AIR QUALITY IMPACT ASSESSMENT

Prepared for

ROOIKAT RECYCLING
GROOT BRAK RIVER

FINAL REPORT
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C H Albertyn, PrEng, CEng, QEP

Lethabo Air Quality Specialists (Pty) Ltd
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P.O. Box 2174, Noorsekloof, 6331
info@laqs.co.za
www.laqs.co.za

Tel: (+27) 87 284 8257
Fax: (+27) 86 536 5597

Contents

AIR QUALITY IMPACT ASSESSMENT
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1 INTRODUCTION

Rooikat Recycling (RR) plans to operate a depolymerization plant to convert waste plastic and shredded tyres into valuable products with minimal impact on the environment in Groot Brak River in the Garden Route District Municipality. The nearest residential area to the planned operations is located approximately 1.1 km north-east of the proposed site.

RR appointed Messrs Sharples Environmental Services CC (SES) to handle the full process of obtaining environmental approval for the proposed operations.

The process is a listed activity (Section 2) in terms of Section 21 of the National Environment Management: Air Quality Act, 20054, as amended, and requires, therefore, an atmospheric emissions license (AEL). SES requested Lethabo Air Quality Specialists (Pty) Ltd (LAQS) to carry out an air quality impact assessment of the depolymerisation plant and submit an application for an AEL on RR's behalf.

LAQS subsequently modelled the dispersion of particulate emissions from the planned operations to estimate ground-level concentrations of particulates and compared the outcome with official ambient air quality standards.

In addition, LAQS modelled the dispersion of RR's emission together with other known sources near the planned site of RR's operations to show the cumulative impact of all emissions on the surrounding area.

This report discusses the steps followed by LAQS to comply with this requirement.

2 RELEVANT GOVERNMENT REGULATIONS

The following Government Regulations apply to this air quality impact assessment and are referred to in the report where applicable.

1. "*National Ambient Air Quality Standards*" as published in Government Notice 1210 of 24 December 2009 (GN1210)
2. "*List of Activities That Result in Atmospheric Emissions*" as published in Government Notice 893 of 22 November 2018 (GN893)
3. "*Regulations Regarding Air Dispersion Modelling*" as published in Government Notice GN R.533 of 11 July 2014 (GN R.533)

3 PROCESS DESCRIPTION

RR plans to construct a new processing plant with a processing capacity of 10 tons per day residential plastic/tyres and will operate as a batch processing plant. The plant will first be commissioned with an initial capacity of 10 tons per day and will serve as a pilot plant to prove and test the concept locally. The pilot plant will allow RR to evaluate the performance of each process steps and optimise the process as a whole to produce the quality of product required.

Once proven successful, production in the pilot plant will be ramped up to 20 tons per day. RR's eventual plans are to establish a large-scale depolymerisation plant with the capability of processing approximately 20 000 tons of residential waste per annum, but such a plant will likely not be located at Groot Brak River.

3.1 PROCESS FLOWS

Please refer to the schematic below and the section below for more detail.

Feedstock will be received at the facility by road. The facility will not serve as a long-term storage site, but only the feed to be processed will be held at the facility.

The feed will be loaded into the auto feeder manually from where it will be loaded into the reactor. The reactor will operate on the gas and HFO produced by the process. The reactor product will be cooled and separated into three streams. The gas stream will be routed back to the reactor for energy generation and the resulting HFO and carbon black will be sold as products. The process thus has no waste streams.

The depolymerization process will produce two product streams, i.e. high-carbon solids (carbon black) and a gas stream. The gas stream will pass through a condensing stage to produce heavy fuel oil (HFO). All non-condensable gases will be returned to the reactor to serve as heating fuel and may be supplemented with some of the HFO.

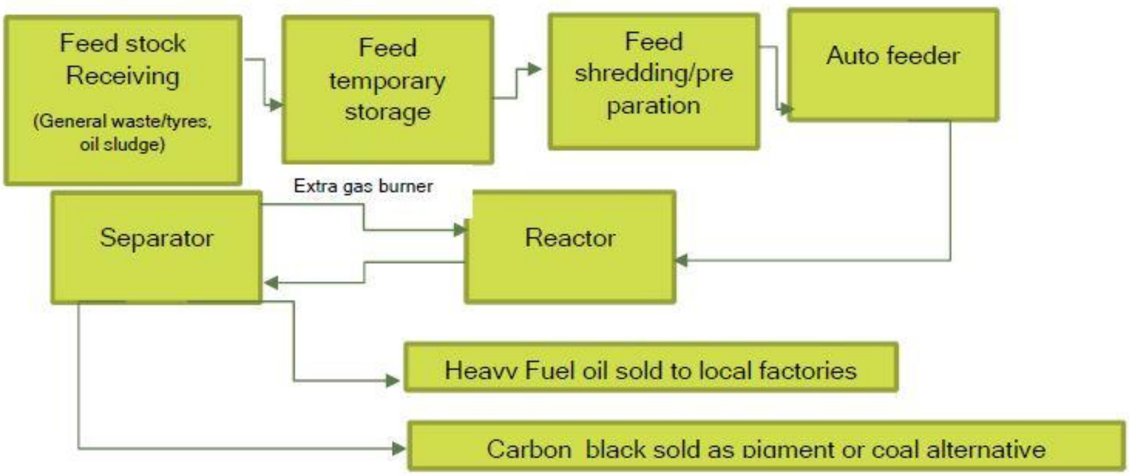

Figure 1: Roikat Recycling Process Flow chart

Receiving of General waste and Hazardous waste

All waste will be delivered to the site for processing. Loads will be weighed in order to ensure that complete batch sizes are ready for processing.

All waste made ready for process will be stored on cemented surfaces.

Storage of waste

Tyres will be stored in accordance to the Waste Regulations. Note that this will not be a long term storage site and that only waste to be processed will be on site.

All waste will be stacked in skips in a central area where the stock of at least 1 – 2 days may be accumulated.

All general waste stored will be cleaned prior to stacking to avoid dirty run-off water forming.

All tyres to be used will be cut up into smaller pieces prior to being loaded into the reactor chamber. Encased steel will be recovered and sold to recycling companies.

The various waste product streams destined for depolymerization will be blended to provide a stable feed composition into the reactor, thus contributing to stable operating conditions.

The Process

The reactor chamber will be loaded by a hydraulic loader to ensure a firm stacking and avoid space being underutilized.

Heating to approximately 350 ºC will initially be by LP gas or heavy fuel oil until the depolymerization process generates its own gas and fuel oil. This gas and oil will then be piped to the heating chamber and used as heating fuel.

Carbon black will be dumped in an underground bunker from where it will be moved mechanically to be bagged for use off site.

Gases from the reactor will be passed to a condenser the gases where the condensable fraction will be converted to liquid to form combustion oil.

Non-condensable gases will be returned to the reactor to serve as energy source for heating of the reactor. The system will not use flare-off to rid the system of unwanted gases, but in case of emergency the off gases will be flared.

After combustion in the reactor all off-gas will pass through a wet scrubber system prior to being emitted to atmosphere. Due to the heat steam will be formed that will be released.

Products of the Pyrolysis Process

Steel: The steel is the high quality steel rings that make up around 10% of the total make-up of tyres. Steel will be stored in skips on-site in a designated area for regular collection by a reputable scrap metal dealer.

Carbon Black: Carbon black will be moved from the reactor chamber into an underground bunker from where it will be mechanically lifted to be bagged/pelletized and sold off. Carbon Black is used extensively in the rubber; plastics and ink industries. It can also be sold as a coal alternative.

Oil / HFO: Condensable gases are passed through the condensers and form oil. These oils are sought after as industrial or heating oil. Further processing will be required to yield high value oil or fuel. The oil will be stored temporarily in an above ground storage facility. No long term storage.

Gases: Condensable gases are passed through the condensers and are condensed into oil. The non-condensable gases are re-routed back to the heating chamber and are used to heat the process and replace the use of LPG gas. After burning the off gas is cooled, scrubbed and released into the atmosphere.

NOTE: Gases will only be flared in the unlikely event of an emergency being detected by the computerised control system.

4 ATMOSPHERIC EMISSION LICENSE REQUIREMENTS

The process planned by RR is included in the *National List of Activities Which Result in Atmospheric Emissions* as published in Government Notice No. 893 on 22 November 2013 (GN893), as amended. The activities fall under the following two sub-categories:

-- **Sub-category 3.4**, "*Char, charcoal and carbon black production*" with a general description of "*Production of char, charcoal and the production and use of carbon black*". This sub-category applies to all installations producing more than 20 tons of char or charcoal per month, or consuming more than 20 tons carbon black per month.

Emission limits defined for this sub-category are:

- Total particulate matter (TPM): 50 mg/Nm^3
- Poly-aromatic hydrocarbons (PAH): 0.1 mg/Nm^3

Both emission limits are at dry conditions and at 273 K and 101.3 kPa.

-- **Sub-category 8.1**, "*Thermal treatment of general and hazardous waste*" with a general description of "*Facilities where general and hazardous waste are treated by the application of heat*". This Sub-category applies to all locations designed to treat more than 10 kg waste per day.

Emission limits defined for this sub-category are:

- Total particulate matter (TPM): 10 mg/Nm^3
- Carbon monoxide (CO): 25 mg/Nm^3
- Sulphur dioxide (SO_2): 50 mg/Nm^3
- Oxides of nitrogen (as NO_2): 200 mg/Nm^3
- Hydrogen chloride (HCl): 10 mg/Nm^3
- Hydrogen fluoride (HF): 1 mg/Nm^3
- Sum of Pb, As, Sb, Cr, Co, Cu, Mn, Ni, V: 0.5 mg/Nm^3
- Mercury (Hg): 0.05 mg/Nm^3
- Cd + Tl: 0.05 mg/Nm^3

- Total organic compounds (TOC): 10 mg/Nm^3
- Ammonia (NH_3): 10 mg/Nm^3
- Dioxins and furans (PCDD + PCDF): 0.1 ng/Nm^3

All emission limits are at dry conditions and at 273 K and 101.3 kPa, except for dioxins and furans where the emission limits is at a reference oxygen concentration of 10%.

5 DISPERSION MODELLING STUDY

The Department of Environmental Affairs moved to homogenise dispersion modelling in South Africa by publishing relevant Regulations in GN R.533. Throughout this report mention is made of compliance with this set of Regulations.

The dispersion modelling study was carried out with EnviMan, a GIS-based emissions management software suite produced by Opsis AB in Sweden. The dispersion modelling component of the suite consists of the following four modules:

Mapper: A map manipulation tool

Emissioner: An extensive, relational emissions data base

EnviMet: A meteorological data management program

Planner: The actual dispersion model

5.1 MAPPER

Mapper is a digital map compiler. It is used to define GIS map sets to be used by all EnviMan GIS modules. It can import a variety of digital maps and structure the data in suitable forms, e.g. sheets, objects, etc.

It is the basis of the EnviMan GIS suite as it defines all co-ordinates for subsequent use by the various EnviMan modules.

5.2 EMISSIONER

Emissioner is a comprehensive, relational emissions data base that locates emission sources at fixed co-ordinates on the map compiled with Mapper. Sources are placed on the map by the user and the co-ordinates are automatically generated by Mapper.

Emissioner can handle particulate and gaseous emissions from the following sources:

-- Point sources, e.g. industrial stacks
-- Area sources, e.g. landfill sites
-- Grid sources, e.g. complete informal settlement areas
-- Line sources, e.g. motor vehicle emissions

Of these, point sources on RR's's site are applicable to this air quality impact assessment.

5.3 ENVIMET

Envimet uses meteorological data collected at ground level to calculate meteorological data sets used in dispersion modelling studies. Of primary importance are those parameters that determine scaling of the boundary air layer. These are:

- Wind speed
- Wind direction
- Temperature
- Solar radiation

These parameters are used by Envimet to calculate all of the parameters, e.g. stability of the air boundary layer, mixing heights, climate sets, etc., which are required by Planner in calculating the dispersion of pollutants from a source.

5.4 PLANNER

Planner is the dispersion module of the EnviMan suite and links with Mapper, Emissioner and Envimet to carry out dispersion modelling activities. It is designed to run simulations of air quality based on emission data created in Emissioner for the following scenarios:

- Hypothetical weather definitions, i.e. user-supplied information about temperature, wind speed, wind direction, cloud cover, etc.
- True weather period, i.e. using recorded data from a weather monitoring station to simulate plume dispersion hour-by-hour over a defined period
- Statistical weather period, i.e. using a pre-calculated sample of various weather conditions that typically occur during a year. This allows the creation of annual air quality maps for comparison against national guidelines and limit values.

Of these scenarios, the statistical period is applicable to the study of plume dispersion from RR's operations.

Planner makes use of three different dispersion models, two of which are aimed at motor vehicle emissions. Use is made of the Aermod dispersion model for the purposes of calculating the dispersion of plumes from point, area and grid sources. Aermod is a USEPA-approved Gaussian plume dispersion model and is capable of simulating dispersion of pollutants over a distance up to approximately 50 km from the source.

Aermod is listed as an approved dispersion model in GN R.533.

5.5 INPUT DATA

5.5.1 Mapper

A digital map in the format of a GoogleEarth(TM) bitmap was imported into Mapper. The map covers the an area of 9 km x 5.8 km and is given in Figure 2 below.

Figure 2: Map covering the Area of Study

5.5.2 Emissioner

Compulsory information for point sources is:

-- Height of stack
-- Internal diameter of stack
-- External diameter of stack
-- Flue gas temperature
-- Flue gas velocity
-- Height and width of adjacent structures that could influence the wind profile

Compulsory information for area sources is:

-- Area from which emissions occur
-- Release height of emissions
-- Height and width of adjacent structures that could influence the wind profile

Output units:

Given an input of tons per annum, the output of Planner is in units of micrograms per cubic meter (µg/m^3).

5.5.3 EnviMet

A set of meteorological parameters collected in Mossel Bay was obtained by LAQS and imported into EnviMet. The dataset covers the period from 1 November 2016 to 30 June 2020 and includes the necessary parameters required by EnviMet.

All of the data included in the dataset has been validated and bad or missing data forms less than 1% of the dataset.

5.5.4 Planner

Planner does not require any user input as it extracts data from Mapper, Emissioner and Envimet.

5.6 EMISSIONS

5.6.1 Rooikat Recycling Emissions

GN R.533 specifies that official emission limits must be used to calculate annual emissions from the process. A list of emission limits applicable to RR's planned operations is given in Section 4.

In addition, RR provided the following design details of the stack serving the reactor:

-- Height 10 m

-- Diameter, 0.75 m

-- Flue gas temperature 44 ºC

-- Flue gas velocity 5.6 m/s

RR further stated that the pilot plant will operate for a maximum of 19 hours per day due to its batch operating nature and from Monday to Saturday.

LAQS focused on those pollutants for which ambient air quality standards have been published in GN 1210. The relevant pollutants and calculated annual emissions are given in Table 1 below.

Pollutant	Annual emissions, tons
PM10 particulates	0.12
Sulphur dioxide	0.59
Nitrogen dioxide	2.34
Carbon monoxide	0.59
Lead	5.9E-03
Benzene (*)	1.2E-01

Table 1: Annual Emissions, tons per annum
(*): Please see Section 5.7

5.6.2 Cumulative Sources

Emissions from the following sources were included in the cumulative impact assessment:

-- PG Bison, Woodline

-- Rheebok Bricks

Copies of the relevant atmospheric emission licences (AELs) and recent emissions surveys were kindly made available to LAQS by the Garden Route District Municipality. Stack details were obtained from the AELs while annual emissions were calculated from the emissions surveys, resulting in the following annual emissions:

Pollutant	PG Bison - Woodline	Rheebok Bricks
PM10 particulates	8.46	8.92
Sulphur dioxide	68.46	287.08
Nitrogen dioxide	7.23	15.47
Carbon monoxide	2.39	8.18
Lead	4.6E-04	1.1E-02

Table 2: Cumulative emissions, tons per annum

5.7 CONSERVATIVE APPROACH

In estimating annual emissions from RR's process LAQS followed a conservative approach in which emissions are rather overestimated, rather than underestimated. The rationale is that if this approach shows the impact on air quality to be low, actual operating conditions will then have an even lower impact on air quality in the area.

The conservative approach included the following:

-- LAQS assumed that all emissions meet the definition of PM10 particles. This is an overestimation of particulate emissions as PM10 particulates are a sub-set of total particulate matter.

PM10 was used as air quality impact indicator as official ambient air quality standards for PM10 have been defined, but not for TPM particulates.

-- All emissions of organic compounds from RR's operations were assumed to be benzene. This is an overestimation of benzene emissions. GN 893 provides emission limits for "total organic compounds (TOC)". By definition TOC consists of all organic compounds, i.e. volatile as well as semi-volatile, of which benzene is only one compound.

6 RESULTS

LAQS modelled the dispersion of pollutants that may be emitted from RR's operations for comparison of results against official ambient air quality standards as published by the Department of Environmental Affairs in GN1210. Of the pollutants included in GN1210, ambient air quality standards have been defined for PM10, SO_2, NO_2, CO, lead (Pb) and benzene (C_6H_6).

All simulations were carried out for a receptor height of 2 metres above ground level and a plume dispersion period of 60 minutes. This simulation period ensured that very low winds, e.g. 1 m/s, would carry pollutants some distance from the plant.

Secondly, LAQS investigated the cumulative impact that emissions from all known sources in the vicinity of RR's proposed pilot plant would have on the area surrounding the industrial activities.

The approach was to determine both annual average ground-level concentrations and 99-percentile concentrations (the levels below which concentrations will occur for 99% of the time) of all compounds, except Pb and C_6H_6 for which annual average air quality standards only have been set. A 99-percentile level was chosen as it is the closest comparison to the ambient air quality limit exceedances allowed legally (please see Section 7).

In addition, the maximum estimated ground-level concentrations were determined, as well as where these would occur.

6.1 EMISSIONS FROM ROOIKAT OPERATIONS

The dispersion of pollutants from Rooikat's operations is shown graphically in Figures 3 to 12 below.

Figures 3 and 4 respectively show the annual average and 99-percentile 24-hour average ground-level concentrations of PM10 emissions.

Figures 5 and 6 respectively show the annual average and 99-percentile ground-level concentrations of sulphur dioxide (SO_2) emissions.

Figures 7 and 8 respectively show the annual average and 99-percentile ground-level concentrations of nitrogen oxides (NO_2) emissions.

Figures 9 and 10 respectively show the 8-hour average and 99-percentile ground-level concentrations of carbon monoxide (CO) emissions.

Figure 11 shows the annual average ground-level concentrations of lead (Pb) emissions.

Figure 12 shows the annual average ground-level concentrations for benzene (C_6H_6) emissions.

In addition to the graphical presentations, results are summarised in tabular format in Table 3.

Figure 3: Annual Average PM10 Concentrations - Rooikat Operations Only
Maximum scale is 1 µg/m^3. Ambient air quality standard is 40 µg/m^3

Figure 4: 99-percentile PM10 Daily Averaged Concentrations - Rooikat Operations Only
Maximum scale is 5 μg/m^3. Ambient air quality standard is 75 μg/m^3

Figure 5: Annual Average SO_2 Concentrations - Rooikat Operations Only
Maximum scale is 1 µg/m^3. Ambient air quality standard is 50 µg/m^3

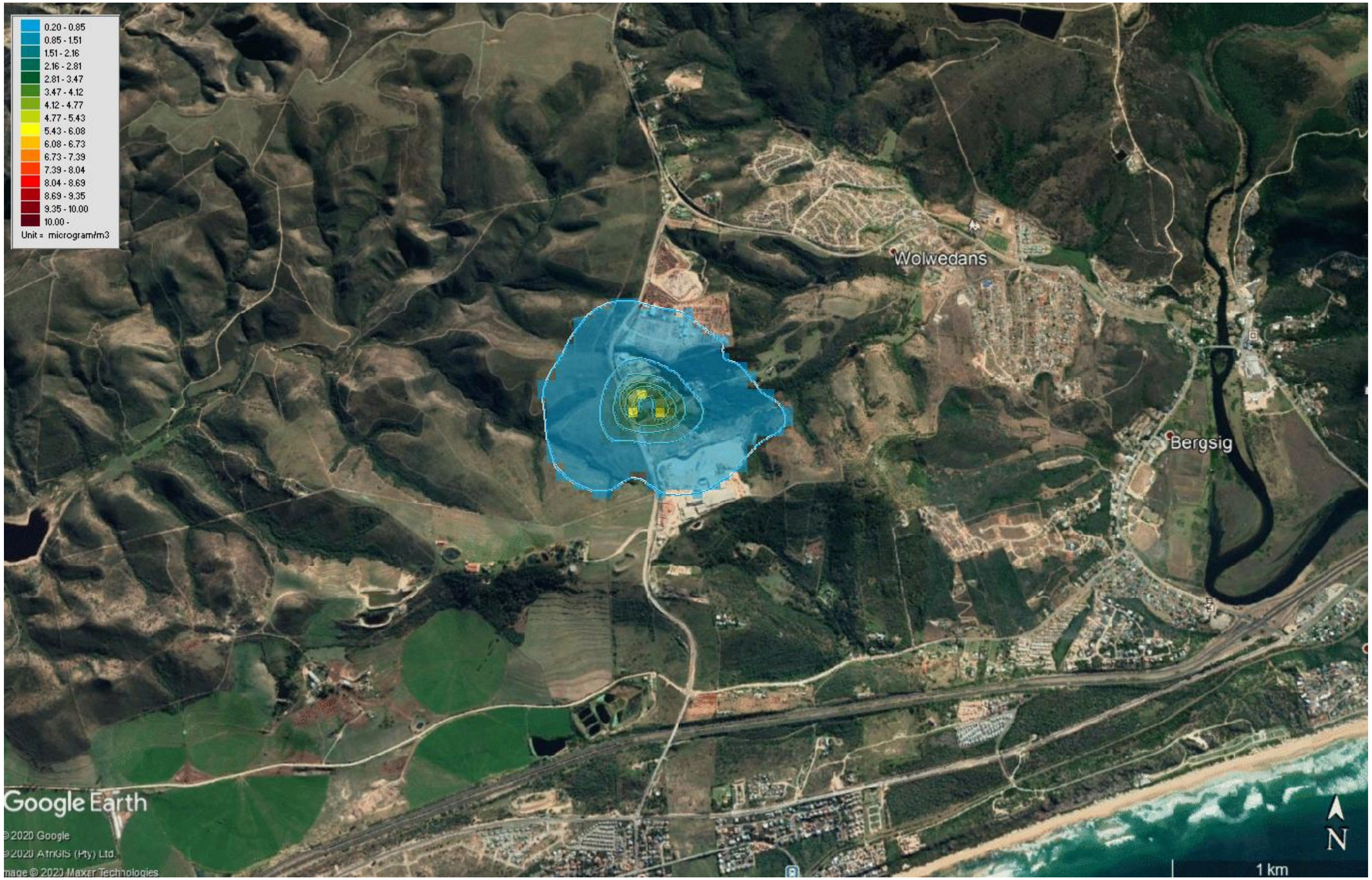

Figure 6: 99-percentile SO_2 Concentrations - Rooikat Operations Only
Maximum scale is 10 µg/m^3. Ambient air quality standard is 350 µg/m^3

Figure 7: Annual Average NO_2 Concentrations - Rooikat Operations Only
Maximum scale is 3 μg/m^3. Ambient air quality standard is 40 μg/m^3

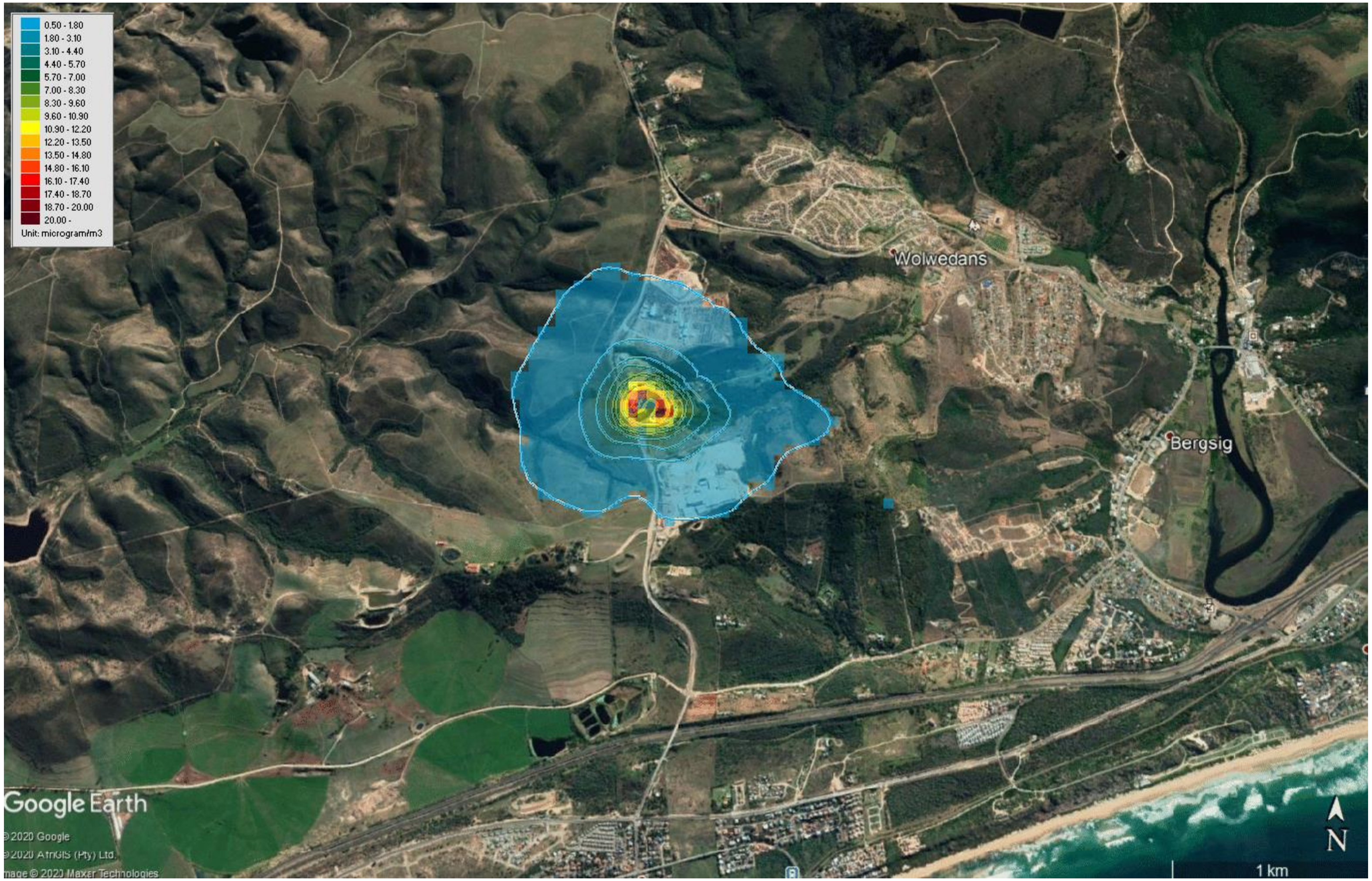

Figure 8: 99-percentile NO_2 Concentrations - Rooikat Operations Only
Maximum scale is 20 μg/m^3. Ambient air quality standard is 200 μg/m^3

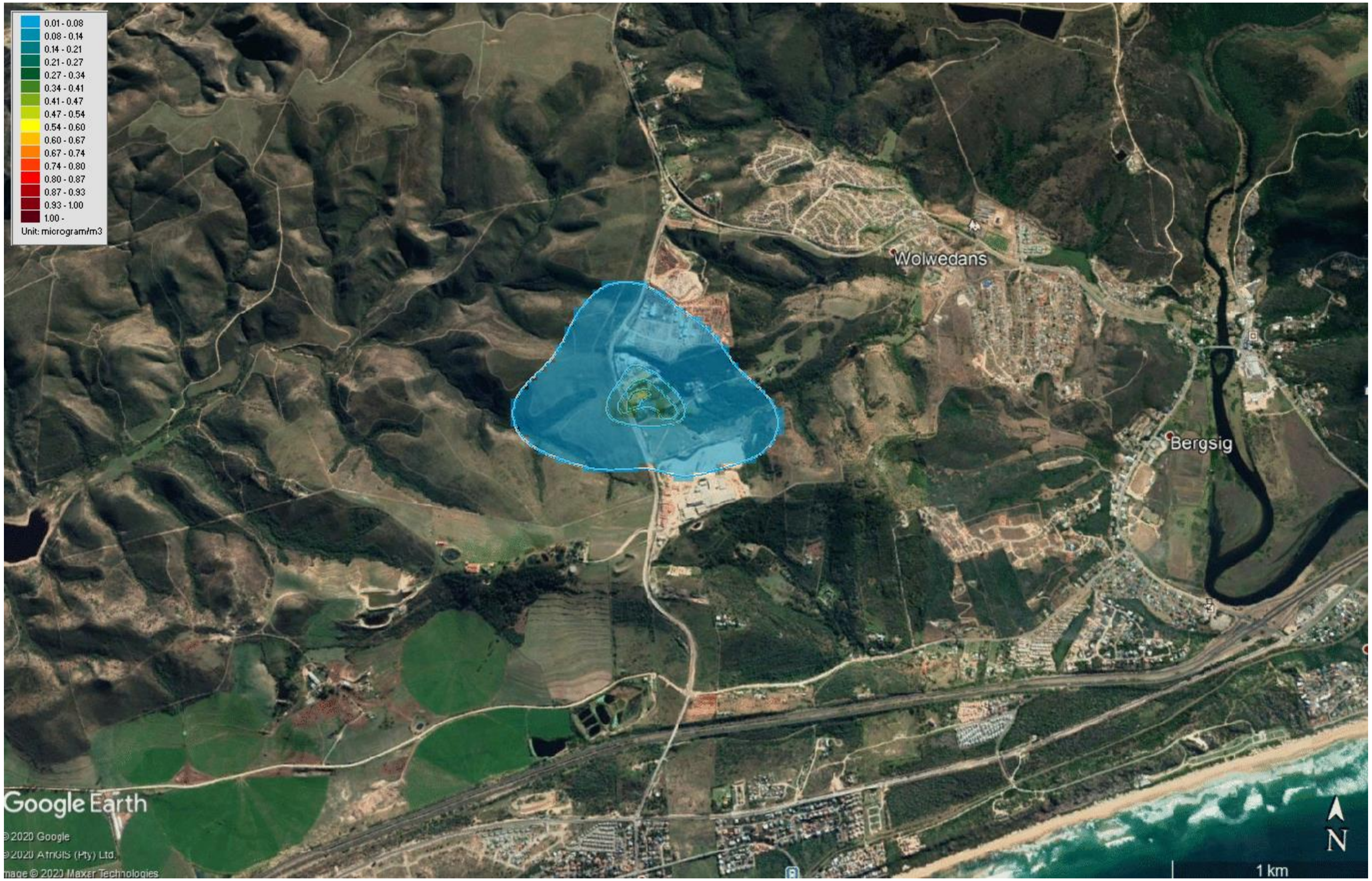

Figure 9: 8-hour Average CO Concentrations - Rooikat Operations Only
Maximum scale is 1 µg/m^3. Ambient air quality standard is 10 000 µg/m^3 (10 mg/m^3)

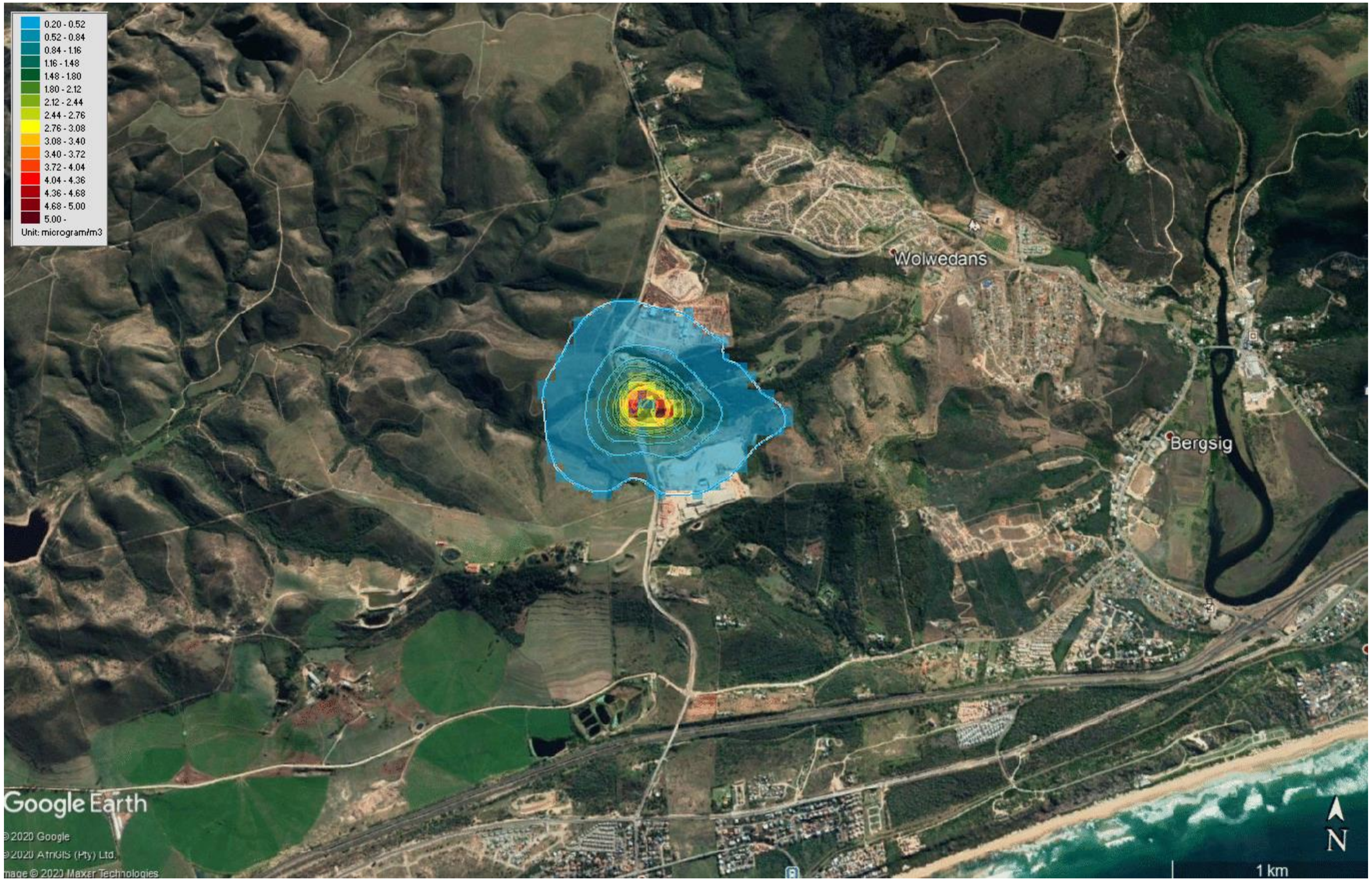

Figure 10: 99-percentile CO Concentrations - Rooikat Operations Only
Maximum scale is 5 µg/m^3. Ambient air quality standard is 30 000 µg/m^3 (30 mg/m^3)

Figure 12: Annual Pb Concentrations - Rooikat Operations Only
Maximum scale is 5 ng/m^3. Ambient air quality standard is 500 ng/m^3 (0.5 µg/m^3)

Figure 12: Annual Average C_6H_6 Concentrations - Rooikat Operations Only
Maximum scale is 1 ng/m^3. Ambient air quality standard is 5 000 ng/m^3 (5 µg/m^3)

6.2 CUMULATIVE EMISSIONS

The potential emissions of lead and benzene from other sources in the area are not known. As a result the cumulative dispersion PM10, SO_2, NO_2 and CO only was investigated.

The dispersion of pollutants from all known sources in the area is shown graphically in Figures 13 to 20 below.

Figures 13 and 14 respectively show the annual average and 99-percentile 24-hour average ground-level concentrations of all PM10 emissions.

Figures 15 and 16 respectively show the annual average and 99-percentile ground-level concentrations of all sulphur dioxide (SO_2) emissions.

Figures 17 and 18 respectively show the annual average and 99-percentile ground-level concentrations of all nitrogen oxides (NO_2) emissions.

Figures 19 and 20 respectively show the 8-hour average and 99-percentile ground-level concentrations of all carbon monoxide (CO) emissions.

In addition to the graphical presentations, results are summarised in tabular format in Table 3.

Figure 13: Annual Average PM10 Concentrations – Cumulative Sources
Maximum scale is 2 μg/m^3. Ambient air quality standard is 40 μg/m^3

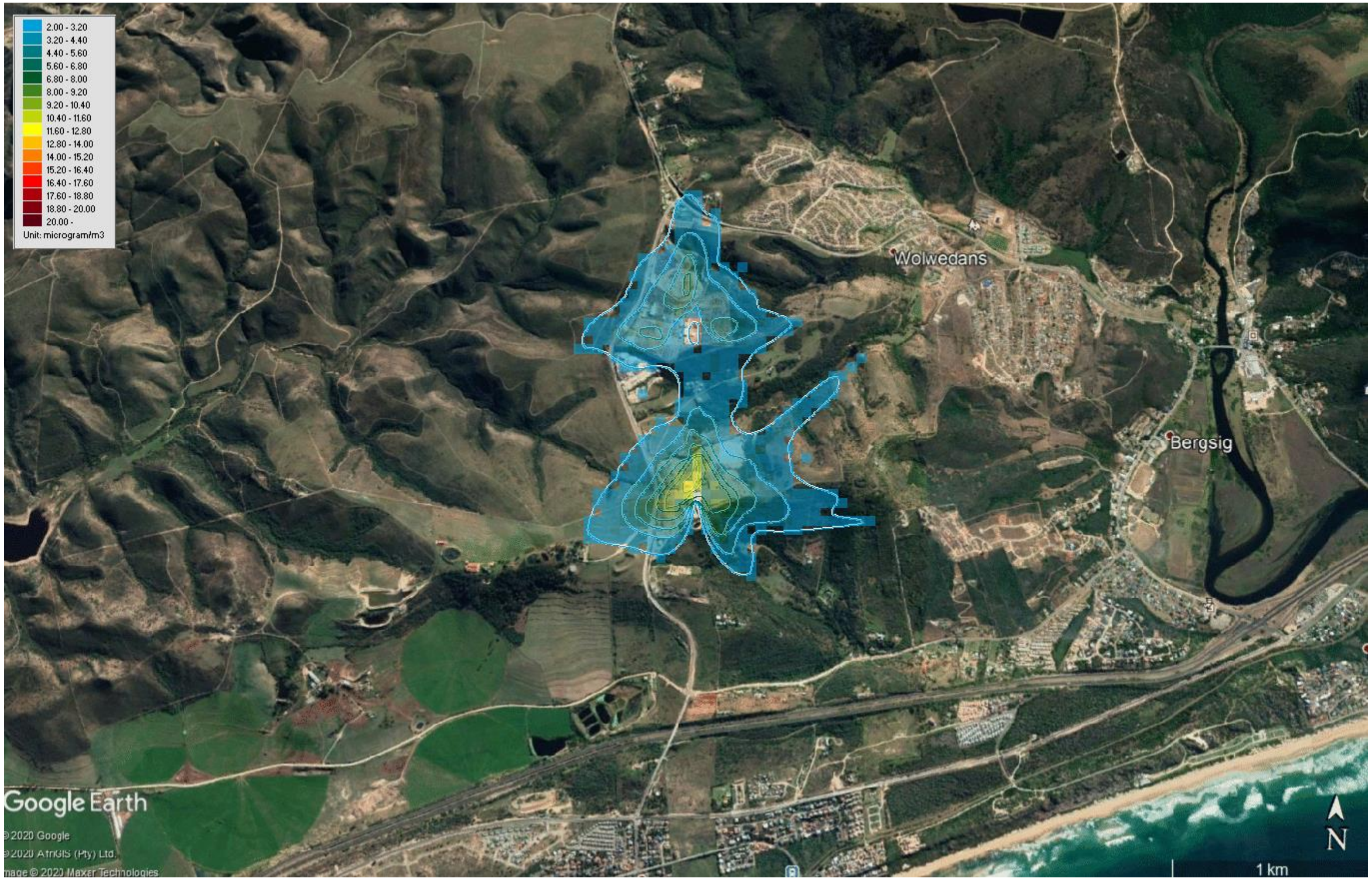

Figure 14: 99-percentile PM10 Daily Averaged Concentrations - Cumulative Sources
Maximum scale is 20 µg/m^3. Ambient air quality standard is 75 µg/m^3

Figure 15: Annual Average SO_2 Concentrations - Cumulative Sources
Maximum scale is 2 µg/m^3. Ambient air quality standard is 50 µg/m^3

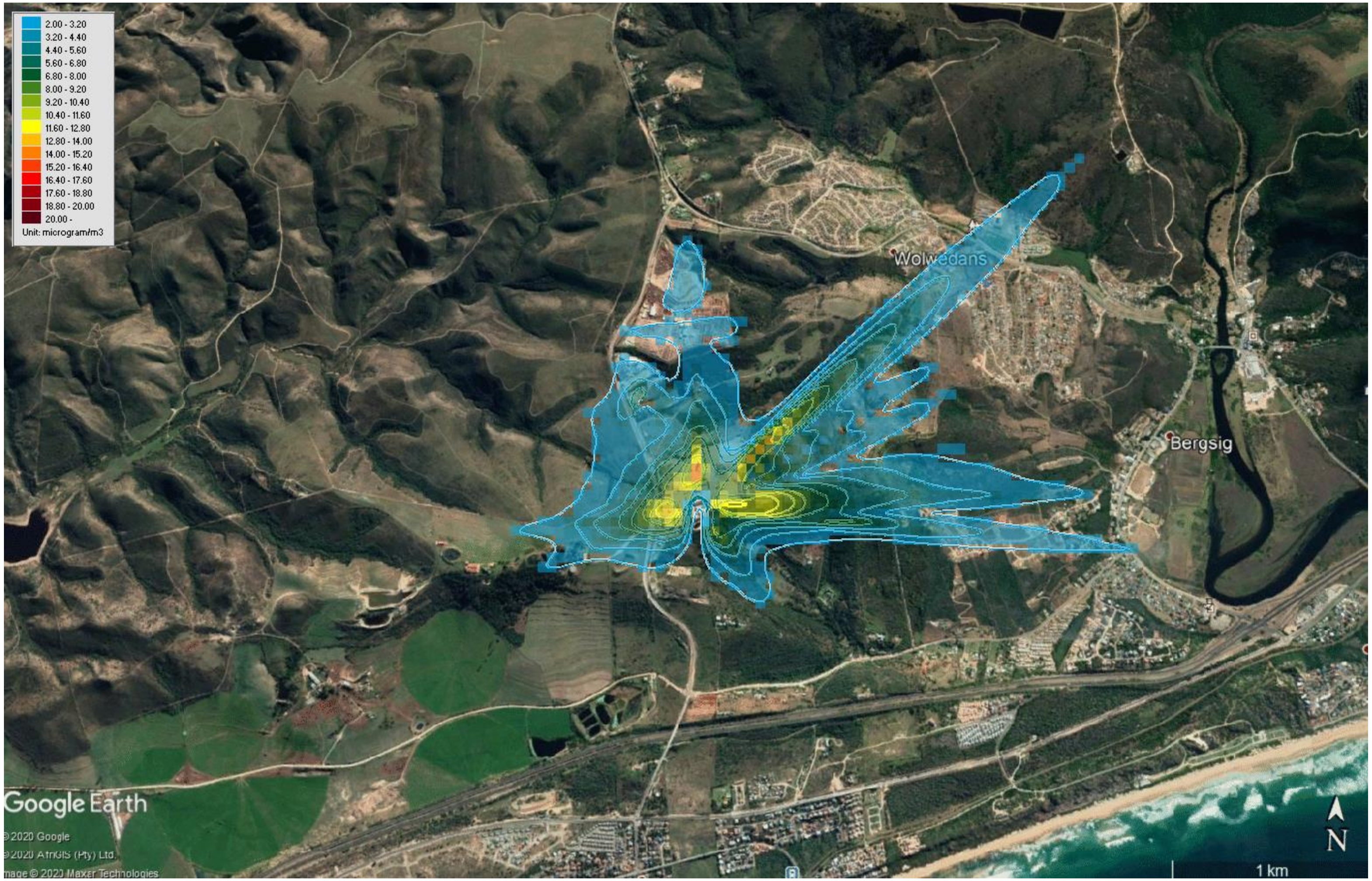

Figure 16: 99-percentile SO_2 Concentrations - Cumulative Sources
Maximum scale is 20 µg/m^3. Ambient air quality standard is 350 µg/m^3

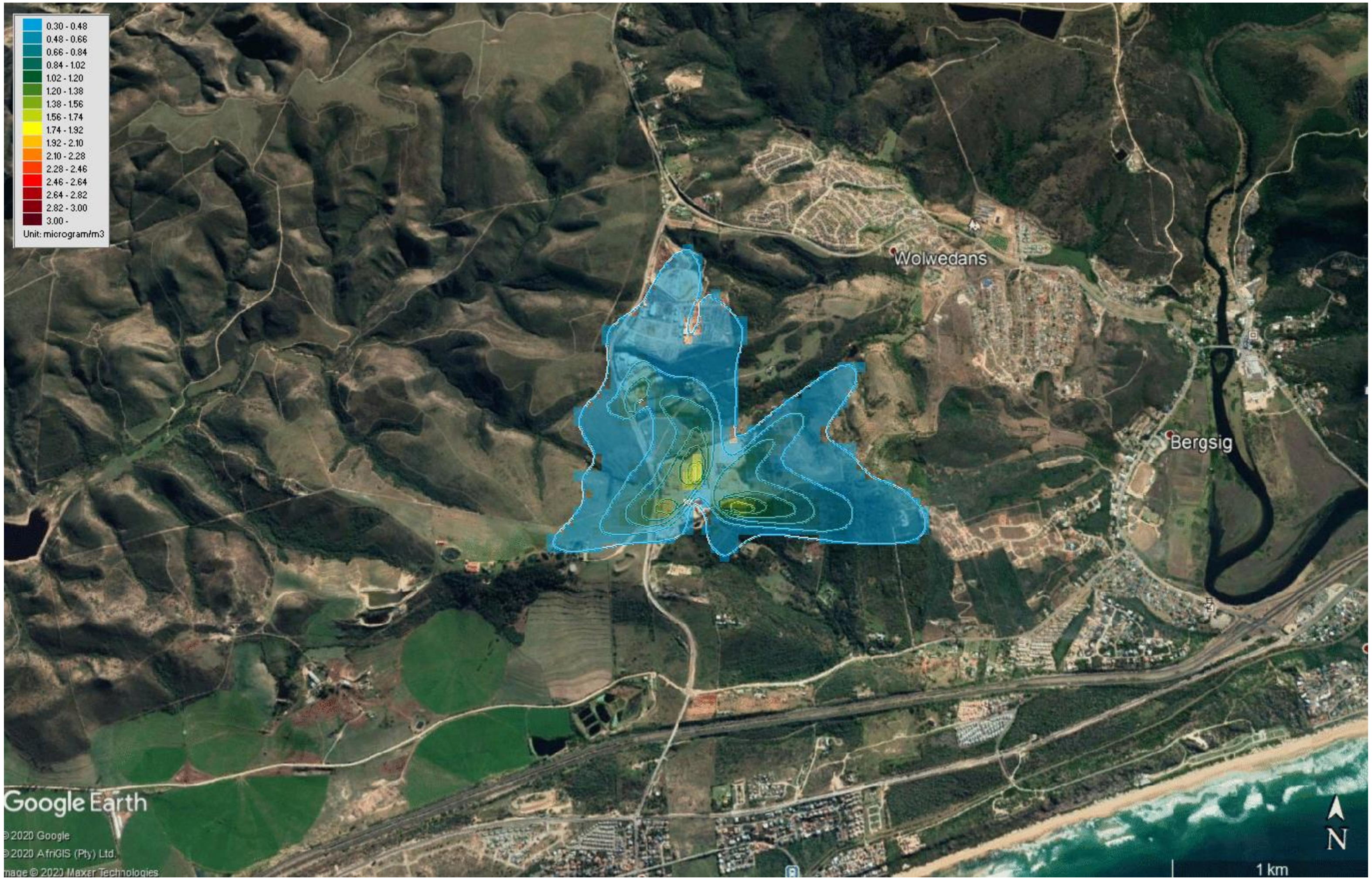

Figure 17: Annual Average NO_2 Concentrations - Cumulative Sources
Maximum scale is 3 µg/m^3. Ambient air quality standard is 40 µg/m^3

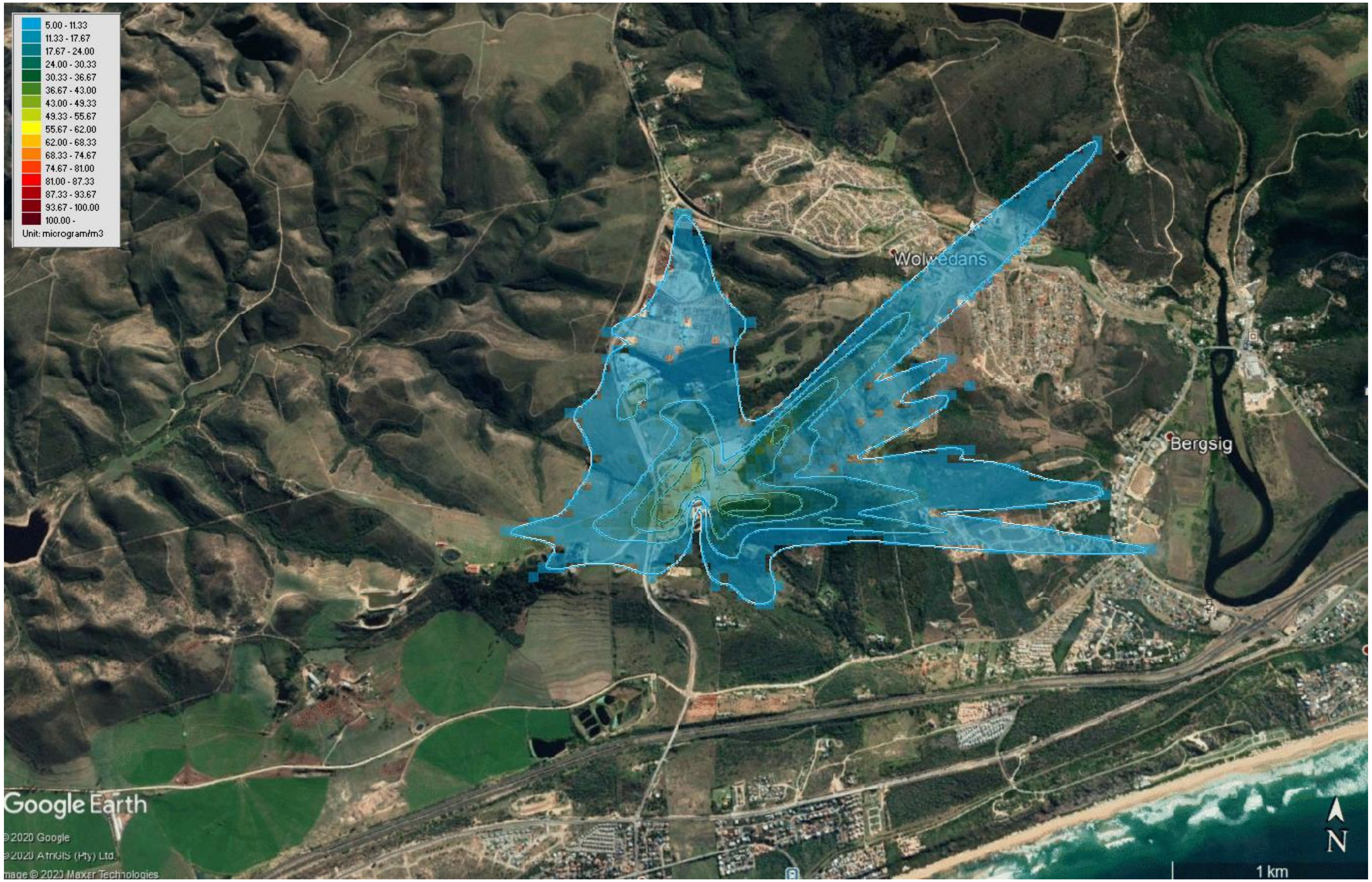

Figure 18: 99-percentile NO_2 Concentrations - Cumulative Sources
Maximum scale is 100 µg/m^3. Ambient air quality standard is 200 µg/m^3

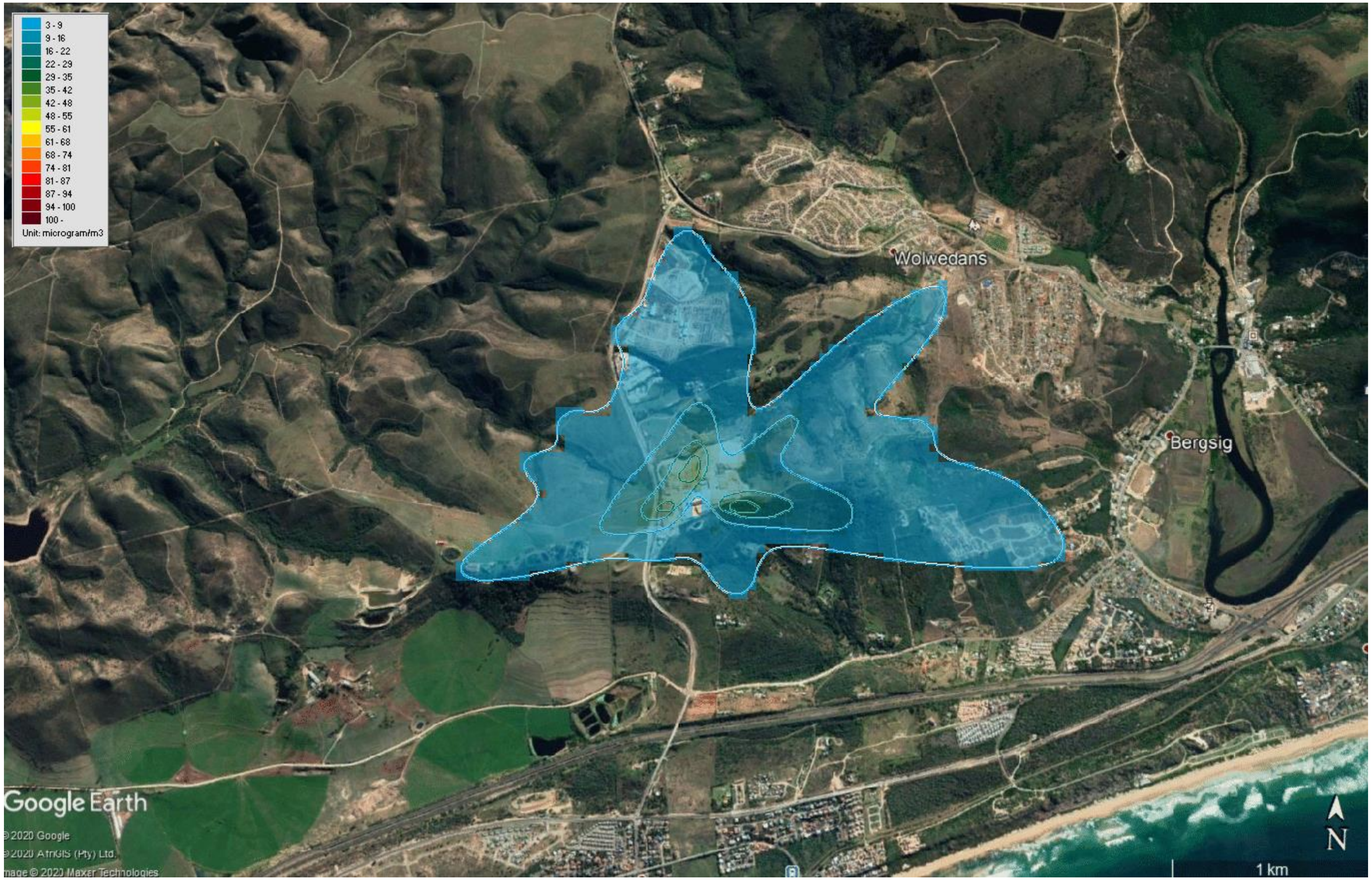

Figure 19: 8-hour Average CO Concentrations - Cumulative Sources
Maximum scale is 100 µg/m^3. Ambient air quality standard is 10 000 µg/m^3 (10 mg/m^3)

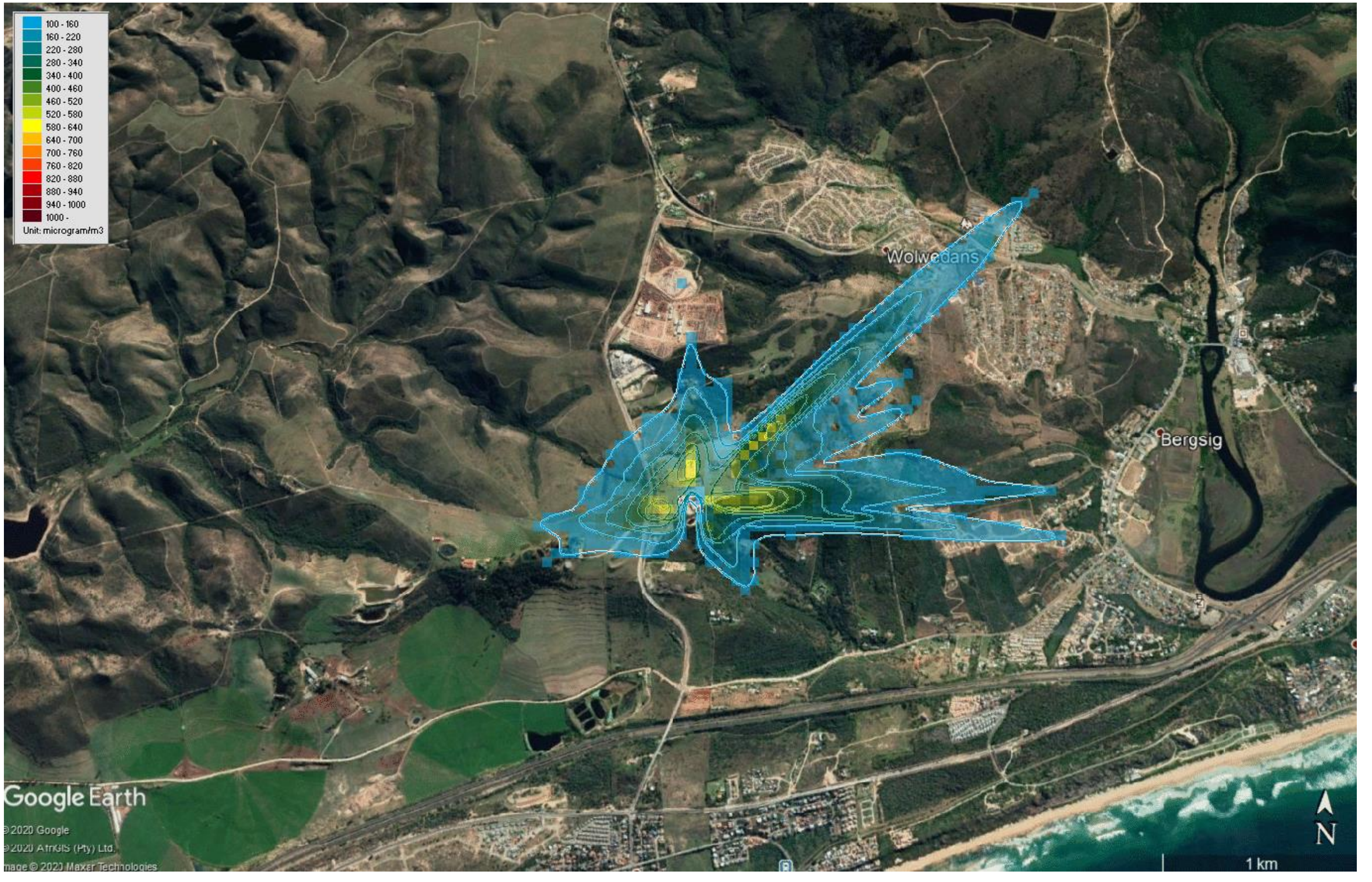

Figure 20: 99-percentile CO Concentrations - Cumulative Sources
Maximum scale is 1 000 µg/m³. Ambient air quality standard is 30 000 µg/m³ (30 mg/m³)

	Rooikat Recycling			AQ standard	Cumulative Sources			AQ standard
	Annual average	99-percentile	Where		Annual average	99-percentile	Where	
PM10	0.04	1	180 m north-west of RR site	40	0.8	12.4	On Rheebok Bricks property	75
SO_2	0.4	5.6		50	0.6	14.2		350
NO_2	1.5	20.6		40	1.7	30.9		200
CO	0.3	5.1		10 000	30.4	600		30 000
Pb	0.002			0.5				
C_6H_6	0.04			5				
	At residential area north-east							
PM10	<0.1	<0.1		40	<0.1	0.7		75
SO_2	<0.1	<0.1		50	<0.1	0.5		350
NO_2	<0.1	0.2		40	0.1	1.2		200
CO	<0.1	<0.1		10 000(*)	1.2	21.7		30 000(*)
Pb	<0.1			0.5				
C_6H_6	<0.01			5				

(*): Air quality standards are 10 mg/m^3 and 30 mg/m^3 respectively

Table 3: Summary of estimated ground-level concentrations, µg/m^3

7 IMPACT ON OVERALL AIR QUALITY

Ambient air quality standards for some pollutants were published by the Department of Environmental Affairs (DEA) in Government Notice No. 1210 on 24 March 2009 (GN1210), including for PM10 particulates. The limits and the number of times they may be exceeded are:

PM10

Annual average:	40 µg/m^3, no exceedances allowed
Maximum daily concentration:	75 µg/m^3, 4 exceedances allowed

SO_2

Annual average limit	50 µg/m^3, no exceedances allowed
1-hour maximum	350 µg/m^3, 88 exceedances allowed

NO_2

Annual average limit	40 µg/m^3, no exceedances allowed
1-hour maximum	200 µg/m^3, 88 exceedances allowed

CO

8-hour running average	10 mg/m^3, 11 exceedances allowed
1-hour maximum	30 mg/m^3, 88 exceedances allowed

Pb

Annual average limit	0.5 µg/m^3, no exceedances allowed

C_6H_6

Annual average limit	5 µg/m^3, no exceedances allowed

7.1 ROOIKAT OPERATIONS ONLY

7.1.1 PM10 Particulate Matter

The highest annual average concentration of PM10 is estimated to be less than 0.1 µg/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises. This value is well below the ambient air quality standard of 40 µg/m^3.

The highest annual average concentration of PM10 at the residential area to the north-east is estimated to be also less than 0.1 µg/m^3.

The maximum 99-percentile daily concentration of PM10 was shown to be 0.8 µg/m^3 and was modelled to occur along the south-western fence line of RR's premises. The concentration is well below the maximum daily standard of 75 µg/m^3.

The highest 99-percentile daily concentration of PM10 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

7.1.2 Sulphur Dioxide

The highest annual average concentration of SO_2 is estimated to be 0.4 µg/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises.. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of SO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile hourly concentration of SO_2 was shown to be 5.6 µg/m^3 and was modelled to occur along the south-western fence-line of RR's premises. The concentration is well below the maximum daily standard of 350 µg/m^3.

The highest 99-percentile concentration of SO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

7.1.3 Nitrogen Dioxide

The highest annual average concentration of NO_2 is estimated to be 1.5 µg/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of NO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile hourly concentration of NO_2 was shown to be 20.6 µg/m^3 and was modelled to occur along the south-western fence-line of RR's premises. The concentration is well below the maximum daily standard of 350 µg/m^3.

The highest 99-percentile concentration of NO_2 at the residential area to the north-east is estimated to be 0.2 µg/m^3.

7.1.4 Carbon Monoxide

The highest 8-hour average concentration of CO is estimated to be 0.3 µg/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises. This value is well below the ambient air quality standard of 10 mg/m^3.

The highest 8-hour average concentration of CO at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile hourly concentration of NO_2 was shown to be 5.1 µg/m^3 and was modelled to occur along the south-western fence-line of RR's premises. The concentration is well below the maximum daily standard of 30 mg/m^3.

The highest 99-percentile concentration of NO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

7.1.5 Lead

The highest annual average concentration of Pb is estimated to be 2.2 ng/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of Pb at the residential area to the north-east is estimated to be less than less than 0.1 ng/m^3.

7.1.6 Benzene

The highest annual average concentration of C_6H_6 is estimated to be 0.04 ng/m^3 and was modelled to occur approximately 180 metres north-west of RR's premises. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of C_6H_6 at the residential area to the north-east is estimated to be less than less than 0.01 ng/m^3.

7.2 CUMULATIVE IMPACT

When the estimated impact of RR's operations is compared with the cumulative impact, as shown in Table 3 above, it can be seen that contributions from RR's emissions will be negligible.

7.2.1 PM10 Particulate Matter

The highest annual average concentration of PM10 is estimated to be 0.8 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. This value is well below the current ambient air quality standard of 40 µg/m^3.

The highest annual average concentration of PM10 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile daily concentration of PM10 was shown to be 12.4 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. The concentration is well below the maximum daily standard of 75 µg/m^3.

The highest 99-percentile daily concentration of PM10 at the residential area to the north-east is estimated to be 0.7 µg/m^3.

7.2.2 Sulphur Dioxide

The highest annual average concentration of SO_2 is estimated to be 0.6 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of SO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile hourly concentration of SO_2 was shown to be 14.2 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. The concentration is well below the maximum daily standard of 350 µg/m^3.

The highest 99-percentile concentration of SO_2 at the residential area to the north-east is estimated to be less than 0.5 µg/m^3.

7.2.3 Nitrogen Dioxide

The highest annual average concentration of NO_2 is estimated to be 1.7 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. This value is well below the ambient air quality standard of 50 µg/m^3.

The highest annual average concentration of NO_2 at the residential area to the north-east is estimated to be less than 0.1 µg/m^3.

The maximum 99-percentile hourly concentration of NO_2 was shown to be 30.9 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. The concentration is well below the maximum daily standard of 350 µg/m^3.

The highest 99-percentile concentration of NO_2 at the residential area to the north-east is estimated to be 0.2 µg/m^3.

7.2.4 Carbon Monoxide

The highest 8-hour average concentration of CO is estimated to be 30.4 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. This value is well below the ambient air quality standard of 10 mg/m^3.

The highest 8-hour average concentration of CO at the residential area to the north-east is estimated to be 1.2 µg/m^3.

The maximum 99-percentile hourly concentration of NO_2 was shown to be 600 µg/m^3 and was modelled to occur on the property of Rheebok Bricks. The concentration is well below the maximum daily standard of 30 mg/m^3.

The highest 99-percentile concentration of NO_2 at the residential area to the north-east is estimated to be 20.7 µg/m^3.

8 DISCUSSION

8.1 MODEL RELIABILITY

The results of any computer model are only as reliable as the quality of the input data.

8.1.1 Emissioner:

The concentrations of all pollutants from RR's planned pilot plant included in this study were calculated from official emission limits, as stipulated in GN R.533, using design flue gas velocities. However, the actual velocities that will occur when the process is in full operation may differ which will result in different annual emissions.

Throughout estimation of emissions LAQS followed a conservative approach in which maximum emissions (use of emission limits) or worst dispersion conditions (lower flue gas temperatures) were used in order to over-estimate emissions, thus suggesting a worst-case scenario.

8.1.2 EnviMet:

The meteorological data assembled by LAQS is comprehensive and gaps in the data are less than 1% of the total amount of data. The dataset consists of validated data and contains all of the necessary parameters required for dispersion modelling purposes. LAQS is, therefore, of the opinion that the weather data set is reliable. The distribution of winds in the Mossel Bay area is shown graphically in Figure 21. It shows that the most frequent wind directions, and the highest wind speeds, are from a north-easterly direction.

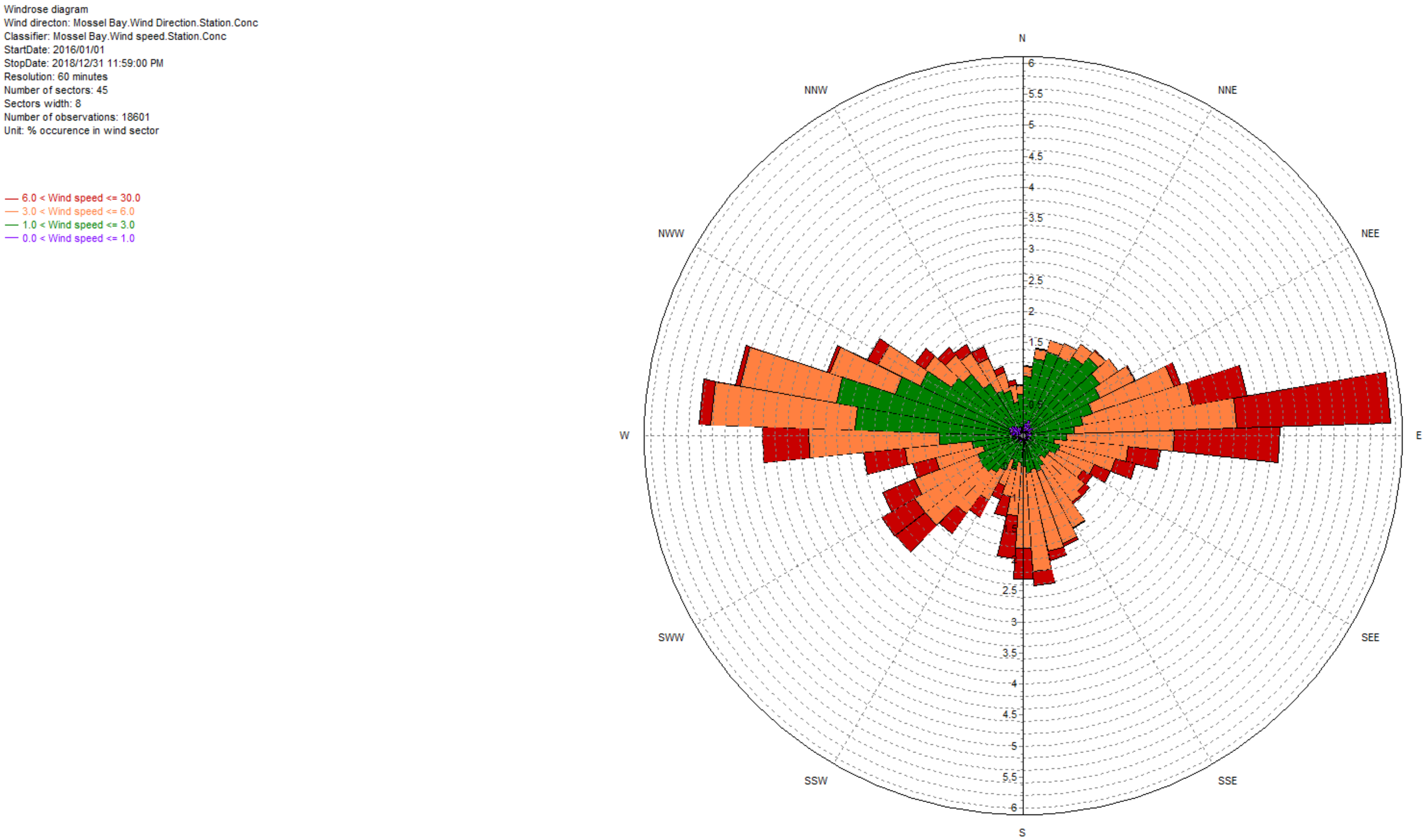

Figure 21: Frequency of Wind Direction

8.1.3 Planner:

As was stated previously, the user provides no direct data input to Planner. It uses Aermod, a USEPA-approved Gaussian plume dispersion model, and there is no reason to doubt the reliability of the dispersion calculations. Aermod is also listed as an approved plume dispersion model in GN R.533.

9 CONCLUSIONS

The annual emissions from RR's planned operations, as discussed in Section 5.6, were based on emission limits and design flue gas conditions, as stipulated in GN R.533. It is accepted that a degree of uncertainty may exist as the actual emissions during full operations may differ from design values.

Nevertheless, the impact of RR's emissions on air quality in the area is negligible as all estimated ground-level concentrations are well below the official air quality standards published in GN1210.

Emissions from PG Bison Woodline and Rheebok Bricks were based on actual emission measurements and can be regarded as typical of emissions from these two operations.

The cumulative impact of all sources on air quality in the area shows that the highest concentrations are modelled to occur on Rheebok Bricks' site. It further shows that the maximum ground-level concentrations are well below the relevant ambient air quality standards.

10 RECOMMENDATIONS

The calculated annual emissions and associated estimated air quality impact is so low that LAQS cannot make any further recommendations to reduce the impact on air quality in the area.

It is understood that GN893 states the necessity of continuous emissions monitoring (CEM) system to monitor pollutants emitted from the process. It further states that results must be reported at NTP, dry gas conditions and referenced to 10% O_2. The latter requirement implies that flue gas temperature, pressure, H_2O and O_2 must also be measured continuously, in addition to the other parameters listed under Sub-category 8.1 in GN893.

Of the pollutants listed, CEM systems are to monitor every pollutant listed continuously (or at least semi-continuously), except the list of heavy metals (excluding Hg) and TOC.

TOC is a broad term that includes all organic compounds which makes continuous monitoring a virtually impossible task. It is, however, possible to monitor total volatile organic compounds continuously.

When specifying the need to install a CEM system, a few issues need to be taken into account:

- -- The capital costs of a comprehensive CEM system to measure all of the compounds continuously can be expected to amount to approximately R3.5–R4 million.
- -- Annual running costs can be expected to amount to approximately 10% of capital costs.
- -- While it is possible to install a system to measure all of the parameters, finding calibration systems to calibrate the CEM system for all parameters is not so easy.
- -- Where calibration materials are not available, CEM output must be correlated against manual emissions measurements and can equally result in significant costs.

LAQS would like to recommend that a comprehensive CEM system is not stipulated for the pilot plant stage of RR's plans, but rather a system that monitors the key components that are indicative of the efficiency of the process, e.g. CO, VOCs, etc. Other compounds, e.g. SO_2, NO_2, etc., can be measured manually at regularly intervals.

The pilot plant is, after all, a development tool that will be used to define operating parameters for a large-scale installation. Once such an installation is set up and comprehensive CEM system can form part of the capital expenditure of the process.