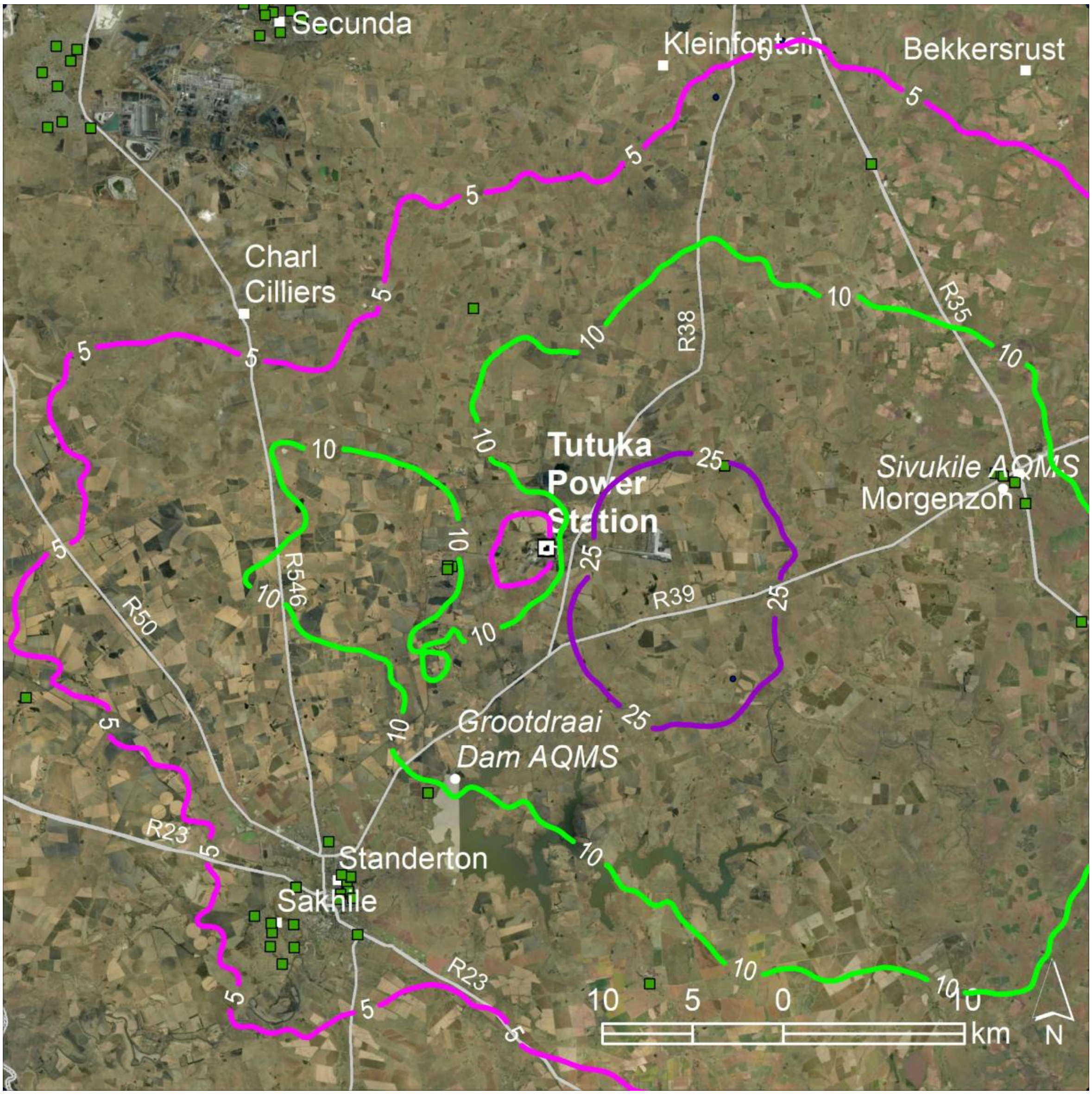

Figure 7-24: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 200 µg/m³)

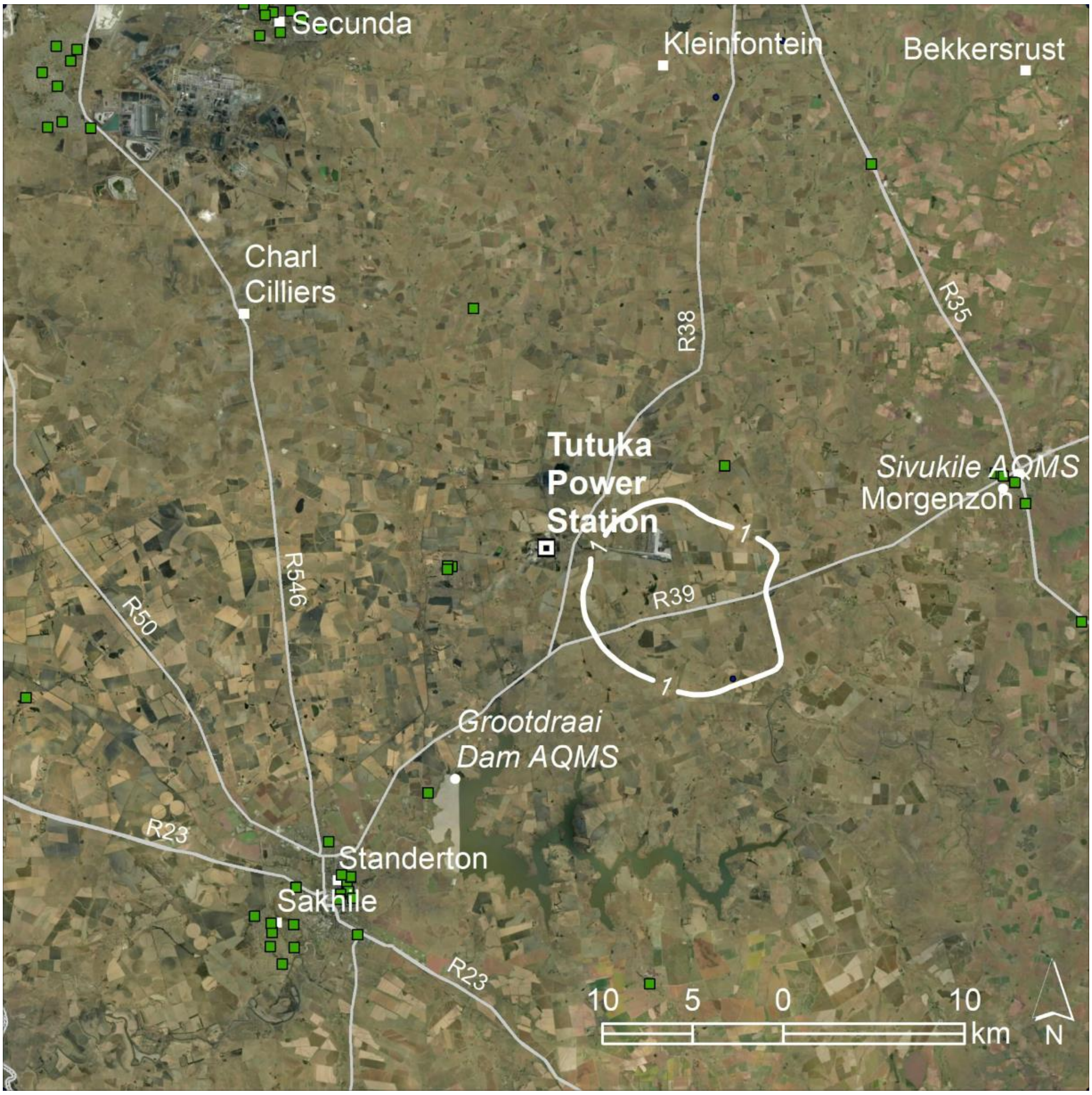

Figure 7-25: Predicted annual average NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 40 µg/m³)

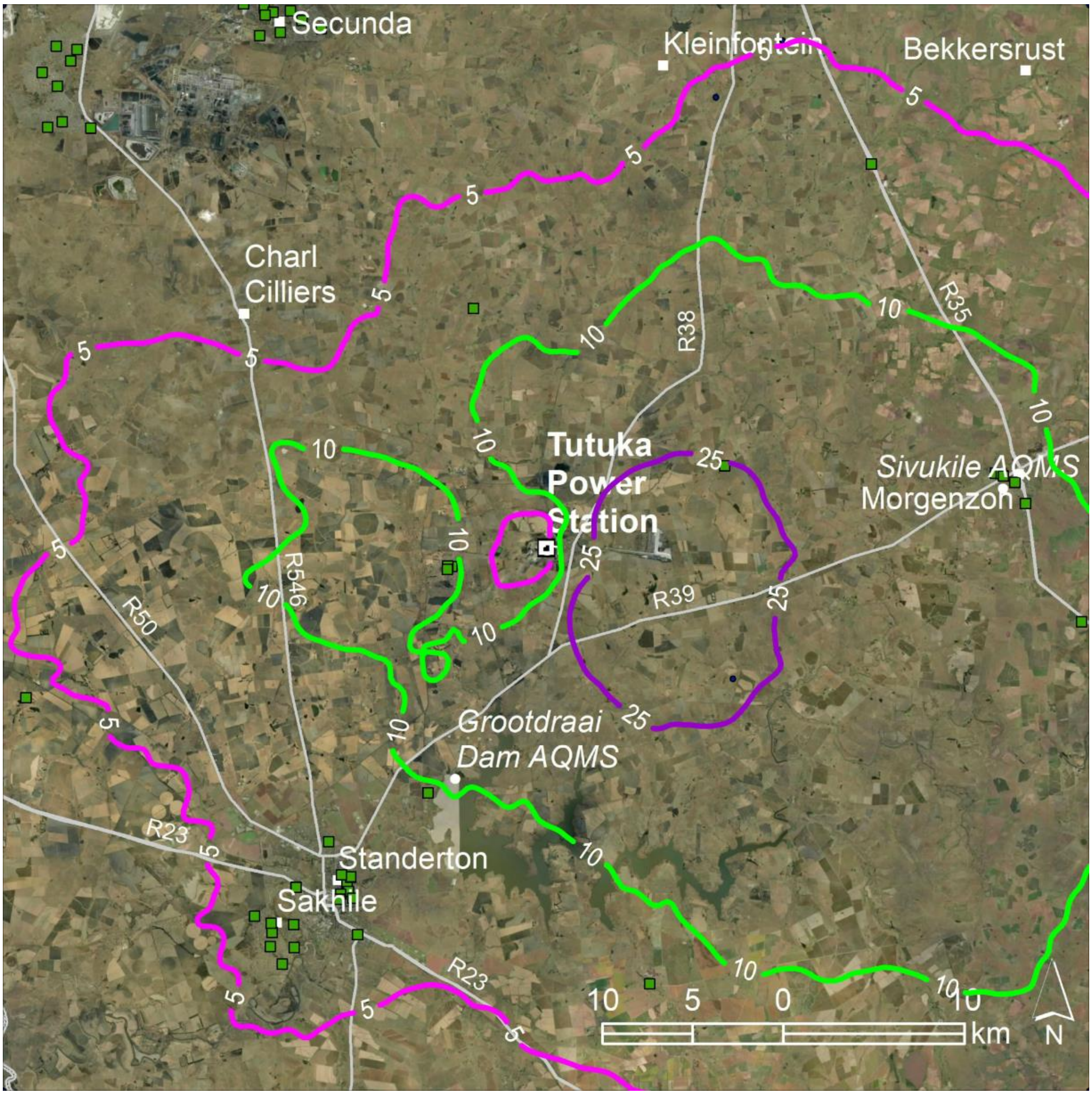

Figure 7-26: Predicted 99th percentile 1-hour NO_2 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 200 µg/m³)

7.2.3.3 Particulates (PM_{10})

The isopleth plots for PM_{10} are similar for all of the scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations. The fugitive emission from the coal stock stockyard and the ash dump are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient PM_{10} concentrations of changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources, i.e. the decrease in PM stack emissions in Scenario B (2031) is not seen in the model output.

In all scenarios the predicted annual average concentrations exceed the NAAQS of 40 $\mu g/m^3$ in an area up to 3 km around the power station. The area where the predicted 24-hour concentrations exceed the limit value of 75 $\mu g/m^3$ extends up to 10 km around the power station.

There are no sensitive receptors in the area where the NAAQS is exceeded. Even so, it must be remembered that the predictions are conservative given the assumption that TPM = PM_{10} = $PM_{2.5}$. Remembering too that the fugitive emissions have the greatest effect on ambient concentrations close to the source, while the effect of the stack emissions is generally further from the power station.

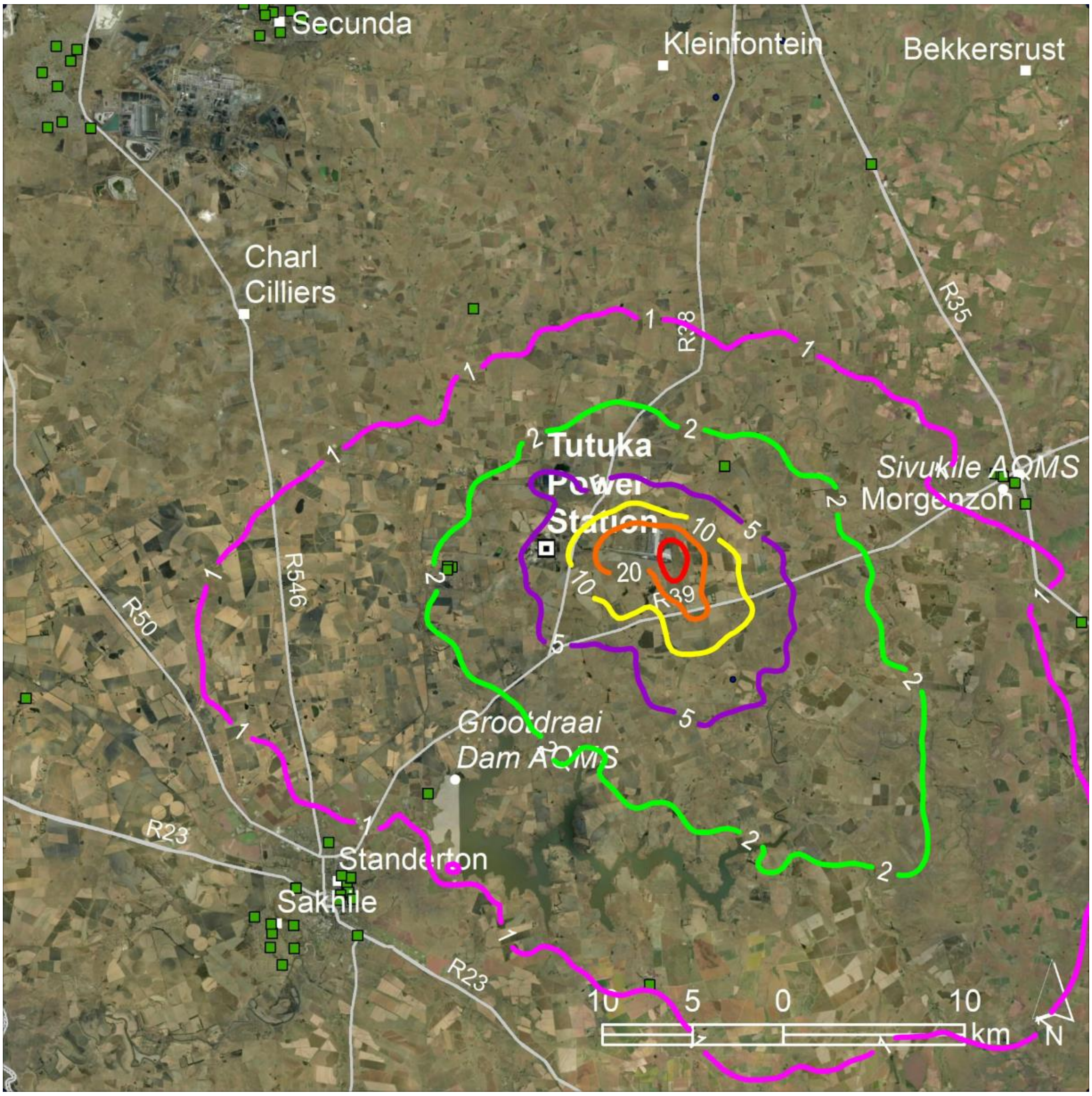

Figure 7-27: Predicted annual average PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (NAAQS limit 40 µg/m³)

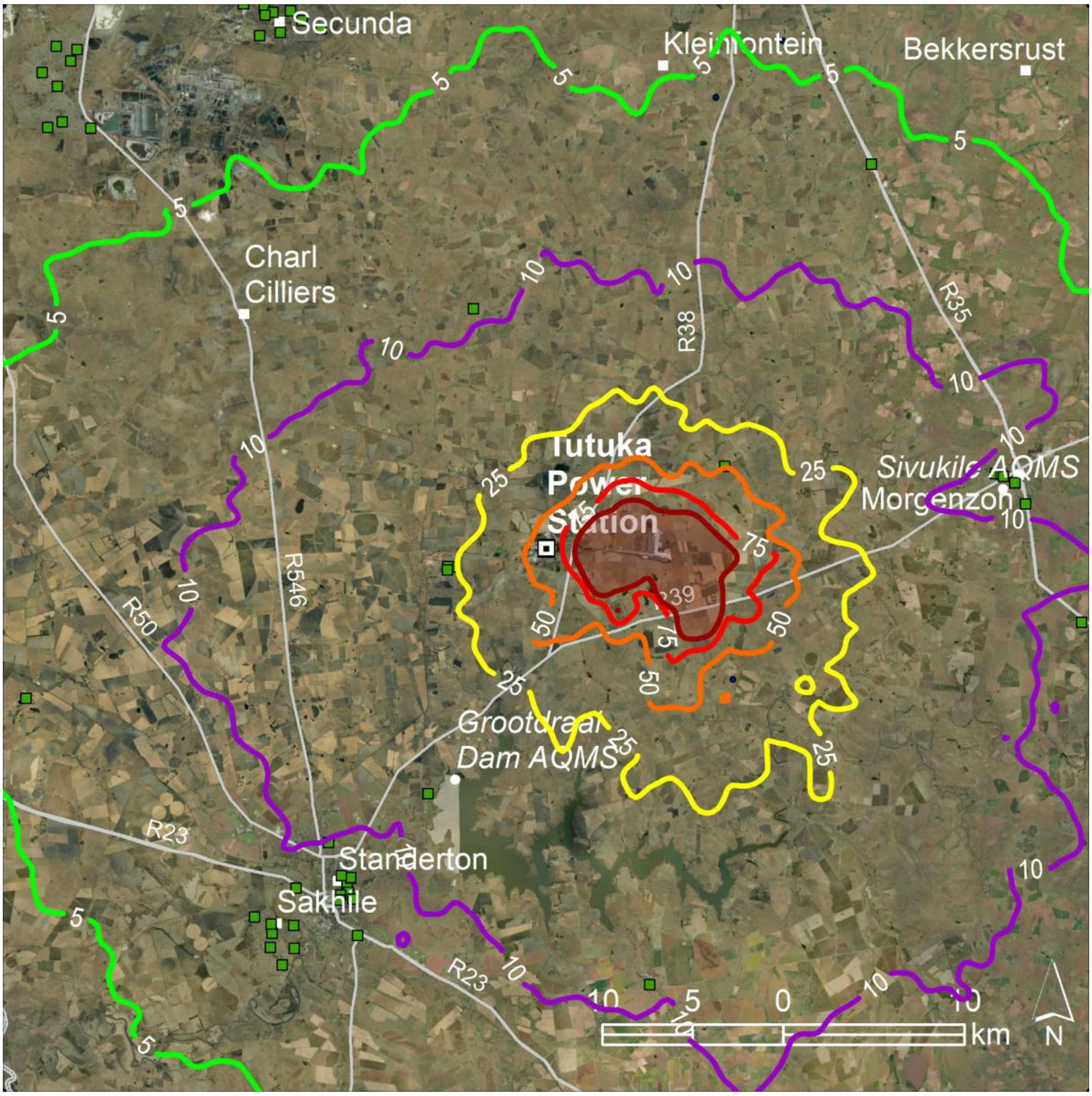

Figure 7-28: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m^3 resulting from emissions from Tutuka: Scenario 1 (Current) (NAAQS limit 75 µg/m^3)

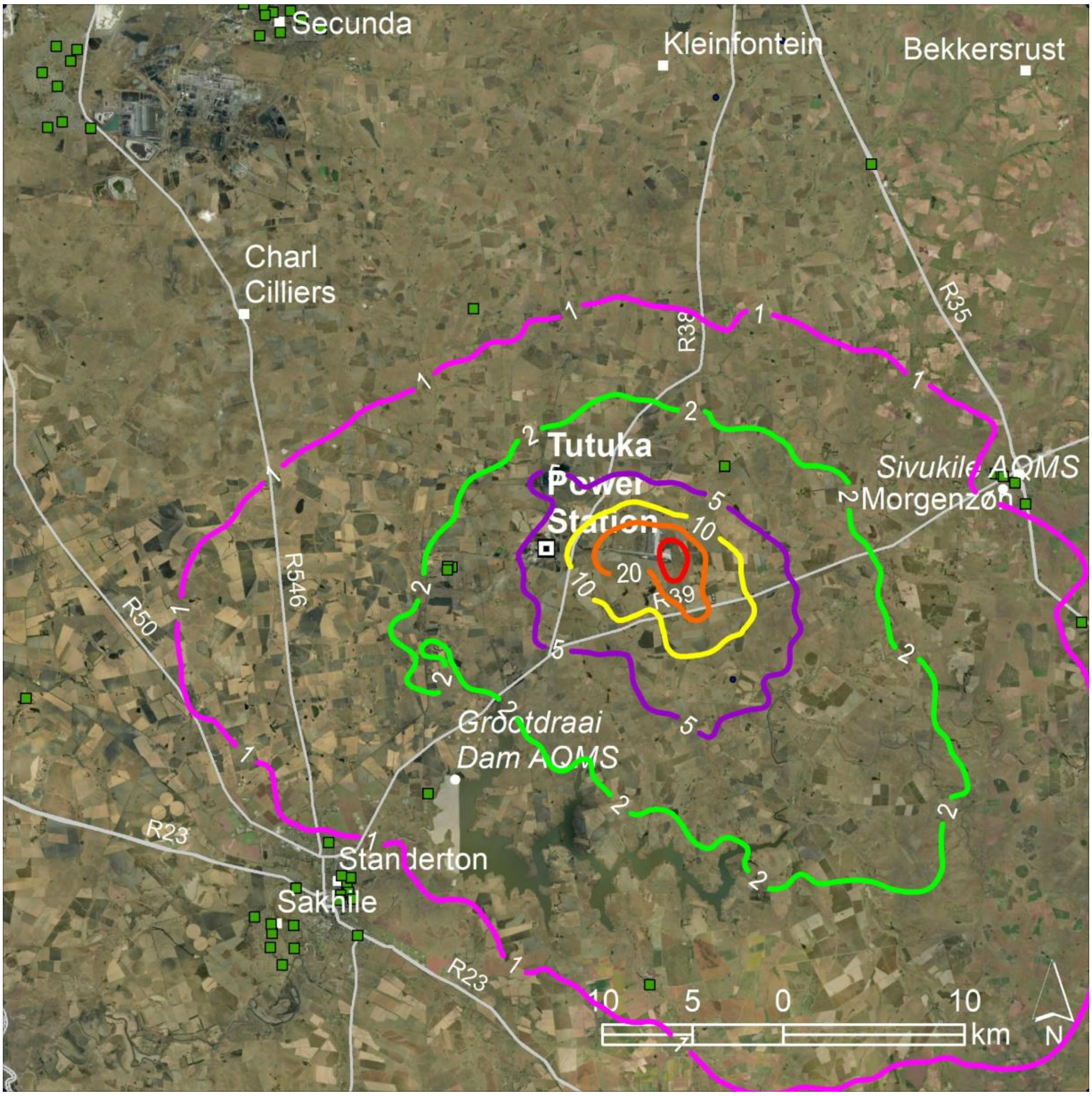

Figure 7-29: Predicted annual average PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 40 µg/m³)

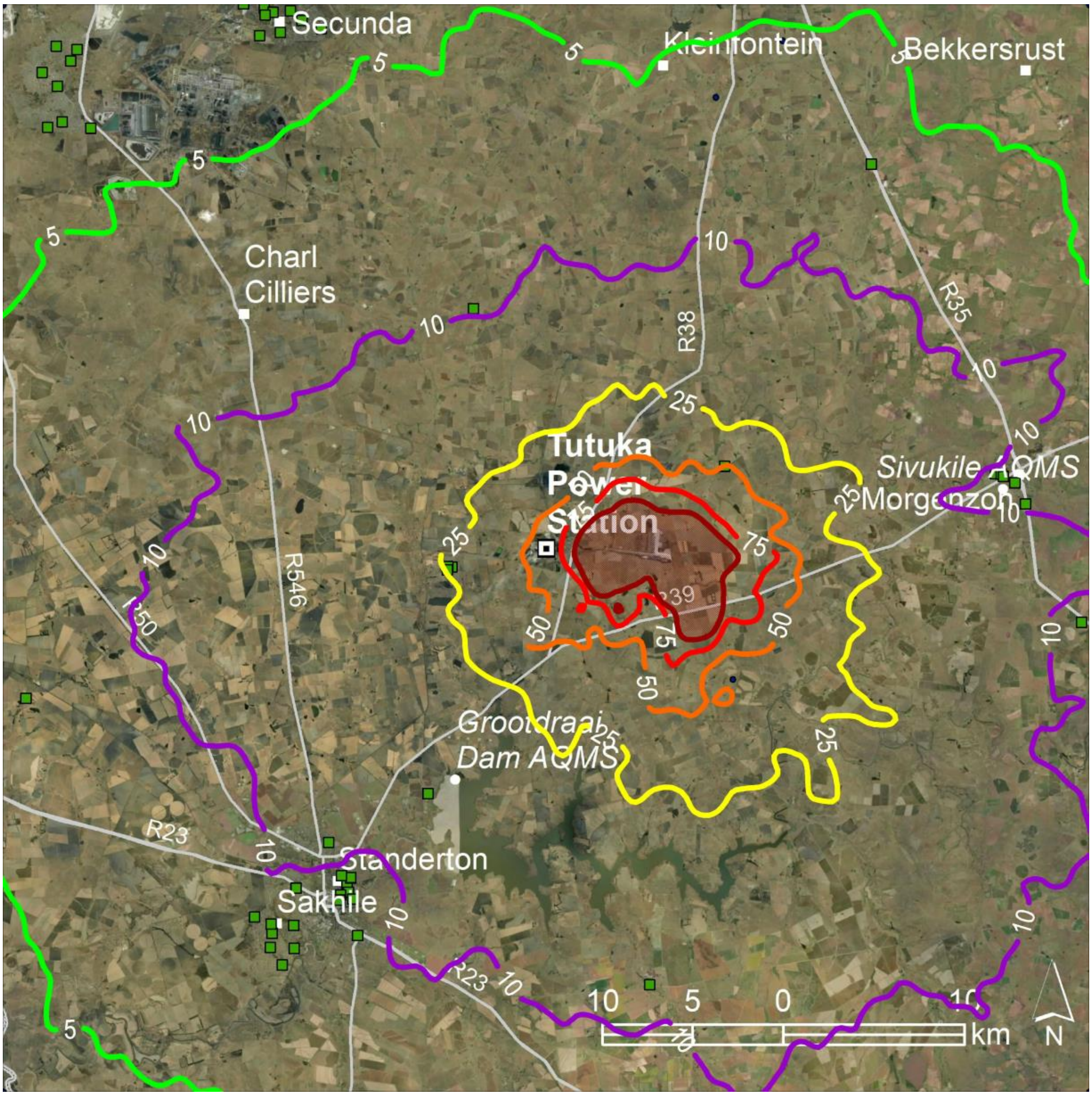

Figure 7-30: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 75 µg/m³)

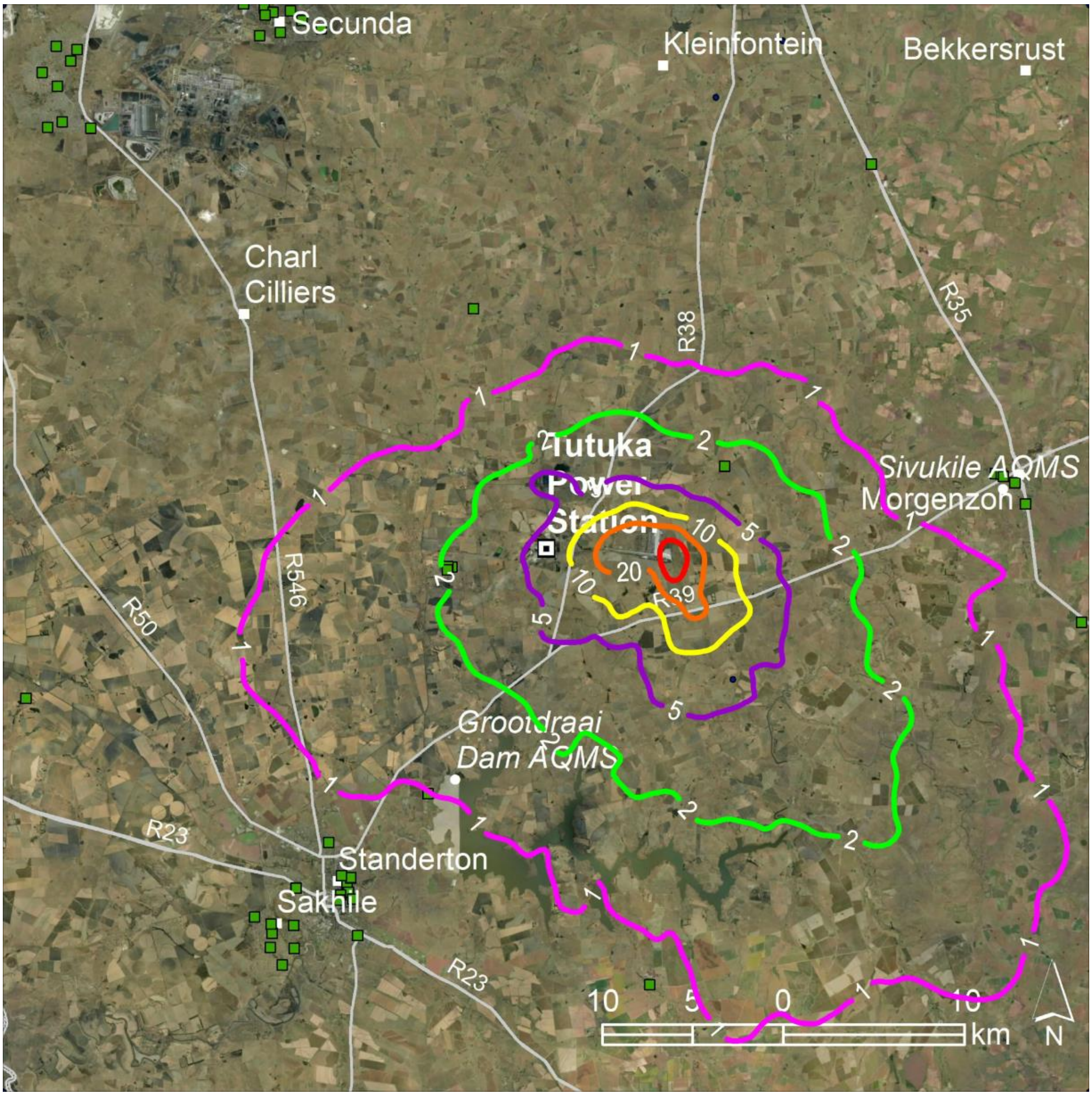

Figure 7-31: Predicted annual average PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 40 µg/m³)

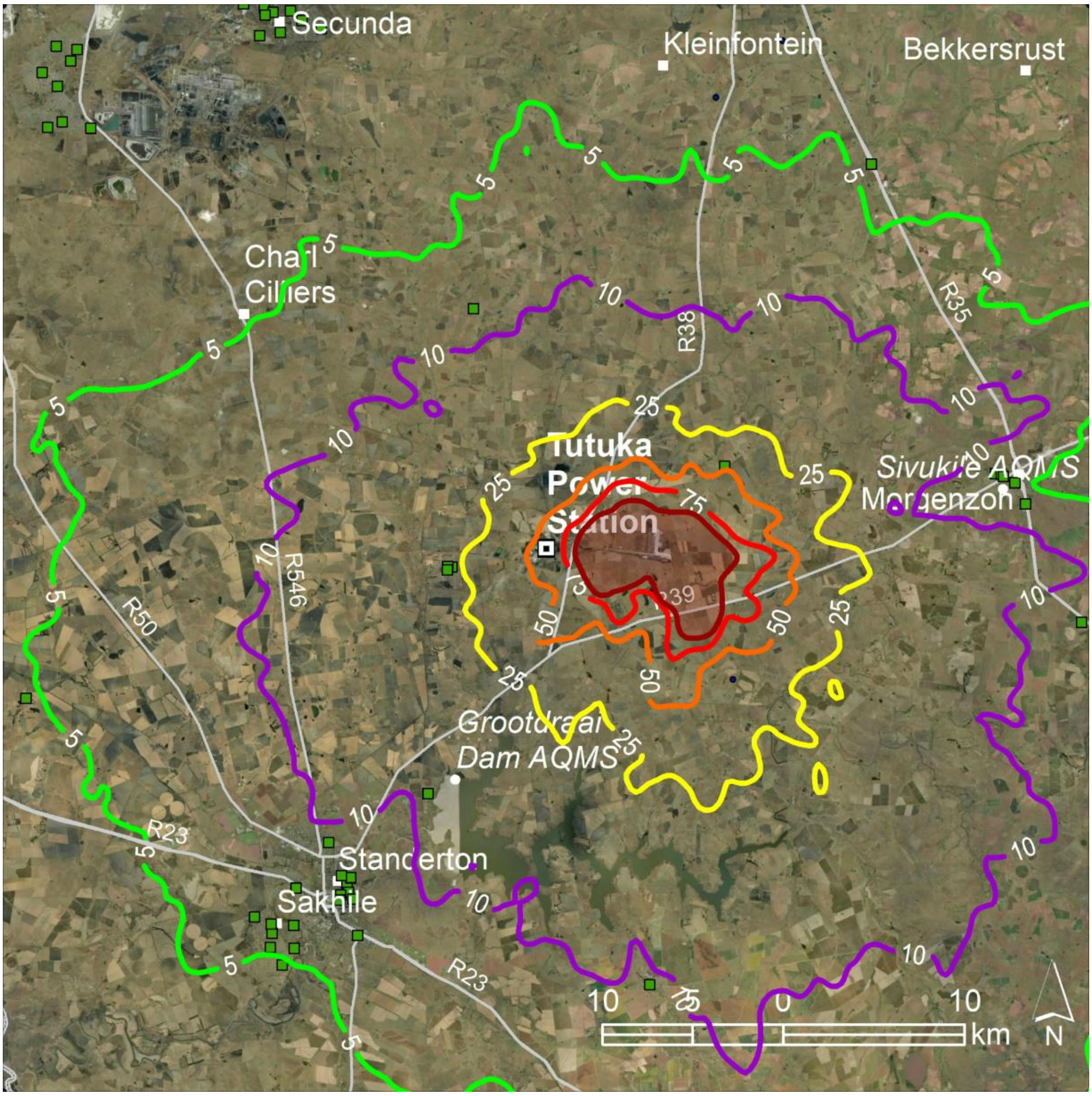

Figure 7-32: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 75 µg/m³)

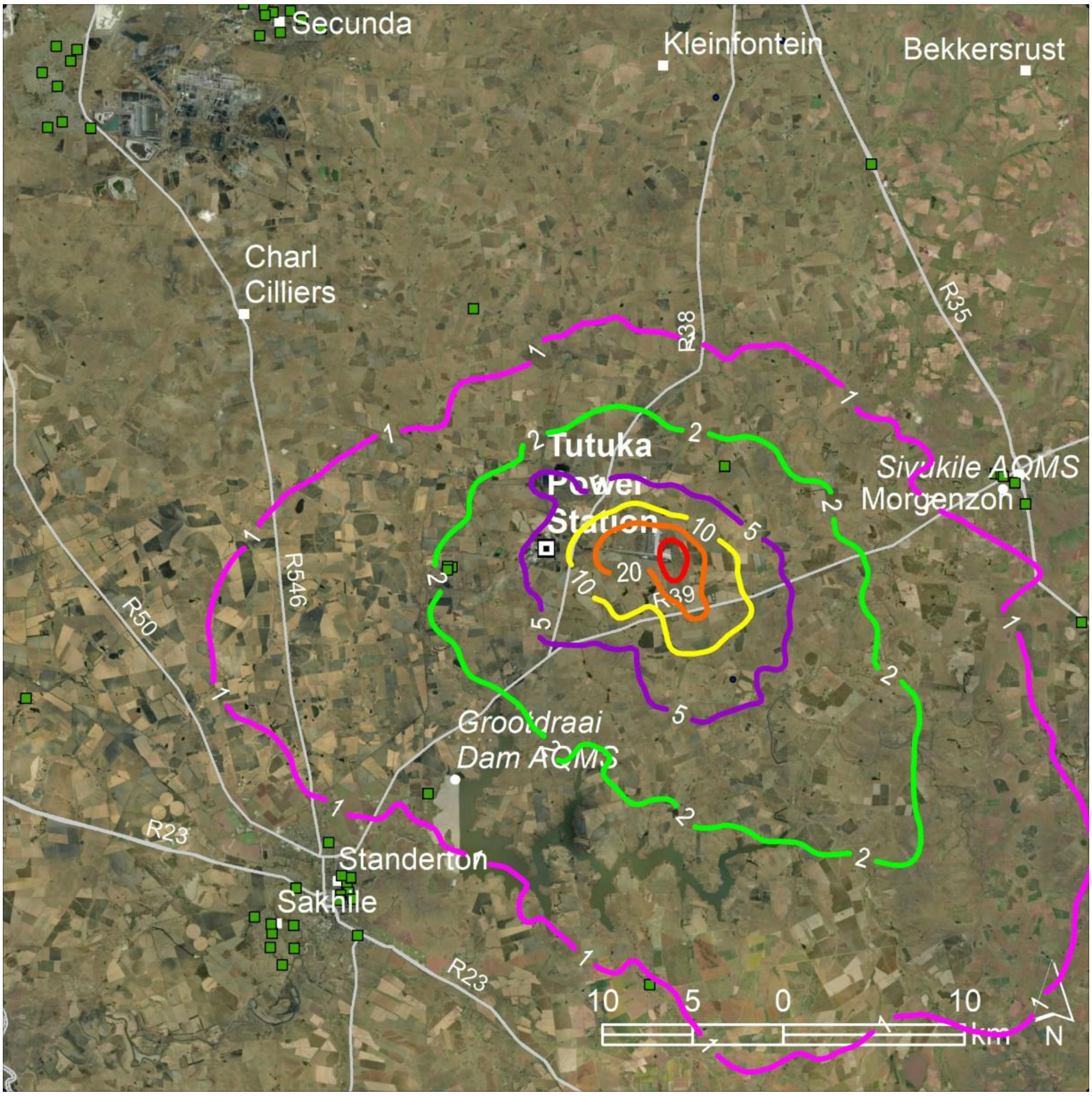

Figure 7-33: Predicted annual average PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 40 µg/m³)

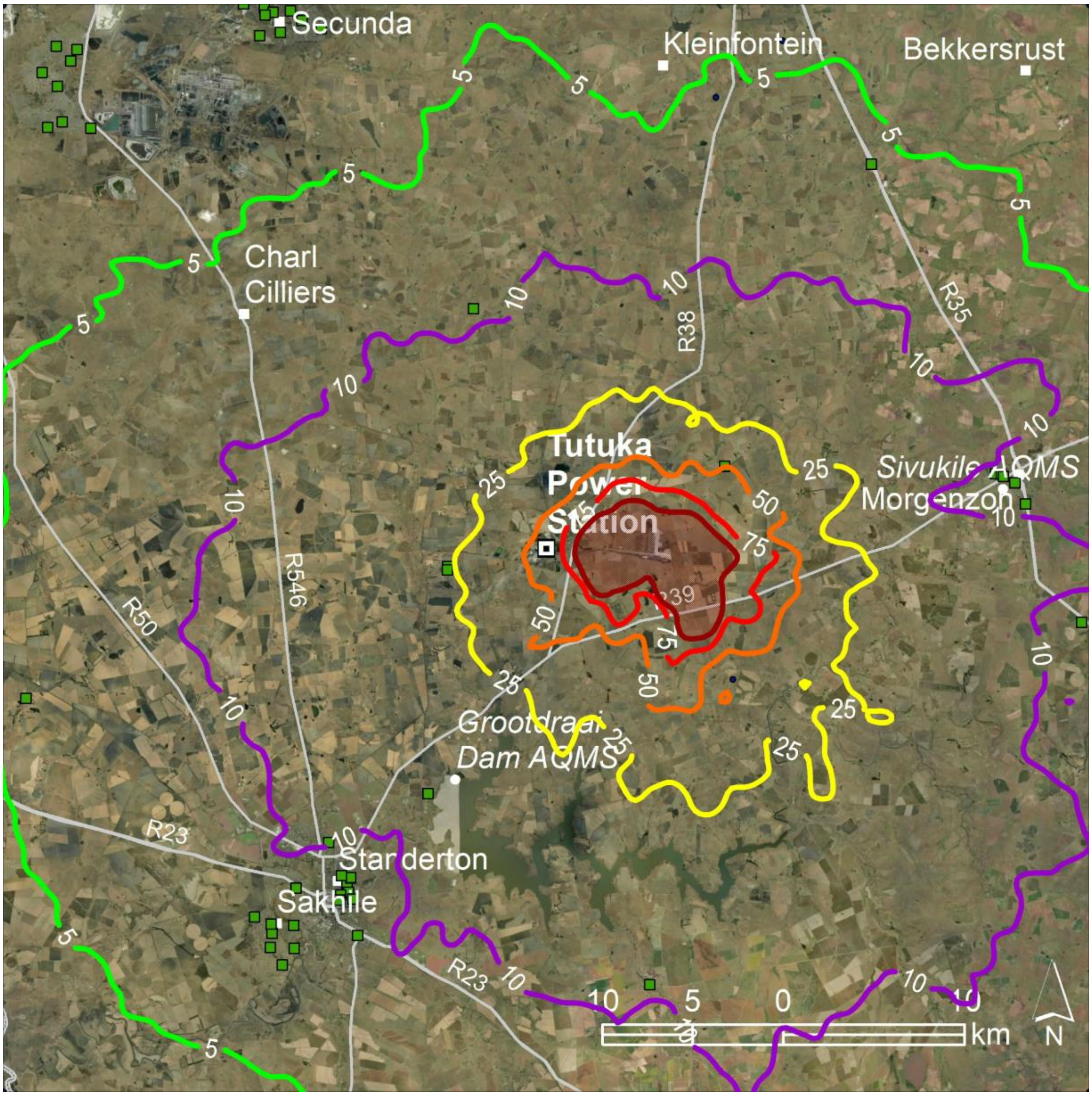

Figure 7-34: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 75 µg/m³)

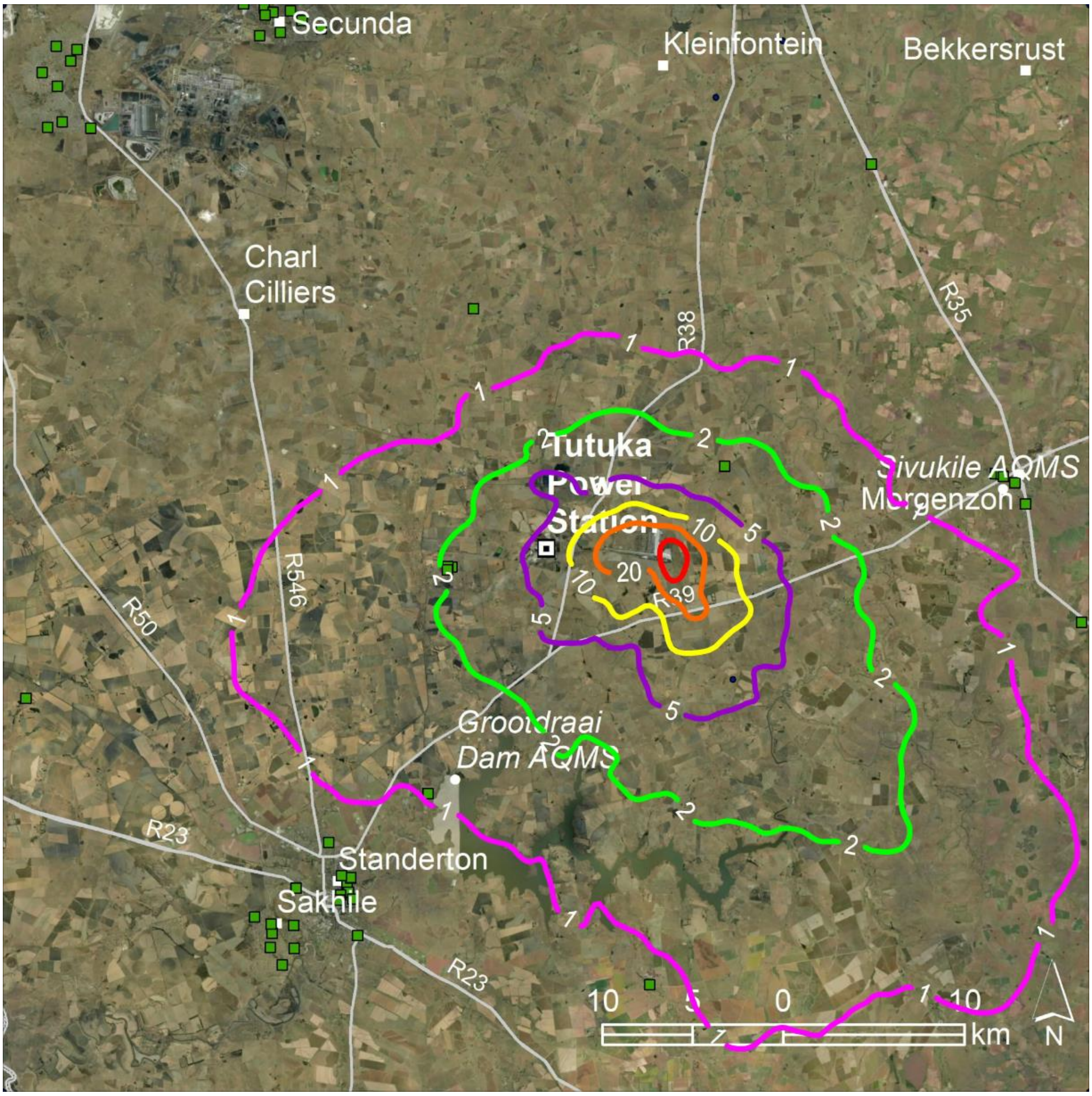

Figure 7-35: Predicted annual average PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 40 µg/m³)

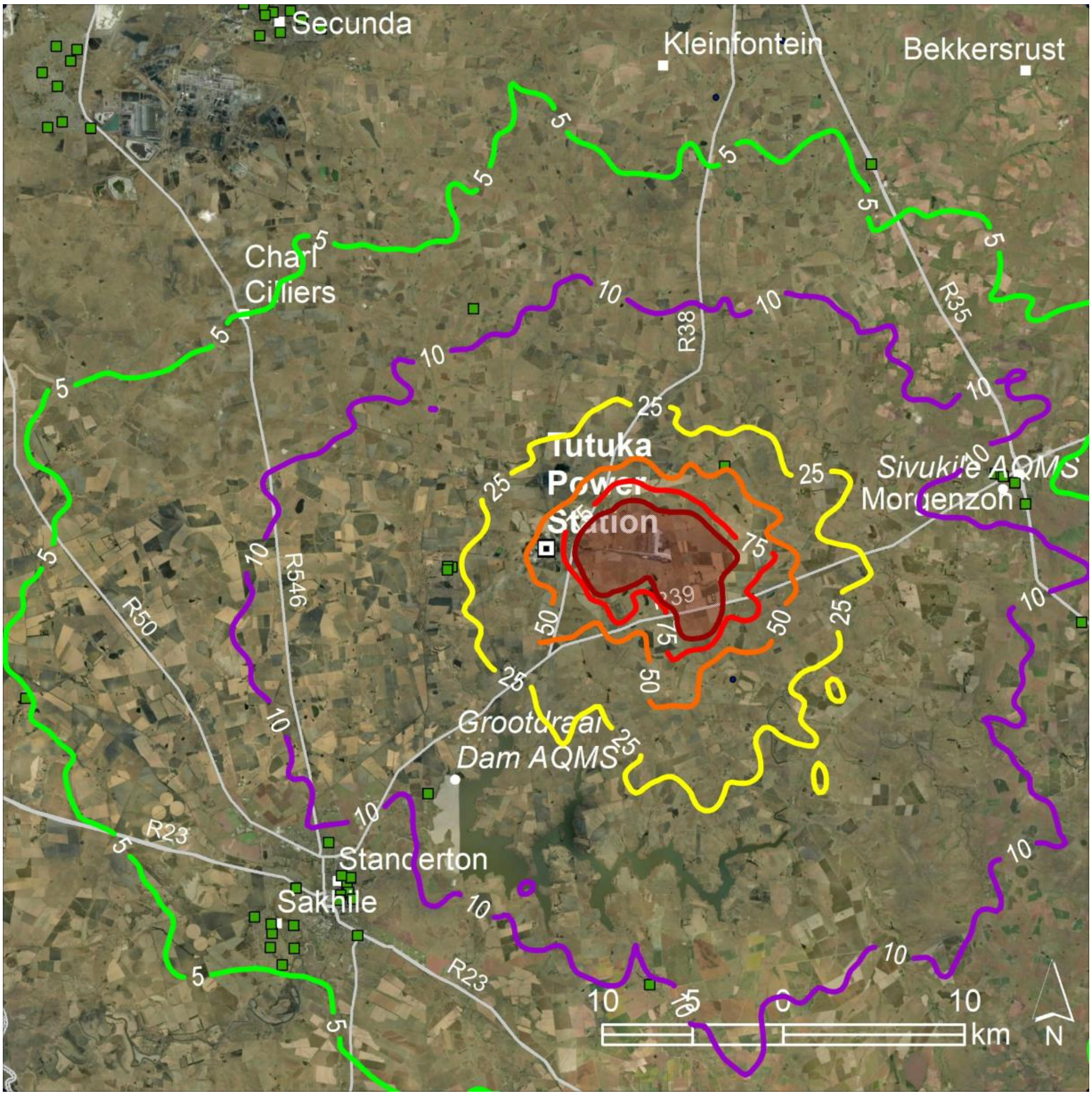

Figure 7-36: Predicted 99th percentile of the 24-hour PM_{10} concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 75 µg/m³)

7.2.3.4 Particulates ($PM_{2.5}$)

The isopleth plots for $PM_{2.5}$ are similar for all of the scenarios due to the significant contribution of the low-level fugitive sources to the ambient concentrations. The fugitive emission from the coal stock stockyard and the ash dump are the same for all scenarios, hence the similarity in the model results for the five scenarios. The effect on ambient $PM_{2.5}$ concentrations of changes in the stack PM emissions is masked in the model output by the effect of the fugitive sources, i.e. the decrease in PM stack emissions in Scenario B (2031) is not seen in the model output.

In Scenario 1 (Current) and Scenario A (2025) the predicted annual average concentrations exceed the NAAQS of 20 $\mu g/m^3$ in an area up to 5 km around the power station. With the stricter limit value of 15 $\mu g/m^3$ from 01 January 2023 the area where the NAAQS is exceeded is increased to approximately 7 km around the power station, i.e. in Scenario B (2031), Scenario C (2036) and Scenario D (MES).

In Scenario 1 (Current) and Scenario A (2025) the predicted 24-hour concentrations exceed the NAAQS of 40 $\mu g/m^3$ in an area up to 10 km around the power station. With the stricter limit value of 25 $\mu g/m^3$ from 01 January 2023 the area where the NAAQS is exceeded is increased to approximately 15 km around the power station, i.e. in Scenario B (2031), Scenario C (2036) and Scenario D (MES).

There is one sensitive receptor in the area where the NAAQS is exceeded, the Amalumgelo Primary School which is 10.6 km east-northeast of Tutuka. In Scenario 1 (Current) and Scenario A (2025) there are 3 predicted exceedances at the Amalumgelo Primary School which complies with the NAAQS. With the more stringent limit value from 01 January 2030 the 16 predicted exceedances in Scenario B (2031), Scenario C (2036) and Scenario D (MES) do not comply with the NAAQS.

It must be remembered that the predictions are conservative given the assumption that TPM = PM_{10} = $PM_{2.5}$. Remembering too that the fugitive emission have the greatest effect on ambient concentrations close to the source, while the effect of the stack emissions is generally further from the power station.

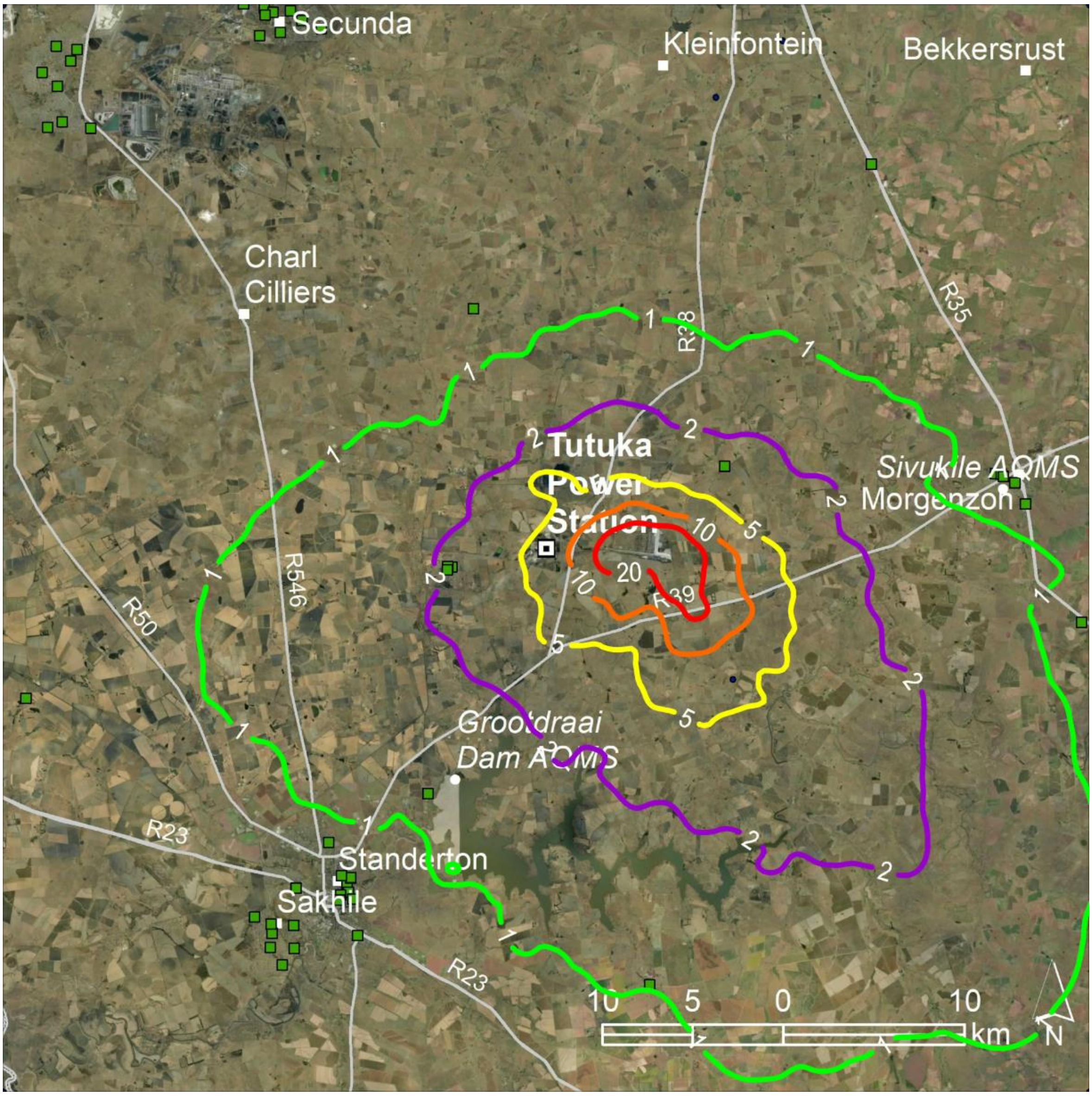

Figure 7-37: Predicted annual average $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (NAAQS limit 20 µg/m³)

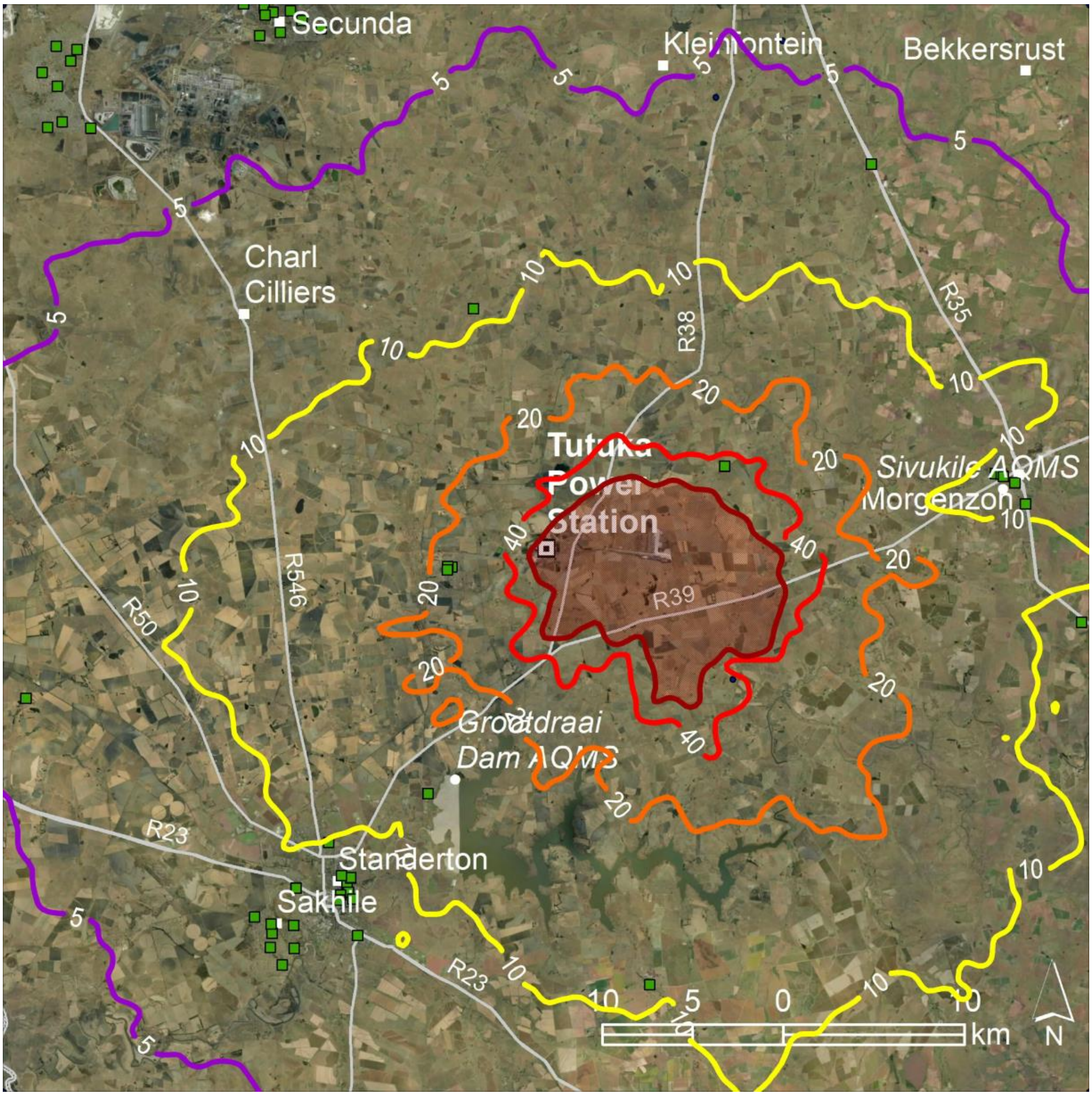

Figure 7-38: Predicted 99th percentile of the 24-hour PM2.5 concentrations in µg/m³ resulting from emissions from Tutuka: Scenario 1 (Current) (NAAQS limit 40 µg/m³)

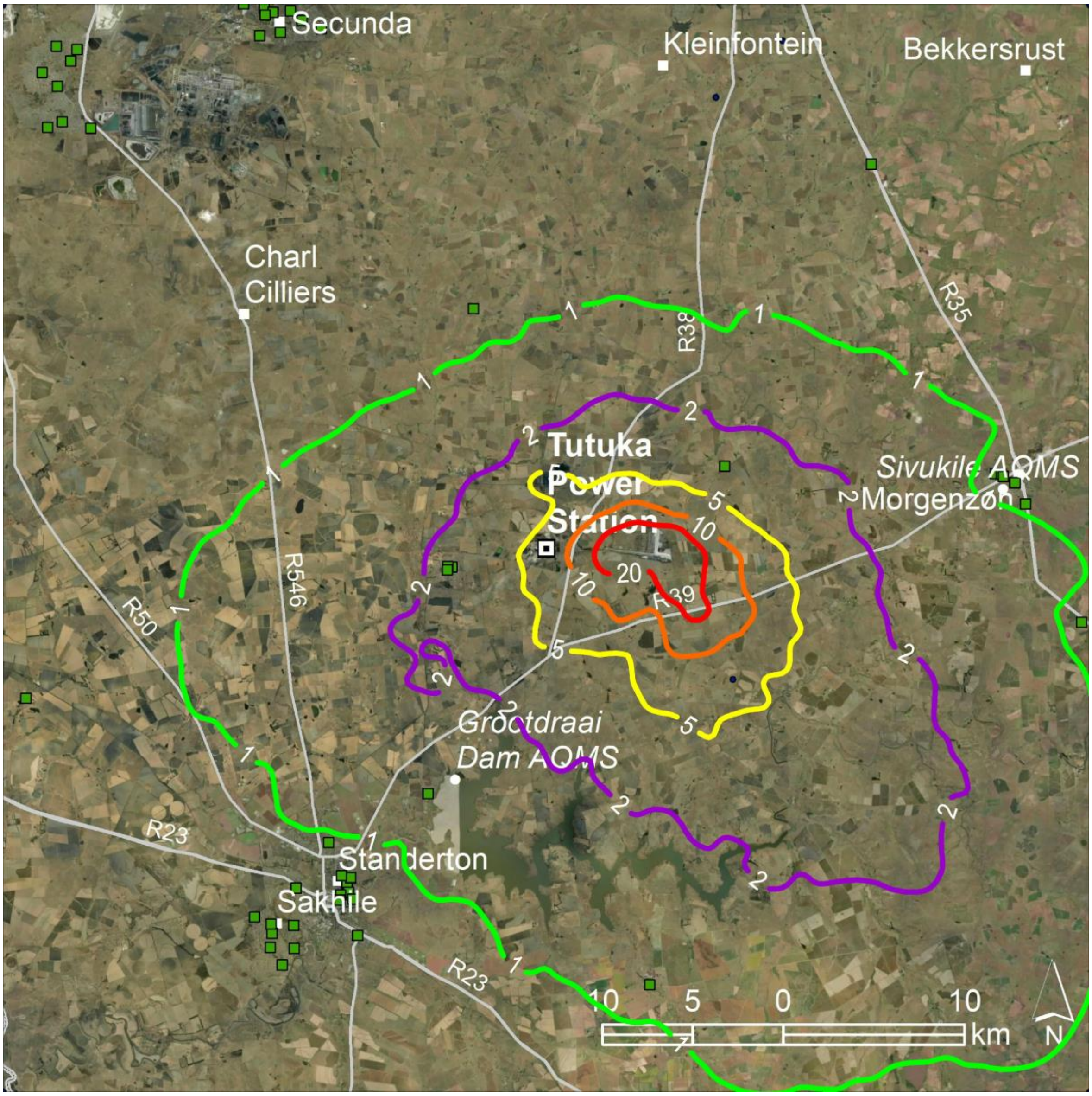

Figure 7-39: Predicted annual average $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 20 µg/m³)

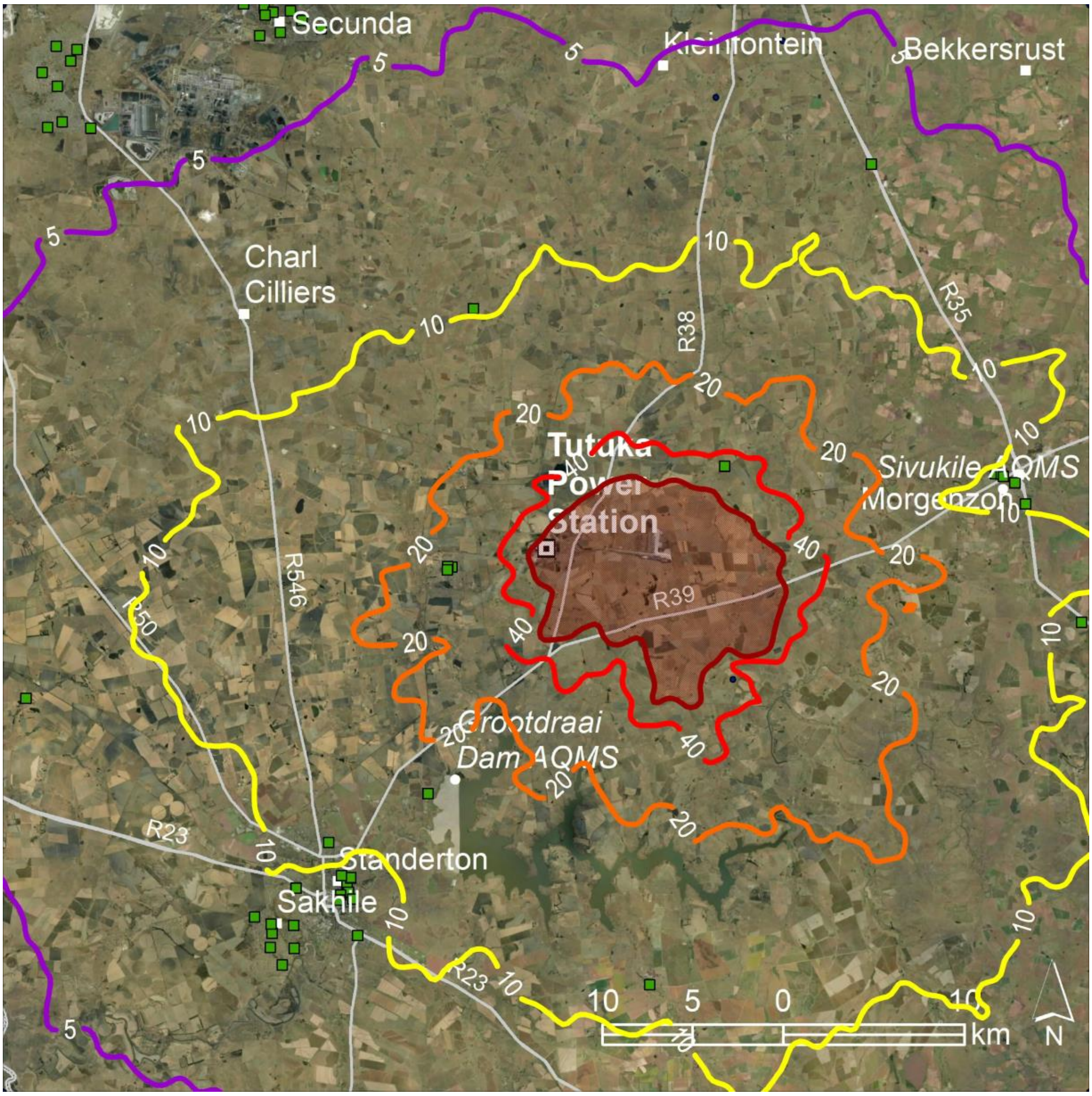

Figure 7-40: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario A (2025) (NAAQS limit 40 µg/m³)

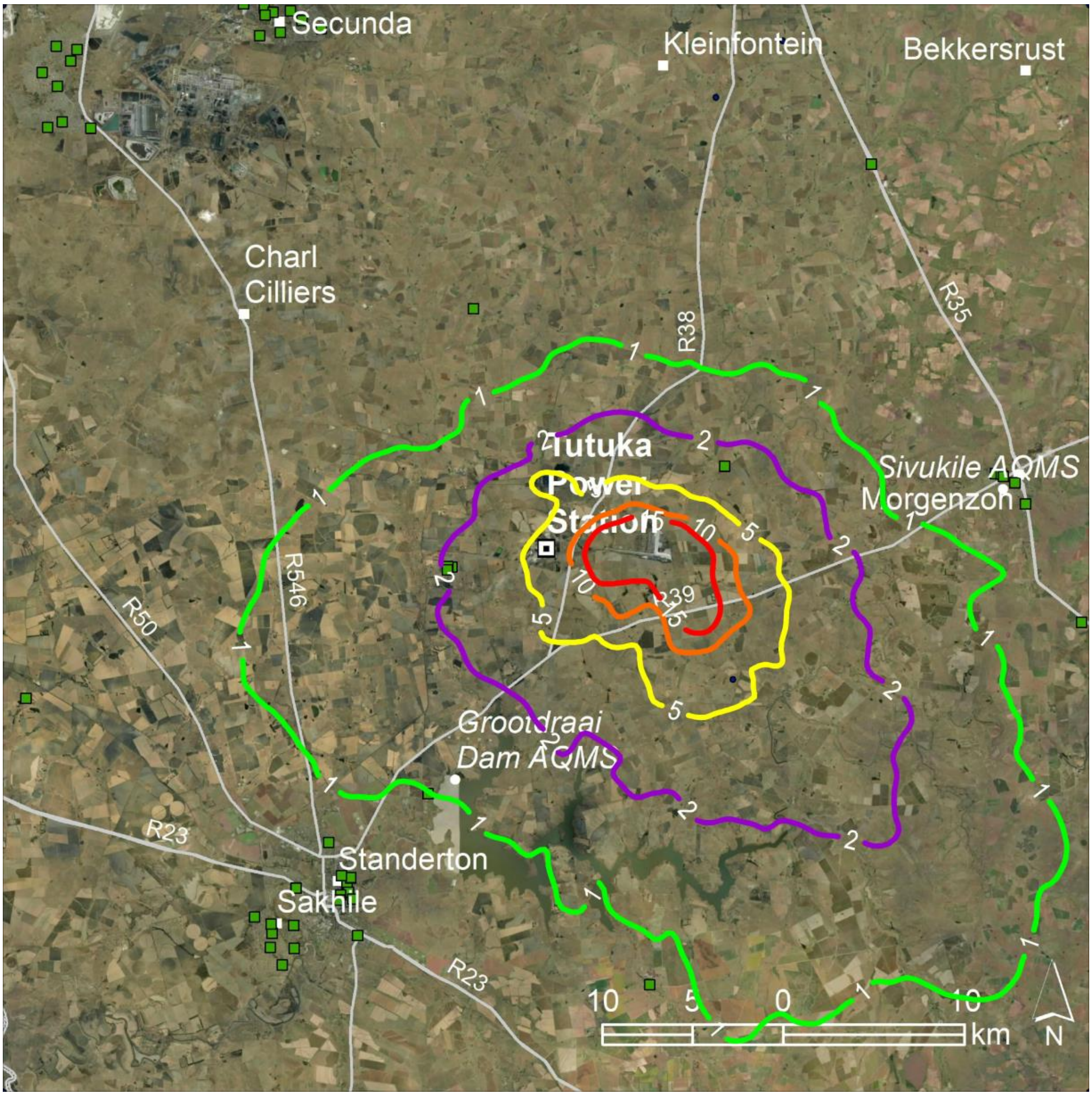

Figure 7-41: Predicted annual average $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 15 µg/m³)

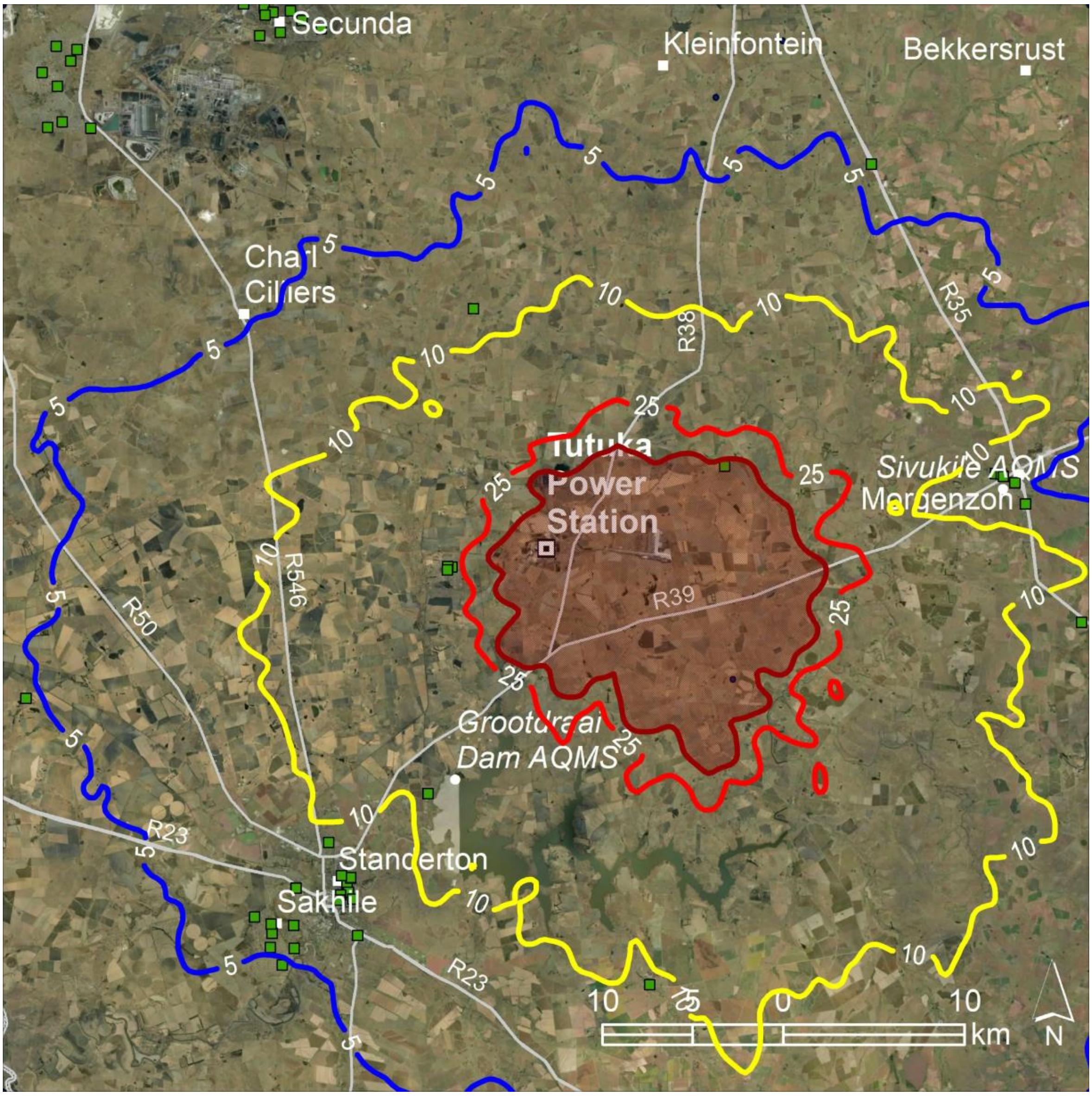

Figure 7-42: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario B (2031) (NAAQS limit 25 µg/m³)

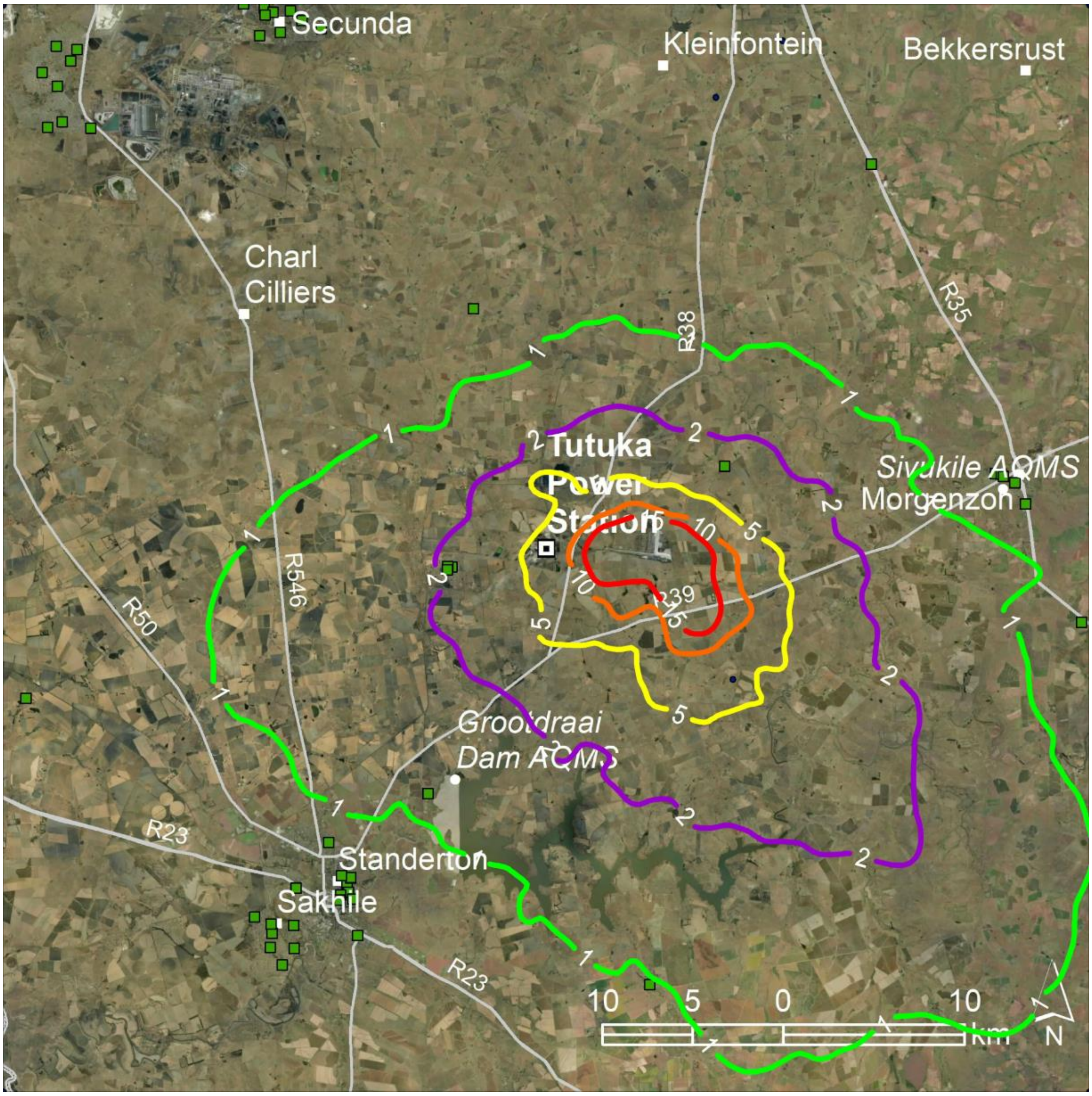

Figure 7-43: Predicted annual average $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 15 µg/m³)

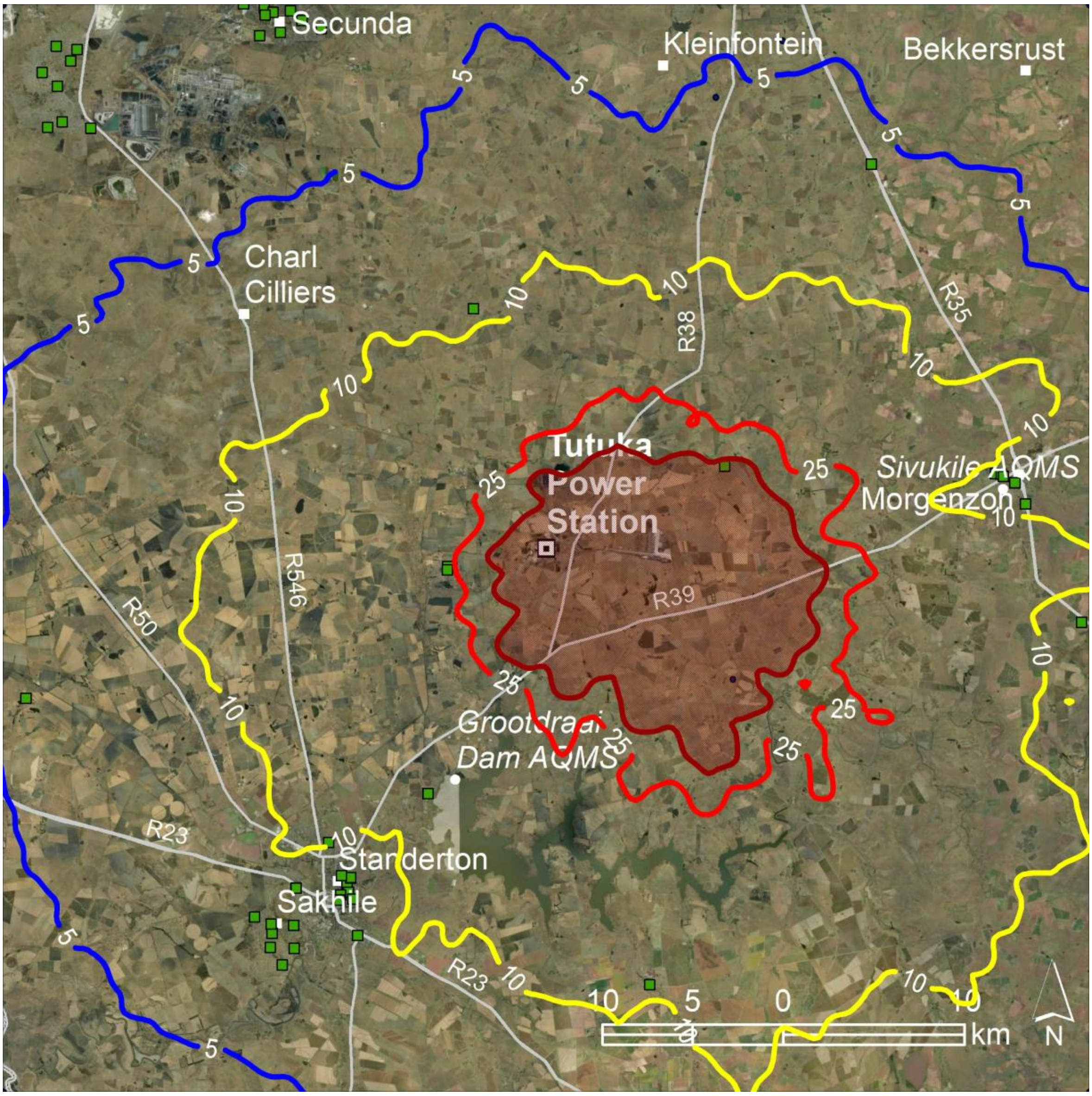

Figure 7-44: Predicted 99[th] percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario C (2036) (NAAQS limit 25 µg/m³)

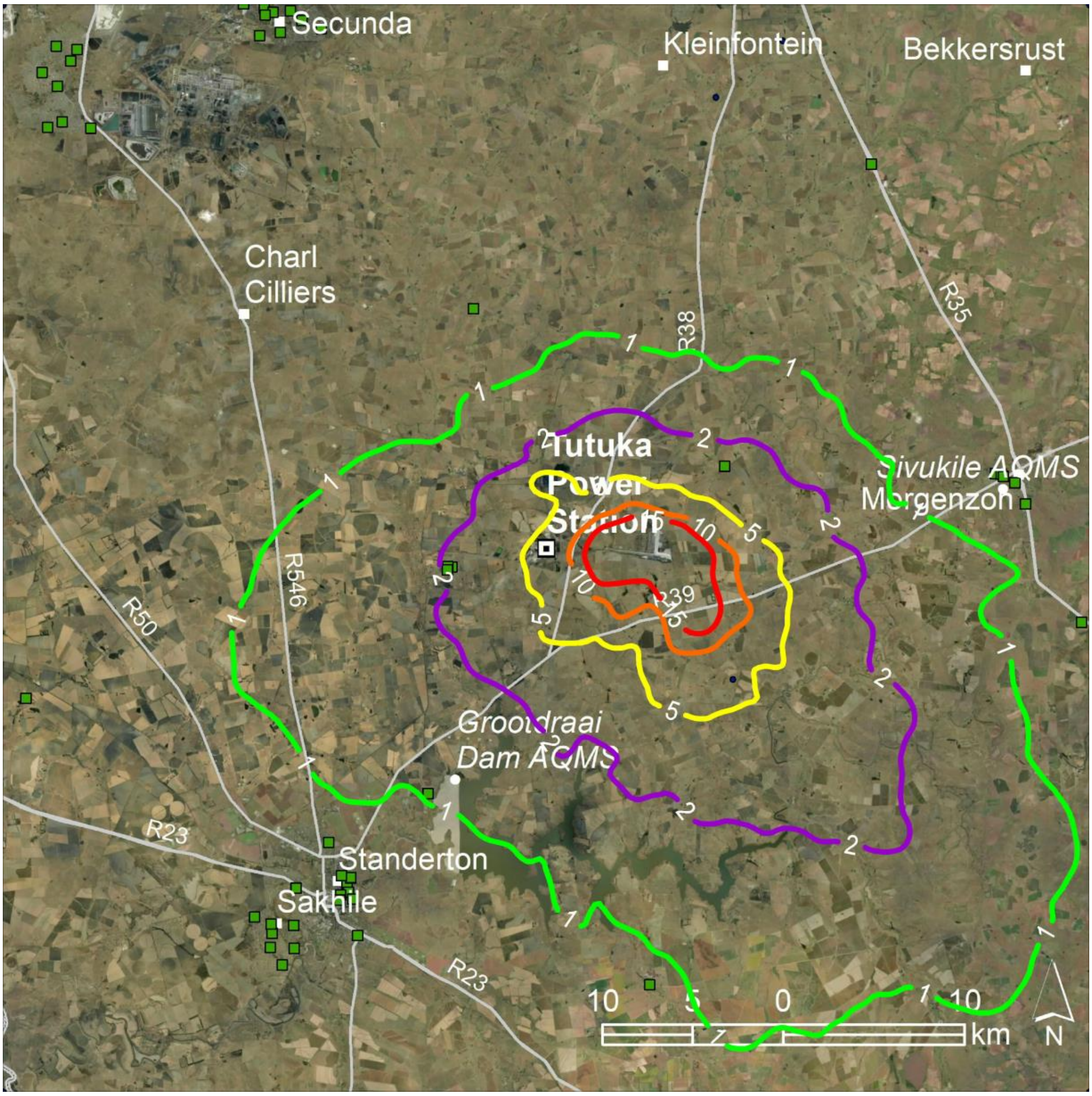

Figure 7-45: Predicted annual average $PM_{2.5}$ concentrations in μg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 15 μg/m³)

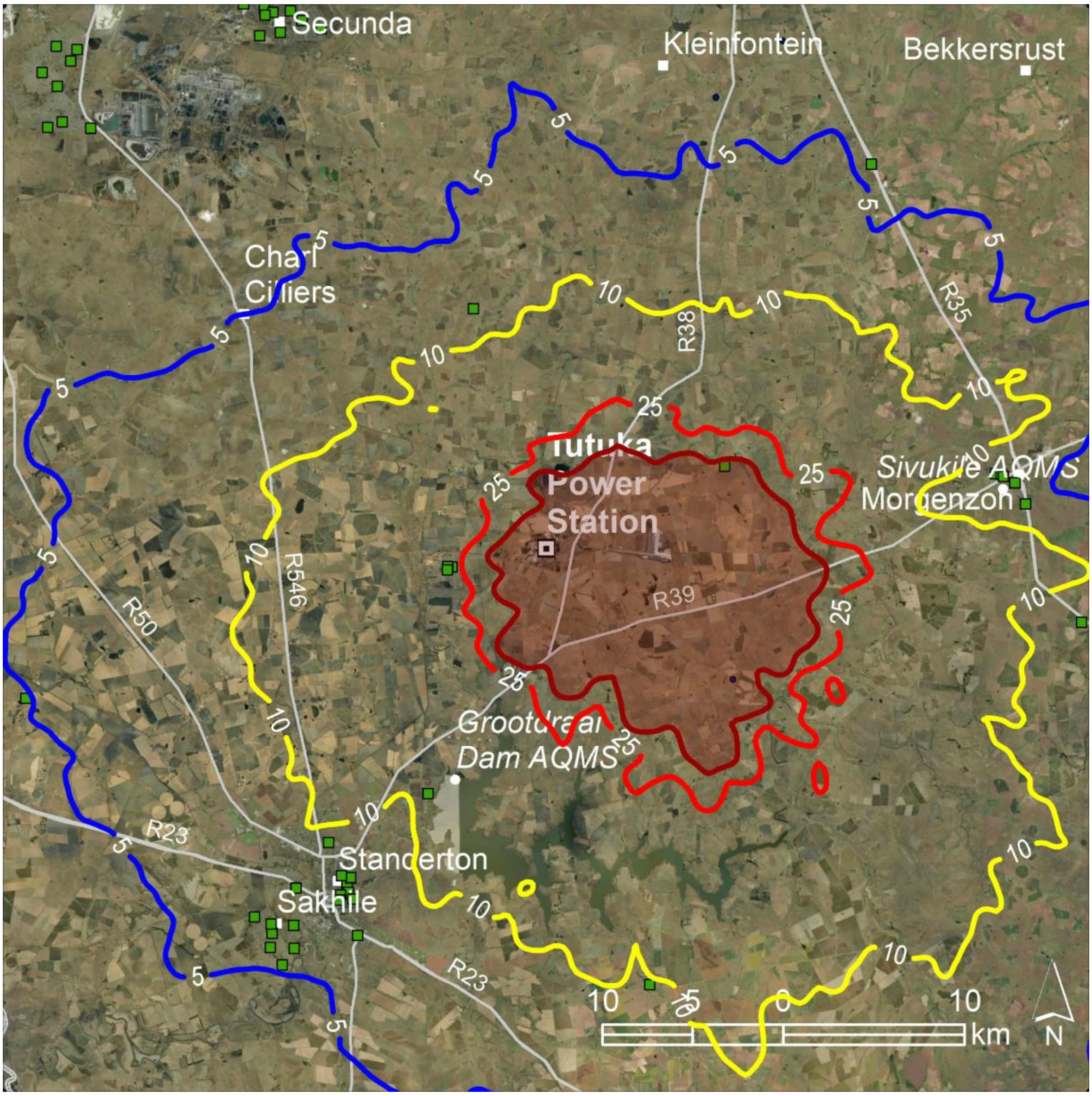

Figure 7-46: Predicted 99th percentile of the 24-hour $PM_{2.5}$ concentrations in µg/m³ resulting from emissions from Tutuka: Scenario D (MES) (NAAQS limit 25 µg/m³)

7.3 Analysis of Emissions' Impact on the Environment

This AIR has focused on potential human health impacts, comparing modelled concentrations of SO_2, NO_2, PM_{10} and $PM_{2.5}$ with the respective health-based NAAQS. An assessment of the atmospheric impact of the facility on the environment was therefore not undertaken as part of this AIR.

8. COMPLAINTS

Tutuka maintains a complaints register. No air quality related complaints were received during the 3-year assessment period, 2021 to 2023.

9. CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

Abatement equipment control technology at Tutuka is only for the control of PM emissions. The station is presently unable to comply with the MES for PM for new plants is therefore upgrading the ESPs and Dust Handling Plants (DHPs), installing flue gas conditioning and High Frequency Power Supplies (HFPS) to reduce PM emissions. It is intended to complete this work by 2029. The station is also planning to install low NOx burners to bring NOx emissions into compliance with the MES for new plants. It is not intended to install SO_2 reduction technology at the station and total SO_2 emission will be managed through plant optimisation and load restriction.

10. COMPLIANCE AND ENFORCEMENT ACTIONS

A pre-compliance notice was received on the 16 February 2022 relating to AEL non-compliances. This was addressed and closed by Eskom.

A compliance notice was received on the 10 July 2023 relating to air quality, which has been addressed by Eskom. It was officially closed by the licensing authority at Gert Sibande District Municipality on the 20 August 2024.

A letter was received from DFFE in 2023/24 requesting proof of closure of actions relating to water, air quality, and waste. This was addressed and closed by Eskom.

11. SUMMARY AND CONCLUSION

In this AIR five emission scenarios are assessed for Tutuka to support Eskom's application for exemption from the MES using dispersion modelling to simulate the resultant ambient concentrations. The five sequential scenarios from current emissions to 2036 capture Eskom's emission reduction strategy. These are from Scenario 1 using actual emissions from 2021 to 2023, Scenario A using proposed 2025 emissions, Scenario B using proposed 2031 emissions, Scenario C using proposed 2036 emissions and Scenario D which assumes the MES to demonstrate the relative effect of compliance.

Noteworthy findings from the modelling results for SO_2 and NO_2 may be summarised as follows:

i) Ambient SO_2 and NO_2 concentrations are attributed to the stack emissions only.
ii) For all scenarios and all averaging periods the predicted concentrations comply with the NAAQS throughout the modelling domain.

Noteworthy findings from the modelling results for PM_{10} and $PM_{2.5}$ may be summarised as follows:

i) Ambient PM_{10} and $PM_{2.5}$ concentrations are attributed to the stack emissions and low-level fugitive sources. The stack emissions generally have an effect some distance from the source, while low-level emission have an effect close to the source.

ii) In the modelling the conservative assumption is made firstly that the total PM emission is PM_{10}, and secondly, the total PM emission is $PM_{2.5}$.

iii) The predicted PM_{10} and $PM_{2.5}$ concentrations are high relatively close to the power station, otherwise they are low and comply with the NAAQS throughout the modelling domain, except at one sensitive receptor point west-northwest of Tutuka.

The AIR for Eskom's MES exemption application for Tutuka (uMoya-NILU, 2018) considered stack emissions only, i.e. fugitive sources were excluded. This AIR therefore provides insights into the contribution of stack emission to ground-level concentrations.

In that AIR, the actual PM emissions of 8 581 tonnes/annum from each of the two stacks was simulated. The maximum predicted ambient PM_{10} concentration was 0.6 $\mu g/m^3$, approximately 8 km east of Tutuka. The 99^{th} percentile of the 24-hour predicted PM_{10} concentrations was 6.4 $\mu g/m^3$ and occurred approximately 5 km to the east of Tutuka.

In this AIR, the PM emission for Scenario 1 (Current) is 11% lower than the 2018 AIR, i.e. 7 692 tonnes/annum for each stack. By comparison, the predicted annual PM_{10} concentrations 8 km east of Tutuka are between 10 and 20 $\mu g/m^3$. The predicted 24-hour PM_{10} concentrations 5 km east of Tutuka are greater than 75 $\mu g/m^3$. The decrease in PM emissions from the 2018 AIR to the current AIR is not evident as the ambient concentrations in the current AIR are higher and emphasizes the contribution made by the low-level fugitive sources.

Given the conservative approach to the fugitive emission source simulations, and that this has provided an absolute worst-case emission scenario, and based on recommendations received from uMoya-Nilu, Eskom will be undertaking an additional modelling scenario, assessing only PM, SO2, and NOx stack emissions. NOx and SO2 emissions will be included in this scenario to ensure secondary particulate formation is accounted for. This will provide improved insight to impacts directly related to stack emissions, which are the focus of this exemption application.

12. REFERENCES

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Hurley, P.J., Physick, W.L. and Ashok, K.L. (2002): The Air Pollution Model (TAPM) Version 2, Part 21: summary of some verification studies, CSIRO Atmospheric Research Technical Paper No. 57, 46 p.

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13. FORMAL DECLARATIONS

A declaration of the accuracy of the information contained in this Atmospheric Impact Report is included here. A declaration of the independence of the practitioners in the uMoya-NILU consultancy team that compiled this AIR is also included.

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

Name of Enterprise: uMoya-NILU Consulting (Pty) Ltd

Declaration of accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel [duly authorised], declare that the information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 23nd day of October 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

DECLARATION OF INDEPENDENCE – PRACTITIONER

Name of Practitioner: Mark Zunckel

Name of Registered Body: South African Council for Natural Scientific Professionals

Professional Registration Number: 400449/04

Declaration of independence and accuracy of information provided:

Atmospheric Impact Report in terms of Section 30 of the Act

I, Mark Zunckel declare that I am independent of the applicant. I have the necessary expertise to conduct the assessment required for the report and will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in the atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality office is a criminal office in terms of section 51(1)(g) of this Act.

Signed at Durban on this 23nd day of October 2024.

SIGNATURE

Managing Director – uMoya-NILU Consulting
CAPACITY OF SIGNATORY

ANNEXURE 1: NEMA REGULATION – APPENDIX 6

Specialist Reports as per the NEMA EIA Regulations, 2014 (as amended), must contain the information outlined according to Appendix 6 (1) of the Regulations. Table A1 indicates where this information is included in the AIR.

Table A1: Prescribed contents of the Specialist Reports (Appendix 6 of the EIA Regulations, 2014)

Relevant section in GNR. 982	Requirement description	Relevant section in this report
(a) details of—	(i) the specialist who prepared the report; and	Section 2.76
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 2.7 6 & Annexure 2
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 13
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 , 2.1 & 2.73.2
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 5 &, 6, 7
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Site investigation not applicable
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5 & 6.27
(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 alternatives;	Section 2.2 & 2.36.3 & 6.4
(g)	an identification of any areas to be avoided, including buffers;	None identified
(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;	Section 6.37.2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge; Note: Uncertainties should be qualified within the report – there will always be uncertainties due to gaps in knowledge should also be qualified – a gap is to record that not all knowledge can be obtained for a study.	Section 2.98 & 7.1.3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6.47
(k)	any mitigation measures for inclusion in the EMPr;	Section 97

Relevant section in GNR. 982	Requirement description	Relevant section in this report
	Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	
(l)	any conditions for inclusion in the environmental authorisation;	Section 9
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
(n) a reasoned opinion—	(i) whether the proposed activity, activities or portions thereof should be authorised;	Section 11
	(iA) regarding the acceptability of the proposed activity or activities; and	Section 11
	(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; Note: We need to include whether these mitigation measures (excluding ongoing monitoring) can be practically implemented prior to commencement or not.	Section 11
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 1
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	
(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 1 & 3 & 6.2.1

ANNEXURE 2: CURRICULUM VITAE

MARK ZUNCKEL uMOYA-NILU

Firm	:	uMoya-NILU (Pty) Ltd
Profession	:	Air quality consultant
Specialization	:	Air quality assessment, air quality management planning, air dispersion modelling, boundary layer meteorology, project management
Position in Firm	:	Managing director and senior consultant
Years with Firm	:	Since 1 August 2007
Nationality	:	South African
Year of Birth	:	1959
Language Proficiency	:	English and Afrikaans

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
National Diploma (Meteorology)	Technikon Pretoria	1980
BSc (Meteorology)	Univ. of Pretoria	1984
BSc Hons (Meteorology)	Univ. of Pretoria	1988
MSc	Univ. of Natal	1992
PhD	Univ. Witwatersrand	1999

Registered Natural Scientist: South African Society for Natural Scientific Professionals
Ex-Council Member: National Association for Clean Air
Member: National Association for Clean Air

EMPLOYMENT AND EXPERIENCE RECORD

Period	**Organisation details and responsibilities/roles**
1976 – May 1992	South African Weather Bureau : Observer, junior forecaster, senior forecast, researcher, assistant director
June 1992 – July 2007	CSIR: Consultant and researcher, Research group Leader: Atmospheric Impacts
August 2007 to present	uMoya-NILU Consulting: Managing Director and senior air quality consultant

Key and Recent Project Experience:

1996	Project leader & Principal researcher: Atmospheric impact assessment for the proposed Mozal aluminium smelter in Maputo, Mozambique.

1996	Project leader & Principal researcher: Dry sulphur deposition during the Ben MacDhui High Altitude Trace Gas and Transport Experiment (BATTEX) in the Eastern Cape.
1997	Project leader & Principal researcher: Atmospheric impact assessment of the proposed capacity expansion project for Alusaf in Richards Bay.
1997	Project leader & Principal researcher: The Uruguayan ambient air quality project with LATU.
1997	Principal researcher on the Air quality specialist study for the Strategic Environmental Assessment on the industrial and urban hinterland of Richards Bay.
1997	Project leader & Principal researcher: Feasibility study for the implementation of a fog detection system in the Cape Metropolitan area: Meteorological aspects.
2001	Project leader & Principal researcher: Air quality specialist study for the Environmental Impact Assessment for the proposed expansion of the Hillside Aluminium Smelter, Richards Bay.
2001-03	Researcher: The Cross Border air Pollution Impact (CAPIA) project. A 3-year modelling and impacts study in the SADC region.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed Pechiney Smelter at Coega.
2002	Project leader & Principal researcher: Air quality assessment specialist study for the proposed N2 Wild Coast Toll Road.
2002-05	Project leader on the NRF project – development of a dynamic air pollution prediction system
2004	Project leader on the specialist study for expansion at the Natal Portland Cement power station at Simuma, KwaZulu-Natal.
2004-05	Researcher: National Air Quality Management Plan implementation project for Department Environmental Affairs and Tourism.
2005	Researcher in the assessment of air quality impacts associated with the expansion of the Natal Portland Cement power station at Port Shepstone.
2006-07	Project team leader of a multi-national team to develop the National Framework for Air Quality Management for the Department of Environment Affairs and Tourism
2007	Air quality assessment for Mutla Early Production System in Uganda for ERM Southern Africa on behalf of Tullow Oil.
2007-10	Lead consultant on the development of a dust mitigation strategy fro the Bulk Terminal Saldanha and an ambient guideline for Fe_2O_3 dust for Transnet Projects and on-going monitoring.
2008	Lead consultant on the Air quality status quo assessment and scoping for the EIA for the Sonangol Refinery
2008-09	Lead consultant on the development of the air quality management plan for the Western Cape Provincial. Department of Environmental Affairs and Development Planning.
2008-10	Lead consultant on the development of the Highveld Priority Area air quality management plan for the Department of Environmental Affairs and Tourism.
2008	Lead consultant in the development of an odour management and implementation strategy for eThekwini, focussing on Wastewater Treatment Works and odourous industrial sources
2008&10	Lead consultant on the Air Quality Specialist Study for the EIA for the proposed Kalagadi Manganese Smelter at Coega

2008	Lead consultant on the Air Quality Assessment for the Proposed Construction and Operation of a Second Cement Mill at NPC-Cimpor, Simuma near Port Shepstone.
2008	Lead consultant on the Air Quality Specialist Study Report for the New Multi-Purpose Pipeline Project (NMPP) for Transnet Pipelines.
2008	Lead consultant on the Air quality assessment for the proposed UTE Power Power station and RMDZ coal mine at Moatize, Mozambique for Vale.
2008-09	Lead consultant on the Dust source apportionment study for the Coedmore region in Durban for NPC-Cimpor.
2009	Consultant on the Air quality specialist study for the upgrade of the Kwadukuza Landfill, KwaZulu-Natal
2009-10	Lead consultant on the Audit of ambient air quality monitoring programme and air quality training for air quality personnel at PetroSA
2010	Lead consultant on the Qualitative assessment of impact of dust on solar power station at Saldanha Bay
2010	Lead consultant on the Air quality specialist study for the EIA for the Kalagadi Manganese Smelter at Coega
2009-10	Lead consultant on the Air quality specialist study for the Environmental Management Framework for the Port of Richards Bay
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Idwala Carbonates, Port Shepstone
2010	Lead consultant on the Air quality status quo assessment and abatement planning at Sappi Tugela, Mandeni
2010–11	Air quality status quo assessment and revision of the Air Quality Management Plan for City of Johannesburg
2010	Lead consultant on the Air quality status quo assessment and abatement planning at First Quantum Mining's Bwana Mkubwa and Kansanshi mines, Zambia
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Alternative Fuel and Resources Project at Simuma, Port Shepstone
2010–11	Lead consultant on the Air quality specialist study for the EIA for the Coke Oven re-commissioning at ArcelorMittal Newcastle
2010	Qualitative air quality assessment for the EIA for the Mozpel sugar to ethanol project , Mozambique
2011	Development of the South African Air Quality Information System – Phase II The National Emission Inventory
2011	Ambient baseline monitoring for Riversdale's Zambezi Coal Project in Tete, Mozambique
2010-11	Ambient quality baseline assessment for the Ncondeze Coal Project, Tete Mozambique
2011-12	Air quality assessment for the mining and processing facilities at Longmin Platinum in Marikana
2012	Air quality assessment for the proposed LNG and OLNG power stations in Mozambique
2012	Modelling study in Abu Dhabi for the transport and deposition of radio nuclides
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port
2012-13	Air quality management plan development for Stellenbosch Municipality
2012-12	Air quality management plan development for the Eastern Cape Province

2013	Air quality specialist for Tullow Oil Waraga-D and Kinsinsi environmental audit in Uganda
2013	Air quality specialist study for the EIA for the Thabametsi IPP station
2013	Air quality management plan for the Ugu District Municipality
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 9 Eskom power stations
2014	Air quality specialist study for the application for postponement applications of the minimum emission standards for the Engen Refinery in Merebank, Durban
2014-15	Baseline assessment and AQMP development for the uThungulu District Municipality
2013-15	Baseline assessment, AQMP and Threat Assessment for the Waterberg-Bojanala Priority Area
2014-15	Review of the 2007 AQMP for eThekwini Municipality, including metropolitan emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, dispersion modelling and strategy development
2014-14	Dispersion modelling study for Richards Bay Minerals
2015	Air quality assessment for Rainbow Chickens at Hammersdale
2015	Air quality status quo assessment and planning for TNPA ports in South Africa
2016- 7	Lead author of the National State of Air Report for 2005 to 2015, including national emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning
2016	Air quality assessment for Kanshansi Mine, Solwesi, Zambia
2016	Assessment of air quality impacts associated with activities at the Venetia Mine, Limpopo Province
2016	Assessment of air quality impacts associated with activities at the Komati Anthracite Mine, Mpumalanga Province
2016	Air quality assessment for the proposed Powership Project at the Port of Nacala, Mozambique
2016	Air quality assessment for the proposed Richards Bay Gas to Power Project
2017	Baseline assessment and review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial, transport, waste management, biomass burning, residential fuel burning, and dispersion modelling
2017	Baseline assessment and air quality management plan for Northern Cape Province
2017	Air quality assessment for the EIA for the Thabametsi Power Station in Limpopo Province
2017	Air quality assessment for the EIA for the proposed Tshivasho Power Station in Limpopo Province
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Power station in Ekurhuleni
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay
2019	Air quality assessment for the mine expansion project at the Akanani Mine

2019	Air quality impact assessment for the proposed power power station at Nacala, Mozambique
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application
2020	AIR for the proposed Azure Power gas-to-power project in the Western Cape
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape
2016-21	AEL compliance monitoring for Joseph Grieveson, Durban, including dust fallout monitoring and reporting
2018-21	Dust fallout and HF monitoring and reporting for Hulamin, Richards Bay
2018-21	Dust fallout and H_2S monitoring and reporting for at KwaDukuza Landfill for Dolphin Coast Landfill Management (DCLM)
2019-21	AEL compliance monitoring for Umgeni Iron and Steel Foundry, including dust fallout monitoring and reporting

PUBLICATIONS

Author and co-author of 34 articles in scientific journals, chapters in books and conference proceedings. Author and co-author of more than 300 technical reports and presented 47 papers at local and international conferences.

ATHAM RAGHUNANDAN

uMOYA-NILU

Firm : uMoya-NILU Consulting (Pty) Ltd
Profession : Air Quality Consultant
Specialization : Meteorological and Atmospheric Dispersion Modelling, Air Quality Specialist Studies, Project Management, Data Processing, Emission Inventories
Position in Firm : Senior Air Quality Consultant
Years with Firm : 14 years (appointed in 2008)
Nationality : South African
Year of Birth : 1977
Language Proficiency :English (mother tongue), Afrikaans (fair)

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
M.A. (Atmospheric Sciences)	University of Natal, Durban	2003
B.A. Hons. (Environmental Sciences)	University of Durban–Westville	2001
B.Paed. (Education)	University of Durban–Westville	2000

Memberships:

- National Association for Clean Air (NACA)
- South African Society for Atmospheric Sciences (SASAS)
- South African Council of Educators (SACE)

EMPLOYMENT AND EXPERIENCE RECORD

Period	Organisation details and responsibilities/roles
Jan 2003 – Oct 2008	CSIR: Consultant/Researcher in Air Quality Group, Research Group Leader – Air Quality Research Group
Nov 2008 – present	uMoya-NILU: Senior Air Quality Consultant

Key and Recent Project Experience:

2003	Baseline air dispersion modelling study for Natal Portland Cement (Pty) Ltd – Simuma Power station, Port Shepstone – Modelling and Reporting
2004	Air Quality Screening Study for MOZAL 3 – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Station at Oranjemund, Namibia (Site D) – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Kudu Combined Cycle Gas Turbine Power Power station at Uubvlei, Namibia – Modelling and Reporting
2005	Air Quality Specialist Study for a Proposed Cement Milling, Storage and Packaging Facility and a Second Clinker Kiln at Natal Portland Cement (Pty) Ltd – Simuma Power station, Port Shepstone – Modelling and Reporting
2005	Technology Review: Air quality specialist study for the Coega Aluminium Smelter at Coega, Port Elizabeth – Modelling and Reporting
2005	Assessment of Development Scenarios for Hillside Aluminium using Sulphur Dioxide (SO_2) as an Ambient Air Quality Indicator – Modelling and Reporting
2005	Air Quality Scoping Study for Eskom's Proposed Open Cycle Gas Turbine Power Station at Atlantis – Modelling and Reporting
2005	Air Quality Specialist Study for Eskom's Proposed Open Cycle Gas Turbine Power Station at Atlantis, Western Cape – Modelling and Reporting
2005	Air Quality Specialist Study for the Proposed Tata Steel Ferrochrome Project at Richards Bay – Alton North Site – Modelling and Reporting
2005	Air Quality Audit for the Amathole District Municipality - Compilation of detailed emissions inventory
2006	A Regional Scale Air Dispersion Modelling Study for Northeastern Uruguay – Modelling and Reporting

2006	Air Dispersion Modelling Study for Natal Portland Cement (Pty) Ltd for the Proposed AFR Programme at the Simuma Power station, Port Shepstone – Modelling and Reporting
2007	Development of an air quality management strategy for particulate matter at the Bulk Terminal Saldanha - Project Leader and Reporting
2007	Air Quality and Human Health Specialist Study for the Proposed Coega Integrated LNG to Power Project (CIP) within the Coega Industrial Zone, Port Elizabeth, South Africa - Project Leader, Modelling and Reporting
2008	Dispersion Modelling for the Proposed Coega Aluminium Smelter (CAL) at Port Elizabeth - Project Leader, Modelling and Reporting
2008	Modelled and Measured Vertical Ozone Profiles over Southern Africa (as part of the Young Researcher Establishment Fund (2005-2008)) - Project Leader
2008	Air Quality Specialist Study for the Proposed N2 Wild Coast Toll Highway - Project Leader, Modelling and Reporting
2008	Initial Air Quality Impact Assessment for the Proposed Illovo Ethanol Power station in Mali, West Africa - Project Leader, Modelling and Reporting
2008	Modelling Mercury Stack Emissions from South African Coal-fired Power Power stations – Modelling and Reporting
2009	Air Quality Management Plan for the Western Cape Province – Baseline Assessment – Modelling
2009	Proposed Exxaro AlloyStream™ Manganese Project in the Coega Industrial Development Zone: Air Quality Impact Assessment – Modelling and Reporting
2009	Air Quality Specialist Study for the Kalagadi Manganese Smelter at Coega, Eastern Cape – Modelling and Reporting
2009	Qualitative Air Quality Impact Assessment for the Wearne Platkop Quarry – Modelling and Reporting
2009	Specialist Air Quality Study for the Vopak Terminal Durban Efficiency Project – Modelling
2009	Qualitative Air Quality Impact Assessment for the Proposed ETA STAR Coal Mine at Moatize, Mozambique – Modelling and Reporting
2009	Specialist Air Quality Study for the Kwadukuza Landfill Upgrade Project – Modelling and Reporting
2010	Ambient dust assessment at Saldanha Bay for the period October 2006 to September 2009 for Transnet Bulk Terminal Saldanha – Reporting
2010	Dust Impact Assessment for the Proposed Saldanha Bay Pilot PV power station – Reporting
2010	Modelling Particulate Emission Concentration Scenarios for Eskom's Kriel Power Station – Modelling and Reporting
2010	Air Quality Dispersion Modelling for MOZAL, Mozambique – Modelling and Reporting
2010	Air Quality Management Plan for the Highveld Priority Area – Air Quality Baseline Assessment for the Highveld Priority Area – Modelling
2010	Ambient Air Quality Modelling and Monitoring at Sappi, Mandeni – Modelling and Reporting
2010	Dust Impact Study at Idwala Carbonates – Modelling and Reporting
2010	Air quality specialist study for the EIA for the proposed re-commissioning of an existing coke oven battery at ArcelorMittal South Africa, Newcastle Works – Modelling

2010	Air quality specialist study for the proposed storage and utilisation of alternative fuels and resources at NPC-Cimpor's Simuma facility, Port Shepstone, KwaZulu-Natal – Modelling and Reporting
2010	Air quality status quo assessment and abatement planning at First Quantum Mining's Bwana Mkubwa and Kansanshi mines, Zambia – Modelling
2010	Air quality specialist study for the proposed briquetting power station at the Mafube Colliery – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Stanger – Modelling and Reporting
2011	Air quality modelling study for the Copeland reactor at Sappi Tugela – Modelling and Reporting
2011	Air quality monitoring and modelling study for the Copeland reactor at Mpact Paper, Piet Retief – Modelling and Reporting
2011	Air Quality Study for the Basic Environmental Assessment for the Proposed Biomass Co-Firing Facility at the Arnot Power Station – Modelling and Reporting
2011	Assessment of Scenarios for Developing and Implementing a Sulphur Dioxide Emissions Licensing Strategy for Hillside Aluminum – Modelling and Reporting
2011-12	Air quality assessment for the mining and processing facilities at Lonmin Platinum in Marikana – Modelling and Reporting
2012	Development of an Air Quality Management Plan for Anglo's Mafube Colliery in Mpumalanga – Modelling and Reporting
2012	Air quality assessment for the proposed manganese ore terminal at the Ngqura Port – Modelling and Reporting
2012	Air Quality Impact Assessment for NPC Cimpor – Modelling and Reporting
2013	Air Quality Impact Assessment for Proposed AfriSam Power station in Coega – Modelling
2013	Air quality assessment for the Orion Engineered Carbons Co-Gen Power station – Modelling
2013	Air quality assessment for the Orion Engineered Carbons - Main Boiler – Modelling
2013	Air quality assessment for the EIA for the Sekoko Coal Mine – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Thabametsi IPP station – Modelling and Reporting
2013	Air quality specialist study for the EIA for the Mamathwane Common User facility – Modelling and Reporting
2013-14	Air quality specialist study for the application for postponement of the minimum emission standards for 16 Eskom power stations: Acacia, Arnot, Camden, Kendal, Grootvlei, Hendrina, Kendal, Komati, Kriel, Lethabo, Majuba, Kendal, Kendal, Madupi, Kendal, Port Rex – Modelling and Reporting
2014	Air quality specialist study for the application for postponement of the minimum emission standards for the Engen Refinery in Merebank, Durban – Modelling and Reporting
2013-14	Baseline assessment and air quality management plan for the Waterberg-Bojanala Priority Area – Modelling

2013 Air Quality Specialist Study for the EIA for the Pandora Platinum Mine Joint Venture – Modelling and Reporting

2013 Air Quality Specialist Study for the EIA for the Proposed New Tailings Storage Facility (TD8) and Associated Infrastructure at Lonmin's Western Platinum Mine and Eastern Platinum Mine – Modelling and Reporting

2015 Waterberg-Bojanala Priority Area Air Quality Management Plan and Threat Assessment – Modelling

2015 Air Quality Management Plan for eThekwini Municipality – Modelling and Reporting

2015 Air Quality Management Plan for the uThungulu District Municipality – Modelling and Reporting

2015 Dispersion Modelling for Richards Bay Minerals – Modelling and Reporting

2015 Atmospheric Impact Report in support of Sancryl Chemicals's application for a verification to the existing AEL as a result of the introduction of Ethyl Acrylate and Vinyl Acetate, Prospecton – Modelling and Reporting

2016 Dispersion Modelling Study for the City of Johannesburg – Modelling and Reporting

2016 Air Quality Specialist Study for the Department of Energy's Emergency Power IPP Project at Richards Bay and Saldanha Bay – Modelling and Reporting

2016 Atmospheric Impact Report in support of the EIA for the Proposed Gas to Power Power station in Zone 1F of the Richards Bay IDZ – Modelling and Reporting

2016 Atmospheric Impact Report for the EIA for the proposed Tshivhaso Coal-fired Power Power station, Lephalale – Modelling and Reporting

2016 TNPA Air Quality Study – Dispersion Modelling for 8 Ports in South Africa: Port of Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town and Saldanha Bay – Modelling and Reporting

2016 Atmospheric Impact Report for Durran's Calcination Power station – Modelling and Reporting

2016 Air Quality Assessment for the EIA for the Floating Power Power station in Nacala, Mozambique – Modelling and Reporting

2016 Ambient Air Quality Assessment for 2016 for Kansanshi Mining Plc – Modelling and Reporting

2016 Air Quality Impact Assessment for the EIA for the Proposed Hilli FLNG Project in Cameroon – Modelling and Reporting

2016 Kansanshi Smelter and TSF1 Modelling Scenarios for Kansanshi Mining Plc – Modelling and Reporting

2016 Air Quality Assessment the Proposed Accommodation Facility at the Venetia Mine in Limpopo – Modelling and Reporting

2016 Atmospheric Impact Report in support of the EIA for the Proposed Optimisation of the Process Power station at Nkomati Anthracite Mine – Modelling and Reporting

2017 Atmospheric Impact Report in support of the DRDAR Atmospheric Emission License (AEL) application for the proposed replacement and use of an incinerator at their State Veterinary Laboratories located in Grahamstown, Middelburg and Queesntown in the Eastern Cape – Modelling and Reporting

2017 Baseline Assessment and Review of the 2009 AQMP for Gauteng Province, including emission inventory development for all sectors, i.e. industrial,

	transport, waste management, biomass burning, residential fuel burning, and dispersion modelling – Modelling and Reporting
2017	Baseline Assessment and Air Quality Management Plan for Northern Cape Province – Modelling and Reporting
2017	Atmospheric Impact Report in support of Maloka Machaba Surfacing's application for an Atmospheric Emission License (AEL) for a proposed asphalt power station located in Polokwane – Modelling and Reporting
2017	Assessment of modelling scenarios involving an increase in the open area of the cone on the Common Stack for the pretreater, reformer and CHD furnaces at Engen Refinery – Modelling and Reporting
2017	Atmospheric Impact Report in support of the Atmospheric Emission License (AEL) application and stack-height assessment for the proposed Thabametsi Power Power station near Lephalale, Limpopo – Modelling and Reporting
2017	Dispersion Modelling Study for the Beeshoek Mine, near Postmasburg, Northern Cape – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Bellmall Thermal Power station in Ekurhuleni – Modelling and Reporting
2018	Air quality assessment for the EIA for the proposed Simba Oil mini Refinery in Tororo, Uganda – Modelling and Reporting
2018-19	Air dispersion modelling for input to the Atmospheric Reports for the postponement application for 14 Eskom power stations – Modelling and Reporting
2019	Air quality impact assessment for the proposed NamPower expansion project in Walvis Bay – Modelling and Reporting
2019	Air quality assessment for the mine expansion project at the Akanani Mine – Modelling and Reporting
2019	Air quality impact assessment for the proposed power power station at Nacala, Mozambique – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for Dow Southern Africa - New Germany – Modelling and Reporting
2019	Atmospheric Impact Report in support of Tau-Pele Construction's application for an Atmospheric Emission License (AEL) for a proposed emulsion and asphalt power station located in Indwe, Eastern Cape – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the EIA for the Proposed Material Source and Processing Sites Along the N3 Between Durban and Hilton, KwaZulu-Natal: RCL1, RCL9 and Harrison's Quarry – Modelling and Reporting
2019	Atmospheric Impact Report in Support of the Atmospheric Emission License (AEL) Amendment Application and Basic Assessment for the Vopak Efficiency (Growth 4) Expansion Project, Durban, South Africa – Modelling and Reporting
2020	AIR for the KarpowershipSA proposal in the Ports of Ngqura, Richards Bay and Saldanha Bay – Modelling and Reporting
2020	AIR for the Coega Development Corporation gas-to-power project at 4 sites in the CDC – Modelling and Reporting
2020	AIRs for 10 Eskom coal-fired power power stations on the Highveld to support their postponement application – Modelling and Reporting

2020	AIR for the proposed Azura Power gas-to-power project in the Western Cape – Modelling and Reporting
2020	Atmospheric Impact Report for the proposed 315 MW LPG Power Power station at Saldanha Bay – Modelling and Reporting
2021	Air quality assessment for the proposed optimisation project at Beeshoek Iron Ore Mine, Postmasburg, Northern Cape – Modelling and Reporting
2021	Air quality assessment for the proposed expansion at Akanani Mine in Limpopo – Modelling and Reporting
2021	AIR for the proposed Frontier Power Gas-to-Power project at Saldanha Bay, Western Cape
2021	AIR for the 2021 shutdown and start-up at Engen Refinery in Merebank – Modelling and Reporting
2021	AIR for the proposed expansion of the Swartkops Ore handling facility in Port Elizabeth, Eastern Cape – Modelling and Reporting
2021	Atmospheric Impact Report in support of the Proposed 200 MW Engie CB Hybrid Power Project in the Coega Special Economic Zone (SEZ) – Modelling and Reporting
2021	Air Quality Impact Assessment for the proposed Mining of TSF-1 at the Stibium Mopani Mine near Gravelotte, Limpopo Province – Modelling and Reporting
2021	Addendum to the Atmospheric Impact Report in support of the proposed Mulilo-Total 200 MW Gas-fired Power Station, Coega Special Development Zone, Eastern Cape – Reporting
2021	Air Quality Assessment for the EIA for the Tete 1 400 MW Coal-Fired Power Power station, Tete Province, Mozambique – Modelling and Reporting
2021	Atmospheric Impact Report in support of Tugela Asphalt's application for an Atmospheric Emission License (AEL) for a proposed asphalt power station located in Mandini, KwaZulu-Natal – Modelling
2021	Atmospheric Impact Report for Nkomati Mine – Modelling and Reporting
2022	Emission Inventory for Lanxess for 2021 – Reporting
2022	Annual Report for Puregas: Atmospheric Emission License - Submission to the City of Ekurhuleni in compliance with the Atmospheric Emission Licence of the facility for the Reporting Period Year 2021 – Reporting
2022	Emission Inventory for Puregas for 2021 – Reporting
2022	Emission Inventory for Dow Advanced Materials for 2020 – Reporting
2022	Atmospheric Impact Report for the Engen Cape Town Terminal – Modelling and Reporting

PUBLICATIONS

Author and co-author of 5 articles in scientific journals and conference proceedings. Author and co-author of more than 200 technical reports for external contract clients. Presented 4 papers at local conferences. A full list of publications, conference papers and contract reports is available on request.

NOPASIKA XULU

Firm	:	uMoya-NILU (Pty) Ltd
Profession	:	Senior Air Quality Consultant
Specialization	:	Air Quality Assessment, Air Dispersion Modelling; Project Management; Data Analysis; Report Writing and Reviews
Position in Firm	:	Senior Air Quality Consultant
Years with Firm	:	Since 27 March 2023
Nationality	:	South African
Year of Birth	:	1985
Language Proficiency	:	English and IsiZulu (read, write. Speak)

EDUCATION AND PROFESSIONAL STATUS

Qualification	Institution	Year
BSc. Environmental Studies	Univ. of Witwatersrand	2011
BSc Hons (Env. Studies)	Univ. of Witwatersrand	2012
BSc MSc (Env Sciences)	NWU Potchefstroom	2017

EMPLOYMENT AND EXPERIENCE RECORD

Period	Organisation details and responsibilities/roles
Oct 2016 – Dec 2018	Gondwana Environmental Solutions (Pty) Ltd: Air Quality Management Plans; Report Writing; Business Development and Marketing, Researcher,
July 2019 – March 2023	Rayten Engineering Solutions (Pty) Ltd: Air Quality Consultant, Project Management; Report Writing and Review; Data Analysis; Dispersion Modelling and Air Quality Impact Assessment; Research; Compiling Atmospheric Emission License (AEL) Applications; Populating National Atmospheric Emissions Inventory System; AEL Compliance Auditing; Dust Emission Reduction Plans; Greenhouse Gas Emissions Inventory Reporting; Facilitating/ Attending meetings; Liaising with Clients and Suppliers.

March 2023 – Present: uMoya – Nilu Consulting (Pty) Ltd Senior Air Quality Consultant, Dispersion Modelling and Air Quality Impact Assessments; Project Management

Key Project Experience:

2019 – 2023: Project Leader: Air Quality Impact Assessment projects (Harmony Moab Khotsong; EzeeTile Bloemfontein, EzeeTile Mokopane; Transvaal Galvanizers; Duho Drying; Lingaro Drying; Nama Copper Pty Ltd) Project Leader: AEL Applications and Reporting (Harmony Kopanang Operations; Harmony Mponeng Operations; Sibanye Gold Mines; Sibanye Platinum

Mines; TotalEnergies Marketing; Matt Cast Supplies CC; Independent Crematorium SA; City of Tshwane Crematorium; Buffalo City Municipality Crematorium; Wahl Industries; Transvaal Galvanizers)

2014 – 2017: Researcher: Air Quality Assessment in low-income residential areas in the Highveld

Publications: Author: Xulu, N.A., Piketh, S.J. Feig,G.T., Lack, D.A and Garland,R.M., (2020).Characterizing Light Absorbing Aerosols in a Low –Income Settlement in South Africa. Aerosol Air Quality Aerosol Air Quality Research. https://doi.org/10.4209/aaqr.2019.09.004

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