APPENDIX L

Greenhouse Gas Emissions and Climate Change Impact Opinion

REPORT

Greenhouse Gas Emissions and Climate Change Opinion for the Proposed Metsimaholo Underground Coal Mine

Seriti Coal (Pty) Ltd

Submitted to:

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18101804-324366-9

February 2019

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1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd (Golder) has been appointed by Seriti Coal (Pty) Ltd (Seriti) to undertake an Environmental and Social Impact Assessment (ESIA) process in support of a new Mining Right Application (MRA) for the proposed Metsimaholo underground coal mine project.

The purpose of this report is to provide a specialist opinion on the potential greenhouse gas (GHG) emissions resulting from the proposed Metsimaholo underground coal mine project, as well as potential impacts of climate change on the project in the intermediate and more distant future. This specialist opinion will be used to inform the ESIA.

Note: *This is specialist opinion is based on experience of the author and informed by readily available information on the subject matter. No primary data collection was undertaken in preparation of this specialist opinion.*

2.0 GREENHOUSE GAS EMISSIONS

The calculated annual GHG emissions from the proposed Metsimaholo underground coal mine project range between 78 226 tCO_{2eq} and 162 616 tCO_{2eq} (DEA, 2014). If in 2010[1], South Africa's total GHG footprint was 428 368 000 tCO_{2eq}, the proposed project will contribute between 0.02% and 0.04% to South Africa's total GHG emissions (DEA, 2014).

This calculation is based on GHG emissions from the following activities, which are described in more detail in the sections to follow.

- Underground coal mining;
- Beneficiation of coal; and
- *In situ* GHG emissions.

Underground Coal Mining

Typically, an underground coal mine (bord and pillar mining method) uses on average 11 to 25 kWh of energy per tonne of coal mined (USGS, 2011). Figure 1 presents a typical breakdown of energy usage by an underground coal mine. It can be seen that mining accounts for the majority of energy usage (51%), followed by hoisting (22%), pumping (9%), ventilation (7%), drilling (6%), break and convey (3%), and ancillary services (2%).

[1] Latest data available for South Africa. Therefore this is used as a point of illustration.

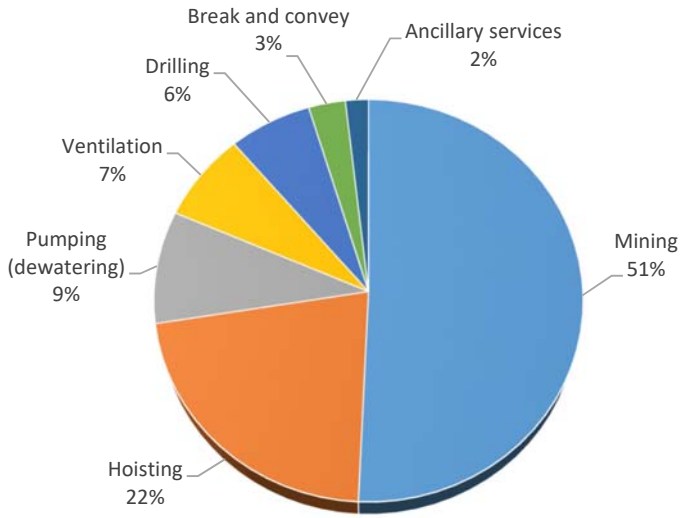

Figure 1: Typical breakdown of energy usage in underground coal mining (USGS, 2011)

The calculated annual GHG emissions from underground coal mining at the proposed Metsimaholo underground coal mine ranges between 32 010 tCO_{2eq} and 72 750 tCO_{2eq} per annum, based on average energy consumption per tonne of coal mined (11 to 25 kWh/t), Eskom's country specific emissions factor for electricity generation (0.97 $kgCO_{2eq}$/kWh) (Eskom, 2018), and steady state production of 3 million tonnes of coal per annum.

Beneficiation of Coal

Typically, crushing, grinding and cleaning of coal uses on average 15 to 30 kWh of energy per tonne of coal mined (USGS, 2011).

The annual GHG emissions from beneficiation of coal at the proposed Metsimaholo underground coal mine is estimated to be 43 650 tCO_{2eq} to 87 300 tCO_{2eq} per annum, based on average energy consumption per tonne of coal crushed, ground, and cleaned (15 to 30 kWh/t), Eskom's specific emissions factor for electricity generation in South Africa (0.97 $kgCO_{2eq}$/kWh), and steady state production of 3 million tonnes of coal per annum.

In situ GHG Emissions

The geological processes which lead to the formation of coal also produce methane (CH_4) and carbon dioxide (CO_2) (DEA, 2014). Methane is a key greenhouse gas as its global warming potential is 24 times greater than that of carbon dioxide.

According to the Intergovernmental Panel on Climate Change (IPCC) (2008), the major sources of GHG emissions from both surface and underground coal mines are:

- **Mining emissions:** Release of carbon dioxide and methane stored in the coal and surrounding strata during mining operations; and
- **Post mining emissions:** Release of carbon dioxide and methane during the handling, processing and transportation of the coal. The coal will continue to emit GHGs even after being mined, but at a much slower rate than during the coal breakage stage.

In underground coal mines, ventilation of the mine causes significant amounts of methane to be pumped to the surface and into the atmosphere. In contrast, the release of methane from surface coal mining operations is relatively low.

The annual *in situ* GHG emissions from the mining, handling and transport of coal at the proposed Metsimaholo underground coal mine was estimated using country specific emission factors for South Africa, and steady state production of 3 million tonnes of coal per annum. As shown in Table 1, a total of 2 566 tCO2eq will be emitted on an annual basis, with coal mining accounting for the majority of the emissions (81%).

Table 1: Calculated *in situ* GHG emissions from mining, handling and transportation of coal at the proposed Metsimaholo underground coal mine

Activity	GHG	Emissions factor (kgCO2eq/t)	tCO2eq
Coal mining	CH_4	0.552	1 656
	CO_2	0.141	423
		Sub-total	***2 079***
Post-mining (handling and transport)	CH_4	0.129	387
	CO_2	0.033	99
		Sub-total	***486***
		TOTAL	**2 566**

If in 2010, South Africa's total *in situ* GHG emissions from mining, handling and transport of coal was 2 266 000 tCO_{2eq} (DEA, 2014), the proposed Metsimaholo underground coal mine project will contribute approximately 0.1% to these GHG emissions. Thus illustrating the minimal impact the proposed project has on the country's total emissions.

3.0 CLIMATE CHANGE

This section briefly describes the potential impacts of climate change on the proposed Metsimaholo underground coal mine project. This assessment was undertaken at desktop level, and based primarily on the work of Knoesen *et al.* (2009) on Orange-Senqu River basin, in which the project is located. As such no primary data collection or modelling was undertaken.

Climate change refers to a significant change in the trends of expected patterns of 'average' climate and its 'average' variability (Knoesen *et al.*, 2009). As demonstrated above, humans are contributing to changes in the climate through for example the release of greenhouse gasses, which enhances global warming.

The impact of climate change is expected to be extensive, but at the same time diverse (Knoesen *et al.*, 2009). For example, temperatures are projected to rise everywhere, with some regions likely to experience higher increases than others. Extreme events, such as violent storms, floods and droughts, are also expected to increase in their frequency and intensity. Many ecosystems are also expected to be damaged by climate change due to rising air and water temperatures, and changes in the availability of water, forcing species to migrate in order to survive. As a consequence, the potential impacts of climate change need to be carefully considered in planning into the future.

The *ACRU* hydrological model was used to determine the impact of climate change on the hydrology and water resources in the Orange-Senqu River basin in the present (1971 – 1990), intermediate future (2046 – 2065), and more distant future (2081 – 2100) (Knoesen *et al.*, 2009). The General Circulation Model ECHAM5/MPI-OM, which is based on the A2 emissions scenario (i.e. assumed that GHG emissions continue relatively

unabated to the year 2100), was used to inform the *ACRU* hydrological model with respect to changes in temperature, rainfall, and extreme hydrological events.

Table 2 presents a summary of the key findings of the study that may be relevant to the proposed Metsimaholo underground coal mine project. This includes the potential impact of climate change on:

- Mean annual temperatures;
- Crop evaporation;
- Mean annual rainfall;
- Rainfall days;
- Mean annual streamflow;
- Floods; and
- Meteorological droughts.

Table 2: Expected changes in the intermediate and more distant future

Variable	Description	Time Periods	
		2046 - 2065	2081 - 2100
Mean annual temperature	Increasing mean annual temperatures can have a significant effect on a number of elements, including: ■ Evaporation rate; ■ Frequency and intensity of rainfall events; ■ Distribution and variability of rainfall year on year; ■ Soil moisture content; ■ Heat wave episodes; and ■ Meteorological and hydrological droughts.	Increase of 2°C to 3°C in mean annual temperatures	Increase of 6°C to 7°C in mean annual temperatures
Crop evaporation	Increasing temperatures can have a profound effect on transpiration or evaporation from crops, which can result in plant stress and/or changes in water demands.	Increase of 10% to 15% in crop evaporation.	Increase of 20% to 25% in crop evaporation.
Mean annual rainfall	Mean annual rainfall is used to measure the long-term quantity of water available to a region.	Increase of up to 10% in mean annual rainfall.	Increase of 30% to 100% in mean annual rainfall.
Rainfall days	In addition to mean annual rainfall, it is also important to consider the frequency and intensity of the rainfall, which can be measured in rainfall days.	Increase of 10% to 20% in the number of rainfall days greater than 10 mm.	Increase of 30% to 100% in the number of rainfall days greater than 10 mm.
Mean annual streamflow	As a result of increasing rainfall, mean annual streamflow is expected to increase, which can result in localised flooding and soil erosion.	Increase of up to 10% in mean annual streamflow.	Increase of 30% to 100% in mean annual streamflow.

Variable	Description	Time Periods	
		2046 - 2065	2081 - 2100
Floods	Flooding occurs when water overtops the existing channels of streams and rivers, or overflows stormwater drains. Short duration floods, or flash floods, are generally associated with severe thunderstorms and occur as a result of high intensity rainfall over a short period.	Increase of up to 10% in one day floods with a two-year return period (or probability of occurrence).	Increase of 20% to 30% in one day floods with a two-year return period
Meteorological droughts	Droughts occur when an area or place experiences a shortage of water in some form or another for an extended period of time, generally as a consequence of below average rainfall. Meteorological droughts generally precede other types of drought, and occur when precipitation is below 'normal' or 'average' for a prolonged period of time.	No change in frequency of short duration (one year) and long duration (three years) severe droughts. Greater than 30% decrease in frequency of short duration (one year) and long duration (three years) mild droughts.	

4.0 CONCLUSION

In summary, it is estimated that annual GHG emissions from the proposed Metsimaholo underground coal mine will range between 78 226 tCO_{2eq} and 162 616 tCO_{2eq}, which will contribute between 0.02% and 0.04% to South Africa's total GHG footprint (if 2010 used as a marker). As such, the contribution of the proposed project to South Africa's total GHG emissions is deemed to be insignificant.

Based on available information, it is expected that climate change will impact on the proposed Metsimaholo underground coal mine project in intermediate (2046 – 2065), and more distant future (2081 – 2100). Key changes include increasing mean annual temperatures, crop evaporation, mean annual rainfall, rainfall days, mean annual streamflow, and short duration floods. In contrast, the number of mild short duration (one-year) and long duration (three-years) meteorological droughts are expected to decrease in the intermediate future. The potential impacts of climate change can be mitigated to a large extent through careful planning that takes cognisance of these potential changes.

5.0 REFERENCES

DEA (2014). *GHG Inventory for South Africa: 2000 – 2010*. Department of Environmental Affairs. Pretoria.

Eskom (2018). *Integrated Report*. Eskom. Pretoria.

IPCC (2008). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change. Japan.

Knoesen, D., Schulze, R., Pringle, C., Summerton, M., Dickens, C. and Kunz, R. (2009). *Water for the Future: Impacts of Climate Change on Water Resources in the Orange-Senqu River Basin*. Report to NeWater, a project funded under the Sixth Research Framework of the European Union. Institute of Natural Resources, Pietermaritzburg, South Africa.

USGS (2011). *Estimates of Electricity Requirements for the Recovery of Mineral Commodities, with Examples Applied to Sub-Saharan Africa*. Report No. 2011–1253. U.S. Geological Survey.

Signature Page

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APPENDIX A

Document Limitation

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GOLDER ASSOCIATES AFRICA (PTY) LTD

APPENDIX B

Specialist Declaration and CV

SPECIALIST DECLARATION

As required under Appendix 6 of the Environmental Impact Assessment Regulations, 2014 (as amended), I, **Michael van Niekerk**, declare that:

- I act as an independent specialist in this application;
- 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 Acts, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with all applicable Acts and Regulations in compiling this report;
- 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 declaration are true and correct.

Signature of the specialist:

Golder Associates Africa (Pty) Ltd

Name of company (if applicable):

28 February 2019

Date:

Education

MSc Geography and Environmental Science, University of KwaZulu-Natal, Durban, 2009

BSc (Honours) Geography and Environmental Science (Cum Laude), University of KwaZulu-Natal, Durban, 2006

BSc Geography and Environmental Management (Dean's Commendation), University of KwaZulu-Natal, Durban, 2005

Certifications

IEMA Certified Carbon Footprint Analyst, July 2018

Languages

English – Fluent

Afrikaans – Fluent

Midrand

Environmental Practitioner

Michael is an Environmental Assessment Practitioner in the Mine Environment Division of Golder Associates Africa. He generally specialises in field of strategic environmental planning, as well as integrated environmental management, particularly ESIAs / EIAs, BAs, and ESMPs/EMPrs, environmental auditing, and WML, Amendment and S24G applications.

In the last 10 years he has however developed skills and expertise in a number of related fields. This includes ecosystem services assessments, climate change and energy efficiency, greenhouse gas assessments, and sustainable waste management.

Employment History

FutureWorks – Kloof

Senior Environmental Consultant (2008 to 2015)

Michael joined FutureWorks in 2008 after completing his MSc at the University of KwaZulu-Natal. During his 6 years at FutureWorks, Michael worked on a number of EIAs, BAs, WMLs, S24G applications, and amendment applications, strategic planning projects (e.g. EMFs, SDFs and LAPs), and ecosystem services assessments.

PROJECT EXPERIENCE – CLIMATE CHANGE AND GREENHOUSE GAS ASSESSMENTS

Mozambique Gas-to-Power Project Inhambane, Mozambique	Determine the potential GHG emissions from the proposed Mozambique Gas-to-Power Project during the construction, operational, and closure phases. This included an assessment of the estimated GHG emissions against pre-determined thresholds, the contribution of GHG emissions to Mozambique's national GHG emissions, and product unity intensity.
Developing a Framework for Analysing the Economic Impacts of Climate Change on Coastal Systems in the Western Indian Ocean Western Indian Ocean	Develop a framework for analysing the economic impacts of climate change on coastal systems in the Western Indian Ocean which can be used by affected countries to leverage climate change mitigation and adaptation funding. This included identification of potential impacts of climate change on affected countries and the potential costs associated with these impacts.
Durban Climate Change Strategy eThekwini Municipality, KwaZulu-Natal, South Africa	Develop the Durban Climate Strategy for the eThekwini Municipality, which includes an overview of Durban's GHG emissions, projected changes in climate, the vision, goals, objectives and responses of the strategy, as well as an implementation plan, and monitoring and evaluation plan. Importantly, this strategy was developed in consultation with relevant stakeholders through a series of sector-specific or theme workshops.
KwaZulu-Natal Green Economy Strategy KwaZulu-Natal, South Africa	Prepare the KZN Green Economy Strategy for the KZN Department of Economic Development and Tourism. This strategy was developed in collaboration with the various provincial departments that will ultimately be responsible for implementation of the strategy.
Unlocking the Green Economy in KwaZulu-Natal KwaZulu-Natal, South Africa	Research project for the KZN Department of Economic Development and Tourism to determine best practice for unlocking the green economy in KZN. This included literature review of international best practice and series of focus group meeting and workshops with key stakeholders from selected sectors.
COP17/CMP7 Responsible Accommodation Campaign eThekwini Municipality, KwaZulu-Natal, South Africa	Co-authored toolkit developed for the COP17/CMP 7 Responsible Accommodation Campaign, an initiative by the eThekwini Municipality to encourage hospitality businesses to be more responsible i.e. energy efficient, conserve water and manage waste sustainably. This included series of workshops with selected key stakeholders.
Guideline for Designing Green Roof Habitats eThekwini Municipality, KwaZulu-Natal, South Africa	Co-authored guideline document entitled "Guideline for Designing Green Roof Habitats". This guideline profiled the lessons learned from EPCPD's pilot green roof project, which was developed as part of eThekwini's Municipal Climate Change Protection Programme.

PROJECT EXPERIENCE – ENERGY

Implementation of ISO 50001 at Transnet Pipelines South Africa	Assist Transnet Pipelines, which owns, operates, manages and maintains a network of 3800 km of high-pressure petroleum and gas pipelines in implementing ISO 50001 certified Energy Management System.
RECP Assessment of Value Logistics Durban and Cape Town, South Africa	Resource Efficiency and Cleaner Production (RECP) assessment of four Value Logistics warehousing facilities in Durban and Cape Town. Also included the identification, high-level costing and prioritisation of energy and water saving opportunities
RECP Assessment of Iso Moulders and Rising Sun Durban, KwaZulu-Natal, South Africa	Resource Efficiency and Cleaner Production (RECP) assessment of Iso Moulders, a polystyrene packaging producer, and Rising Sun, a local community newspaper printer. Also included the identification, high-level costing and prioritisation of energy and water saving opportunities.
Detailed Energy Audit of Corruseal Packaging Durban, KwaZulu-Natal, South Africa	Identify the key energy sources and significant energy users at Corruseal, a large corrugated card producer in Durban. Also included the identification, high-level costing and prioritisation of energy saving opportunities.
Detailed Energy Audit of Nampak Glass Johannesburg, Gauteng, South Africa	Identify the key energy sources and significant energy users at Nampak Glass, one of the largest glass bottle producers in South Africa. Also included the identification, high-level costing and prioritisation of energy saving opportunities.
Detailed Green Technology Report for Broadway Sweets Johannesburg, Gauteng, South Africa	Prepare a detailed green technology report and resource efficiency assessment for Broadway Sweets in Johannesburg as part of grant application from the Department of Trade and Industry.
Energy Savings Review Follow-Up Services eThekwini Municipality, KwaZulu-Natal, South Africa	Provide follow-up services for a number of companies that have previously undertaken an energy savings survey or review. Companies include Jonday Foods, Duys Component Manufacturers, Spunprint (Pty) Ltd, and Eston Brick and Tile. This includes tracking progress in implementation of recommended energy saving opportunities and evaluation of available financing options.
Energy Efficiency Policy and Strategy for RBCT Richards Bay, KwaZulu-Natal, South Africa	Develop energy efficiency policy and strategy for Richards Bay Coal Terminal as part of the NBI PSEE Programme. This included the development and rollout of an energy awareness campaign.
Pre-Feasibility Assessment for Implementation of Daylight Saving Time in the eThekwini Municipality eThekwini Municipality, KwaZulu-Natal, South Africa	Pre-Feasibility Assessment for implementation of Daylight Saving Time in the eThekwini Municipality. This included best practice literature review of daylight saving time implementation in countries around the world, and high-level assessment of potential socio-economic impacts of implementation of daylight saving time in Durban.

Local Government Toolkit for Financing Energy Efficiency and Renewable Energy South Africa	Prepare a toolkit to guide local government in financing energy efficiency and renewable energy initiatives. This includes a high-level description of available financing mechanisms, an assessment of these mechanisms, and tools for unlocking project financing.
Guideline on Energy Efficiency in Municipal Water and Wastewater Infrastructure South Africa	Prepare guideline document on energy efficiency and renewable energy in municipal water and wastewater infrastructure. The guideline provides motivation for investing in energy efficiency and renewable energy, suggestions for planning and implementing initiatives, and case examples.
Energy Strategies for King Sabata Dalindyebo, Mbombela, Rustenburg and Polokwane Municipalities Eastern Cape, Mpumalanga, North West and Limpopo, South Africa	Develop Energy Strategies for King Sabata Dalindyebo, Mbombela, Rustenburg and Polokwane Municipalities. Each strategy generally included an overview of current energy context, vision, principles, and objectives, and implementation plan, The development of each strategy generally involved an extensive engagement process with relevant municipal departments to raise awareness and build capacity around energy efficiency and renewable energy.
Case Study on Energy Savings in Commercial & Residential Buildings in Durban eThekwini Municipality, KwaZulu-Natal, South Africa	Profile manufacturing, retail, and hospitality businesses, as well as schools and private residences that have made significant reductions in energy use. This included preparation of two guideline documents to create awareness on potential energy savings.

TRAINING

Carbon Footprint Analyst Course
Terra Firma Academy, 2018

Programme in Project Management
USB-ED University of Stellenbosch Business School, 2011

Training Course on Real World EIA
Vicki King of Metamorphosis Environmental, 2008

PROFESSIONAL AFFILIATIONS

Member of International Association for Impact Assessment South Africa (IAIAsa)

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