Climate Change Assessment for the Combined-Cycle Gas Turbine Power Plant at Kelvin Power Station

Project done on behalf of **Environmental Impact Management Services (Pty) Ltd**

Project Compiled by:

R von Gruenewaldt

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Address: 62 Constantia Avenue, Mnandi AH, Centurion
Postal: PostNet Suite #18 Private Bag x59, Halfway House, 1685
Tel: +27 (0)11 805 1940

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Prepared by	Renee von Gruenewaldt, (Pr. Sci. Nat.), MSc (University of Pretoria)
Reviewed by	Gillian Petzer, (Pr. Eng.), BEng (Chemical) (University of Pretoria)
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Revision Record

Revision Number	**Date**	**Reason for Revision**
Rev 0	July 2024	For internal review
Rev 1	July 2024	For client review

EXECUTIVE SUMMARY

Airshed Planning Professionals (Pty) Ltd (Airshed) was commissioned by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake a Climate Change Assessment (CCA) for the proposed Combined-Cycle Gas Turbine (CCGT) Power Plant (hereafter referred to as the project).

Project specific information together with local and internationally published emission factors were used to calculate Scope 1 (direct), Scope 2 (indirect) and Scope 3 (indirect) greenhouse gases (GHG) emissions for the proposed project. Locally published literature was referred to, to understand the projected changes to climate for the area.

The physical risks of climate change on the study area (based on the (Intergovernmental Panel on Climate Change) IPCC's fifth assessment report (AR5) data) can be summarised as follows:

- Climate:
  - Temperature:
    - Baseline: 0.84 hot days (90th percentile)
    - High mitigation RCP4.5[1] climate situation: 9.5 hot days with an increase in temperature of 2.75°C (90th percentile)
    - Low mitigation RCP8.5 climate situation: 12 hot days with an increase in temperature of 3°C (90th percentile)
  - Rainfall:
    - Baseline: 9.94 extreme rainfall days (90th percentile)
    - High mitigation RCP4.5 climate situation: 0.08 extreme rainfall days with a decrease in rainfall of 7.7 mm (90th percentile)
    - Low mitigation RCP8.5 climate situation: 1.32 extreme rainfall days with an increase in rainfall of 46.6 mm (90th percentile)
- Hazards assuming the low mitigation RCP8.5 climate situation:
  - Wildfires: low increased risk with 17 increased fire danger days;
  - Drought: Low risk of increased frequency;
  - Exposure to heat extremes: medium potential increase; and,
  - Urban flooding: low increased risk.

Based on information provided, the project is likely to result in an estimated total of 5 853 t carbon dioxide equivalent (CO_2e) direct emissions (1 672 t CO_2e annually) and 7 355 t CO_2e indirect emissions (2 101 t CO_2e annually) due to construction activities. For project operations, the estimated total GHG emissions is 19 210 749 t CO_2e (direct) (960 537 t CO_2e annually) and 3 872 961 t CO_2e (indirect) (193 648 t CO_2e annually). This was calculated to represent 0.001% (construction) and 0.33% (operation) of the remaining South African annual GHG budget.

The impact of the project on climate change was assessed to have a high negative risk rating.

The project will be required to report CO_2e emissions annually via the South African Greenhouse Gas Emission Reporting System (SAGERS) monitoring and reporting system.

[1] Representative Concentration Pathways (RCP) are climate change scenarios to project future greenhouse gas concentrations.

Conclusion

Although South Africa is on a drive to illuminate fossil fuel driven energy, this needs to be done with a Just Energy Transition. This includes the gradual movement towards lower carbon technologies, while not negatively impacting society, jobs and livelihoods. The Just Energy Transition is important to the country and to our future growth and sustainability as an organisation.

From a GHG emissions perspective reference is made to the United Stated Environmental Protection Agency's (US EPA's) Emissions and Generation Resource Integrated Database (eGRID), released in 2018 with 2016 data, which shows that at the national level, natural gas units have an average emission rate of 898 pounds CO_2 per megawatt-hour (MWh), while coal units have an emissions rate of 2,180 pounds CO_2 per MWh[2]. Natural gas units, therefore, on average, release ~58% less CO_2 per MWh compared to coal units.

From the perspective of climate change and given that GHG emissions are lower than coal burning electricity generation, it is the opinion of the specialist that the project be authorised, on condition that GHG emissions are reported annually according to legal requirements.

[2] Available: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

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LIST OF ACRONYMS AND SYMBOLS

AFF	Agriculture, Forestry and Fishing
Airshed	Airshed Planning Professionals (Pty) Ltd
AR5	IPCC's fifth assessment report
AR6	IPCC's sixth assessment report
BAU	Business-As-Usual
°C	Degrees Celsius
CCA	Climate Change Assessment
CCGT	Combined-cycle gas turbine
CCRA	Climate Change Reference Atlas
CCS	Carbon Capture and Sequestration (or Carbon Capture and Storage)
CH_4	Methane
CMIP	Coupled Model Intercomparison Project
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DEFRA	Department for Environment Food & Rural Affairs
DFFE	Department of Forestry, Fisheries and Environment (previously DEA)
DWS	Department of Water and Sanitation
EBRD	European Bank for Reconstruction and Development
ECMWF	European Centre for Medium-Range Weather Forecasts
EHV	Extra High Voltage
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EPA	Environmental Protection Agency
FOLU	Forestry and Other Land Use
GCMs	Global Climate Change Models
GDP	Gross domestic product
GG	Government gazette
GHG	Greenhouse gases
GHGIP	National Greenhouse Gas Improvement Programme
GN	Government notice
Gt	Giga tonne
GVA	Gross Value Added
GWP	Global warming potential
ha	Hectar
H_2O	Water vapour
HFCs	Hydrofluorocarbons
HRSG	Heat Recovery Steam Generator
IPCC	Intergovernmental Panel on Climate Change
km	Kilometre
kWh	Kilowatt hour
LUCF	Land-Use Change and Forestry LUCF
m^3	Cubic metre
ML	Million litres
mm/yr	Millimetres per year
MW	Megawatt
Nm^3	Normal meter cubed
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emission Inventory System
NCEP	National Centres for Environmental Prediction
NEM:AQA	National Environmental Management: Air Quality Act

NDCs	Nationally determined contributions
NOAA	National Oceanic and Atmospheric Administration
NWRS	National Water Resource Strategy
O_3	Ozone
PFCs	Perfluorocarbons
PIC	Public Investment Corporation
PPP	Pollution Prevention Plan
PUFA	Polyunsaturated fatty acids
PV	Photovoltaic
RCA4	Rossby Centre regional model
RCPs	Representative Concentration Pathways
REDD+	Reducing Emissions from Deforestation and forest Degradation
SA	South Africa
SAAELIP	South African Atmospheric Emission Licensing and Inventory Portal
SAAQIS	South African Air Quality Information System
SAGERS	South African Greenhouse Gas Emission Reporting System
SAWS	South African Weather Services
SF_6	Sulfur hexafluoride
SPI	Standardized Precipitation Index
SSP	Shared Socioeconomic Pathway
SST	Sea surface temperatures
SUDS	Sustainable Urban Drainage Systems
t	Tonne
TCFD	Taskforce for Climate-related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation

Note:

The spelling of “sulfur” has been standardised to the American spelling throughout the report. "The International Union of Pure and Applied Chemistry, the international professional organisation of chemists that operates under the umbrella of UNESCO, published, in 1990, a list of standard names for all chemical elements. It was decided that element 16 should be spelled “sulfur”. This compromise was to ensure that in future searchable data bases would not be complicated by spelling variants. (IUPAC. Compendium of Chemical Terminology, 2nd ed. (the "Gold Book"). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). XML on-line corrected version: http://goldbook.iupac.org (2006) created by M. Nic, J. Jirat, B. Kosata; updates compiled by A. Jenkins. ISBN 0-9678550-9-8.doi: 10.1351/goldbook)"

Climate Change Assessment for the Combined-Cycle Gas Turbine Power Plant at Kelvin Power Station

1 INTRODUCTION

Kelvin Power Pty Ltd ("Kelvin") is a coal fired power plant situated in Kempton Park, Johannesburg, South Africa, owned by the Anergi group ("Anergi") and Public Investment Corporation ("PIC"). The existing power plant comprises of: (i) the still operational B Station which was built in the 1960s and includes seven 60 MW steam turbines and eight pulverised coal boilers, and (ii) the now decommissioned A Station which was built in the 1950s. The A station ceased operations in 2012 and a Basic Assessment has been approved for its demolition.

A pre-feasibility study was concluded in 2023 to assess the various technology options available to generate 450 MW to 650 MW on the current A Station site. The pre-feasibility study's objective was to identify proven technology available for generation on the available site considering the infrastructure available. The study concluded that a combined-cycle gas turbine (CCGT) Power Plant with a net output of approximately 600 MW comprising one H class gas turbine, a heat recovery boiler and a steam turbine, would be the optimum technology for this site. The plant is expected to operate as a mid-merit plant with an annual average capacity factor of 50%.

The main structures at the plant would consist of:

- Gas turbine building;
- Steam turbine building;
- Heat Recovery Steam Generator (HRSG);
- Mechanical draft cooling tower;
- Extra High Voltage (EHV) substation;
- Auxiliary buildings;
- Administration buildings; and,
- Exhaust stack.

The site allocated to the new plant is in the area of the redundant A Station auxiliary plant formerly occupied by the A Station dry coal store, coal tipplers, coal stockpile and cooling towers. In addition to the construction area of the permanent plant, other construction facilities such as laydown areas, fabrication shops, warehousing, construction offices, and welfare facilities would be required. The A Station auxiliary plant area is sufficient to accommodate both the permanent plant and the construction facilities outlined above.

Cooling water would be sourced from the existing Kelvin water supply pipelines. Treated sewage wastewater (grey water) would be supplied to the power plant from Diepsloot ~37 km away for use as cooling water. Approximately 52 033 m³ per day of such water has previously been supplied to the Kelvin power plant and as such, quantity would be available for the new plant. The new plant is expected to consume approximately 11 000 m³ per day of water per day when operating as a mid-merit plant with a capacity factor of 50%. The Diepsloot pump house and water pipeline to the plant is the responsibility of, and is maintained by, Kelvin Power. The grey water is dosed with biocides, algaecides, and a corrosion inhibitor.

In addition to the new plant that would be constructed on the Kelvin site, an electrical connection to an Eskom / City Power substation and a gas pipeline to the Sasol gas pipeline system would be required. Should the new plant be connected to the City Power Sebenza substation, a transmission line of approximately 1 km would be required. Alternatively, if the connection was to the Eskom North Rand substation, a transmission line of approximately 5 km would be required. Construction of this transmission line would be the responsibility of Kelvin. A new 25 km gas supply pipeline connecting the new plant to the Sasol high pressure gas transmission system would be required. Construction of this gas supply pipeline would be the responsibility of Sasol.

Figure 1-1: CCGT layout

Airshed Planning Professionals (Pty) Ltd (Airshed) was commissioned by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake a Climate Change Assessment (CCA) for the proposed CCGT Power Plant (hereafter referred to as the project).

1.1 Scope of Work

The scope of work included a desktop Climate Change Assessment in line with the Consultation on Intention to Publish the National Guideline for Consideration of Climate Change Implications in Applications for Environmental Authorisations, Atmospheric Emission Licenses, and Waste Management Licenses, by:

1. Quantifying the greenhouse gas (GHG) emissions during the construction, operation, and closure and decommissioning phases of the project compared to the global and national emission inventories; and compared to international benchmarks for the project.
2. Discussing the robustness of the project in terms of forecasted climate change impacts to the area over the lifetime of the project.
3. Discussing the vulnerability of communities in the immediate vicinity of the project to climate change.
4. Proposing management and mitigation strategies.
5. Preparation of a climate change statement report.

1.2 Specialist Details

1.2.1 Statement of Independence

Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.

1.2.2 Competency Profile – RG von Gruenewaldt (MSc (Meteorology), BSc, Pr. Sci Nat.)

Reneé von Gruenewaldt is a Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP) and a member of the National Association for Clean Air (NACA).

Following the completion of her bachelor's degree in atmospheric sciences in 2000 and honours degree (with distinction) with specialisation in Environmental Analysis and Management in 2001 at the University of Pretoria, her experience in air pollution started when she joined Environmental Management Services (now Airshed Planning Professionals) in 2002. Reneé von Gruenewaldt later completed her master's degree (with distinction) in Meteorology at the University of Pretoria in 2009.

Reneé von Gruenewaldt became partner of Airshed Planning Professionals in September 2006. Airshed Planning Professionals is a technical and scientific consultancy providing scientific, engineering and strategic air pollution impact assessment and management services and policy support to assist clients in addressing a wide variety of air pollution related risks and air quality management challenges.

She has experience on the various components of greenhouse gas emission foot-printing and climate change assessment statements where she has been the principal specialist and manager on these projects.

A comprehensive curriculum vitae of Reneé von Gruenewaldt is provided in Appendix A.

The declaration of independence for Reneé von Gruenewaldt is provided in Appendix B.

2 REGULATORY CONTEXT AND IMPACT ASSESSMENT CRITERIA

Greenhouse gases (GHGs) are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (IPCC, 2007). Human activities since the beginning of the Industrial Revolution (taken as the year 1750) have produced a 40% increase in the atmospheric concentration of carbon dioxide, from 280 ppm in 1750 to 415 ppm in early September 2021 (NOAA, 2021). This increase of CO_2 in the Earth's atmosphere has occurred despite the uptake of a large portion of the emissions by various natural "sinks" involved in the carbon cycle (NOAA, 2021). Anthropogenic CO_2 emissions (i.e., emissions produced by human activities) come from combustion of fossil fuels, principally coal, oil, and natural gas, along with waste processing and decomposition, deforestation, soil erosion and animal agriculture (IPCC, 2007).

The following sections describe the alignment of South African national policies regarding greenhouse gas emissions and reporting with international agreements and targets.

2.1 International Agreements

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change, (UNFCCC) as a framework for international cooperation to combat climate change by limiting average global temperature increases and the resulting climate change, and coping with impacts that were, by then, inevitable.

By 1995, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed country parties to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. As agreed in Doha in 2012, the second commitment period began on 1 January 2013 and will end in 2020 (UNFCCC, 2017) but due to lack of ratification has not come into force.

The Paris Agreement (2016) builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The central aim of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2.0°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives.

The Paris Agreement requires all Parties to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts.

In 2018, Parties took stock of the collective efforts in relation to progress towards the goals set in the Paris Agreement to inform the preparation of NDCs. There will also be a global stocktake every five years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties.

As of October 2022, 194 Parties of the 197 Parties to the UNFCCC Convention, including South Africa, had ratified the Paris Agreement. South Africa submitted its NDC to the UNFCCC on 25 September 2016 and an updated NDC in September 2021.

2.2 South African National Climate Change Response Policy 2011

South Africa ratified the UNFCCC in August 1997 and acceded to the Kyoto protocol in 2002, with effect from 2005. However, since South Africa is an Annex 1 country it implies no binding commitment to cap or reduce GHG emissions. South Africa later also ratified the Paris Agreement (as signed on 22 April 2016) which although not bound to commit to a cap or reduce GHG emissions, pledged to reduce emissions by 34% below Business-As-Usual (BAU) emissions by 2020 and 42% below BAU by 2025. The proposed 2030 target range represents a 28% reduction in GHG emissions commitment from the original 2015 NDC targets. However, these original goals were ambitious and South Africa subsequently shifted from BAU-based targets for 2020 and 2025 in terms of the Cancun Agreement under the UNFCCC, to absolute GHG emissions targets under the Paris Agreement. This update demonstrates reducing the upper range of South Africa's targets by a more realistic 17% for 2025 and 28% for 2030, respectively.

The National Climate Change Response White Paper, passed by Cabinet in October 2011, stated that in responding to climate change, South Africa has two objectives: to manage the inevitable climate change impacts and to contribute to the global effort in stabilising GHG emissions at a level that avoids dangerous anthropogenic interference with the climate system. The White Paper proposes mitigation actions, especially a departure from coal-intensive electricity generation, be implemented in the short- and medium-term to match the GHG trajectory range. Peak GHG emissions are expected between 2020 and 2025 before a decade long plateau period and subsequent reductions in GHG emissions.

The White Paper also highlighted the co-benefit of reducing GHG emissions by improving air quality and reducing respiratory diseases by reducing ambient particulate matter, ozone, and sulfur dioxide concentrations to levels in compliance with the National Ambient Air Quality Standards (NAAQS) by 2020. To achieve these objectives, the Department of Forestry, Fisheries and Environment (DFFE) established a national GHG emissions inventory that reports through the South African Atmospheric Quality Information System (SAAQIS).

The draft Climate Change Bill was published for comment on the 8th of June 2018 and introduced to parliament on the 18th of February 2022 (B9-2022). The Bill is aligned with international policies guidelines and South Africa's NDC and aim to reduce GHG emissions as primary driver to anthropogenic climate change. The aim of the Bill is to achieve an effective climate change response through a long-term just transition to a low carbon economy that is climate resilient and allows for sustainable development of South Africa. When in force, the Bill will:

- Establish provincial and municipal forums on climate change which will be responsible for co-ordinating climate change response actions in each province.
- Strengthen the establishment of the Presidential Climate Change Coordinating Commission (4PC). Although, the 4PC has already been established and has been working for the Government since December 2020, its establishment only carries legal force after the Bill becomes an Act.
- Establish a National Adaptation Strategy to guide South Africa's adaptation to the impacts of climate change and develop adaptation scenarios which anticipate the likely impacts over the short, medium, and long term.

- Determine a national GHG emissions trajectory, which must be reviewed every five years, and which indicates an emissions reduction objective.
- Put in place a 5-yearly sectoral emission targets for identified sectors and sub-sectors that must be aligned with the national GHG emissions trajectory and include quantitative and qualitative GHG emission reduction goals.
- Bring into force the carbon budget allocation mechanism, which will be linked to the Carbon Tax Act, which will replace the current National Pollution Prevention Plan mechanism which is enforced under the National Environmental Management: Air Quality Act (NEM:AQA).

The Bill is nearing the end of its parliamentary process having been passed by the National Council of Provinces and been returned to the National Assembly for concurrence. It is likely to be enacted during the operational lifetime of the proposed project activities, if not before.

2.3 Nationally Determined Contribution

The first South African NDC submission was completed in 2016. This was undertaken to comply with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the UNFCC. An update of the first NDC was published submitted to the UNFCCC on 27 September 2021[1] in preparation for the 26th Conference of the Parties (held in Glasgow, Scotland in November 2021). This document describes South Africa's NDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions with updated revisions to the adaptation goals and mitigation targets.

As part of the updated adaption portion the following goals have been assembled:

1. Goal 1: Enhance climate change adaptation governance and legal framework.
2. Goal 2: Develop an understanding of the impacts on South Africa of 1.5 and 2°C global warming and the underlying global emission pathways through geo-spatial mapping of the physical climate hazards, and adaptation needs in the context of strengthening the key sectors of the economy. This will provide the scientific basis for strengthening the national and provincial governments' readiness to respond to climate risk.
3. Goal 3: Implementation of National Climate Change Adaptation Strategy adaptation interventions for the period 2021 to 2030, where priority sectors have been identified as biodiversity and ecosystems; water; health; energy; settlements (coastal, urban, rural); disaster risk reduction, transport infrastructure, mining, fisheries, forestry, and agriculture.
4. Goal 4: Mobilise funding for adaptation implementation through multilateral funding mechanisms.
5. Goal 5: Quantification and acknowledgement of the national adaptation and resilience efforts.

As part of the mitigation portion the following have been, or can be, implemented at National level:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer projects as part of a Renewable Energy Independent Power Producer Procurement Programme. An additional 6 300 MW is being deliberated.
- A "Green Climate Fund" has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.

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[1] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/South%20Africa%20First/South%20Africa%20updated%20first%20NDC%20September%202021.pdf

- Carbon Capture and Sequestration (or Carbon Capture and Storage) (CCS).
- To support the use of electric and hybrid electric vehicles.
- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar photovoltaic (PV); wind power; CCS; and advanced bioenergy.
- Updated targets based on revised 100-year global warming potential (GWP) factors (published in the Annex to decision 18/CMA.1 of the Intergovernmental Panel on Climate Change's (IPCC) 5th assessment report) and based on exclusion of land sector emissions arising from natural disturbance. The updated NDC mitigation targets, consistent with South Africa's fair share, are presented in Table 2-1.

Table 2-1: South Africa's NDC mitigation targets

Year	Target	Corresponding period
2025	South Africa's annual GHG emissions will be in a range between 398 - 510 Mt CO_2-e.	2021-2025
2030	South Africa's annual GHG emissions will be in a range between 398 - 440 Mt CO_2-e.	2026-2030

2.4 Greenhouse Gas Emissions Reporting

Regulations pertaining to GHG reporting using the National Atmospheric Emission Inventory System (NAEIS) were published on 3 April 2017 (Government Notice (GN) 257 in Government Gazette (GG) 40762 and amendment – GNR 994 in Government Gazette 43712). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only. The three broad scopes for estimating GHG are:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

The South African Greenhouse Gas Emission Reporting System (SAGERS) web-based monitoring and reporting system is used to collect GHG information in a standard format for comparison and analyses. The system forms part of the national atmospheric emission inventory component of South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP).

The DFFE is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC's default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors. Methodological guidelines for GHG emission estimation, which include country specific emission factors for fuels used in stationary and mobile combustion, have been issued (DFFE, 2022b)

Also, the Carbon Tax Act (Act 15 of 2019) includes details on the imposition of a tax on the CO_2-e of GHG emissions. Certain production processes indicated in Annexure A of the Declaration of Greenhouse Gases as Priority Pollutants (GN 710 in GG 40966, 21 July 2017) with GHG more than 0.1 Mt/year, measured as carbon dioxide equivalent (CO_2-e), are required to submit a pollution prevention plan to the Minister for approval. The proposed project will be required to report CO_2-e emissions but may not be required to prepare a pollution prevention plan, unless directed by the minister.

2.5 GHG Inventories

2.5.1 National GHG Emissions Inventory

South Africa is a GHG contributor and is undertaking steps to mitigate and adapt to the changing climate. DFFE is categorised as the lead climate change institution and is required to coordinate and manage climate related information such as development of mitigation, monitoring, adaption and evaluation strategies (DFFE, 2022a). This includes the establishment and updating of the National GHG Inventory. The National Greenhouse Gas Improvement Programme (GHGIP) has been initiated; it includes sector specific targets to improve methodology and emission factors used for the different sectors as well as the availability of data.

The 2020 National GHG Inventory was prepared using the 2006 IPCC Guidelines (IPCC, 2006). According to the draft 9th National GHG Inventory Report (DFFE, 2024), the total GHG emissions in 2022 were estimated at approximately 478.888 Mt CO_2e (excluding Land Use, Land Use Change and Forestry (LULUCF)). This was a 2.2% decrease from the 2000 total GHG emissions (excluding LULUCF). LULUCF is estimated to be a net carbon sink which reduces the 2022 GHG emissions to 435.828 Mt CO_2e. The assessment (excluding LULUCF) showed the main sector contributing to GHG emissions in 2022 to be the energy sector, contributing 78% to the total GHG emissions.

2.5.2 GHG Emission Inventory for the Sector

The proposed project would be categorised in the energy category for both the global GHG inventory and for the national GHG inventory. According to the World Resources Institute – CAIT Climate Data Explorer[2] the 2021 global GHG emissions from the energy category were approximately 370 408 Mt CO_2-e; 75.5% of the total GHG emissions (including Land-Use Change and Forestry (LUCF)). The South African energy sector contributed 426.12 Mt CO_2-e, ~1.14% of the global emissions from the energy sector in 2021.

2.5.3 Draft National Guideline for Consideration of Climate Change in Development Applications, June 2021

The DFFE published (on 25 June 2021) a notice under the NEMA requesting public comment on the *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 has been developed to support the inclusion of climate change considerations into the Environmental Impact Assessment (EIA) process, and to create a consistent approach for such incorporation, which will help proponents to assess:

- how a proposed development will likely exacerbate climate change;
- the impact of a development on features (natural and built) that are crucial for climate change adaptation and resilience; and,
- the sustainability of a development in the context of climate change projection.

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[2] http://cait.wri.org/

The Guideline puts forward “a consistent approach in providing interested and affected parties (for example, proponents, EAPs and specialists) with the minimum requirements to consider when undertaking a climate change assessment, which forms part of an application for environmental authorisation, an atmospheric emissions licence, and/or waste management licence”.

One of the impact requirements for a climate change assessment is an estimation of the GHG emissions, direct and indirect (including upstream GHG emissions) that will be released into the atmosphere annually throughout the impact related to the activity.

The comment period for amendments to the draft guideline has now closed but the final guideline has not yet been published. As far as possible the guideline has been followed in the preparation of this climate change impact assessment in support of environmental authorisation.

3 PHYSICAL RISKS OF CLIMATE CHANGE ON THE REGION

The discussions of physical risks of climate change discussed in this section are likely to be relevant to the project as well as to the communities surrounding the project even if the project is not authorised.

3.1 Vulnerability

The Green Book (CSIR, 2019); was developed to be an online platform providing quantitative scientific evidence on the likely impacts that climate change and urbanisation will have on South Africa's cities and towns. A profile for each local municipality, including individual settlements and neighbourhoods, was built in terms the rates of socio-economic, economic, physical and environmental risks associated with urbanisation, population growth and climate change (Le Roux, et al., 2019). The risk profile was accessed for the Ekurhuleni Municipality[3]. The Ekurhuleni Municipality socio-economic vulnerability score[4] (out of 10) is 2.5 for 1996, reducing to 1.9 for 2011. The lower score in 2011 compared to 1996 indicates improvement of socio-economic factors. The Ekurhuleni Municipality for socio-economic vulnerability ranks 3rd out of 9 in the province and 19th out of 213 in the country. The Ekurhuleni Municipality economic vulnerability score[5] (out of 10) is 3.2 for 1996, increasing to 4.5 for 2011. The economic vulnerability ranks 3rd out of 9 in the province and 61st out of 213 in the country. The physical vulnerabilities[6] ranks 2nd out of 9 in the province and 2nd out of 213 in the country. The environmental vulnerability[7] ranks 9th out of 9 in the province and 212th out of 213 in the country.

3.2 Climate

3.2.1 Baseline Climate

Climate change metrics focus on temperature; the number of very hot days (where temperatures exceed 35°C); rainfall and extreme rainfall events (more than 20 mm in 24 hours). The baseline (1961 to 1990) annual averages for these metrics were

3 https://riskprofiles.greenbook.co.za/

4 Defined as the vulnerability of households based on household composition; education and health; access to basic services; safety and security.

5 Defined as the susceptibility of the municipality to external shocks based on economic diversity; size of economy; labour force; gross domestic product (GDP) growth rate; and inequality.

6 Defined by the physical fabric of connectedness of the settlements within the municipalities and structural robustness.

7 This indicator represents the balance between preserving the natural environmental and the pressures of population growth, urbanisation, and economic development. The indicator is based on air quality, environmental governance and competition between ecology and the urban environment.

accessed for the area near the project site from the South Africa 'Green Book'[8] (CSIR, 2019). The metrics include three percentiles[9] (10th, 50th, and 90th) as an indication of the variability within the measured data set.

Baseline annual average temperature was in the range 15.57°C (10th percentile) and 15.81°C (90th percentile) (Figure 3-1) with the number of very hot days varying between 0.12 (10th percentile) and 0.84 (90th percentile) days per year (Figure 3-2). The annual average rainfall range between the 10th and 90th percentiles is 832.92 mm and 916.83 mm (Figure 3-3). Extreme rainfall days varied between 8.89 (10th percentile) and 9.94 (90th percentile) days per year (Figure 3-4).

[8] https://greenbook.co.za/

[9] A percentile is a statistical measure to indicate the value below which a given percentage of observations in a group of observations falls. For example, the 90th percentile is the value below which 90% of the observations fall. The 10th percentile is the value below which 10% of the observations fall.

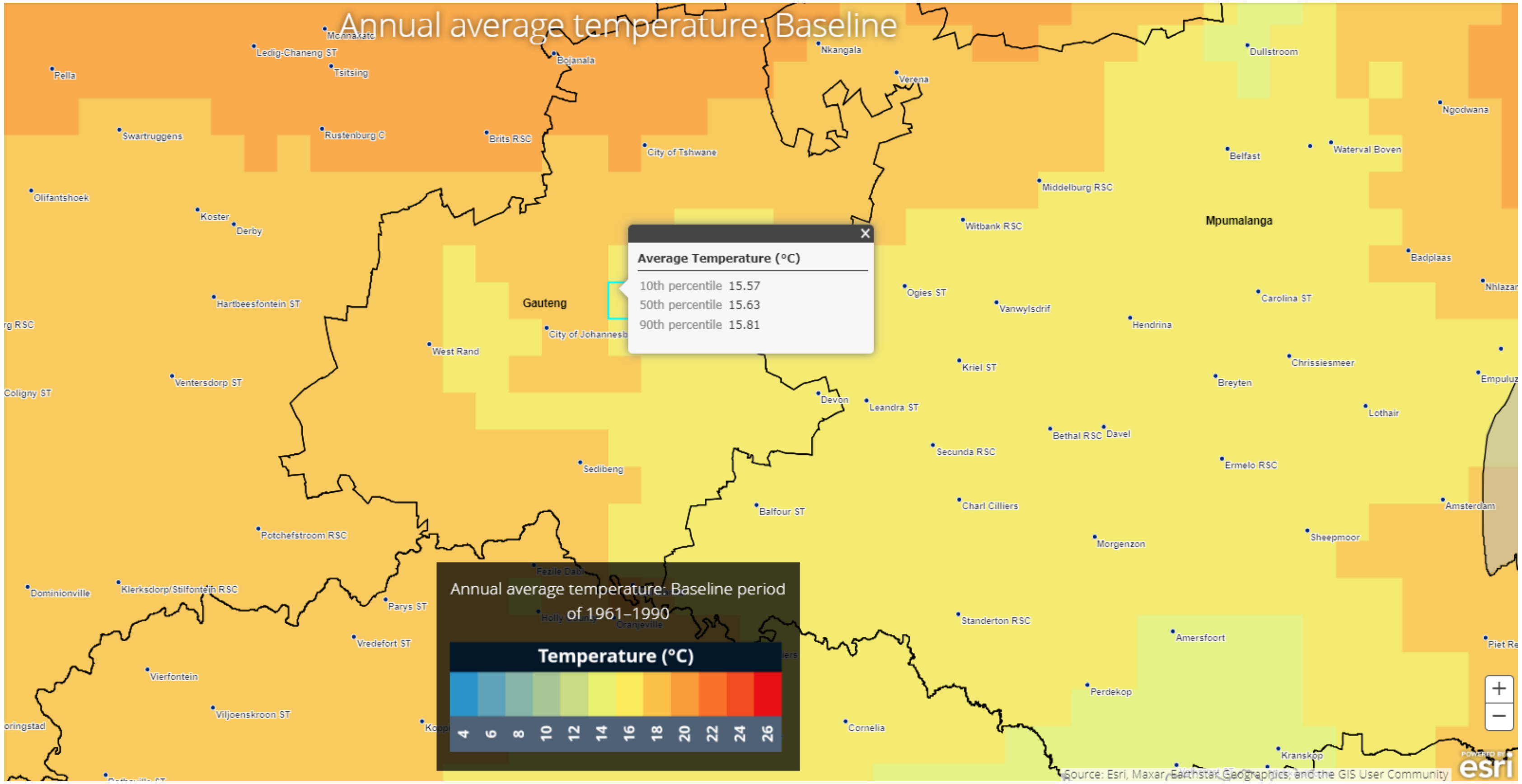


Figure 3-1: Baseline (1961 to 1990) annual average temperature for the project area (CSIR, 2019)

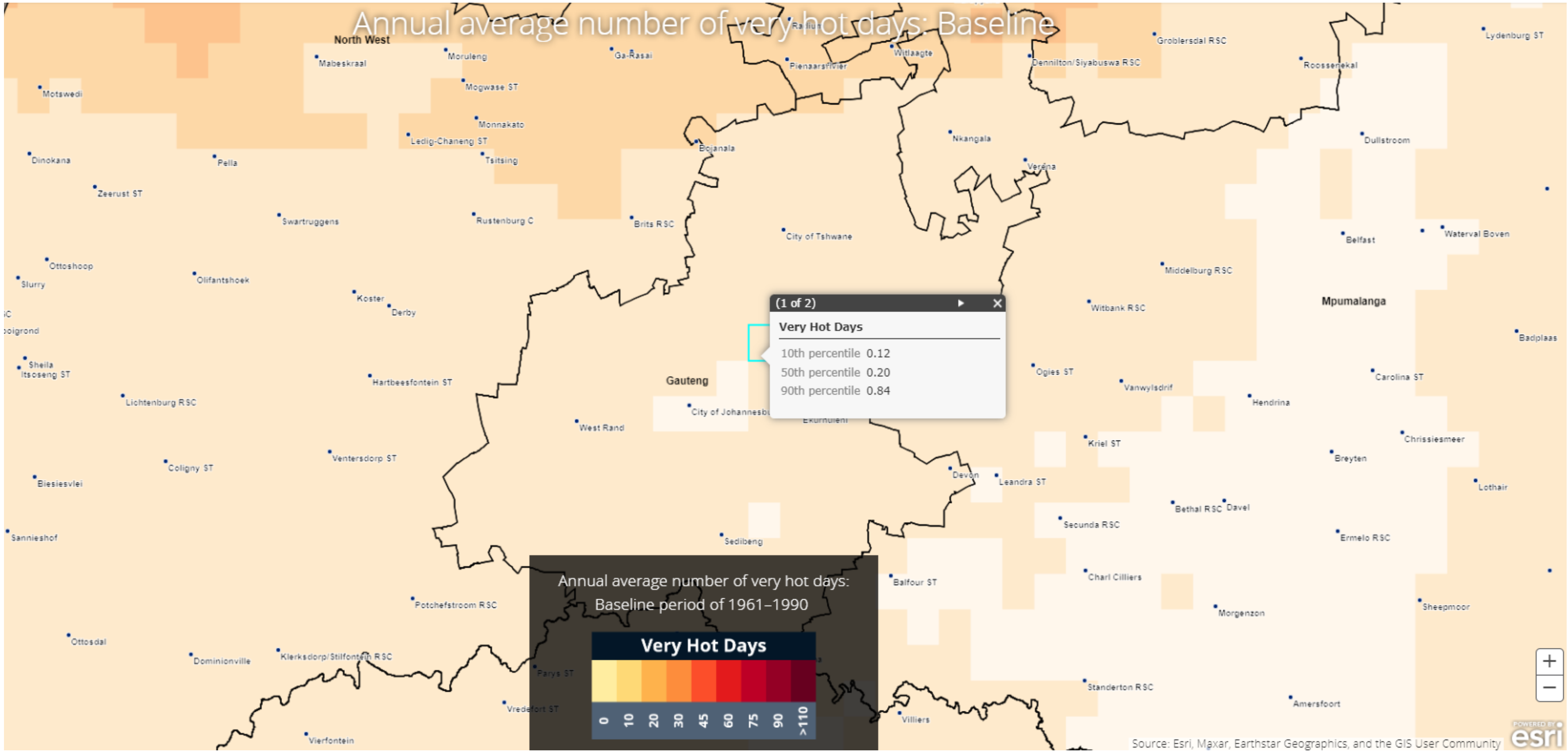


Figure 3-2: Baseline (1961 to 1990) number of very hot days (>35°C) annually for the project area (CSIR, 2019)

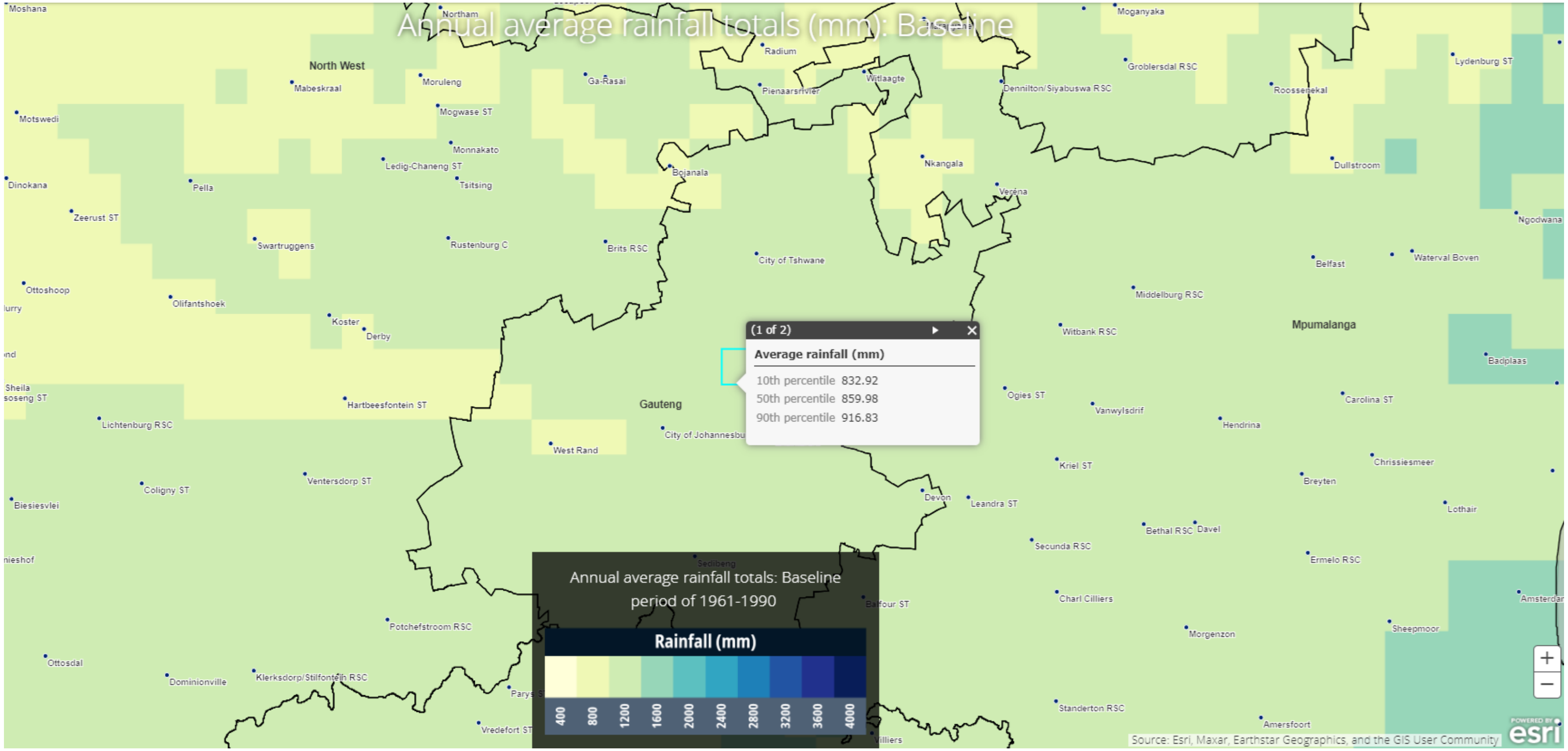


Figure 3-3: Baseline (1961 to 1990) annual average rainfall for the project area (CSIR, 2019)

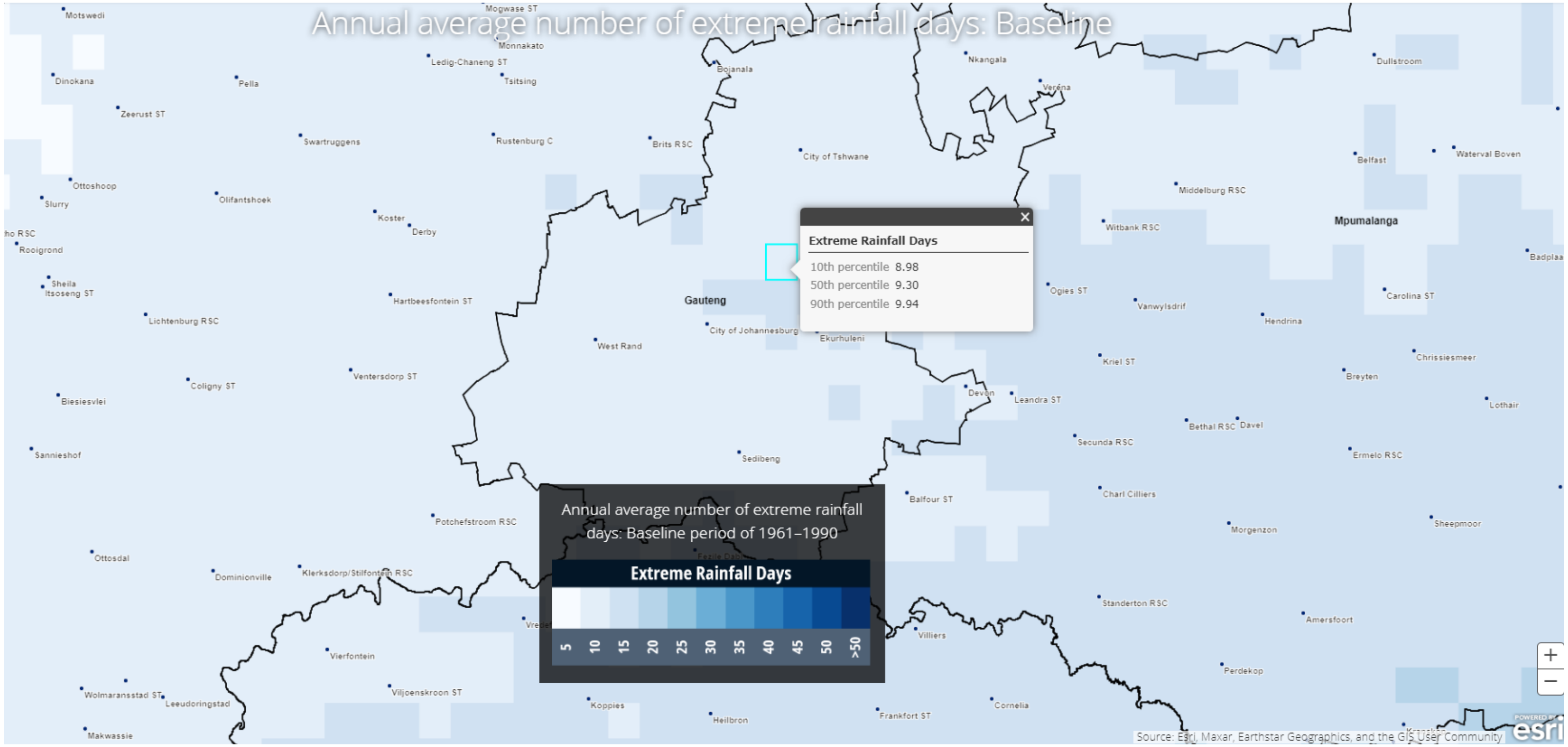


Figure 3-4: Baseline (1961 to 1990) annual average number of extreme rainfall days (>20 mm in <24 hours) for the project area (CSIR, 2019)

Recent change in climatic conditions near the project site were accessed from MeteoBlue[1] a weather forecasting platform developed at the University of Basel, Switzerland and based on models of National Oceanic and Atmospheric Administration (NOAA) or National Centres for Environmental Prediction (NCEP). The data sets also include historical climate data tracking changes in climate by referencing ERA5, the fifth generation ECMWF (European Centre for Medium-Range Weather Forecasts) atmospheric reanalysis of the global climate, for the period between 1979 to 2021, with a spatial resolution of 30 km. Based on a point selected over the project site, an increasing trend in the annual average temperatures have been observed from 15.3°C in 1979 to 16.7°C in 2023 (Figure 3-5 – top panel). The lower part the graph shows the so-called warming stripes. Each coloured stripe represents the average temperature for a year - blue for colder and red for warmer years. The change in rainfall over the same period (1979 – 2023) displays a slight decreasing trend from 807.5 mm in 1979 to 720.1 mm in 2023 (Figure 3-6), where the difference from long-term average for each year in the data set is visualised by the stripes in the lower panel of Figure 3-6 (brown stripes indicate lower than average rainfall and green stripes above average rainfall).

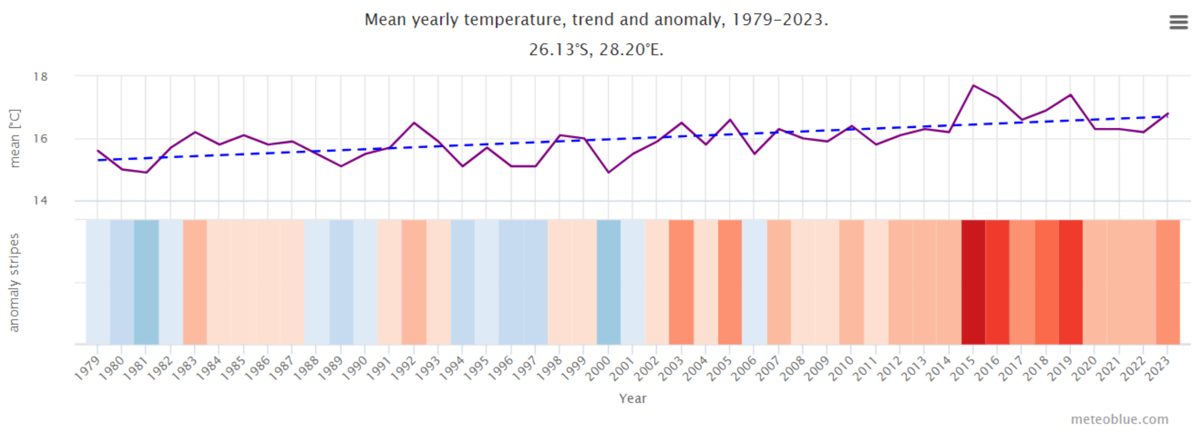


Figure 3-5: Annual average temperature (top panel) and temperature anomaly (lower panel) between 1979 and 2023 (meteoblue AG, 2024)

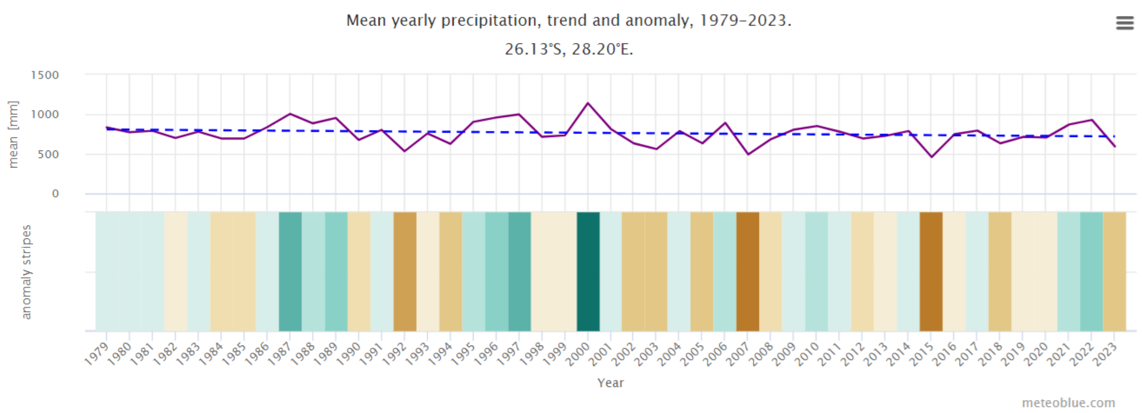


Figure 3-6: Annual average rainfall (top panel) and rainfall anomaly (lower panel) between 1979 and 2023 (meteoblue AG, 2024)

[1] https://www.meteoblue.com

3.2.2 Projected Future Climate

In 2017 the South African Weather Services (SAWS) published an updated Climate Change Reference Atlas (CCRA) based on Global Climate Change Models (GCMs) projections (SAWS, 2017). It must be noted that as with all atmospheric models there is the possibility of inaccuracies in the results as a result of the model's physics and accuracy of input data; for this reason, an ensemble of models' projections is used to determine the potential change in near-surface temperatures and rainfall depicted in the CCRA. The projections are for 30-year periods described as the near future (2036 to 2065) and the far future (2066 to 2095). Projected changes are defined relative to a historical 30-year period (1976 to 2005). The Rossby Centre regional model (RCA4) was used in the predictions for the CCRA which included the input of nine GCMs results. The RCA4 model was used to improve the spatial resolution to 0.44° x 0.44°- the finest resolution GCMs in the ensemble were run at resolutions of 1.4° x 1.4° and 1.8° x 1.2°. Findings from downscaled climatic simulations using six global climate models, at an 8 km x 8 km resolution over South Africa, for the time slab 2021 to 2050 were included in the Green Book (Engelbrecht, 2019).

In both the CCRA and the Green Book, two trajectories are included based on the four Representative Concentration Pathways (RCPs) discussed in the IPCC's fifth assessment report (AR5) (IPCC, 2013). RCPs are defined by their influence on atmospheric radiative forcing in the year 2100. RCP4.5 represents an addition to the radiation budget of 4.5 W/m^2 as a result of an increase in GHGs. The two RCPs selected were RCP4.5 representing the medium-to-low pathway and RCP8.5 representing the high pathway. RCP4.5 is based on a CO_2 concentration of 560 ppm and RCP8.5 on 950 ppm by 2100. RCP4.5 is based on if current interventions to reduce GHG emissions being sustained (after 2100 the concentration is expected to stabilise or even decrease). RCP8.5 is based on if no interventions to reduce GHG emissions being implemented (after 2100 the concentration is expected to continue to increase).

3.2.2.1 RCP4.5 Trajectory

Based on the median, for the region in which the proposed project is situated, the annual average near surface temperatures (2 m above ground) are expected to increase by ~2.5°C for the near future and ~3.0°C for the far future (SAWS, 2017). The Green Book projected temperature changes in the near future (2021 to 2050) indicate a 50th percentile increase of 2.31°C and a 90th percentile increase of 2.75°C (Figure 3-7, Engelbrecht, et al., 2019). The number of very hot days are expected to increase by 5.6 days per year (50th percentile) to 9.5 days per year (90th percentile) (Figure 3-8). Between 2021 and 2050 the annual rainfall near the project site is projected to increase by 46 mm per year (50th percentile) (Figure 3-9, Engelbrecht, et al., 2019), with extreme rainfall days unlikely to see a substantial change in the near future (Figure 3-10, Engelbrecht, et al., 2019).

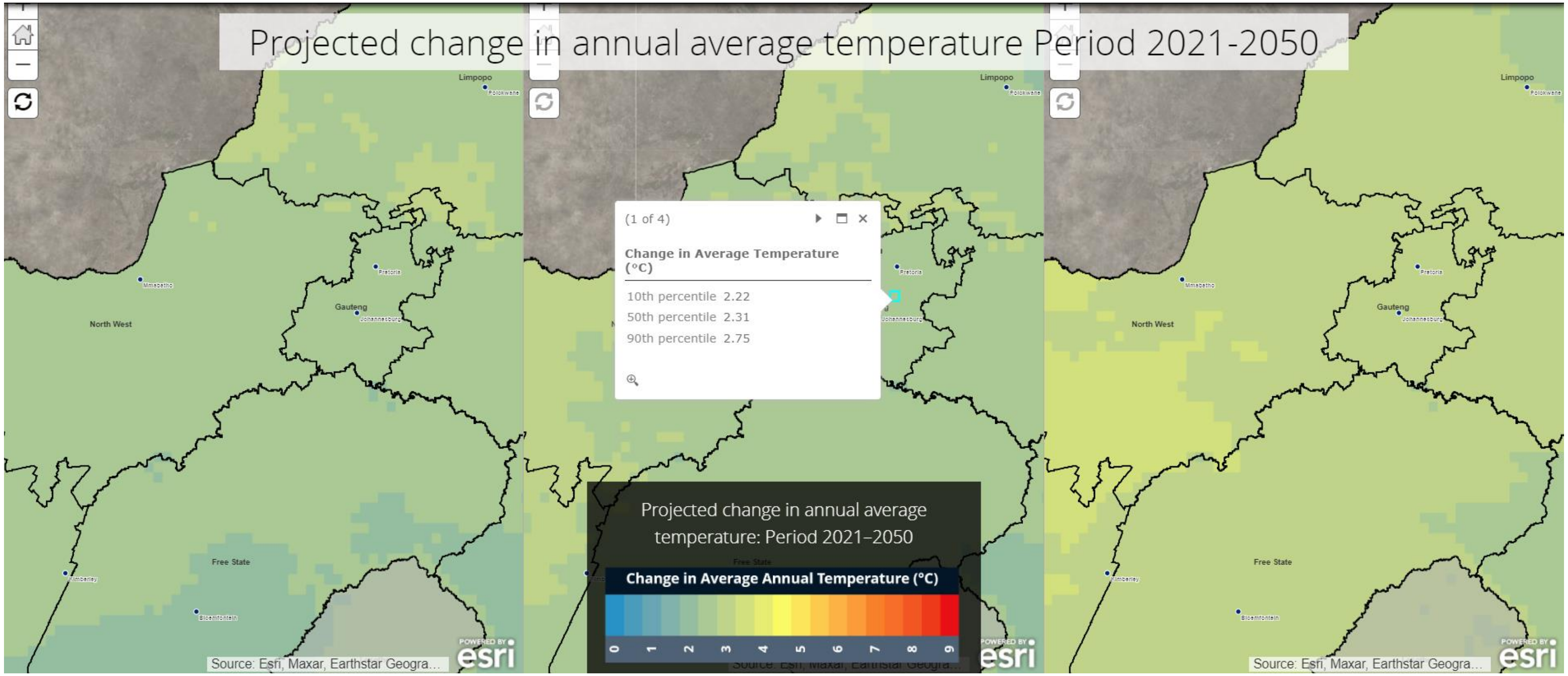


Figure 3-7: Projected change in annual average temperature for the near future (2021 – 2050) for the RCP4.5 trajectory

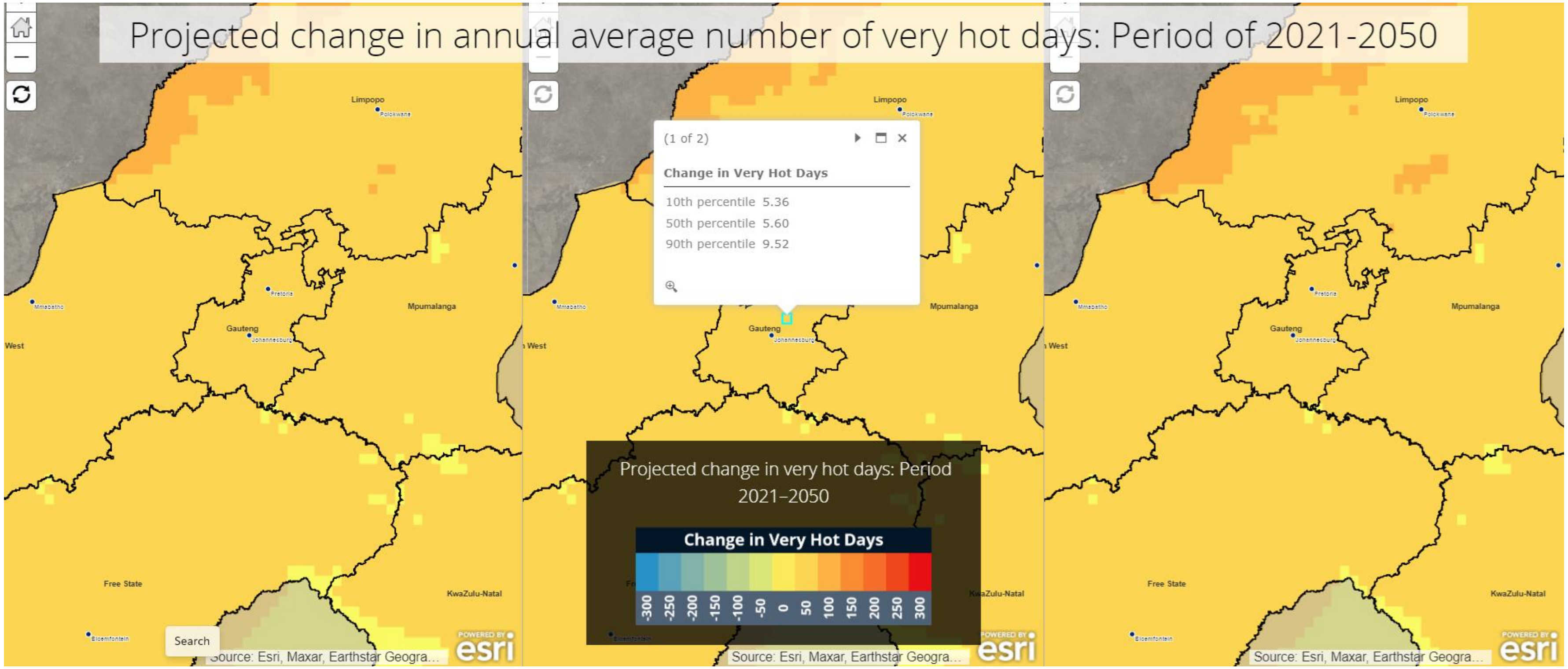


Figure 3-8: Projected change in very hot days for the near future (2021 – 2050) for the RCP4.5 trajectory

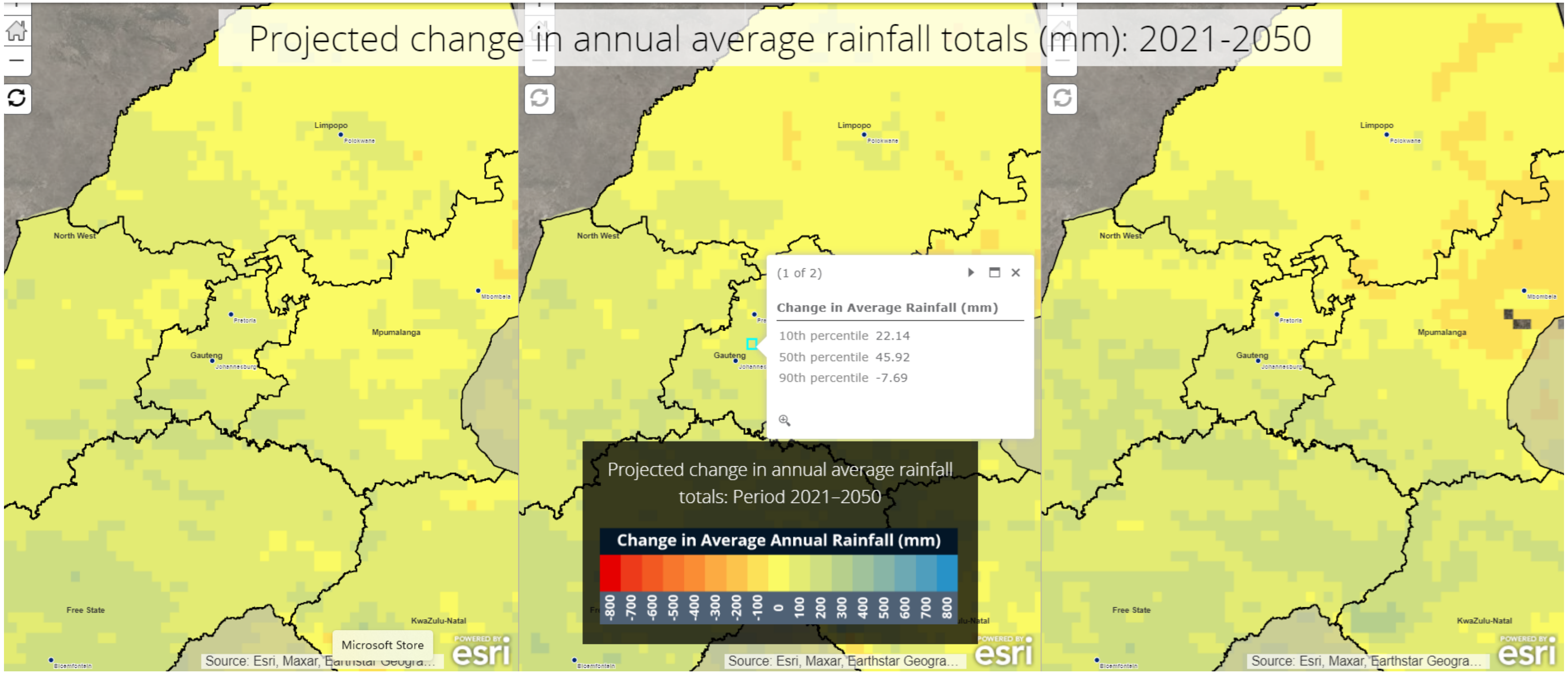


Figure 3-9: Projected change in annual average rainfall for the near future (2021 – 2050) for the RCP4.5 trajectory

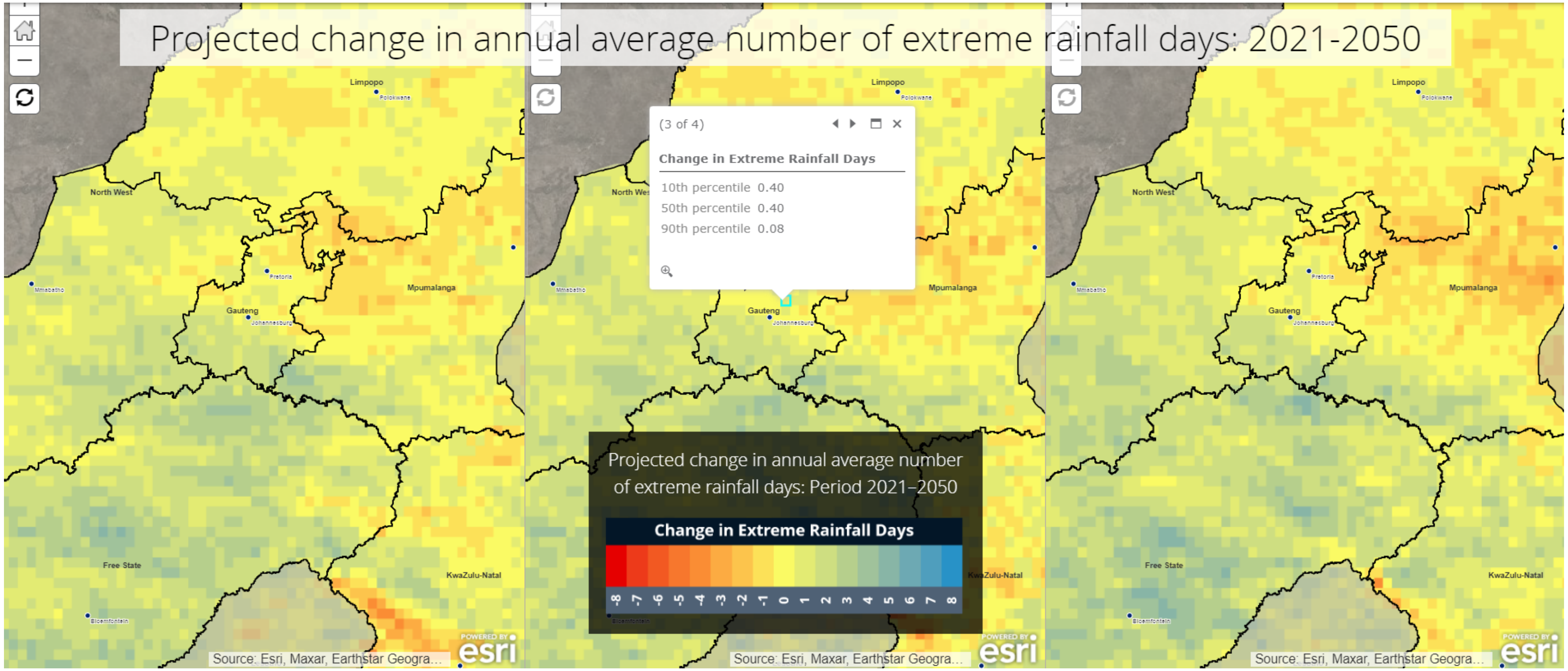


Figure 3-10: Projected change in annual average number of extreme rainfall days (>20 mm in <24 hours) for RCP4.5 trajectory

3.2.2.2 RCP8.5 Trajectory

Based on the median, the region in which the project and receptors are situated, the annual average near surface temperatures (2 m above ground) are expected to increase by 3.0°C and 4.5°C for the near and far future respectively (SAWS, 2017). The Green Book projected temperature changes in the near future (2021 to 2050) indicate a 50th percentile increase of 2.83°C and a 90th percentile increase of 2.99°C (Figure 3-11, Engelbrecht, *et al.*, 2019). The number of very hot days are expected to increase to 9 days per year (50th percentile) (Figure 3-12). Between 2021 and 2050 the annual rainfall near the project site was projected to decrease by 90 mm per year between 2021 and 2050 (50th percentile) (Figure 3-13, Engelbrecht, *et al.*, 2019), with extreme rainfall days unlikely to see a substantial change in the near future (Figure 3-14, Engelbrecht, *et al.*, 2019).

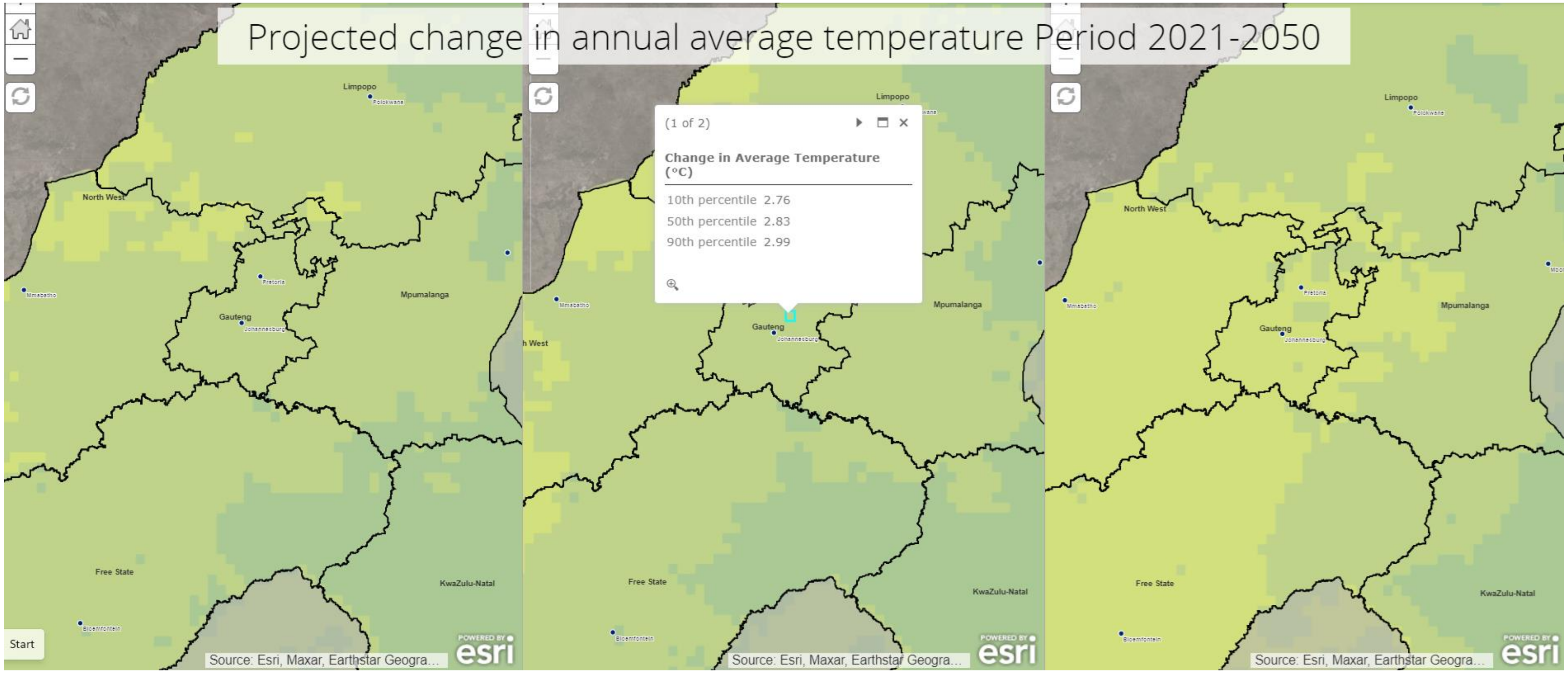


Figure 3-11: Projected change in annual average temperature for the near future (2021 – 2050) for the RCP8.5 trajectory

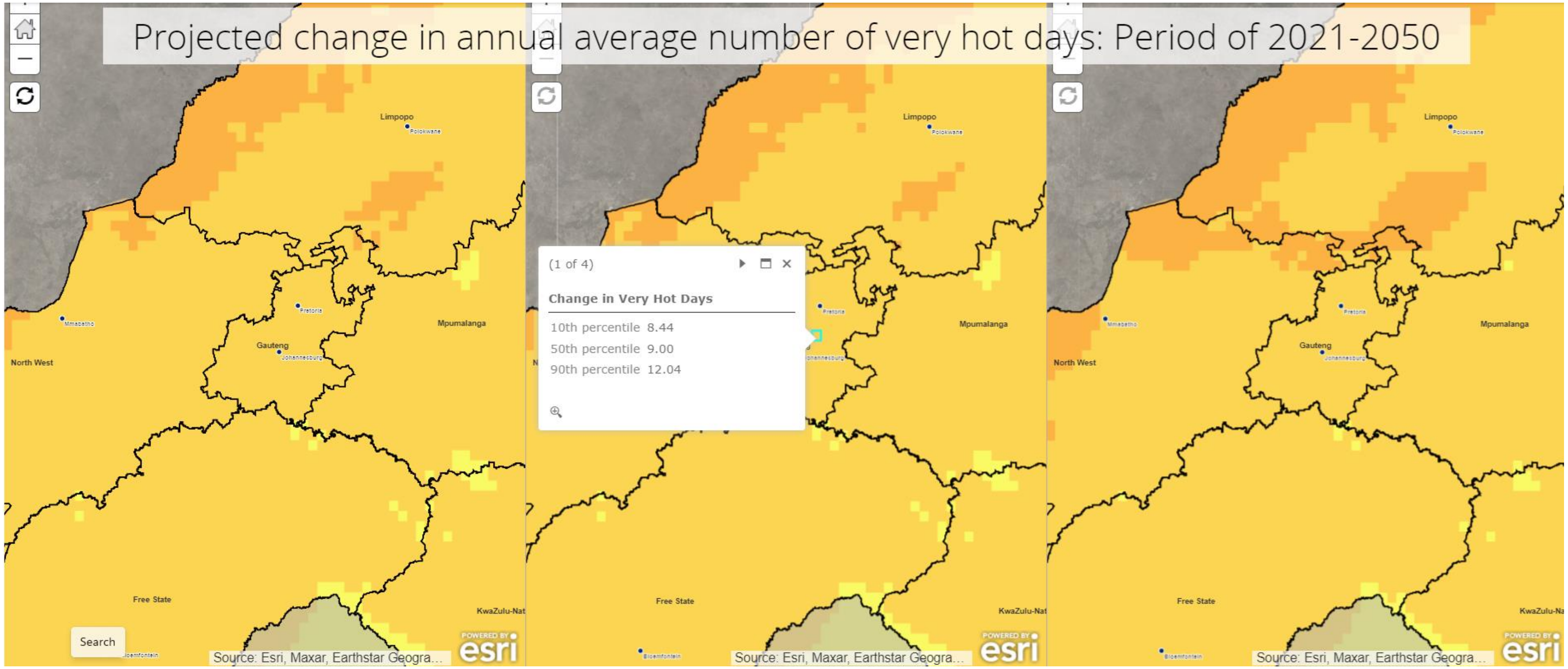


Figure 3-12: Projected change in very hot days for the near future (2021 – 2050) for the RCP8.5 trajectory

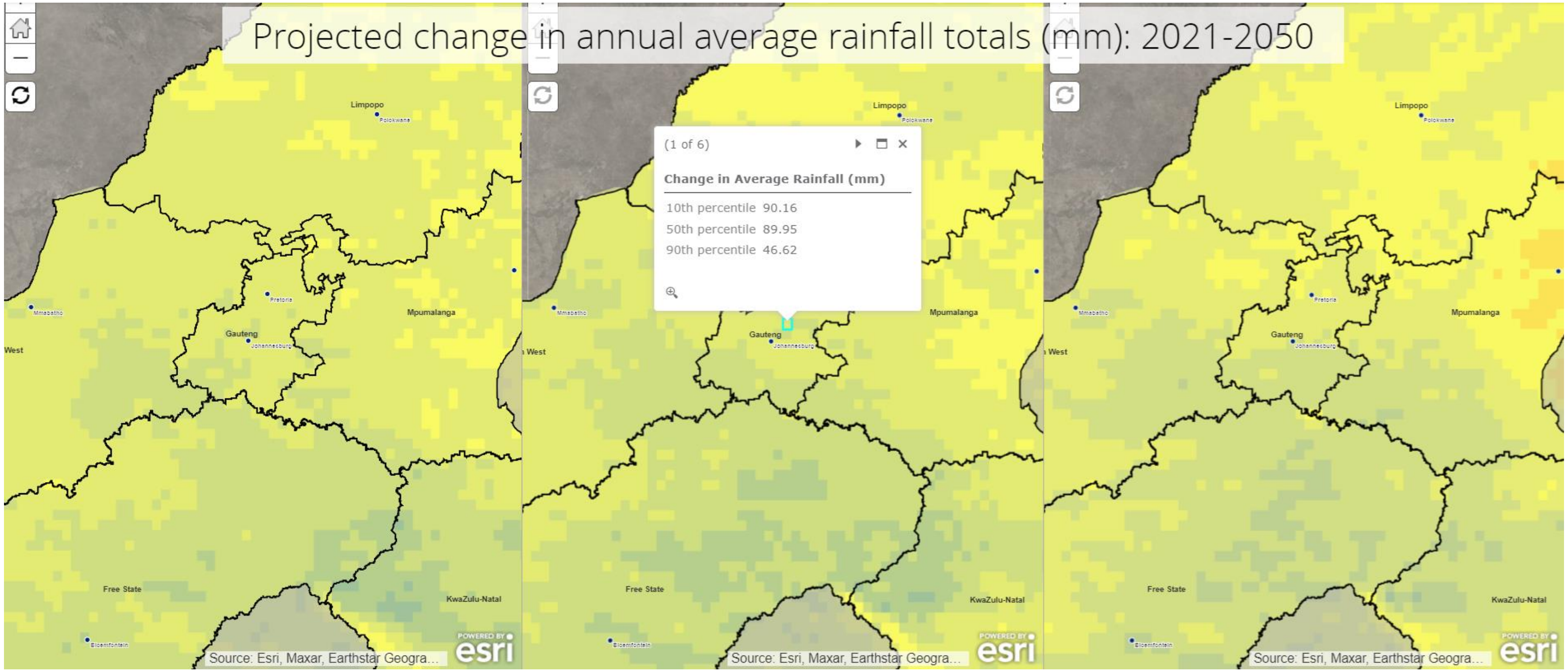


Figure 3-13: Projected change in annual average rainfall for the near future (2021 – 2050) for the RCP8.5 trajectory

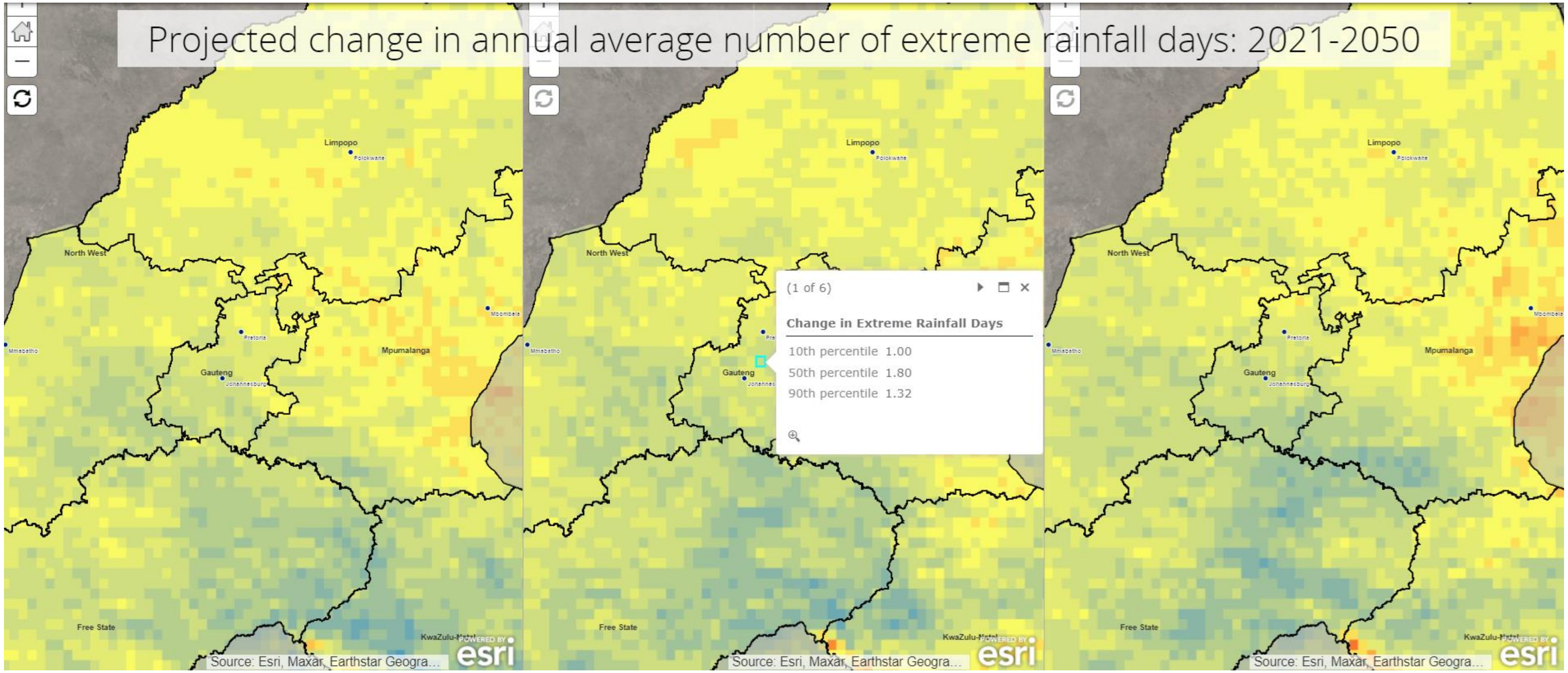


Figure 3-14: Projected change in annual average number of extreme rainfall days (>20 mm in <24 hours) for RCP8.5 trajectory

3.2.2.3 IPCC's Sixth Assessment Report: Temperature and Rainfall Projections

The most recent IPCC data are from the Coupled Model Intercomparison Project (CMIP) which were derived from the sixth phase of the CMIPs (CMIP6) and supports the IPCC's Sixth Assessment Report (AR6) which was released on 9 August 2021 (Working Group I), 28 February 2022 (Working Group II and 4 April 2022 (Working Group III). Projection data is presented at a 1.0º x 1.0º (100 km x 100 km) resolution. The scenarios are the result of complex calculations that depend on how quickly humans curb greenhouse gas emissions, whilst also capturing socioeconomic changes in areas such as population, urban density, education, land use and wealth. For example, a rise in population is assumed to lead to higher demand for fossil fuels and water. Education can affect the rate of technology developments. Emissions increase when land is converted from forest to agricultural land. Each scenario is labelled to identify both the emissions level and the so-called Shared Socioeconomic Pathway, or SSP, used in those calculations. This first scenario is the only one that meets the Paris Agreement's goal of keeping global warming to around 1.5°C above preindustrial temperatures, with warming hitting 1.5°C but then dipping back down and stabilizing around 1.4°C by the end of the century. Projected changes are defined relative to a historical 20-year period (1995 to 2014).

The AR6 projections for the study area for the scenario RCP2.6 indicate an increase in annual average temperatures of 1.5°C for the period 2041 to 2060 and 1.6°C for the period 2081 to 2100. The projections for the RCP4.5 indicate an increase in annual average temperatures of 1.9°C for the period 2041 to 2060, to 2.9°C for the period 2081 to 2100 (IPPC, 2022). Although the CCRA and AR6 projections are based on different baselines, with the former earlier by a decade, and the definitions of the scenarios not exactly the same, the temperature projections are in the same order of magnitude.

The AR6 projections for rainfall in the study area for RCP2.6 indicate a decrease in annual rainfall of 2.6% for the period 2041 to 2060, to 3.5% for the period 2081 to 2100. The projections for RCP4.5 indicate decrease of rainfall of 4% for the period 2041 to 2060, to 2.9% for the period 2081 to 2100 (IPPC, 2022).

3.3 Hazards

The Green Book risk profile includes an assessment of projected risk to the Ekurhuleni Municipality in 2050, mostly based on the low mitigation RCP8.5 climate simulations, and highlights the following:

- Low increased risk of wildfires with 17 increased fire danger days over the project area (Figure 3-15);
- Very low risk of increased drought frequency over the project area and the Standardized Precipitation Index (SPI)[1] of -1.03 (Figure 3-16);
- Medium potential increase in exposure to heat extremes over the project area (Figure 3-17); and,
- Low risk of increased urban flooding over the project area with moderate increase in rainfall days expected (1.084) (Figure 3-18).

1 The Standardized Precipitation Index (SPI) is a widely used index to characterize meteorological drought on a range of timescales. SPI index.

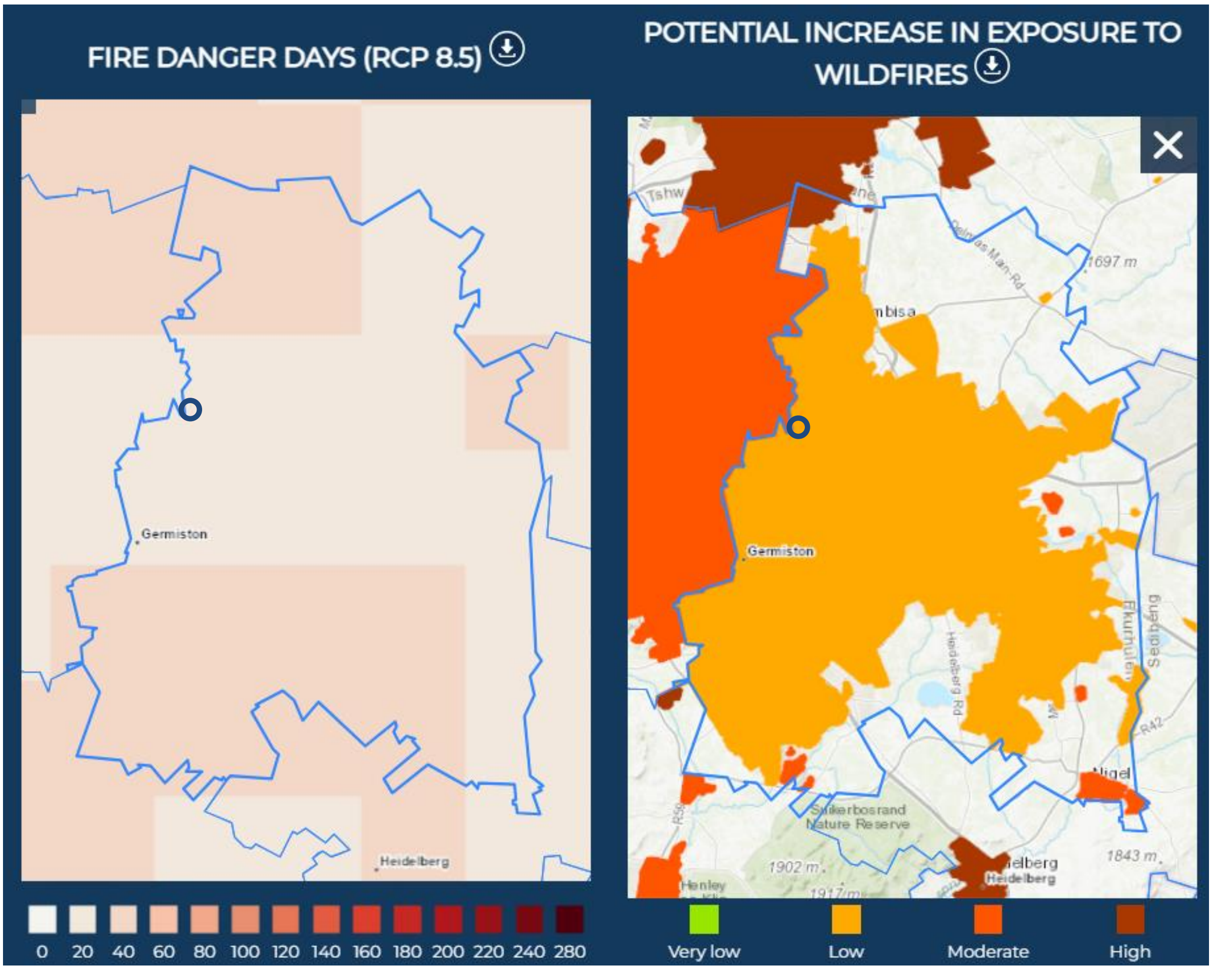


Figure 3-15: Risk of increased wildfires for Ekurhuleni Municipality in 2050 based on RCP8.5 trajectory (dark blue marker indicates approximate location of the project)

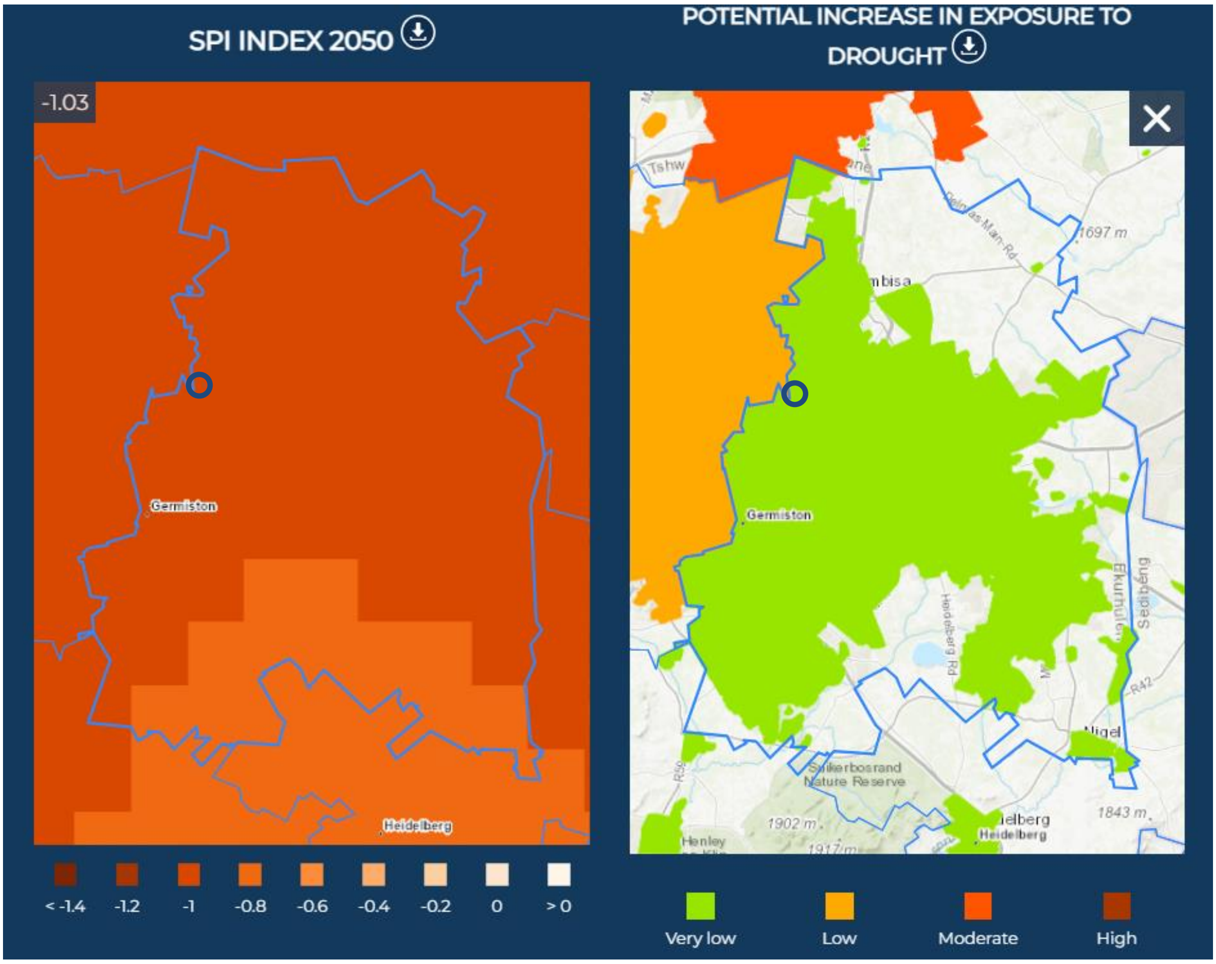


Figure 3-16: Risk of increased drought tendencies for Ekurhuleni Municipality in 2050 based on RCP8.5 trajectory (dark blue marker indicates approximate location of the project)

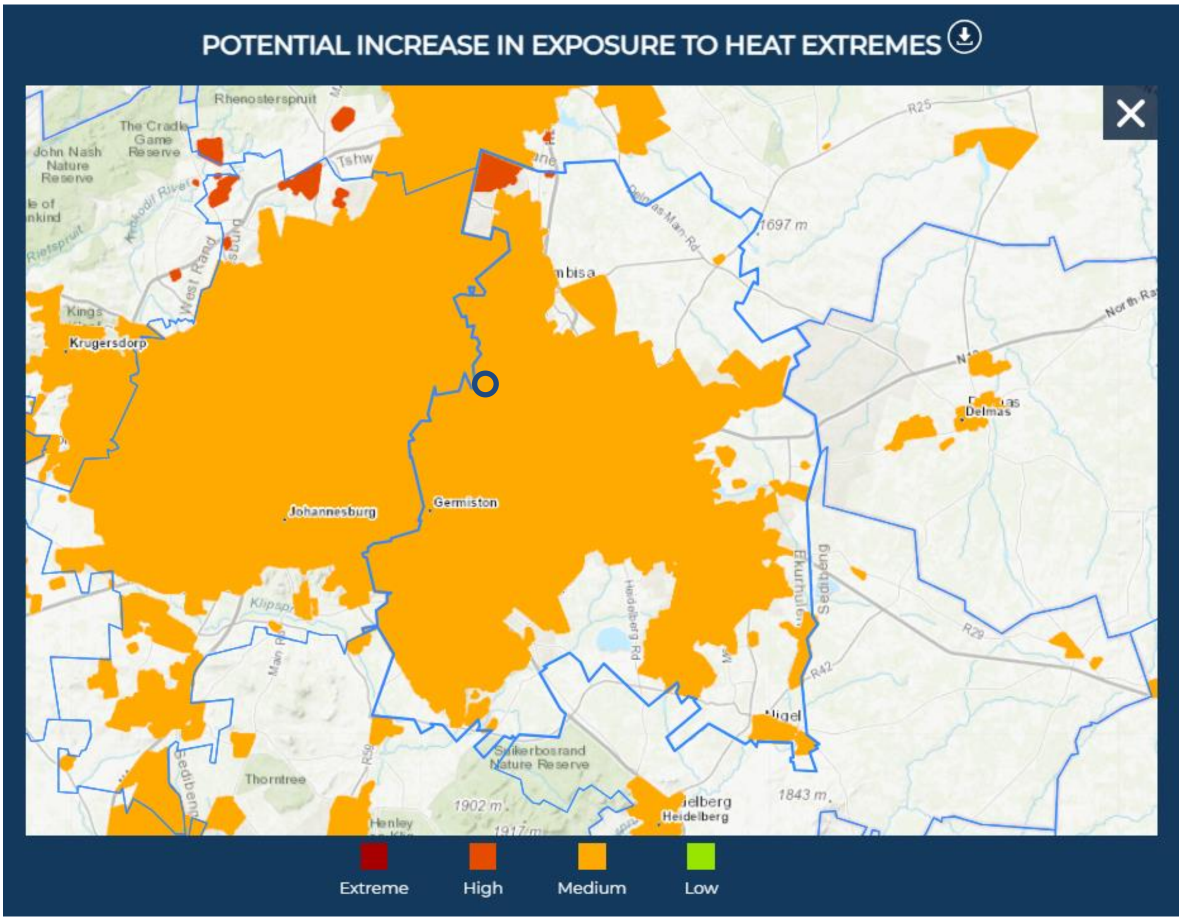


Figure 3-17: Risk of increased heat extremes for Ekurhuleni Municipality in 2050 based on RCP8.5 trajectory (dark blue marker indicates approximate location of the project)

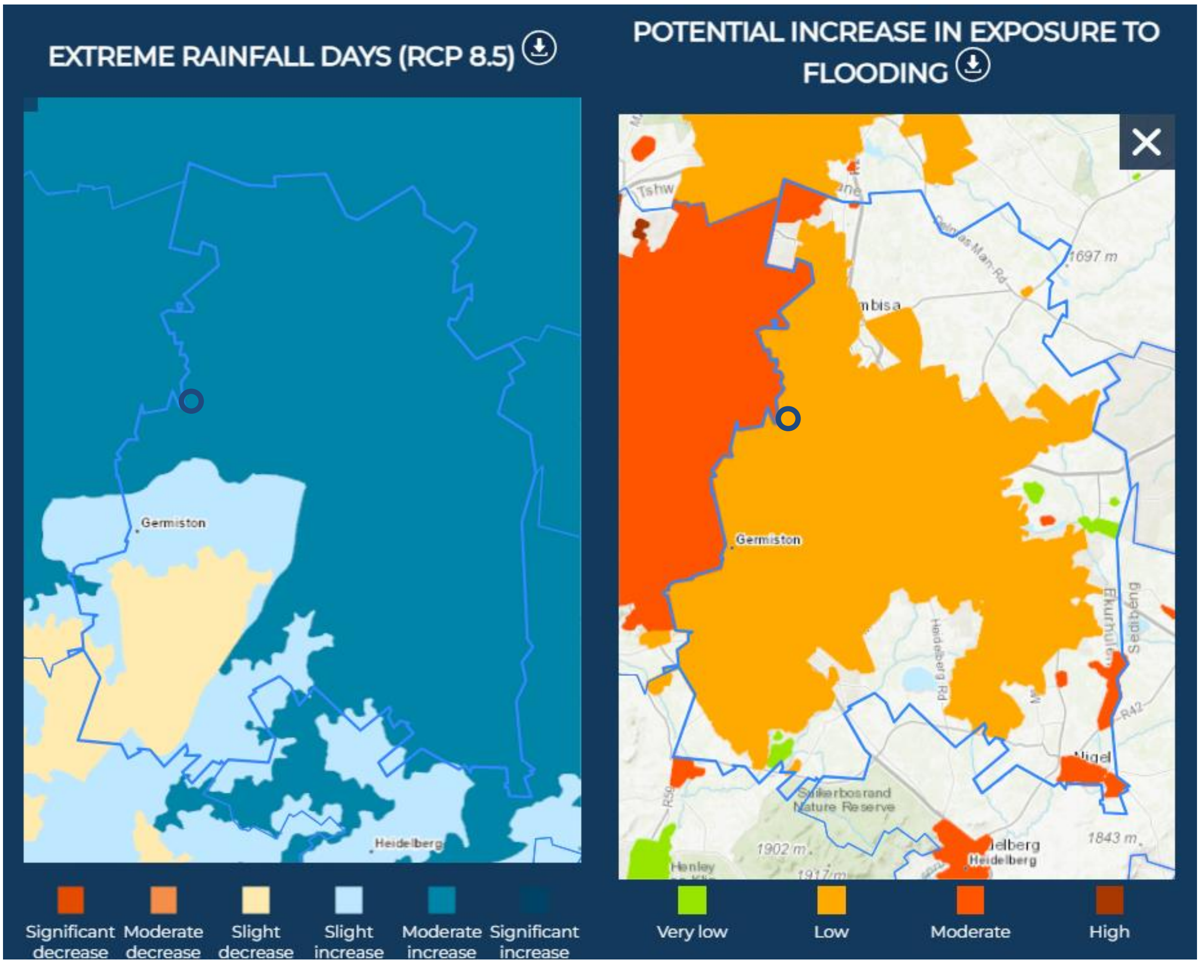


Figure 3-18: Risk of increased flooding for Ekurhuleni Municipality in 2050 based on RCP8.5 trajectory (dark blue marker indicates approximate location of the project)

In addition to the hazards identified in the Green Book, Hofste, *et al.,* (2019) currently rate the project area at extremely high risk of water stress (Figure 3-19) with a projection of near normal risk of water stress for the future (2050 based on a conservative low mitigation trajectory) (Figure 3-20).

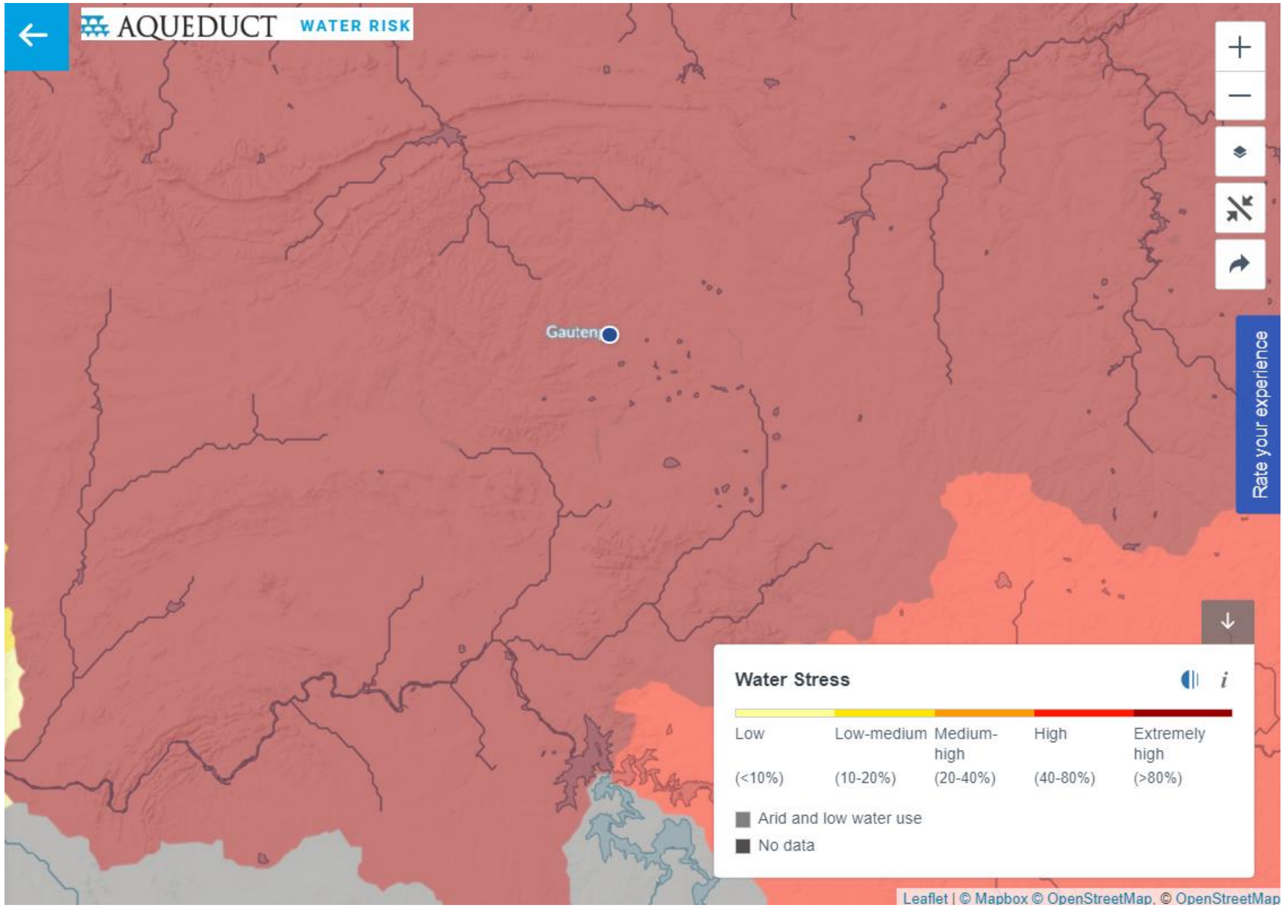


Figure 3-19: Current water stress for the project area (Hofste, et al., 2019) (blue dot indicates project location)

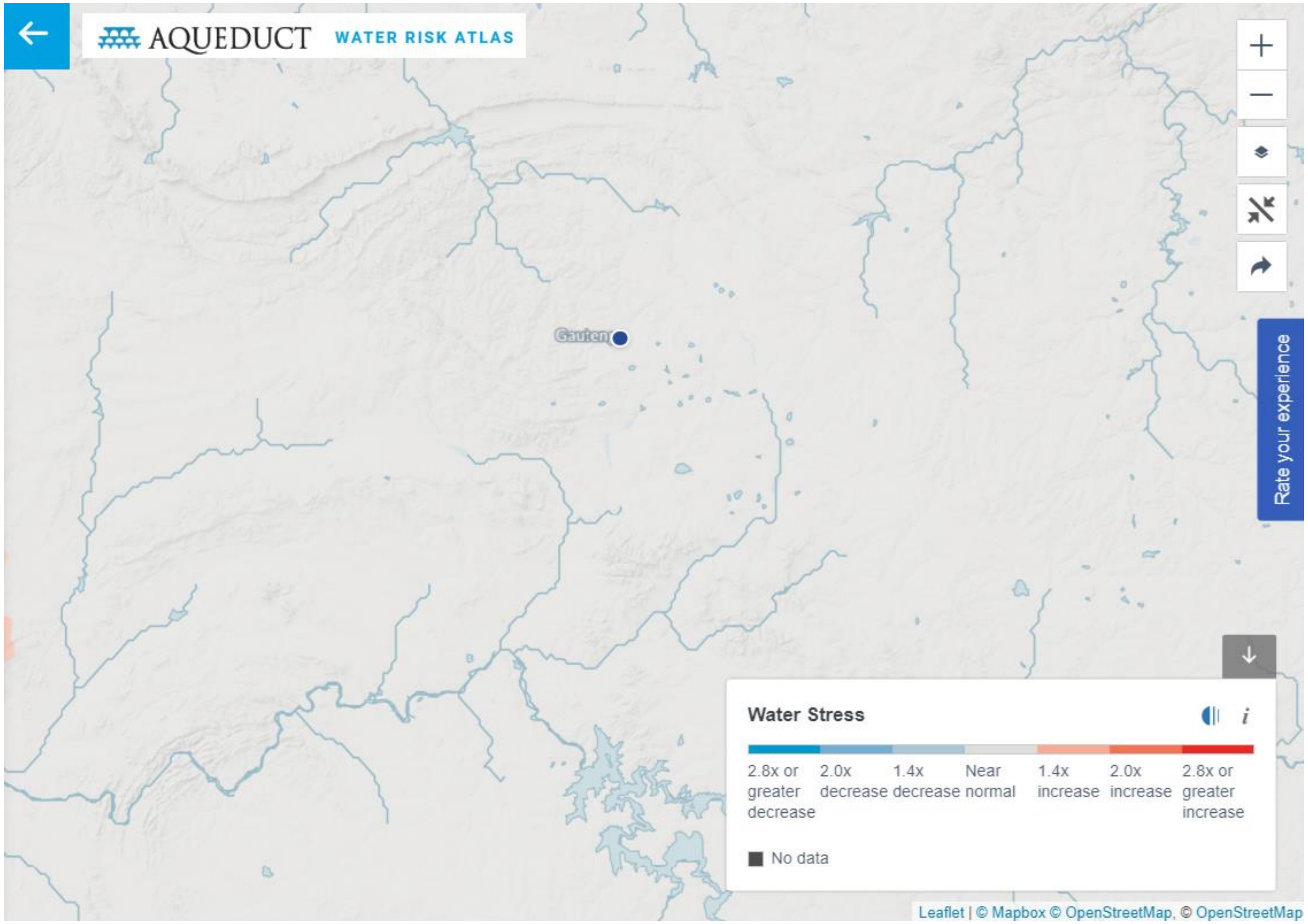


Figure 3-20: Projected (2050) water stress for the project area (Hofste, et al., 2019) (blue dot indicates project location)

3.4 Impact of Climate Change

To understand the impact that climate change might have on the major resources of the Ekurhuleni Municipality it is first necessary to provide an overview of the current situation, which has been provided for water, economy, and agriculture.

3.4.1 Water Supply

3.4.1.1 Current Resources

Figure 3-21 provides the current water supply vulnerability (i.e., demand versus supply) for the Ekurhuleni Municipality (1) based on the data compiled for the Department of Water and Sanitation (DWS) All Town's Study (Cole, 2017). The current water demand and supply for the municipality is 287.06 l/p/d (litres per person per day), with all water sourced from surface water.

SURFACE WATER USAGE	
Demand Per Capita (l/p/d)	287.06
Supply Per Capita (l/p/d)	287.06
Current Vulnerability	1

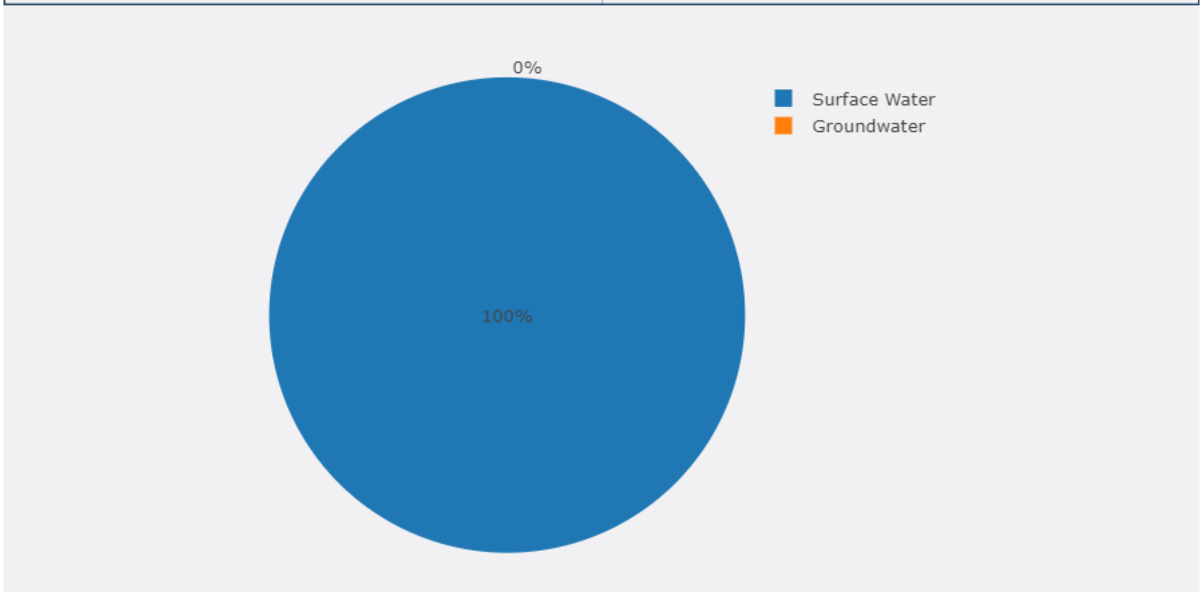
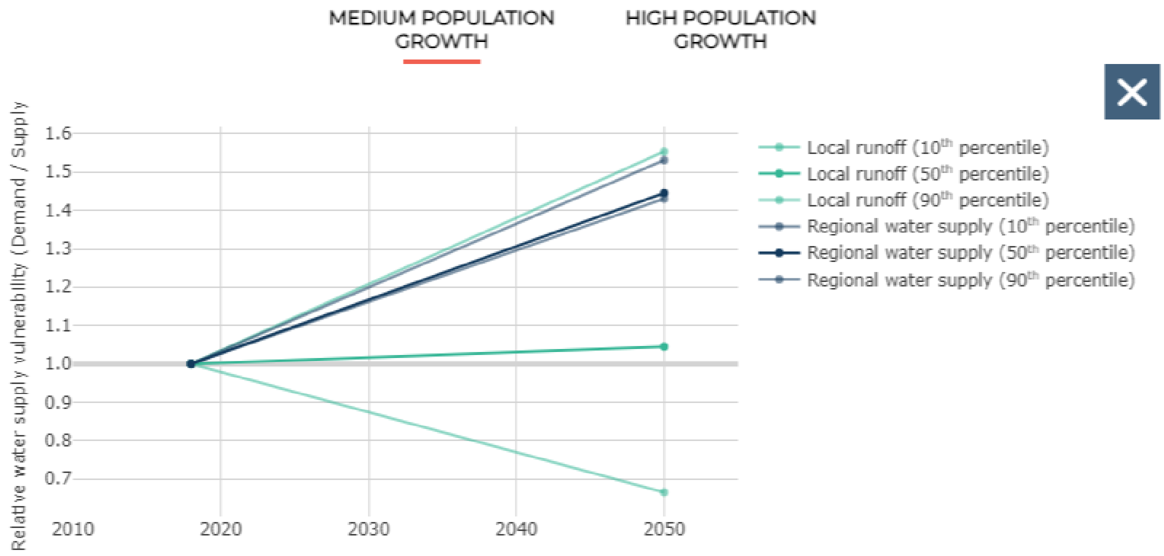


Figure 3-21: Current water availability for the Ekurhuleni Municipality

3.4.1.2 Impact on Resources

Figure 3-22 shows the estimated current and future water supply vulnerability (i.e., the ratio of demand to supply) based on: 1) a local water supply perspective incorporating changes to population growth coupled with exposure to climate risk (based on impacts on local runoff), and 2) a regional water supply perspective (based on impacts of regional water supply assuming supply is part of the integrated regional and national bulk water supply network). The mean annual precipitation for the municipality is predicted to decrease by 4% for 2050 with a regional urban water supply increase of 0.5%.



VULNERABILITY CONTRIBUTION FACTORS	PERCENTAGE CHANGE
Mean annual precipitation	-3.85%
Mean annual evaporation	11.35%
Mean annual runoff	39.01%
Regional urban water supply	0.48%
Population growth	30.43%

Figure 3-22: Estimated current and future (2050) water supply vulnerability based on medium population growth for the Ekurhuleni Municipality

3.4.2 Surface Water

3.4.2.1 Current Situation

The Ekurhuleni Municipality is within the Limpopo Primary Catchment (Figure 3-23).

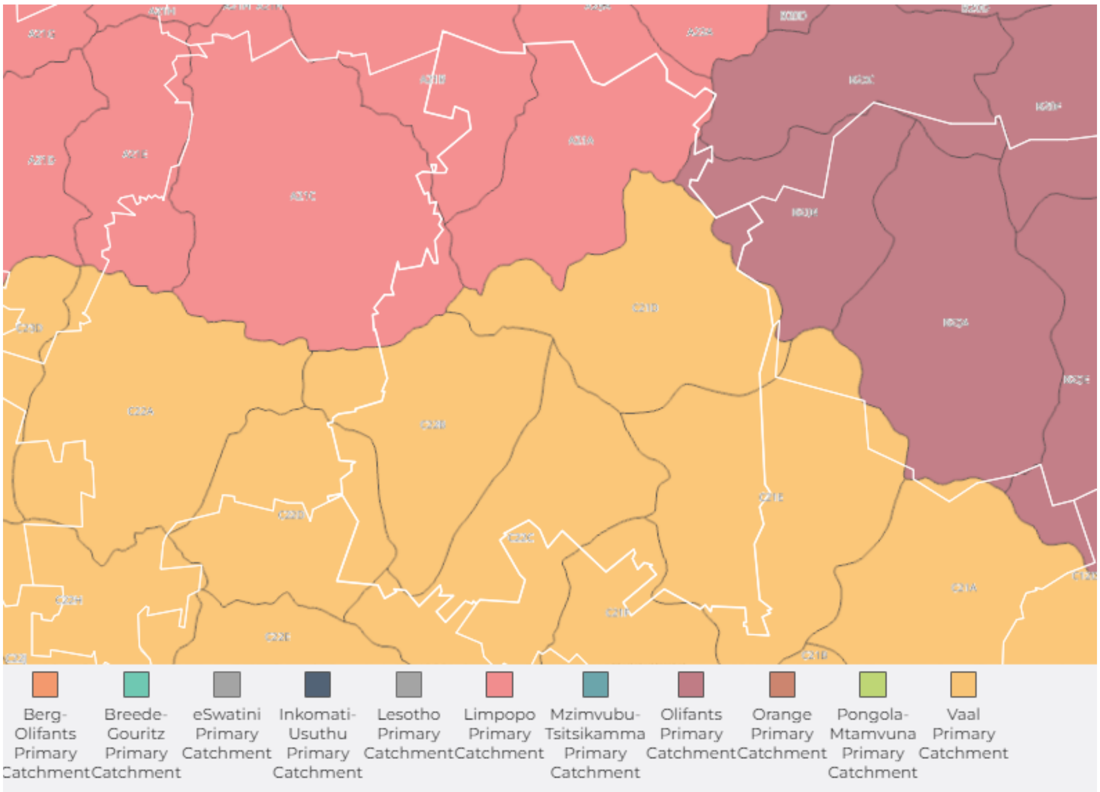


Figure 3-23: Quaternary catchment areas for the Ekurhuleni Municipality

Figure 3-24 depicts the current annual and monthly surface water runoff, precipitation and evaporation for the Limpopo Primary Catchment associated with the Ekurhuleni Municipality. Precipitation and evaporation for the municipality is currently 686 mm/yr and 1 659 mm/yr respectively.

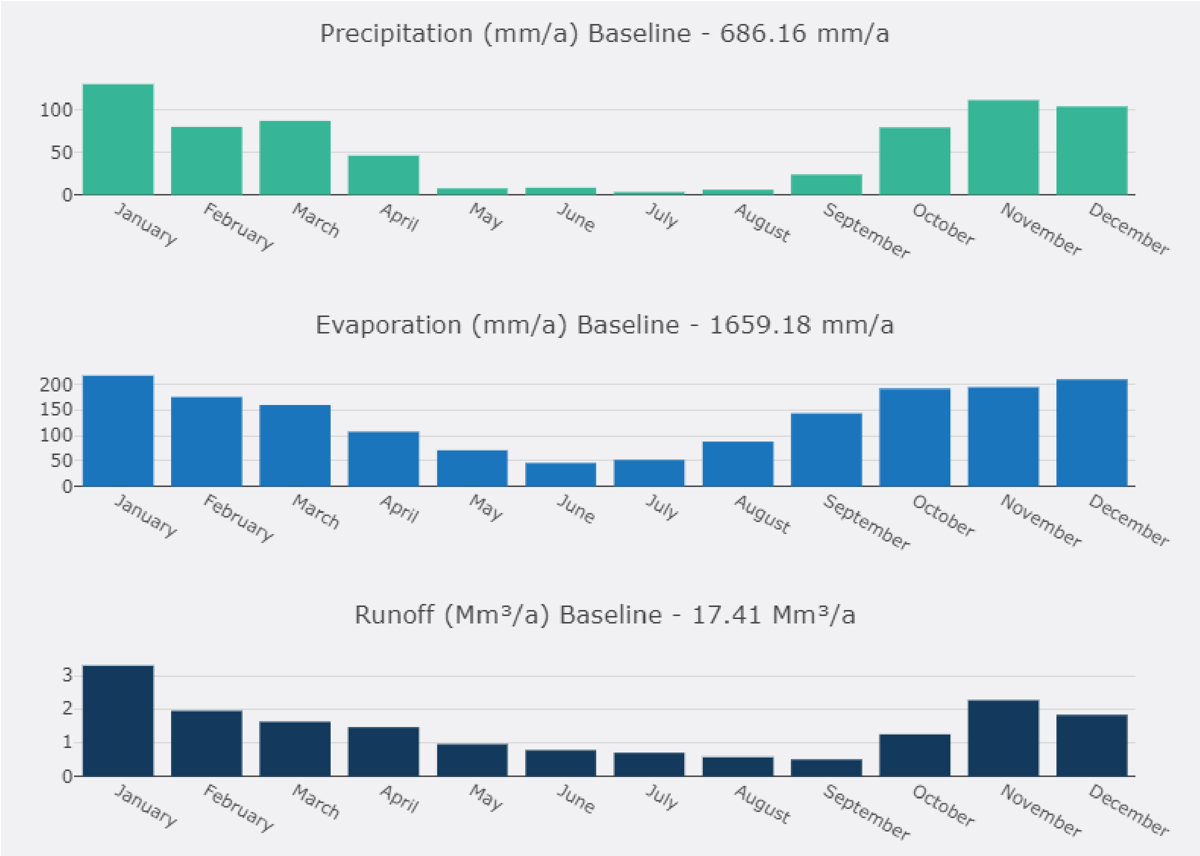


Figure 3-24: Current annual and monthly surface water runoff, precipitation and evaporation for the Ekurhuleni Municipality which falls under the Limpopo Primary Catchment

3.4.2.2 Projected Impact

Figure 3-25 provides the projected monthly change for future (2050) evaporation, precipitation, and estimated runoff values.

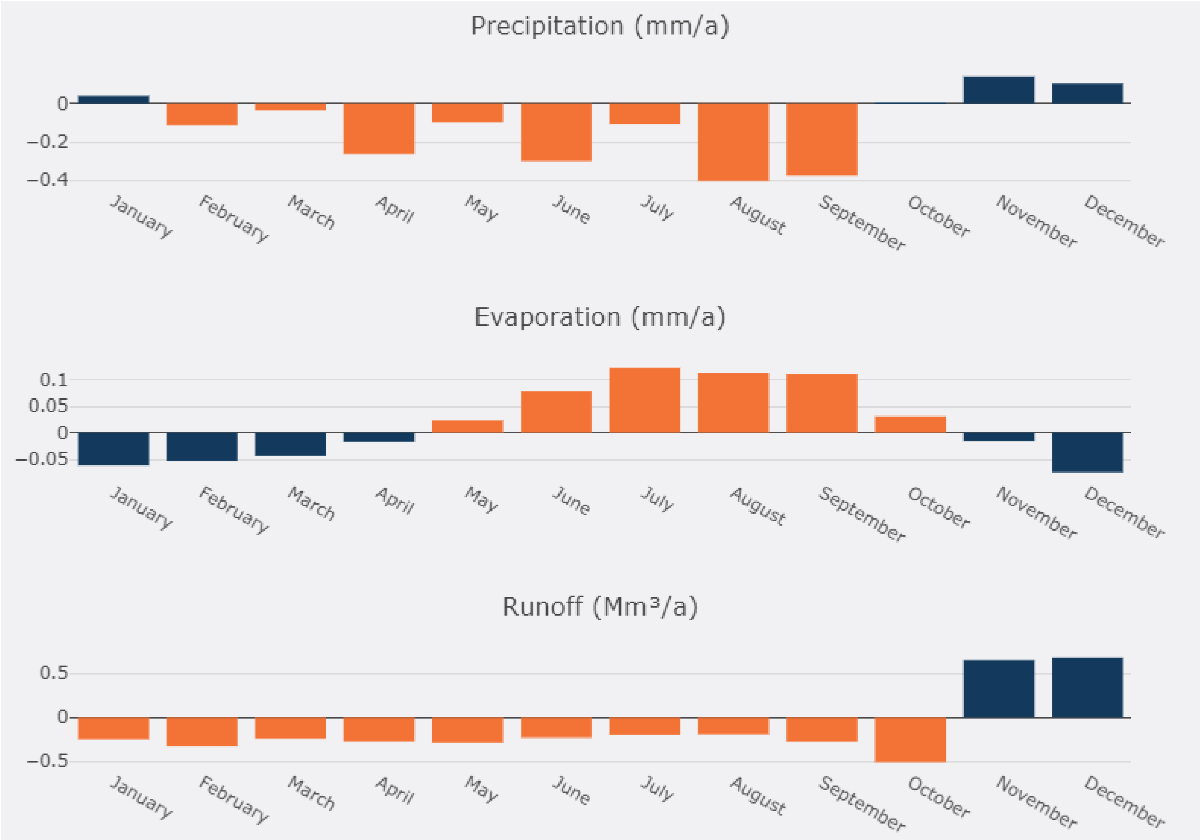


Figure 3-25: Projected monthly change to future (2050) evaporation, precipitation, and estimated runoff values

3.4.3 Ground Water

3.4.3.1 Current Situation

The groundwater recharge potential map indicates the occurrence and distribution of groundwater resources across the municipality, showing distinctive recharge potential zones. The groundwater dependency map indicates where settlements get their main water supply from, be it groundwater, surface water or a combination of both sources. Settlements that rely on groundwater, either entirely or partially, are deemed groundwater dependent. The project area is surface water dependent.

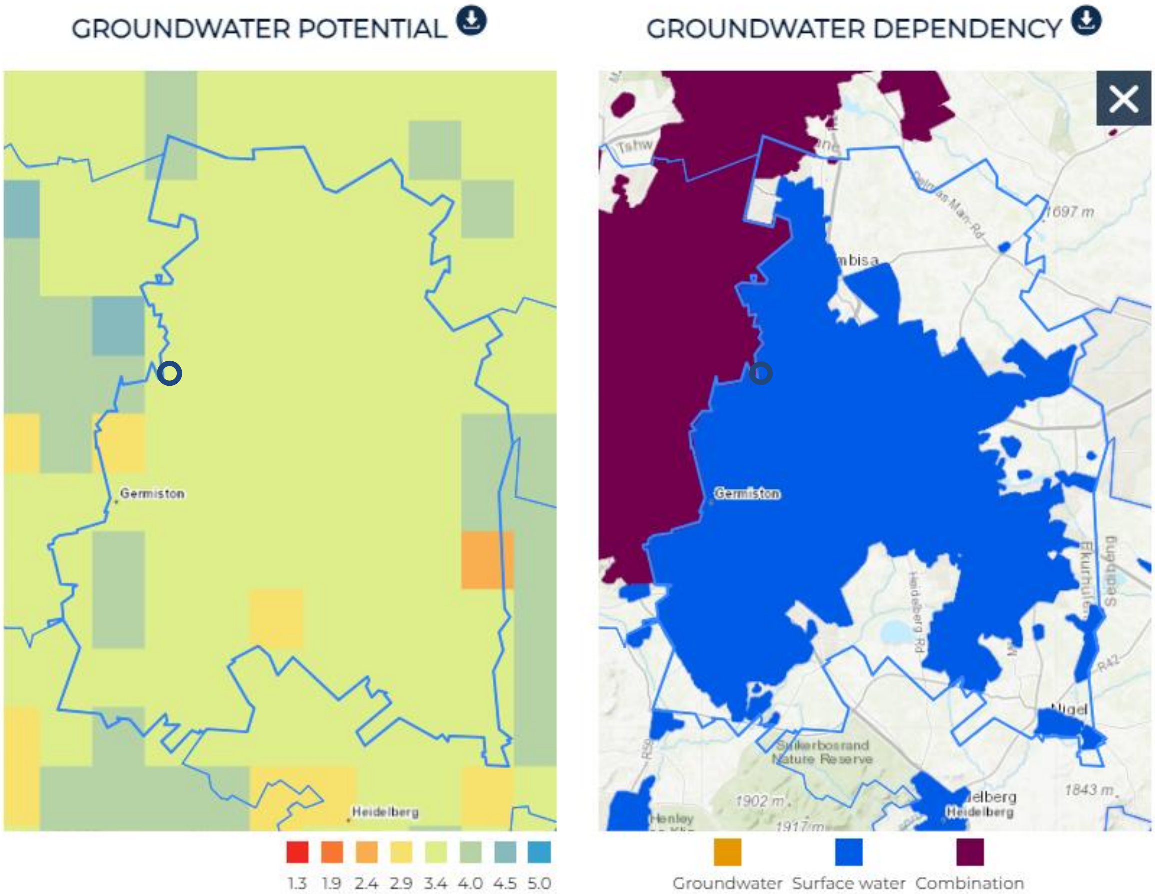


Figure 3-26: Groundwater potential and dependency for the Ekurhuleni Municipality (dark blue marker indicates approximate location of the project)

3.4.3.2 Projected Impact

A groundwater depletion risk map was created to determine which of South Africa's groundwater dependent settlements may be most at risk to groundwater depletion based on decreasing groundwater aquifer recharge potential and significant increases in population growth pressure by 2050.The groundwater depletion risk map (Figure 3-27) is based on the settlement aquifer recharge potential of the 50th percentile RCP8.5 scenario, and the medium population growth scenario. The project area is not groundwater dependant.

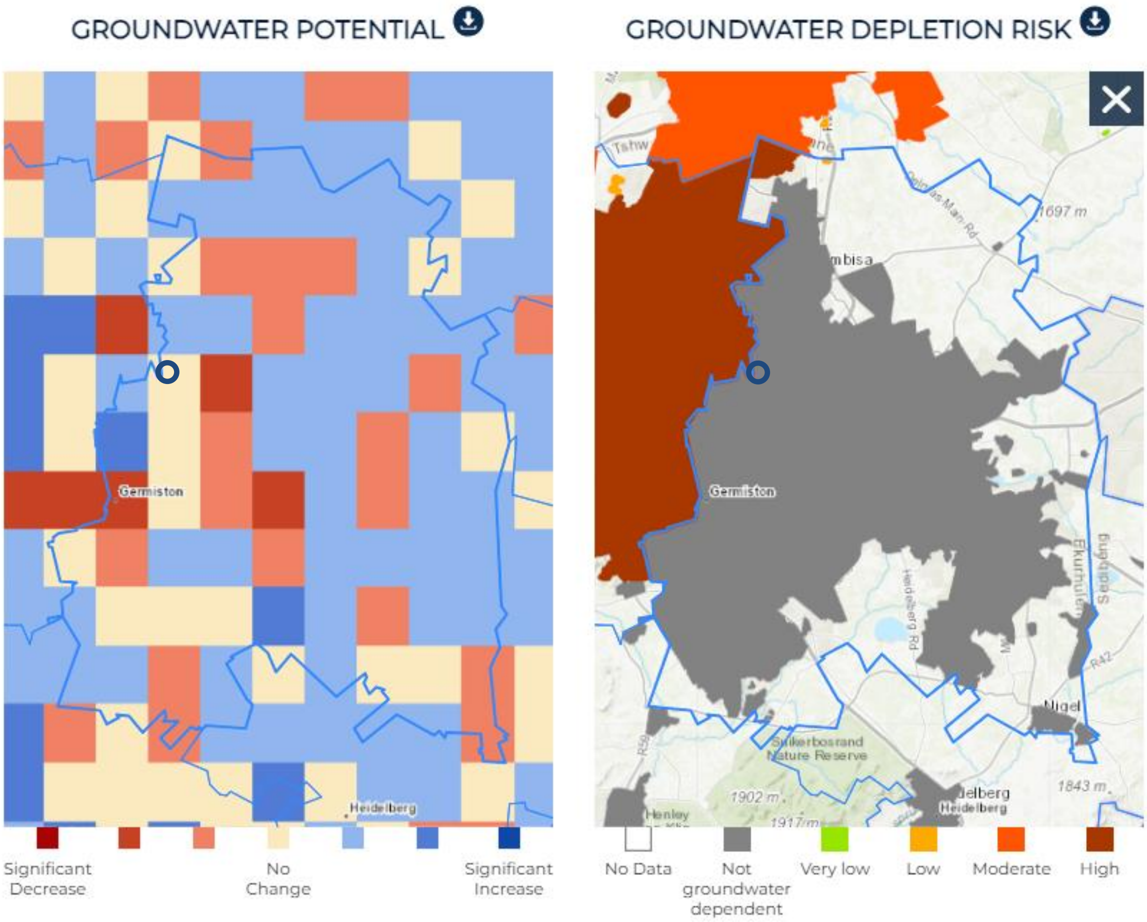


Figure 3-27: Groundwater potential and depletion for 2050 for the Ekurhuleni Municipality (dark blue marker indicates approximate location of the project)

3.4.4 Economy

Figure 3-27 shows the contribution that the different economic sectors make to the total Gross Value Added (GVA)[14] of the Ekurhuleni Municipality as well as its national GVA rank (total GVA contribution to the national GVA). The Ekurhuleni Municipality ranks 5th in the national GVA rank.

[14] Gross value added (GVA) is an economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region.

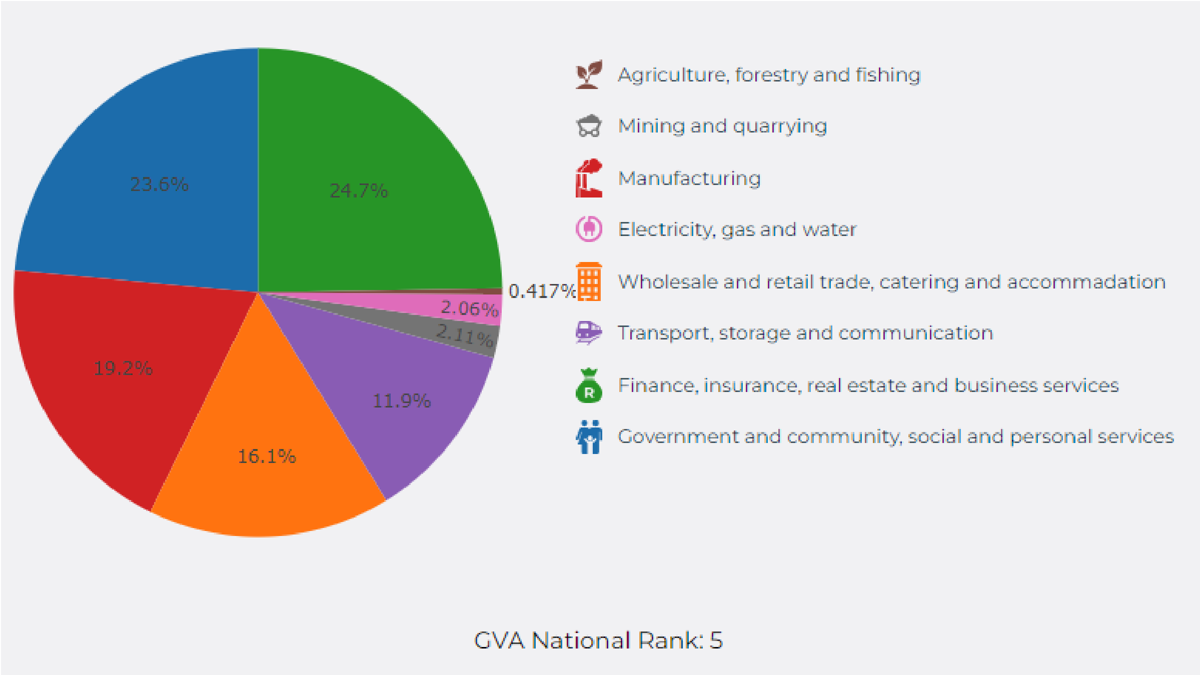


Figure 3-28: The contribution that the different economic sectors make to the total GVA of the Ekurhuleni Municipality

Table 3-1 summarises the forecasted economic gains or losses for the Ekurhuleni Municipality, under both the RCP4.5 and RCP8.5 scenarios, for each of the contributing economic sectors.

Table 3-1: Forecasted economic gains or losses for the RCP4.5 and RCP8.5 scenarios

RCP 4.5 Impacts		RCP 8.5 Impacts	
Average	-2.53%	Average	-3.75%
Agriculture Sector	-4.55%	Agriculture Sector	-6.75%
Forestry Sector	-5.59%	Forestry Sector	-8.31%
Fishing Sector	-5.85%	Fishing Sector	-8.69%
Mining Sector	0.25%	Mining Sector	0.37%
Manufacturing Sector	1.68%	Manufacturing Sector	2.46%
Electricity & Gas Sector	-5.39%	Electricity & Gas Sector	-8.01%
Water Sector	0.94%	Water Sector	1.39%
Service Sector	-1.69%	Service Sector	-2.51%

3.4.5 Agriculture, Forestry and Fisheries

The main agricultural commodities for the Ekurhuleni Municipality are beef cattle and maize (Table 3-2). Agriculture, Forestry and Fishing (AFF) sector contributes 0.42% to Ekurhuleni Municipality GVA production and 1.23% to Ekurhuleni total employment. The total AFF GVA production of Ekurhuleni Municipality contributes 1.39% of the national AFF GVA (Table 3-2).

Table 3-2: Economic contribution of main commodities for Ekurhuleni Municipality

MAIN COMMODITIES		
BEEF CATTLE	MAIZE FOR GRAIN	
AFF contributes 0.42% to Ekurhuleni GVA production	AFF contributes 1.23% to Ekurhuleni total employment	The total AFF GVA production of Ekurhuleni Municipality contributes 1.39% to the national AFF GVA, ranking them as the 14th biggest contributor

The main agricultural commodities for 2050 for the Ekurhuleni municipality are still beef cattle and maize (under an RCP8.5 low-mitigation scenario) (Table 3-3). The climate for the municipality is expected to be hotter and wetter with more extreme rainfall events. The hot moist conditions will result in increased spread of disease and parasites. There is the potential for increased maize yield for the near future with heat stress negatively impacting on production towards 2050.

Table 3-3: Projected economic contribution of main commodities for Ekurhuleni Municipality

MAIN COMMODITIES	
BEEF CATTLE	MAIZE FOR GRAIN
CLIMATE IMPACT	
Change in climate expected: Hotter and wetter with more extreme rainfall events.	
Increased water availability. Hot and moist conditions cause increased spread of disease and parasites. Reduced growth & reproduction performance due to heat stress.	Potential increase in maize yield for near future. However, towards 2050, heat stress can negatively impact on production.

3.4.6 Other Resources

The impacts of climate change on other resources are summarised in Table 3-4.

Table 3-4: the impacts of climate change on other resources

Parameter	Results of Climate Change				Reference
	Increase in temperature and heat stress	Drought and decrease in rainfall	Increase in rainfall and inland flooding	Increased wind speed	
Transport and Mobility	• Increased rate of infrastructure deterioration leading to pavement failure including cracking, rutting, potholes, flushing, and stripping. • Increased stress on bridges, particularly expansion joints, through thermal expansion and increased movement. • Corrosion of steel reinforcing in concrete structures due to increase in surface salt levels in some locations. • Increased infrastructure maintenance cost for road repair and reconstruction work, causing traffic delays and emergency service response delays. • Increased frequency and intensity of wildfires leading to more road closures. • Increased vehicle accidents, due to low pavement adhesion, leading to higher rates of transport-related fatalities.	• Reduced water resources available for construction and maintenance. • Reduced production of some agricultural produce leading to changes in freight flows in the network.	• Increased rate of infrastructure deterioration, especially in areas with poor infrastructure maintenance history. • Temporary and permanent flooding of road, rail, port and airport infrastructure. • Structural integrity of roads, bridges and tunnels could be compromised by higher soil moisture levels. • Potential destruction of bridges and culverts. • Erosion of embankments and road bases leading to undermining of roads or railways. • Increased risk of landslides, slope failures, road washouts and closures. • Undermining of bridge structures (scouring). • Closure of roadways and tunnels leading to traffic delays. • Transportation system disruptions, impacts to traffic signalling and low water crossings. • Increased weather-related accidents.	• Increased drag on vehicles resulting in increased fuel consumption. • Increased safety risk for pedestrians and cyclists due to flying objects or being uncontrollably dragged by winds, additionally leading to reduced trip making by pedestrians and cyclists.	(Mokonyama & Van Wyk, 2018)
Solid Waste	• Increased risk of combustion at open waste disposal sites and illegal dumps and increase in explosion risk associated with methane gas. • Increased rate of decay of putrescible waste resulting in increased odour, breeding of flies, and attracting of vermin. • Increased health and safety concern regarding heat stroke to staff collecting waste. • Increased risk of landfill site instability and failure due to changes in consumption patterns with increased waste creation (i.e., glass, plastic and paper cups).		• Increased risk of flooding due to pressure on stormwater and leachate management systems at landfills. • Increased demand for capacity to cope with large volumes of waste generated by flood events. • Increase in soil saturation causing decreased stability of slopes and landfills linings (if clay or soil based) at waste management facilities. • Inundation of waste releasing contaminants to waterways, pathways and low elevation zones. • Potential loss of value and degradation of paper and cardboard for recycling due to increased moisture content. • Increased flooding causing the risk of localised disruption of waste collection rounds. • Flooding in areas with untreated, dumped waste causing the risk of groundwater contamination. • Increased flooding causing the risk of litter entering the storm water systems.	• Possible increase in nuisance due to waste dispersed by high winds leading to increased health effects associated with particulate matter (air pollution).	(Oelofse, 2018)
Stormwater	• Potential risk of undermining the temperature regime of temperature-sensitive stormwater ponds and receiving waters, resulting in a decrease in water quality. • Increased corrosion in stormwater drains due to a combination of higher temperatures, increased strengths, longer retention times, and stranding of solids.	• Increased shrinking soils increasing the potential for cracking, increased infiltration and exfiltration of water mains and sewers, which in turn exacerbates treatment and groundwater or storm water contamination.	• Increased risk of flooding due to pressure on stormwater systems. • Increased risk of litter entering the stormwater systems. • Increased risk of damage and failure of stormwater systems due to overloading during floods and intense rainfall events. • Failure of stormwater treatment devices during high flow events leading to by-pass and / or flushing of contaminated water. • High wet-weather hydraulic loads and bottlenecks in stormwater and networks due to inflow and sewer infiltration, leading to local inundation and overflows of untreated wastewater. • Increased rainfall causes soil erosion thus damaging underground stormwater systems. • Increased surface and stream erosion causing deposition of sediments in receiving environments. • Stream morphology for undeveloped, developing and fully developed urban areas, may change, hence affecting existing outfall structures and potential stormwater pond locations.	• Increased wind speed and intensity causing changes in rainfall over complex topography including increasing upwind of hills and ranges.	(Dunker & Van Wyk, 2018)

Parameter	Results of Climate Change				Reference
	Increase in temperature and heat stress	Drought and decrease in rainfall	Increase in rainfall and inland flooding	Increased wind speed	
Sanitation	• Increased heat waves, accompanied by dry weather, can exacerbate already stressed water supply systems leading to competition between sectors for water services, affecting sanitation.	• Decrease in water supply for sanitation through decrease in available water to flush sewage systems adequately. • Declining annual rainfall threatening the viability of water-borne sanitation systems, and the capacity of surface water to dilute, attenuate and remove pollution. • Sewers are structurally vulnerable to drying, hence shrinking soils increase the potential for cracking, increased infiltration, and exfiltration, which in turn exacerbates treatment and groundwater or storm water contamination. • Increased corrosion in sewers due to a combination of higher temperatures, increased strengths, longer retention times, and stranding of solids.	• Increased wet-weather hydraulic loads and bottleneck in stormwater and sanitary sewer networks due to inflow and sewer infiltration, causing local inundation and overflows of untreated wastewater. • Increased rainfall and heavy rainfall events increasing the washing of faecal matter into water sources due to flooding of wastewater treatment works. • Increased risk of flooding resulting in both infrastructure damage and contamination of surface and groundwater supplies. • Increased groundwater levels due to flooding, putting risk on sewage treatment plants (which are often positioned on low-lying ground as sewerage systems rely on gravity). • Increased vulnerability of sewerage pipe systems due to their size and complexity, and their exposure to multiple flood damage threats from source, through treatment, to delivery. • Increased vulnerability of pit toilets (widely used in rural areas) due to flooding, causing serious environmental contamination. • Increase in groundwater recharge and groundwater levels causing flooding of subsurface infrastructure such as pit toilets or septic tanks.		(Duncker, 2018)
Information and Communication Technology	• Increased weathering and deterioration of infrastructure resulting in increased maintenance and repair costs. • Heat stress causing structural damage to infrastructure. • Increased energy demands during heatwaves resulting in power outages which can impact on delivery of telecommunications services. • Increases in temperature and higher frequency, duration, and intensity of heat waves increasing the risk of overheating in data centres, exchanges, and base stations, which can result in increased failure rates of equipment. • Increased mean temperature increasing operating temperature of network equipment which may cause malfunctions if it surpasses design limits.	• Decreased precipitation leading to land subsidence and heave, reducing the stability of telecommunications infrastructure above and below ground (foundations and tower structures).	• Increased risk of flooding of low-lying infrastructure, access holes and underground facilities. • Increases in storm frequency or intensity increasing the risk of damage to aboveground transmission infrastructure and impacting on telecommunications service delivery. • Increases in storm frequency leading to more lightning strikes, consequently damaging transmitters, and overhead cables, causing power outages. • Increased cost of insurance for infrastructure in areas with repeated incidents of flooding, as well as withdrawal of risk coverage in vulnerable areas by private insurers. • Road closures due to flooding thus inhibiting service and/or restoration efforts. • Rising sea levels and corresponding increases in storm surges, increasing the risk of saline corrosion of coastal telecommunications infrastructure, and leading to erosion or inundation of coastal and underground infrastructure.	• Increased risk of storm surges impacting on coastal infrastructure. • Increased storm intensity and frequency impacting on electricity and telecommunications infrastructure.	(Naidoo, 2018)

Parameter	Results of Climate Change				Reference
	Increase in temperature and heat stress	Drought and decrease in rainfall	Increase in rainfall and inland flooding	Increased wind speed	
Health	• More exposure to high temperatures causing increased health risks including heat strokes. • Heat waves increase threat of cardiovascular, kidney, and respiratory disorders. • Increase in fire danger days causing increased loss of life and damage to health infrastructure. • Wildfire smoke significantly reducing air quality, both locally and in areas downwind of fires. Smoke exposure increases respiratory and cardiovascular hospitalizations; emergency department visits; medication dispensations for asthma, bronchitis, chest pain, chronic obstructive pulmonary disease, and respiratory infections; and medical visits for lung illnesses. • Increased emissions in biogenic volatile organic compounds from vegetation causing increases in air pollution. • Increase in evaporative emissions from cars contributing to exposure to, and health impacts from, air pollution. • Increase in distribution of vector-borne diseases in warmer areas. • Increased water temperatures leading to an increase in algal blooms which can likely lead to increases in food- and waterborne exposures. • Increased temperatures combined with fewer clouds (e.g., from increased subsidence that is projected for parts of South Africa) causing increased exposure to Information and Communication Technology which will have negative impacts on health. • Increased temperatures increasing the reaction between certain pollutants and sunlight and heat, resulting in more severe hazardous smog events.	• Decreased soil moisture potentially creating more wind-blown dust which has negative impacts on air quality. • Increase in water-borne diseases and diarrhoeal diseases due to inadequate water availability. • Decreased precipitation causing changes in salinity of water, resulting in an increase in algal blooms which can likely lead to increases in food- and waterborne exposures. • Increase in stagnant air, decreasing air quality.	• Wetter climate combined with increased temperatures may have negative health impacts as many diarrhoeal diseases vary seasonally, typically peaking during the rainy season. • Extreme rainfall and higher temperatures increasing the prevalence of fungi and mould indoors, with increased associated health concerns. • Increased flooding increasing the risk of drinking and wastewater treatment facilities being flooded, meaning that diarrhoeal diseases can be transmitted as wastewater systems overflow or drinking water treatment systems are breached. • Increase in natural disasters (e.g., floods) creating a conducive environment for the occurrence of mental health problems.	• Increase in wind-blown dust combined with low humidity causing increased cases of meningitis (Davis, 2014).	(Garland, 2018)
Energy	• Increased heat causing expansion of overhead cables, and cable sag. Sagging below a certain level result in a reduction in the amount of electricity transmitted. • Increased heat stress on electricity transmission networks (overhead cables). • Increase in heat island effect increasing energy demand for cooling, leading to grid stress. • Increased threat of wildfires causing widespread damage to infrastructure and causing disruptions to service provision.		• Increase in flooding causing damage to electricity transmission and distribution infrastructure, poles, lines and sub-stations. • Increase in frequency and cost of maintenance of concrete structures due to frequent and intense rainfall, flooding, or sea level rise. • Increased repair events increasing stress put on service crews and resulting in delays to power restoration.	• Winds causing damage to energy supply infrastructure as winds cause overhead lines to sag, reducing electricity transmission. • Extreme winds causing poles and trees to fall, causing further damage to energy supply infrastructure such as overhead lines.	(Thambiran & van Wyk, 2018)

Parameter	Results of Climate Change				Reference
	Increase in temperature and heat stress	Drought and decrease in rainfall	Increase in rainfall and inland flooding	Increased wind speed	
Ecosystem Services	• Increased risks of water shortages increasing demand for irrigation of gardens and agriculture. • Increased evapotranspiration rates with rising temperatures, reducing the water available in reservoirs and water available for reliant ecosystems. • Increase in temperature leading to water loss via evapotranspiration resulting in decreased water quality and loss of wetlands. • Loss or degradation of indigenous species, including threatened species or ecosystems. • Increased threat from invasive species as competition for water increases. • Dieback or death of susceptible plants (e.g., street trees) and animals (e.g., fish). • Reduced availability of water and increased evapotranspiration resulting in reductions in harvested area (cropping area), yield (ton/ha) and quality. • Warmer winters resulting in reduced period of dormancy (rest period) in deciduous fruit crops, decreasing the production and quality of associated food products. • Warmer climate resulting in shifts in the growing season and life cycles of various plants, including crops, resulting in pests and diseases having a greater destructive impact as well as a shift in climatically suitable areas for specific crops. • Increased humidity levels resulting in higher rates of microbial growth in fresh produce, reducing their expiry time. • Increased heat stress on crops changes the micro-nutrients of crops products, decreasing the nutrient density and quality of food. • Increased water temperature leading to increased growth of aquatic weeds which increases breeding of disease vectors and reduces water oxygen levels. • Milder winters and reduced frost increase the duration of the growing season, increasing the survival rate of insects and diseases. • Increased sea surface temperatures (SST) causing shifts in the spatial distribution of fish species. • Increased SST and ocean acidification decreases marine phytoplankton growth and synthesis of omega-3 polyunsaturated fatty acids (PUFA's), affecting the oceanic food chain and consequent ecosystems. • Increased heat stress and higher humidity levels potentially resulting in the exceedance of the temperature humidity index in livestock, causing reduced immunity, fertility, productivity and even mortality of livestock.	• Decreased amounts of rainfall reaching ecosystems as settlements use rainwater harvesting techniques for increased household use. • Increased reliance on irrigation and greater demand for water to maintain public open space and gardens. • Reduced planting and pollination leading to greater risk of erosion and soil loss. • Increasing temperatures together with increased intensity of drought will potentially increase the occurrence of algal blooms in reservoirs and dams which are damaging to ecosystem functioning and water services. • Drought and decreased rainfall causing wetland habitat loss. • Locally specific changes in humidity levels will have impacts on local vegetation. • Increased threat to watershed and aquifer recharge areas, affecting vegetation. • Reduced soil moisture availability increasing moisture stress leading to dieback and death of plants and the loss or degradation of indigenous communities, including threatened species or ecosystems. • Increased moisture stress leading to decline in crop yield and quality, and reduced fodder quantity and quality for livestock. • Drying up of aquatic systems, perennial systems will become seasonal and seasonal systems will die off and be replaced by terrestrial plants. • Increased spread of drought-adapted alien invasive plant species.	• Rainfall in shorter and more violent spells making recharging groundwater difficult. • Increase in intensity of rainfall and flooding leading to increased surface runoff, resulting in increased soil erosion, soil loss and degradation. • Increased rainfall and floods resulting in waterlogged soils which increase the likelihood of crop failure. • Increasingly saturated soils leading to more standing water (ponding) which can result in more insect (pest) activity and their potential to carry diseases. • Increased wave energy and run-up (sea level rise and more storms) causing degradation of natural coastal defence structures.	• Evapotranspiration rates increase with wind speed, reducing the water available in reservoirs and water available for reliant ecosystems. • Increased rate of fire spread and spotting (the ignition of fires ahead of the main fire front) of fires. • Potential damage to or uprooting of vegetation including trees, which can also damage infrastructure. • Potential wind damage to crops, reducing yield and quality (e.g., sandblasting and fruit fall). • Increased windblown materials (e.g., dust, litter) increasing the need for maintenance and city cleaning. • Degradation of natural coastal defence structures and increased damage to hard coastal infrastructure.	(Pieterse & Crankshaw, 2018)
Culture and Heritage	• Increased temperature having significant impacts on the comfort levels of built heritage resources, resulting in the building no longer being fit-for-purpose. • Increased demand for additional heating and cooling resulting in the installation of heating, ventilation, and air-conditioning systems with potential negative consequences on the heritage value. • Increased heat stress potentially impacting on the materials and structural integrity of heritage resources. • Migration of several plant species due to changing climate patterns, posing a threat to the conservation of biodiversity hotspots, and potentially altering heritage places. • Increase in veld and forest fires raising the threat of fire to all heritage resources, natural and built, as well as posing health risks to heritage resource dwellers from exposure to smoke and ash pollution.	• Decreased rainfall impacting negatively on ground moisture levels and thus the geological conditions of sensitive heritage resources. Drying out clays, for example, will shrink and potentially undermine founding conditions.	• Increased rainfall in areas with clay soils resulting in swelling which poses a threat to the structural integrity of heritage resources. • Increased floods and changes in precipitation resulting in increasing vulnerability of archaeological evidence buried underground due to changing stratigraphic integrity of the soils. • Increased threat to materials and structural integrity of heritage resources exposed to higher humidity/ precipitation levels.		(van Wyk, 2018)

4 GHG INVENTORY

4.1 Approach and Methodology

This assessment has been undertaken in accordance with the principles of:

- ISO 14064-1:2006 Greenhouse gases – Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
- Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (GHG Protocol) (World Business Council for Sustainable Development and World Resources Institute, 2015).
- Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (2014).

These guidelines are considered representative of good practice GHG accounting internationally and are applicable to the project.

The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (WRI & WBCSD, 2004), provides two approaches. This includes the assessment of GHGs based on: (1) the organisational boundaries and (2) operational boundaries. For the calculation of GHG footprint for the project, the operational boundary approach was selected.

4.1.1 Organisational Boundaries

For corporate reporting, two distinct approaches can be used to consolidate GHG emissions: the equity share and the control approaches. Companies shall account for, and report, their consolidated GHG data according to either the equity share or control approach as presented below.

In setting organizational boundaries, a company selects an approach for consolidating GHG emissions and then consistently applies the selected approach to define those businesses and operations that constitute the company for the purpose of accounting and reporting GHG emissions. If the reporting company wholly owns all its operations, its organizational boundary will be the same whichever approach is used. For companies with joint operations, the organizational boundary and the resulting emissions may differ depending on the approach used. In both wholly owned and joint operations, the choice of approach may change how emissions are categorized when operational boundaries are set.

4.1.2 Operational Boundaries

To help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three "scopes" (scope 1, scope 2, and scope 3) are defined for GHG accounting and reporting purposes (Figure 4-1).

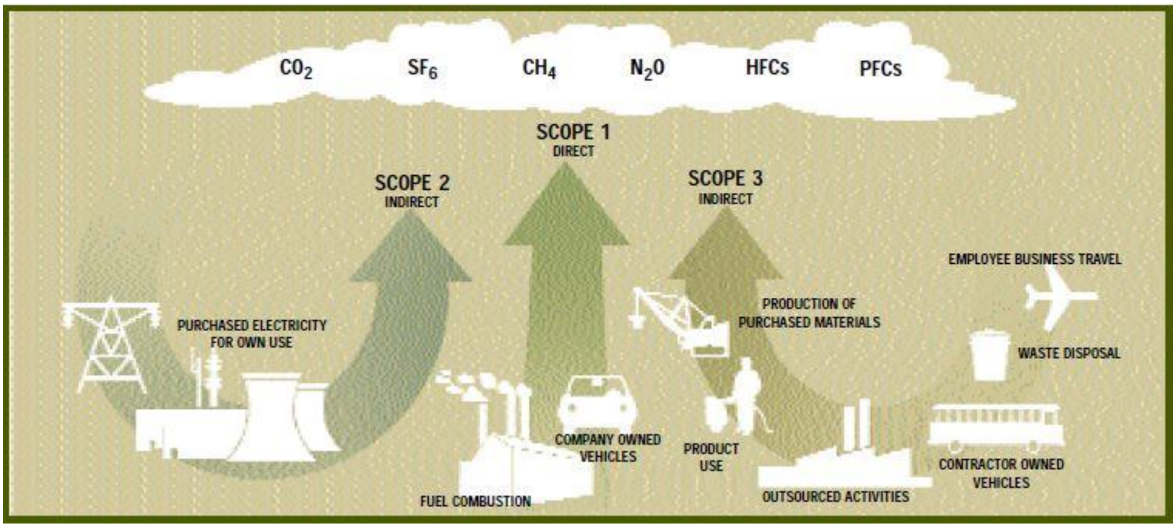


Figure 4-1: Overview of scopes and emissions (WRI & WBCSD, 2004)

4.1.2.1 Scope 1: Direct GHG Emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled vehicles, etc.; and/or emissions from chemical production in owned or controlled process equipment.

4.1.2.2 Scope 2: Electricity - Indirect GHG Emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

4.1.2.3 Scope 3: Other Indirect GHG Emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased materials and product; and use of sold products.

4.2 Greenhouse Gases and Global Warming Potential

The GHGs considered in this assessment and the corresponding global warming potential (GWP) for each GHG are listed in Table 4-1. GWP is a metric used to quantify and communicate the relative contributions of different substances to climate change over a given time horizon. GWP accounts for the radiative efficiencies of various gases and their lifetimes in the atmosphere, allowing for the impacts of individual gases on global climate change to be compared relative to those for the reference gas carbon dioxide. The GWPs from the IPCC Third Assessment report were used in this assessment. These are reflective of radiative forcing over a 100-year time horizon. There are more recent GWP values available (i.e. the IPCC Sixth Assessment report). However, the the recent Methodological Guidelines for Quantification of Greenhouse Gas Emissions (DFFE, 2022) published by the Department of Forestry, Fisheries and Environment stipulate the older GWP values (from the Third Assessment report) to be used.

Table 4-1: Greenhouse gasses and 100-year global warming potentials

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	23
Nitrous oxide (N_2O)	296

4.3 Assessment Boundary

The following GHG emissions have been considered:

- Fuel consumption during project activities
- Electricity consumption during project activities
- Water consumption during project activities
- Transport of raw materials to site
- Transport and disposal of waste materials to a Waste Management Area
- Worker commuting

4.4 Exclusions

The following were excluded from the inventory:

- Embodied emissions in equipment used and transport of equipment to the project site.
- Scope 3 categories not regarded applicable to the project, including:
  - Capital Goods
  - Upstream Leased Assets
  - Downstream Leased Assets
  - Franchises
  - Investments.
- Emissions from treated water as sufficient detailed information is not available at this stage of the project.
- Emissions which are likely to be negligible compared with other emissions from the project, including:
  - Emissions associated with combustion of fuels used in minor quantities such as welding gases, oils and greases.
- Emissions due to clearing of vegetation as the construction is assumed to be on disturbed ground.

4.5 Source Data and Assumptions

The input data and assumptions used in estimating GHG emissions for the different phases of the project are provided in Table 4-2 and Table 4-3.

Table 4-2: Greenhouse gas assessment source data and assumptions for the construction phase of the project

Construction	Value	Unit	Comments
Construction period	3.5	years	36-42 months
Scope 1			
Area cleared	0	ha	Area already disturbed.
Diesel consumed (stationary: i.e. generators, etc.)	1 601 600	litres	Assuming 3.5 years of construction. It is anticipated that up to four 250kW diesel power generators will be operated during the construction period, the average consumption for each generator per hour is approximate 55 l/h at full capacity, therefore the estimate is calculated on 8-hour day for 5 days a week.
Diesel consumed (Mobile/Vehicles)	592 200	litres	Assuming 3.5 years of construction. Total diesel consumption estimated at 169 200 litres/year.
Scope 2			
Electricity consumed by operations (kWh)	-	kWh	No additional grid power will be used for construction.
Scope 3			
Distance travelled by materials to site	1 317 400	km	It is estimated that there will be 50 construction material delivery trips per day, on average for 5 days a week, over an assumed 24-month peak construction period. The assumed distances travelled on average is 50km one-way. This equates to an estimated total distance of 1,300,000km. For long distance transport of abnormal loads from the Port of Durban to the site, it is estimated that there will be 30 trips in total, with a travel distance of 580km one-way. This equates to a total distance of 17,400km.
Concrete required	10 500	m^3	
Steel required	400	t	
Municipal Waste generated	46	t	Construction and municipal waste
Distance travelled from site to landfill in a year	177	km	Assumed 25 km distance to landfill and transported in 13t trucks.
Distance travelled by commuters by car	3 360 000	km	Estimates are based off an assumption that 20% of the workforce will use private vehicles. Approximately 120 car occupants will use 92 commuter cars (average occupancy of 1.3 passengers per car) to access the Site per day during construction activities. This estimation is based on a general calculation of 40 km (round trip, i.e. 20 km in the morning and 20 km in the evening). This estimate is based on most of the workforce coming from Tembisa.
Distance travelled by commuters by taxi	931 840	km	It is estimated that approximately 80% of the workforce will commute by either minibus taxi or bus to the Site during construction activities. Due to the current servicing of public transport around the Site, it is anticipated that taxi transport will be prominent (80% minibus taxis, 20% buses).
Distance travelled by commuters by bus	77 653	km	Estimates are based off an assumption that 80% of the workforce will use minibus taxis or busses. Approximately 480 commuters will make use of public transport; of which approximately 384 commuters will use minibus taxis, and 96 commuters by bus. This equates to 26 taxi's (15 passenger capacity) and 3 buses (45 passenger capacity).
Passengers travelling by bus	45		

Table 4-3: Greenhouse gas assessment source data and assumptions for the operation phase of the project

Operation	Value	Unit	Comments
Operation period	20	years	
Scope 1			
Gas (stationary combustion)	574	million m³ per year	The amount of fuel to be consumed for the total capacity up to 600 MW, for the mid-merit operation, will be approximately 13 million GJ per annum. The estimated volume required, should the plant run 65% of the year, is 574 million m³ per annum.
Gas (stationary combustion)	448 668 430	Nm³/ year	
Diesel (stationary combustion) (litres)	60 000	litres/ year	Over the course of a year up to 5 complete black starts are expected. Each of these starts would require the 10MW diesel generators to run for up to 4 hours. It is estimated that 60,000 litres of diesel per year are required for this purpose.
Diesel (mobile combustion - vehicles) (litres)	182 039	litres/ year	The average for diesel consumption on site for the past eight years is approximately 170,000 litres/year. It is expected that this diesel consumption will be transferred from Station B (expected to be offline by 2029) to the Kelvin redevelopment plant.
Scope 2			
Electricity consumed by operations (kWh)	-	MW	A portion of the electricity generated will be used to operate the plant. The electricity consumed will be up to 15 MW, out of the up to 600 MW generated. No additional power will be taken from the grid.
Scope 3			
Raw water requirement	4.38	ML/ year	The normal potable water for the plant is estimated at 10-12t/day is as 3650 – 4380 t/annum.
Industrial Waste (tonnes)	70	t/ year	
Municipal Solid Waste (tonnes)	95	t/ year	
Distance travelled from site to landfill in a year	635	km	Assumed 25 km distance to landfill and transported in 13t trucks
Distance travelled by commuters by car	673846	km/ year	It is anticipated that approximately 100 personnel will be required to operate the plant. Personnel will travel from surrounding areas per day. It is estimated than 60% of personnel will be skilled workers and will be travelling to Site by car. This equates to an estimated number of 60 commuters travelling to Site by car each day.
Distance travelled by commuters by taxi	62293	km/ year	It is estimated that approximately 40% of the workforce will commute by either minibus taxi or bus to the Site during the operational phase. Due to the current servicing of public transport around the Site, it is anticipated that taxi transport will be prominent (80% minibus taxis).
Distance travelled by commuters by bus	5 191	km/ year	
Passengers by bus	32		32 people travelling by bus

4.6 Emission Factors

The emission factors used for the assessment is provided in Table 4-4 and were mainly sourced from the:

- South African Methodological Guidelines for Quantification of Greenhouse Gas Emissions *gazetted by the* Department of Forestry, Fisheries and Environment, No. 47257(2598) (DFFE, 2022b).
- IPCC guidelines (IPCC, 2006)
- UK Government GHG Conversion Factors for Company Reporting developed by Department for Environment Food & Rural Affairs (DEFRA) and Department for Business, Energy & Industrial Strategy (DEFRA, 2024).

Table 4-4: Emission factors used in the assessment

Emission factors	Value	Unit	Source	Comment	Reference document	Link
Scope 1 - Direct Emissions						
diesel - stationary combustion	74638	kg CO_2 per TJ	(DFFE, 2022)	Diesel	Table A.3 (country specific)	-
diesel - stationary combustion	3	kg CH_4 per TJ	(DFFE, 2022)	Diesel	Table A.1 (IPCC, 2006)	
diesel - stationary combustion	0.6	kg N_2O per TJ	(DFFE, 2022)	Diesel	Table A.1 (IPCC, 2006)	
diesel - mobile combustion	74638	kg CO_2 per TJ	(DFFE, 2022)	Diesel	Table A.3 (country specific)	
diesel - mobile combustion (off-road)	3.9	kg CH_4 per TJ	(DFFE, 2022)	Diesel - offroad	Table A.2 (IPCC, 2006)	
diesel - mobile combustion (off-road)	3.9	kg N_2O per TJ	(DFFE, 2022)	Diesel - offroad	Table A.2 (IPCC, 2006)	
diesel - mobile combustion	4.2	kg CH_4 per TJ	(DFFE, 2022)	Diesel	Table A.2 (IPCC, 2006)	
diesel - mobile combustion	28.6	kg N_2O per TJ	(DFFE, 2022)	Diesel	Table A.2 (IPCC, 2006)	
coal - stationary combustion	94600.0	kg CO_2 per TJ	(DFFE, 2022)	Coking Coal	Table A.1 (IPCC, 2006)	
coal - stationary combustion	1.0	kg CH_4 per TJ	(DFFE, 2022)	Coking Coal	Table A.1 (IPCC, 2006)	
coal - stationary combustion	1.5	kg N_2O per TJ	(DFFE, 2022)	Coking Coal	Table A.1 (IPCC, 2006)	
petrol - mobile combustion	72430.0	kg CO_2 per TJ	(DFFE, 2022)	Petrol	Table A.3 (country specific)	
petrol - mobile combustion	3.5	kg CH_4 per TJ	(DFFE, 2022)	Petrol	Table A.2 (IPCC, 2006)	
petrol - mobile combustion	5.7	kg N_2O per TJ	(DFFE, 2022)	Petrol	Table A.2 (IPCC, 2006)	
Heavy fuel oil - stationary combustion	73090.0	kg CO_2 per TJ	(DFFE, 2022)	Heavy fuel oil	Table A.3 (country specific)	
Heavy fuel oil - stationary combustion	3.0	kg CH_4 per TJ	(DFFE, 2022)	Crude oil	Table A.1 (IPCC, 2006)	
Heavy fuel oil - stationary combustion	0.6	kg N_2O per TJ	(DFFE, 2022)	Crude oil	Table A.1 (IPCC, 2006)	
LPG - stationary combustion	64852.0	kg CO_2 per TJ	(DFFE, 2022)	LPG	Table A.3 (country specific)	
LPG - stationary combustion	1.0	kg CH_4 per TJ	(DFFE, 2022)	LPG	Table A.1 (IPCC, 2006)	
LPG - stationary combustion	0.1	kg N_2O per TJ	(DFFE, 2022)	LPG	Table A.1 (IPCC, 2006)	
Natural gas - stationary combustion	56100.0	kg CO_2 per TJ	(DFFE, 2022)	Natural gas	Table A.1 (IPCC, 2006)	
Natural gas - stationary combustion	1.0	kg CH_4 per TJ	(DFFE, 2022)	Natural gas	Table A.1 (IPCC, 2006)	

Emission factors	Value	Unit	Source	Comment	Reference document	Link
Natural gas - stationary combustion	0.1	kg N_2O per TJ	(DFFE, 2022)	Natural gas	Table A.1 (IPCC, 2006)	
Scope 3 - Indirect Emissions						
3.1 Well-to-tank fuels						
Diesel (100% mineral diesel)	0.62409	kg CO_2e per litre	(DEFRA, 2024)	WTT - fuels	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Natural gas	0.3366	kg CO_2e per m³	(DEFRA, 2024)	WTT - fuels	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
3.2 Upstream Transportation and Distribution						
Heavy goods vehicle	0.81517	kg CO_2e per km	(DEFRA, 2024)	All HGVs (average laden) - freighting goods	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
3.3 Construction						
Concrete	0.119	t CO_2e per tonne	(DEFRA, 2024)	Material used - construction	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Steel	1.91	t CO_2e per tonne	World Steel Association - Environmental Sustainability Indicators 2022	Environmental performance for CO2 emissions intensity	Sustainability indicators 2022	https://worldsteel.org/media-centre/press-releases/2022/sustainability-indicators-2022/
3.4 Water supply						
Water supply	153	kg CO_2e per million litres	(DEFRA, 2024)	Water supply delivered through mains supply network	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
3.5 Waste generated						
Municipal waste	1164.390	kg CO_2e per tonne	(DEFRA, 2024)	Paper (landfill)	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Commercial and industrial waste	520.334	kg CO_2e per tonne	(DEFRA, 2024)	Commercial and industrial waste	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
All Heavy Goods Vehicle (100% laden)	0.98641	kg CO_2e per km	(DEFRA, 2024)	All HGVs (100% laden) - freighting goods	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
3.6 Employee commuting						
Car (average)	0.1645	kg CO_2e per km	(DEFRA, 2024)	Average petrol car	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Taxi (MPV)	0.18287	kg CO_2e per km	(DEFRA, 2024)	MPV petrol	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024
Bus	0.10846	kg CO_2e per km.passenger	(DEFRA, 2024)	Average local bus	DEFRA EF (published July 2024)	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024

Emission factors	Value	Unit	Source	Comment	Reference document	Link
Density and Calorific Values						
Diesel - density	0.8255	kg/l	(DFFE, 2022)		Table D.1 (country specific)	
Petrol - density	0.741	kg/l	(DFFE, 2022)		Table D.1 (country specific)	
HFO - density	0.994	kg/l	(DFFE, 2022)		Table D.1 (country specific)	
LPG - density	0.555	kg/l	(DFFE, 2022)		Table D.1 (country specific)	
Diesel calorific value	35.5	MJ/l	(DFFE, 2022)		Table D.1 (country specific)	
Coal calorific value	19.2958	MJ/kg	(DFFE, 2022)		Table D.1 (country specific)	
Petrol calorific value	32.5	MJ/l	(DFFE, 2022)		Table D.1 (country specific)	
HFO calorific value	43	MJ/kg	(DFFE, 2022)		Table D.1 (country specific)	
LPG calorific value	46.29	MJ/kg	(DFFE, 2022)		Table D.1 (country specific)	
Natural gas calorific value	38.1	MJ/Nm³	(DFFE, 2022)	It is assumed that this is at 15% O_2 as it is not given.	Table D.1 (country specific)	

4.7 Emissions

The estimated GHG emissions for construction (13 208 t CO_2e) and operation (23 083 710 t CO_2e) (1 154 185 t CO_2e annually) of the project is provided in Table 4-5 and Table 4-6 respectively. GHG emissions due to operation phase will contribute 99.9% of the total project GHG emissions.

Table 4-5: Estimated GHG emissions for the construction phase of the project

Source	Input		Total Emissions (t CO_2e)			
	Value	Units	Scope 1	Scope 2	Scope 3	Total
Construction						
Fuel and Energy related activities						
Diesel (Stationary Combustion)	1 601 600	litres (assuming 3.5 years)	4 258			4 258
Diesel (Mobile Combustion)	592 200	litres (assuming 3.5 years)	1 595			1 595
Well-to-tank fuel						
Diesel	2 193 800	litres (assuming 3.5 years)			1 369	1 369
Upstream transportation and distribution						
Raw materials transport to site	1 317 400	km (for construction period)			1 074	1 074
Purchased goods						
Concrete required	10 500	m³			2 993	2 993
Steel required	400	t			764	764
Waste generated						
Municipal Waste	46	t			54	54
Transport of waste to landfill sites	177	km			0.2	0.2
Employee commuting						
Own Vehicle	3 360 000	km (for construction period)			553	553
Taxi	931 840	km (for construction period)			170	170
Bus	77 653	km (for construction period)			379	379
Total t CO2e			*5 853*	-	*7 355*	*13 208*

Table 4-6: Estimated GHG emissions for the operational phase of the project

Source	Input		Annual Emissions (t CO_2e)			
	Value	Units	Scope 1	Scope 2	Scope 3	Total
Operation						
Fuel and Energy related activities						
Natural Gas	574	million m³ per year	959 888			959 888
Diesel (Stationary Combustion)	60 000	litres/ year	160			160
Diesel (Mobile Combustion)	182 039	litres/ year	490			490
Well-to-tank fuel						
Diesel	242 039	litres/ year			151	151
Natural Gas	3 416 400 000	kWh/ year			193 208	193 208
Water supply						
Water supply	4	ML/ year			1	1
Waste generated						
Industrial Waste	70	t/ year			36	36
Municipal Waste	95	t/ year			111	111
Transport of waste to landfill sites	635	km			0.6	0.6
Employee commuting						
Own Vehicle	673 846	km/ year			111	111
Taxi	62 293	km/ year			11	11
Bus	5 191	km/ year			18	18
Total t CO2e per year			*960 537*	-	*193 648*	*1 154 185*
Total t CO2e for operating period			*19 210 749*	-	*3 872 961*	*23 083 710*

The GHG emissions provided as a percentage per scope for project construction and operations is provided in Figure 4-2 and Figure 4-3 respectively. As the project does not have Scope 2 emissions, it has not been included in the figures provided.

Scope 1 and Scope 3 emissions for the project construction is 5 853 tCO_2e (~1 672 tCO_2e per annum) and 7 355 tCO_2e (~2 101 tCO_2e per annum) making up 44% and 56% of the total GHG emissions for project construction respectively. Scope 1 and Scope 3 emissions for the project operations is 19 210 749 tCO_2e (~960 537 tCO_2e per annum) and 3 872 961 tCO_2e (~193 648 tCO_2e per annum) making up 17% and 83% of the total GHG emissions for project operations respectively.

For comparison, international reporting considers a small facility as producing 10 000 tCO_2e per annum, medium at 25 000 tCO_2e per annum and large at 100 000 tCO_2e per annum (for Scope 1 and 2 emissions). This project would thus be considered a large facility.

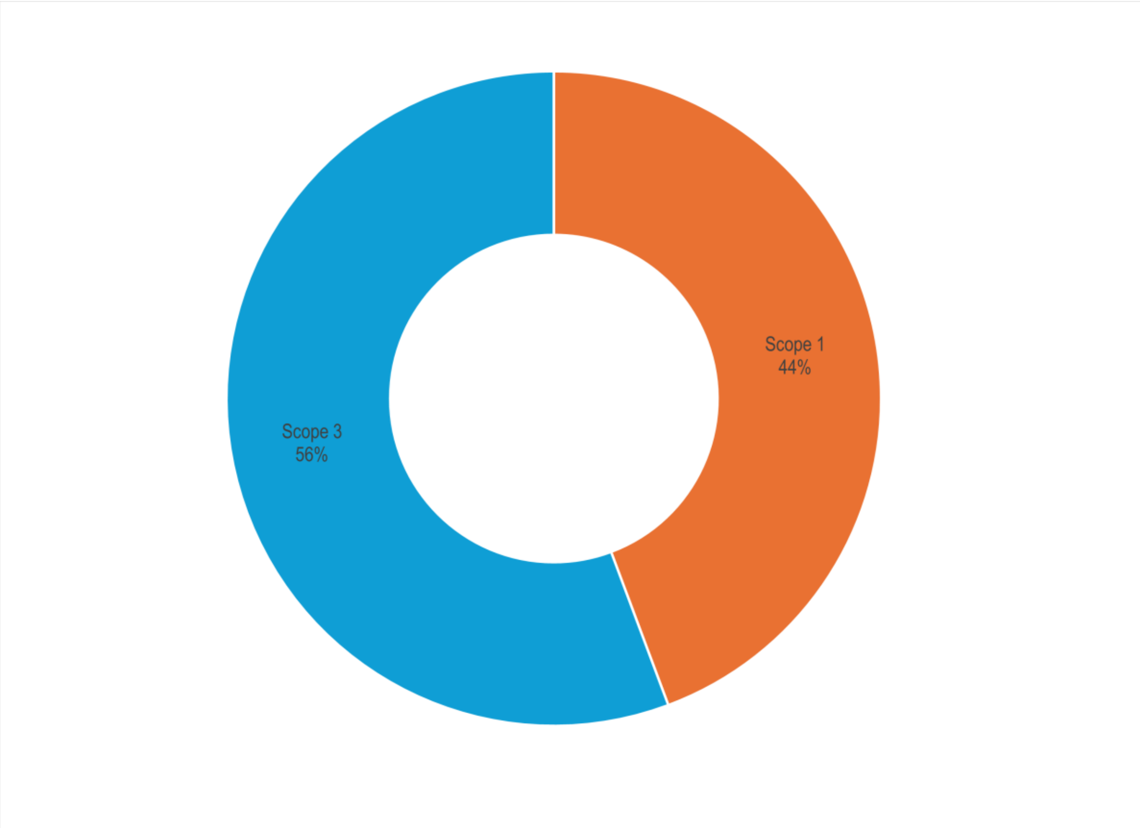


Figure 4-2: Percentage GHG emissions per scope for project construction activities

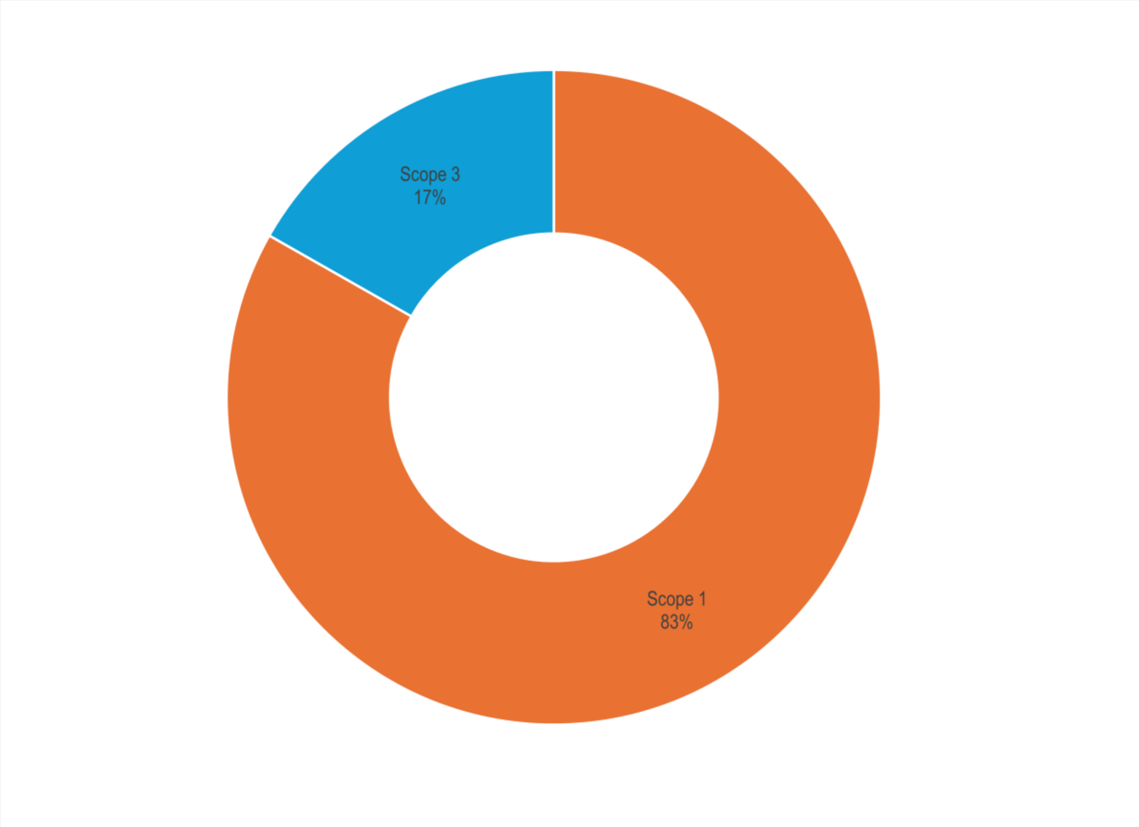


Figure 4-3: Percentage GHG emissions per scope for project operation activities

4.8 The Project's GHG Impact

4.8.1 Comparison to the Current Kelvin Station B Operations (Coal Fired Power Station)

The currently operating Kelvin Station B is a coal fired power station that is to be expected to be offline by 2029. A GHG emissions comparison of the CCGT project to Station B (Scope 1) is made in this section.

The input data and assumptions used in estimating GHG emissions for Station B (Scope 1) is provided in Table 4-7.

Table 4-7: Greenhouse gas assessment source data and assumptions for Station B

Operation	Value	Unit	Comments
Scope 1			
Bituminous coal	951 976	tonnes/year	
Diesel (mobile combustion)	182 039	litres/year	The average for diesel consumption on site for the past eight years is approximately 170,000 litres/year. It is expected that this diesel consumption will be transferred from Station B (expected to be offline by 2029) to the Kelvin redevelopment plant.
Petrol	852	litres/year	
HFO	4 825	tonnes/year	
LPG	4	tonnes/year	

The estimated GHG emissions for Station B are 1 761 995 t CO_2e per annum (Scope 1) (Table 4-8). Compare this to the project which is 960 537 t CO_2e per annum (Scope 1), just less than 55% of Station B Scope 1 GHG emissions.

Table 4-8: Estimated GHG emissions for Station B

Categories	Value	Unit
Scope 1		
Bituminous coal	1 746 299	tCO_2e/ year
Diesel (mobile combustion)	490	tCO_2e/ year
Petrol	2	tCO_2e/ year
HFO	15 190	tCO_2e/ year
LPG	13	tCO_2e/ year
Total Operation Emissions (Scope 1)	*1 761 995*	*tCO_2e/ year*

4.8.2 Impact on the National Remaining Carbon Budget, the National Inventory and the Sasol Group Inventory

According to the updated first NDC (Section 2.3), the South African remaining carbon budget is in the range of 398 – 510 Mt CO_2e for 2025 and 350 – 420 Mt CO_2e by 2030. Using the lower end of the range for 2030, the project activities would contribute approximately 0.001% (construction) and 0.33% (operation) respectively of the remaining carbon budget per year and represent a contribution of 0.001% (construction) and 0.26% (operation) to the 2022 National GHG inventory total.

4.8.3 Alignment with National Policy

Most of the South African GHG policy is in early phases of implementation where GHG emissions have been reported to DFFE since 31 March 2018 and the Carbon Tax Bill came into effect on the 1 June 2019. The project will be required to align GHG reporting with national policy. An annual Carbon Tax environmental levy account will need to be submitted in July of each year after operations commence.

Carbon tax was estimated based on applicable tax-free allowances (Table 4-9) and estimated combustion emissions (Table 4-6), such that the total annual carbon tax in the first full year of operation, and using the 2024 CO_2e per tonne tax rate, was estimated to be approximately R 73 milllion (Table 4-10).

Table 4-9: Tax-free allowances applicable for Main Activity Electricity and Heat Production (>10 MWth) (Schedule 2 of the Carbon Tax Bill, 2018)

Tax Allowance	Percentage deduction	Notes
Basic tax-free allowance for fossil fuel combustion emissions (%)	60	
Basic tax-free allowance for process emissions (%)	0	Not applicable to Electricity and Heat Production
Fugitive Emissions allowance (%)	0	For conservative tax estimate, these allowances were not taken into consideration
Trade exposure allowance (%)	10	
Performance allowance (%)	5	
Carbon budget allowance (%)	5	
Offsets allowance (%)	10	
Maximum allowances (%)	90	

Table 4-10: Estimated annual carbon tax for the CCGT Power Plant

Variable	Units	Value used in Carbon Tax calculation	Notes
Emissions	CO_2-e tonnes	959888	Scope 1 annual GHG emissions due to combustion of natural gas
Sequestrated	CO_2-e tonnes	0	
Combustion allowances total	%	60	
Petrol and diesel emissions	CO_2-e tonnes	0	Not included
Transport fuel allowances total	%	0	
Process related GHG emissions	CO_2-e tonnes	0	Not applicable to Electricity and Heat Production
Process allowances total	%	0	
Fugitive Emissions	CO_2-e tonnes	0	Not included
Fugitive allowances total	%	0	Not applicable to Electricity and Heat Production
Carbon Tax Rate	ZAR/tonne	190	Based on 2019 rate (R120/tonne) where 2% annual increases apply until 2022, and thereafter inflation related increases. It increased from R159/tonne for 2023 to R190/tonne on 1 January 2024 (a 16% increase).
Total Carbon tax estimate		R 72 951 453.60	Per year

5 PHYSICAL RISKS OF CLIMATE CHANGE ON THE PROJECT AND ADAPTATION MEASURES

5.1 Physical Risks of Climate Change to the Project's Operations

With the increase in temperature, there is the likelihood of an increase in discomfort and possibility of heat related illness (such as heat exhaustion, heat cramps, and heat stroke). Both these have the potential to negatively affect employee performance and productivity along with process efficiency.

From a process point of view, elevated ambient temperatures (up to 45°C) may slightly increase evaporative fuel losses from vehicles and increase temperature related wear on equipment. Similarly, there will be increased water use for drinking water and dust emission abatement on roads.

Increased temperatures and increased evaporation rates may also result in lower water availability for facilities and should be noted when sourcing water for the project.

5.2 Transitional Risks and Opportunities of Climate Change on the Project's Operations

The Taskforce for Climate-related Financial Disclosures (TCFD) advocates the disclosure of the financial risks associated with climate change impacts on organisations (TCFD, 2020). These include physical risks resulting in large-scale financial losses caused by storms, droughts, wildfires, and other extreme events (as identified in Section 3). The Taskforce also advocates the quantification of transitional risks associated with the adjustment to low carbon economies, such as the rapid loss in the value of assets due to policy changes or consumer preference; and financial risks to the economy through elevated credit spreads, greater precautionary saving and rapid pricing readjustment (TCFD, 2020). Along with risks, the Taskforce encourages organisations to identify possible opportunities that could build resilience in economies shifting due to climate change.

Although the full financial risk is out of the scope of the of work, potential transitional risks and opportunities applicable to the project are tabulated below (Table 5-1 as summarised from TCFD, 2017).

Table 5-1: Examples of climate-related risks and opportunities and the potential financial impacts (TCFD, 2017)

Type	Climate Related Risk / Opportunity	Potential financial impact	Comments
Risks	Policy and Legal		
	- Increased pricing of GHG emissions	- Increased operating costs (for example higher compliance cost, increased insurance premiums)	Carbon tax bill proposed 2% increase in baseline carbon tax rate until 2022 and thereafter annual inflation-based increases
	- Enhanced emissions reporting obligations	- Write-offs, asset impairment, and early retirement of existing assets due to policy changes	SAGERS online GHG emissions reporting platform in early release stages 2020
	- Mandates on and regulation of existing products and services	- Increased costs and / or reduced demand for products and services resulting from fines and judgements	Country commitment to decarbonise energy supplies by 2050 could influence product demand for gas- generated power. Exceedances of emission standards could result in fines and litigation
	- Exposure to litigation		
	Technology		
	- Substitution of existing products and services with lower emission options	- Write-offs and early retirement of existing assets - Reduced demand for products and services	Country commitment to decarbonise energy supplies by 2050 could influence product demand for gas- generated power.
	- Costs to transition to lower emissions technology	- Capital investments in technology development - Costs to adopt / deploy new practises and processes	Country commitment to decarbonise energy supplies by 2050 could require deployment of carbon capture, utilisation and storage technology to extend the operational lifespan of the gas to power plant.
	Market		
	- Changing customer behaviour	- Reduced demand for goods and services due to shift in consumer preferences	
	- Increased cost of raw materials	- Increased production costs due to changing input prices (for example, water and fuel) and output requirements (for example, wastewater- (brine or turbine wash-water). - Abrupt and unexpected shifts in energy costs - Re-pricing of assets (for example, fossil fuel reserves)	Increased water stress could affect water cost through demand and availability drivers. Proposed LPG supply is via import and therefore could be influenced by international land and security valuations and international market signals.
	Reputation		
	- Shifts in consumer preferences	- Reduced revenue from decreased demand for goods and services - Reduced revenue from decreased production capacity (delayed planning approvals, supply chain interruptions)	Country commitment to decarbonise energy supplies by 2050 could influence product demand for gas- generated power, which could influence consumer choices especially close to the decarbonised target year.

Type	Climate Related Risk / Opportunity	Potential financial impact	Comments
	- Increased stakeholder concern or negative stakeholder feedback	- Reduction in capital availability	Gas to power provides cleaner energy options during transition to decarbonised energy supply therefore capital may be more available than for other fossil fuel technology options. However, it is still based on fossil fuels that may have limited role in energy supplies after 2050, and thus have limited long-term funding arrangements.
Opportunities	Resource efficiency		
	- Use of more efficient modes of transport	- Reduced operating costs (through efficient gains and cost reductions)	Proposed LPG (or NG) pipeline would largely eliminate the transport requirements of LPG.
	- Use of more efficient production and distribution processes	- Increased production capacity, resulting in increased revenue	Increased ambient temperatures could increase plant generative capacity and reduce atmospheric emission rates
	- Use of recycling	- Capital costs of alternative water supplies	Investigation of alternative water supplies could open opportunities to recycle or reuse water since water supplies may become constrained by droughts or quality
	Energy source		
	- Use of lower-emission sources of energy	- Reduced operational costs (for example, through the use of lowest cost abatement technologies)	Gas to power provides cleaner energy option compared with other fossil fuel options, such as coal or diesel, which is applicable during transition to decarbonised energy supply.
		- Reduced exposure to future fossil fuel price increases	
		- Reduced exposure to GHG emissions and therefore less sensitivity to changes in cost of carbon	
	- Use of new technologies	- Returns on investment in low-emission technology	
		- Increased capital availability (as more investors favour lower emission producers)	
	- Participation in carbon market		Carbon tax incentives (through sequestration allowances)
	- Shift towards decentralised energy generation	- Reputational benefits resulting in increased demand for goods and services	Direct supply to customers in the Richards Bay IDZ
	Products and services		
	- Shifts in consumer preferences	- Better Competitive position to reflect shifting consumer preferences, resulting in increased revenues	
	Markets		
	- Access to new markets	- Increased revenue through access to new and emerging markets (for example partnerships with governments, development banks)	
	- Use of public-sector incentives		

5.3 Project Adaptation and Mitigation Measures

Climate change management includes both mitigation and adaptation. The main aim of mitigation is to stabilise or reduce GHG concentrations as a result of anthropogenic activities. This is achievable by lessening sources (emissions) and/or enhancing sinks through human intervention. Mitigation measures are typically the focus of the energy, transport and industry sectors (Thambiran & Naidoo, 2017). Adaptation measures focus on the minimising the impact of climate change, especially on vulnerable communities and sectors. Inclusion of the climate change adaptation in business strategic implementation plans is one of the outcomes defined in the Draft National Climate Change Adaptation Strategy (Government Gazette No.42466:644, May 2019).

5.3.1 General

Additional support infrastructure can reduce the climate change impact on the staff and project, for example the improving thermal and electrical efficiency of buildings to reduce electricity consumption, ensuring adequate water supply for staff and reducing on-site water usage as much as possible. A community development program could be initiated to assist communities near the plant that are vulnerable to climate change impacts, such as thermal and electrically efficient buildings (to minimise electricity needs for heating and cooling) and energy efficient stoves (to minimise the use of woody biomass harvested from natural forests).

5.3.2 Scope 1 (Technology/Sector-Specific)

To minimise GHG emissions would require lower fuel use, however fuel use at the project facility will be dependent on operating hours and electricity demand. Delivery of the natural gas to site via a pipeline would reduce the fuel usage by delivery vehicles, but electricity use for compressors could reduce these benefits. Alternative options for consideration include Carbon Capture and Storage (CCS) or Carbon offsets (for which allowances are contemplated in the Carbon Tax Bill).

CCS is a method of mitigating the contribution of fossil fuel emissions based on capturing CO_2 from large point sources such as power stations and storing it. CCS involves carbon dioxide being concentrated through various options and then permanently stored. The best researched carbon dioxide storage option is geological storage which involves injecting CO_2 directly into underground geological formations. Oil fields, gas fields, saline formations, un-mineable coal seams, and saline-filled basalt formations have been suggested as storage sites. Various physical (e.g., highly impermeable rock) and geochemical trapping mechanisms would prevent the CO_2 from escaping to the surface. The CSIR undertook a study into the potential for CO_2 storage in South Africa (2004). The study concluded that the storage of CO_2 in depleted gas fields, coal mines or gold mines is very limited. Deep saline reservoirs offer the highest potential for the geological storage of CO_2 in South Africa, especially withing the Karoo Super Group sediments of the Vryheid Formation in the north and the Katberg Formation near Burgersdorp/Molteno. However, due to a lack of information about the porosity and permeability of these of reservoirs, significant work is required before CO_2 sequestration into geological formations will be possible (Engelbrecht, Golding, Hietkamp, & Scholes, 2004). The South African CCS Atlas (Cloete, 2010) identified at a theoretical level that South Africa had about 150 Gigatons (Gt) of storage capacity. Less than 2% of this is onshore.

A significant limitation of CCS is its energy penalty. The technology is expected to use between 10 – 40% of the energy produced by a power station to capture the CO_2 (IPCC, 2005). Wide scale adoption of CCS may erase efficiency gains of the last 50 years and increase resource consumption by one third. However, even taking the fuel penalty into account, overall levels of CO2 abatement remain high, at approximately 80 - 90% compared to a plant without CCS.

Carbon offset options could include investment in REDD+ (Reducing Emissions from Deforestation and forest Degradation) initiatives (Thambiran & Naidoo, 2017). REDD+ initiatives in developing countries incentivise communities to undertake forestry and related activities that can contribute to reducing land based GHG emissions associated with deforestation and degradation and through sequestration of CO_2 in forests and agroforestry (Thambiran & Naidoo, 2017). REDD+ programmes are also mechanisms for socio-economic development. However, the expansion of the forestry industry in South Africa, will require quantification of the impact of expanded activities on water resources (as highlighted in the Draft National Climate Change Adaptation Strategy (Government Gazette No.42466:644, May 2019).

6 IMPACT SIGNIFICANCE RATING

6.1 Potential Impact Description

Gaseous pollutants released from the combustion of fuel is the main source of GHGs from the project. The release of GHG includes mainly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), CO_2, N_2O, CH_4 and ozone (O_3) are the primary GHG in the Earth's atmosphere. The effect of climate change is related to changing atmospheric GHG concentrations, increased temperatures, changing weather patterns and sea level rise (indirect negative impact).

6.2 Impact Significance

The calculated CO_2e emissions from the project (Scope 1) is summarised in Section 4.7, estimating 5 853 t for the project construction (3 774 tpa) and 19 210 749 t for the project operations (960 537 tpa).

The project Scope 1 emissions due to the project would contribute approximately 0.001% (construction) and 0.33% (operation) of the remaining carbon budget per year and represent a contribution of 0.001% (construction) and 0.26% (operation) to the 2022 National GHG inventory total.

Local reporting requirements have yet to be developed to describe and assess environmental impacts for GHGs. Guidance is thus taken from international guidelines such as that developed for the Sacramento Metropolitan Air Quality Management District (SMAQMD, 2014). As part of the process to determine if a full GHG analysis and mitigate programme is required, an Initial Study is implemented to determine if a project may have a significant effect on the environment. As such a threshold of 1.1 Gg CO_2e (project construction phase) and 10 Gg CO_2e (operational phase) for stationary source projects per year is applied to new projects (SMAQMD, 2014). These thresholds were based on capturing 90% of the development projects across the state, ensuring that small projects, which generally have low emission levels, and would generally not be considered significant. As an alternative method of measure, a GHG threshold may be based on the classification of projects by the European Bank for Reconstruction and Development (EBRD), in which projects contributing more than 25 Gg CO_2e per year to have significant GHG emissions (EBRD 2019). This is in line with the International Finance Corporation (IFC 2012). Section 8 of the IFC Performance Standards on Environmental and Social Sustainability: "For projects that are expected to or currently produce more than 25 000 Gg CO_2e annually the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognised methodologies and good practice". In terms of the Equator Principles, a developer that is seeking funding from a financial institution that subscribes to the Equator Principles is required to publicly report on its combined Scope 1 and Scope 2 GHG emissions if it exceeds 100 Gg CO_2e annually, for the operational phase of the project, during the life of the loan (Equator Principles, 2013). The Equator Principles also encourage clients to report publicly on projects emitting over 25 Gg CO_2e, in line with the IFC Performance Standards (Equator Principles, 2013). As a further example, the South African Declaration of Greenhouse Gases as Priority Pollutants (Government Gazette 40966 of 21 July 2017) define production processes in Annexure A of the Declaration with the requirement to submit a Pollution Prevention Plan (PPP) to the Minister for approval with GHG in excess of 100 Gg CO_2e.

When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects could replace existing development or baseline activity that has a higher GHG profile. Therefore, the significance of a project's emissions should be based on its net impact over its lifetime, which may be positive, negative or negligible. To meet the South African (SA) NDC targets and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. The proposed project must therefore consider whether and how the project will contribute to or jeopardise the achievement of these targets. Such an assessment would however require a much broader evaluation of the project against all current energy mix and their resources practiced in South Africa. In the absence of such a comprehensive assessment, the current assessment will rely on using thresholds to define the significance of the GHG impact.

The proposed intensity rating for annual emissions is as follows:

25 Gg CO_2e	:	**Very Low** (i.e., threshold used by EBRD, IFC and Equator Principals)
25 – 100 Gg CO_2e	:	**Low** (i.e., DFFE PPP requirement threshold is 100 Gg CO_2e)
100 – 500 Gg CO_2e	:	**Medium** (i.e., DFFE PPP to 0.1% of the total gross SA GHG emissions)
500 – 5 000 Gg CO_2e	:	**High** (i.e., 0.1% to 1.0% of the total gross SA GHG emissions)
>5 000 Gg CO_2e	:	**Very High** (i.e., more than 1.0% of the total gross SA GHG emissions)

The combined GHG emissions for project construction (3 774 t CO_2e) and operations (960 537 t CO_2e) per annum are 0.26% of the total gross SA GHG emissions. The impact significance is therefore considered to be **high**.

7 FINDINGS AND RECOMMENDATIONS

Project specific information together with local and internationally published emission factors were used to calculate Scope 1 (direct), Scope 2 (indirect) and Scope 3 (indirect) GHG emissions for the proposed project. Locally published literature was referred to, to understand the projected changes to climate for the area.

Based on information provided, the project is likely to result in an estimated total of 5 853 t CO_2e direct emissions and 7 355 t CO_2e indirect emissions due to construction activities. For project operations, the estimated total GHG emissions is 19 210 749 t CO_2e (direct) and 3 872 961 t CO_2e (indirect). This was calculated to represent 0.001% (construction) and 0.33% (operation) of the remaining South African annual GHG budget.

The impact of the project on climate change was assessed to have a **high** negative risk rating.

The project will be required to report carbon dioxide equivalent (CO_2e) emissions annually via the NAEIS.

7.1 Conclusion

Although South Africa is on a drive to illuminate fossil fuel driven energy, this needs to be done with a Just Energy Transition. This includes the gradual movement towards lower carbon technologies, while not negatively impacting society, jobs and livelihoods. The Just Energy Transition is important to the country and to our future growth and sustainability as an organisation.

From a GHG emissions perspective reference is made to the United Stated Environmental Protection Agency's (US EPA's) Emissions and Generation Resource Integrated Database (eGRID), released in 2018 with 2016 data, which shows that at the national level, natural gas units have an average emission rate of 898 pounds CO_2 per megawatt-hour (MWh), while coal units have an emissions rate of 2,180 pounds CO_2 per MWh[15]. Natural gas units, therefore, on average, release ~58% less CO_2 per MWh compared to coal units.

From the perspective of climate change and given that GHG emissions are lower than coal burning electricity generation, it is the opinion of the specialist that the project be authorised, on condition that GHG emissions are reported annually according to legal requirements.

[15] Available: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

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APPENDIX A – CURRICULUM VITAE OF ASSESSMENT AUTHOR

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	Reneé von Gruenewaldt (*nee* Thomas)
Profession	Air Quality and Environmental Noise Scientist
Position	Principal consultant
Date of Birth	13 May 1978
Years with Firm	Since January 2002
Nationalities	South African

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP)
- Member of the National Association for Clean Air (NACA)

KEY QUALIFICATIONS

Reneé von Gruenewaldt (Air Quality Scientist): Reneé joined Airshed Planning Professionals (Pty) Ltd (previously known as Environmental Management Services cc) in 2002. She has, as a Specialist, attained over twenty (20) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and nine (9) years of experience in the field of environmental noise assessments. As an environmental practitioner, she has provided solutions to both large-scale and smaller projects within the mining, minerals, and process industries.

She has developed technical and specialist skills in various air quality modelling packages including the AMS/EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff-based model (CALPUFF and CALMET), puff-based HAWK model and line-based models, Lagrangian GRAL model. Her experience with air emission models includes Tanks 4.0 (for the quantification of tank emissions), WATER9 (for the quantification of wastewater treatment works) and GasSim (for the quantification of landfill emissions). Noise propagation modelling proficiency includes CONCAWE, South African National Standards (SANS 10210) for calculating and predicting road traffic noise and CadnaA for propagation of industrial, road and rail noise sources.

Having worked on projects throughout Africa (i.e., South Africa, Mozambique, Malawi, Kenya, Angola, Democratic Republic of Congo, Namibia, Madagascar and Egypt for Air Quality Impact Assessments and Mozambique, Namibia, Botswana, Kenya, Ghana, Suriname and Afghanistan for Environmental Noise Impact Assessments) Reneé has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

RELEVANT EXPERIENCE (AIR QUALITY)

Mining and Ore Handling

Reneé has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite, manganese and mineral sands mines. These include: compilation of emissions databases for Landau and New Vaal coal collieries (SA), impact assessments and management plans for numerous mines over Mpumalanga (viz. Schoonoord, Belfast, Goedgevonden, Mbila, Evander South, Driefontein, Hartogshoop, Belfast, New Largo, Geluk, etc.), Mmamabula Coal Colliery (Botswana), Moatize Coal Colliery (Mozambique), Revuboe Coal Colliery (Mozambique), Toliera Sands Heavy Minerals Mine and Processing (Madagascar), Corridor Sands Heavy Minerals Mine monitoring assessment, El Burullus Heavy Minerals Mine and processing (Egypt), Namakwa Sands Heavy Minerals Mine (SA), Tenke Copper Mine and Processing Plant (DRC), Rössing Uranium (Namibia), Lonmin platinum mines including operations at Marikana, Baobab, Dwaalkop and Doornvlei (SA), Impala Platinum (SA), Pilannesburg Platinum (SA), Aquarius Platinum, Hoogland Platinum Mine (SA), Tamboti PGM Mine (SA), Sari Gunay Gold Mine (Iran), chrome mines in the Steelpoort Valley (SA), Mecklenburg Chrome Mine (SA), Naboom Chrome Mine (SA), Kinsenda Copper Mine (DRC), Kassinga Mine (Angola) and Nokeng Flourspar Mine (SA), etc.

Mining monitoring reviews have also been undertaken for Optimum Colliery's operations near Hendrina Power Station and Impunzi Coal Colliery with a detailed management plan undertaken for Morupule (Botswana) and Glencor (previously known as Xstrata Coal South Africa).

Air quality assessments have also been undertaken for mechanical appliances including the Durban Coal Terminal and Nacala Port (Mozambique) as well as rail transport assessments including BHP-Billiton Bauxite transport (Suriname), Nacala Rail Corridor (Mozambique and Malawi), Kusile Rail (SA) and WCL Rail (Liberia).

Metal Recovery

Air quality impact assessments have been carried out for Highveld Steel, Scaw Metals, Lonmin's Marikana Smelter operations, Saldanha Steel, Tata Steel, Afro Asia Steel and Exxaro's Manganese Pilot Plant Smelter (Pretoria).

Chemical Industry

Comprehensive air quality impact assessments have been completed for NCP (including Chloorkop Expansion Project, Contaminated soils recovery, C3 Project and the 200T Receiver Project), Revertex Chemicals (Durban), Stoppani Chromium Chemicals, Foskor (Richards Bay), Straits Chemicals (Coega), Tenke Acid Plant (DRC), and Omnia (Sasolburg).

Petrochemical Industry

Numerous air quality impact assessments have been completed for Sasol (including the postponement/exemption application for Synfuels, Infrachem, Natref, MIBK2 Project, Wax Project, GTL Project, re-commissioning of boilers at Sasol Sasolburg and Ekandustria), Engen Emission Inventory Functional Specification (Durban), Sapref refinery (Durban), Sasol (at Elrode) and Island View (in Durban) tanks quantification, Petro SA and Chevron (including the postponement/exemption application).

Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the ash expansion projects at Kusile, Kendal, Hendrina, Kriel and Arnot; Fabric Filter Plants at Komati, Grootvlei, Tutuka, Lethabo and Kriel Power Stations; the proposed Kusile, Medupi (including the impact assessment for the Flue Gas Desulphurization) and Vaal South Power Stations. Reneé was also involved and the cumulative assessment of the existing and return to service Eskom power stations assessment and the optimization of Eskom's ambient air quality monitoring network over the Highveld.

In addition to Eskom's coal fired power stations, various Eskom nuclear power supply projects have been completed including the air quality assessment of Pebble Bed Modular Reactor and nuclear plants at Duynefontein, Bantamsklip and Thyspunt.

Apart from Eskom projects, power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Paratus Power Plant).

Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the Waste Water Treatment Works in Magaliesburg, proposed Waterval Landfill (near Rustenburg), Tutuka Landfill, Mogale General Waste Landfill (adjacent to the Leipardsvlei Landfill), Cape Winelands District Municipality Landfill, the Tsoeneng Landfill (Lesotho) and the FG Landfill (near the Midstream Estate). Air quality impact assessments have also been completed for the BCL incinerator (Cape Town), the Ergo Rubber Incinerator and the Ecorevert Pyrolysis Plant.

Cement Manufacturing

Impact assessments for ambient air quality have been completed for the Holcim Alternative Fuels Project (which included the assessment of the cement manufacturing plants at Ulco and Dudfield as well as a proposed blending platform in Roodepoort).

Management Plans

Reneé undertook the quantification of the baseline air quality for the first declared Vaal Triangle Airshed Priority Area. This included the establishment of a comprehensive air pollution emissions inventory, atmospheric dispersion modelling, focusing on impact area "hotspots" and quantifying emission reduction strategies. The management plan was published in 2009 (Government Gazette 32263).

Reneé has also been involved in the Provincial Air Quality Management Plan for the Limpopo Province.

RELEVANT EXPERIENCE (GREENHOUSE GAS EMISSION FOOT-PRINTING AND CLIMATE CHANGE IMPACT STATEMENTS)

Mining and Tailings Storage Facilities

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for numerous mines over the highveld of South Africa and the Democratic Republic of Congo. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

Gas to Power Plants

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for gas to power plants proposed for South Africa. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

RELEVANT EXPERIENCE (NOISE)

Mining

Reneé has undertaken numerous environmental noise assessments for mining operations. These include environmental noise impact assessments including baseline noise surveys for numerous coal, platinum, manganese, tin and zinc mines. Projects include, but are not limited to, Balama (Mozambique), Masama Coal (Botswana), Lodestone (Namibia), Osino (Namibia), Kurmuk (Ethiopia), Gamsberg (SA), Prieska (SA), Kolomela (SA), Heuningkranz (SA), Syferfontein (SA), South 32 (SA), Mamatwan (SA), Alexander (SA) and Marula Platinum Mine (SA), etc.

Power Generation

Environmental noise assessments have been completed for numerous Eskom coal fired power station studies in SA including the Kriel Fabric Filter Plant, Kendal ash facility, Medupi ash facility. Apart from Eskom projects, power plant assessments have also been completed in Botswana (Morupule), Kenya (Or Power geothermal power plants), Suriname (EBS power plant) and SA (Richards Bay combined cycle power plant).

Process Operations

Environmental noise assessments have been undertaken for various process operations including waste disposal facilities (Bon Accord in Gauteng), bottling and drink facilities (Imali and Isanti Project in Gauteng) and Smelter (Gamsberg in Northern Cape).

Transport

An environmental noise assessment was completed for the Obetsebi road expansion and flyover project in Ghana, the Scorpion Zinc Mine transport route in Namibia and the Sisian-Kajaran (North-South Corridor) Road Project in Armenia.

Gas Pipelines

An environmental noise assessment was completed for the Sheberghan gas pipeline in Afghanistan.

Baseline Noise Surveys

Baseline noise surveys have been undertaken for numerous mining and process operation activities (including Raumix quarries, Kolomela and Sibanye Stillwater Platinum Mines (SA)) in support of onsite Environmental Management Programmes.

OTHER EXPERIENCE (2001)

Research for B.Sc Honours degree was part of the "Highveld Boundary Layer Wind" research group and was based on the identification of faulty data from the Majuba Sodar. The project was THRIP funded and was a joint venture with the University of Pretoria, Eskom and Sasol (2001).

EDUCATION

M.Sc Earth Sciences	University of Pretoria, RSA, Cum Laude (2009) Title: *An Air Quality Baseline Assessment for the Vaal Airshed in South Africa*
B.Sc Hons. Earth Sciences	University of Pretoria, RSA, Cum Laude (2001) Environmental Management and Impact Assessments
B.Sc Earth Sciences	University of Pretoria, RSA, (2000) Atmospheric Sciences: Meteorology

ADDITIONAL COURSES

CALMET/CALPUFF	Presented by the University of Johannesburg, RSA (March 2008)
Air Quality Management	Presented by the University of Johannesburg, RSA (March 2006)

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Ghana, Suriname, Afghanistan, Malawi, Liberia, Kenya, Angola, Democratic Republic of Congo, Ethiopia, Afghanistan, Lesotho, Namibia, Madagascar, Egypt, Suriname and Iran.

EMPLOYMENT RECORD

January 2002 - Present

Airshed Planning Professionals (Pty) Ltd, (previously known as Environmental Management Services cc until March 2003), Principal Air Quality and Environmental Noise Scientist, Midrand, South Africa.

2001

University of Pretoria, Demi for the Geography and Geoinformatics department and a research assistant for the Atmospheric Science department, Pretoria, South Africa.

Department of Environmental Affairs and Tourism, assisted in the editing of the Agenda 21 document for the world summit (July 2001), Pretoria, South Africa.

1999 - 2000

The South African Weather Services, vacation work in the research department, Pretoria, South Africa.

CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Understanding the Synoptic Systems that lead to Strong Easterly Wind Conditions and High Particulate Matter Concentrations on The West Coast of Namibia, H Liebenberg-Enslin, R von Gruenewaldt, H Rauntenbach and L Burger. National Association for Clean Air (NACA) conference, October 2017.
- Topographical Effects on Predicted Ground Level Concentrations using AERMOD, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2011.
- Emission Factor Performance Assessment for Blasting Operations, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2009.
- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007.
- A High-Resolution Diagnostic Wind Field Model for Mesoscale Air Pollution Forecasting, R.G. Thomas, L.W. Burger, and H Rautenbach. National Association for Clean Air (NACA) conference, September 2005.
- Emissions Based Management Tool for Mining Operations, R.G. Thomas and L.W. Burger. National Association for Clean Air (NACA) conference, October 2004.
- An Investigation into the Accuracy of the Majuba Sodar Mixing Layer Heights, R.G. Thomas. Highveld Boundary Layer Wind Conference, November 2002.

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

______________________	29/07/2024
Signature of staff member	Date (Day / Month / Year)

Full name of staff member: Reneé Georgeinna von Gruenewaldt

APPENDIX B – DECLARATION OF INDEPENDENCE

forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
Climate Change Assessment for the Combined-Cycle Gas Turbine Power Plant at Kelvin Power Station

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)*', where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Climate Change Assessment
Specialist Company Name	Airshed Planning Professionals (Pty) Ltd
Specialist Name	Reneé von Gruenewaldt
Specialist Identity Number	7805130128080
Specialist Qualifications:	MSc.(Earth Sciences)
Professional affiliation/registration:	South African Council for Natural Scientific Professionals: 400304/07
Physical address:	62 Constantia Ave, Pretoria
Postal address:	PostNet Suite #18, Private Bag x59
Postal address	Halfway House, 1685
Telephone	011 805 1940
Cell phone	083 222 6916
E-mail	renee@airshed.co.za

SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Reneé von Gruenewaldt declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I 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 declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority 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 competent authority; and;
  - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.

Signature of the Specialist

Airshed Planning Professionals (Pty) Ltd

Name of Company:

28 July 2024

Date

SPECIALIST DECLARATION FORM – AUGUST 2023

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Reneé von Gruenewaldt swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Airshed Planning Professionals (Pty) Ltd

Name of Company

28/07/2024.

Date

711 2897
SGT.

Signature of the Commissioner of Oaths

2024.07.28.

Date

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
2024 -07- 2 8
GEMEENSKAPSDIENSSENTRUM
BROOKLYN
SUID-AFRIKAANSE POLISIEDIENS

... FURTHER ... AN AMENDMENT OR A CHANGE

RANG RANK SGT.

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Batho pele- putting people first

Page 3 of 3