Eskom

RESEARCH, TESTING AND DEVELOPMENT

SUSTAINABILITY

CAMDEN AIR QUALITY REPORT

MAY 2022

EXECUTIVE SUMMARY

This monthly report covers the ambient air quality data as monitored at Camden monitoring site in May 2022.

There were no exceedances recorded for all the parameters monitored during the period under review.

Emissions from tall stack emitters and other industrial activities taking place during the day have shown to be impacting on ambient $PM_{2.5}$ and SO_2 concentrations. Emissions from both low level sources and stack emitters are shown to be impacting on ambient NO_2 concentrations.

The dominant wind directions during the daytime were east, south-west and west-south-west. During the night, the most frequent directions were north-west and north-north-west.

The overall percentage data recovered from the monitoring station during the reporting period were 91.5% and the overall monitoring station availability was 95.4%.

DISCLAIMER

1. INTRODUCTION

At the request of Environmental Management, the Research, Testing and Development (RT&D) air quality monitoring team commissioned an ambient air quality monitoring site at Camden Power Station to assess possible impacts of air pollution from Camden Power Station and other pollution sources in the area (Figure 1).

The Camden station is equipped for continuous monitoring of ambient concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) and fine particulate matter (PM) of particulate sizes <10µm and <2.5µm in diameter (PM_{10} and $PM_{2.5}$). In addition, meteorological parameters of wind velocity (WVL), wind direction (WDR), ambient temperature (TMP), humidity (HUM), solar radiation (RAD) and ambient pressure (PRS) are also recorded.

Standard Specifications, Equipment/Techniques used for the measurement of SO_2, O_3 and NO_x conform to US-EPA equivalent method No EQSA-0486-060, EQOA-0880-047 and RFNA-1289-074 respectively. The monitoring site is accredited by the South African National Accreditation System (SANAS). Sampling is carried out in accordance with SANAS TR07-03 and Eskom air quality monitoring guideline, 240-93863318 and the Eskom AQM sampling document, AQM-010-02.

2. SITE LOCATION

The monitoring station was commissioned close to Camden Power Station at co-ordinates: (-26.622639, 30.109028) in June 2003.

Figure 1: Camden Air Quality Monitoring Station in relation to Camden Power Station and other pollution sources

3. DATA RECOVERY

The SANAS guideline figure of 90% per parameter monitored is used as a standard for representative data capture. This describes the required completeness of data set for the reporting of averages and is based on standard arithmetic calculations. The completeness calculations for data sets exclude zero and span data and times where service and/or maintenance is being conducted on the instruments in question. The internal temperature of the monitoring hut is controlled by an air conditioner and is maintained at 25±5°C.

Availability is a management definition related to system reliability. The availability target is not set in terms of data quality criteria and has no associated quality objectives. A target of 100% availability has been set for performance evaluation. Availability is reported as a measure of the percentage of time that electrical power was available to the monitoring station. Table 1 shows the percentage data recovered for each pollutant monitored during the reporting period.

Table 1: Percentage data recovered per parameter in May 2022

Month	NO_1	NO_2	NO_X	O_3	PRS	RAD	RFL	SO_2	TMP	WDR	WSP	WVL	$PM_{2.5}$	PM_{10}	HUM	Data Rec	Station Avail
May	94.1	94.1	94.1	94.2	99.7	99.7	99.7	99.7	94.2	99.7	99.7	99.7	97.2	0	99.7	91.5	95.4

The overall percentage data recovered from the monitoring station during the reporting period were 91.5% and the overall monitoring station availability was 95.4%.

4. SUMMARY OF RESULTS FOR REPORTED PERIOD

Table 2 presents the National Ambient Air Quality Standards and Table 3 is a summary report presenting the highest mean concentrations and the number of exceedances above the respective national air quality standards for each measured parameter.

Table 2: National Ambient Air Quality Standards.

Pollutant	Unit	Period	Limit	Number of annual exceedances allowed	Source
(PM_{10})	µg/m^3	24hr	75	4	DFFE
(PM_{10})	µg/m^3	1year	40	0	DFFE
($PM_{2.5}$)	µg/m^3	24hr	40	4	DFFE
($PM_{2.5}$)	µg/m^3	1year	20	0	DFFE
Nitrogen dioxide	ppb	1year	21	0	DFFE
Nitrogen dioxide	ppb	1hr	106	88	DFFE
Ozone	ppb	8hr	61	11	DFFE
Sulphur dioxide	ppb	1hr	134	88	DFFE
Sulphur dioxide	ppb	10min	191	526	DFFE
Sulphur dioxide	ppb	24hr	48	4	DFFE
Sulphur dioxide	ppb	1year	19	0	DFFE

Table 3: Summary report of parameters at Camden monitoring site for May 2022

Pollutant	Highest Hourly Mean	No of Hourly National Limit Exceedances	Highest Daily Mean	No of Daily National Limit Exceedances	No of 8hr Moving Average Limit	Highest 10min Mean	No of 10min National Limit Exceedances
FPM (PM−2.5) by Beta gauge [ug/m^3]	31.4		11.1	0		35.3	
FPM (PM−10) by Beta gauge [ug/m^3]				0			
Nitric oxide [ppb]	21.2		6.4			47.8	
Nitrogen dioxide [ppb]	10.2	0	7.3			11.5	
Nitrogen oxide [ppb]	23.8		8.1			50.	
Ozone [ppb]	51.6		36.6		0	53.4	
Sigma theta [deg]	50.7		25.1			79.6	
Sulphur dioxide [ppb]	64.7	0	20.3	0		90.4	0
Ambient temperature [deg C]	24.		13.2			24.7	
Wind speed [m/s]	10.7		5.4			11.5	
Wind velocity [m/s]	10.6		5.2			11.4	

There were no exceedances recorded for all the parameters monitored during the period under review.

5. METEOROLOGICAL OBSERVATIONS

Figure 2 shows the daytime and night-time wind roses for the reporting period. The centre of the wind rose depicts the position of the air quality monitoring station. The position of the spokes in the polar diagram represents directions from which the wind was blowing. The length of the segment indicates the percentage of the time the wind blew from that direction and the speed in the various categories are denoted by colours and width.

The dominant wind directions during the daytime were east, south-west and west-south-west. During the night, the most frequent directions were north-west and north-north-west.

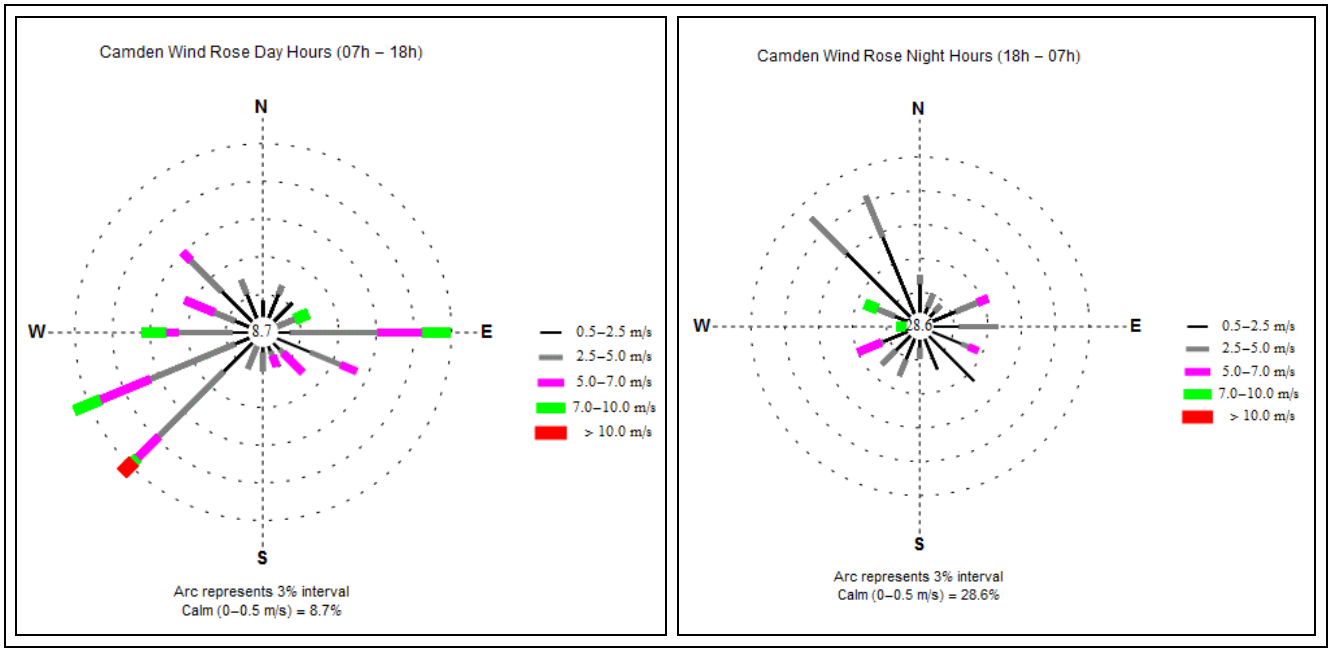

Figure 2: Day and night-time wind roses at Camden monitoring site.

6. DISCUSSION OF POLLUTANTS

Emissions of primary pollutants such as FPM, SO_2, and NO_X from low level sources such as domestic combustion, motor vehicles and smouldering dumps are expected to impact at ground level more significantly during the evening and early morning hours as a result of temperature inversion. Emissions of such pollutants from tall stacks (modern power stations and other industries), are expected to have more significant impact at ground level during the day, due to atmospheric turbulence influences. O_3 and other oxidants are formed in polluted atmospheres as a result of a wide variety of photochemical reactions. A gradual increase of O_3 throughout the day is expected, peaking at mid-afternoon and then decaying once more during the night.

6.1. FINE PARTICULATE MATTER (PM_{10})

There were no data recorded for PM_{10} because the analyser was faulty and removed from site for repairs.

6.2. FINE PARTICULATE MATTER ($PM_{2.5}$)

6.1.1. Source identification by $PM_{2.5}$ diurnal variations

Figure 3 shows the $PM_{2.5}$ hourly mean diurnal variation. Contribution of emissions from tall stack emitters and other industrial activities is noticeable with high concentrations during the day that peaked between 13:00 and 14:00 in the afternoon.

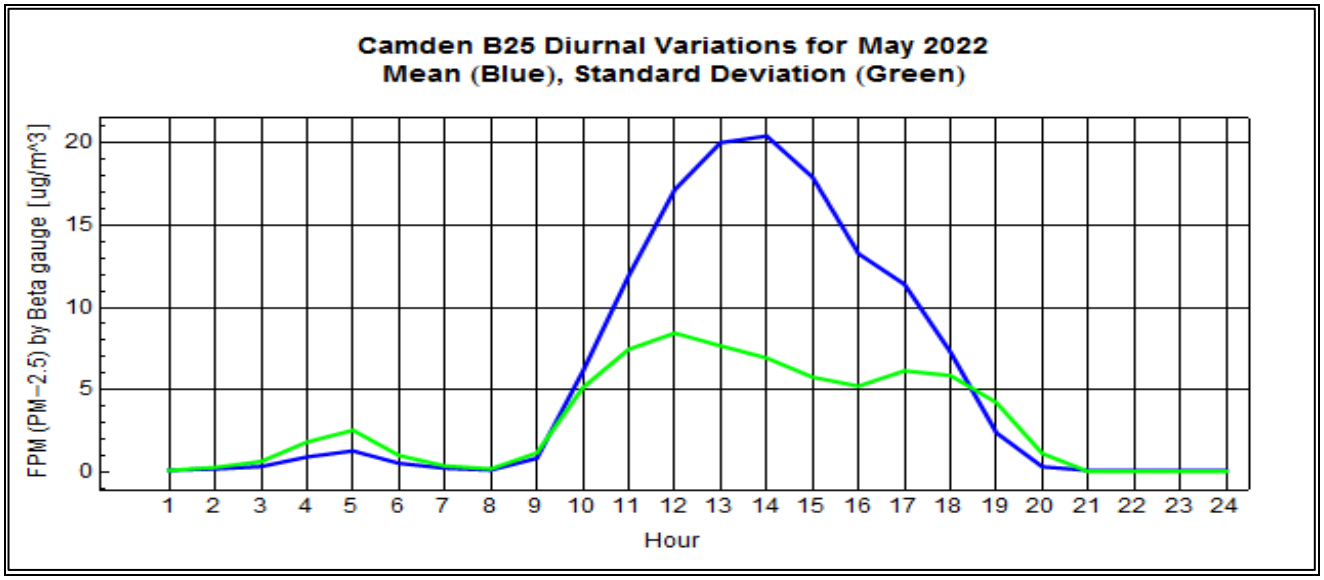

Figure 3: Diurnal variation by $PM_{2.5}$ (Mean concentrations = Blue line, Standard Deviation = Green line)

6.1.2. $PM_{2.5}$ hourly mean event roses and tables

As there are no national ambient air quality hourly $PM_{2.5}$ limits, the 98th percentile daytime and night-time event roses are presented in Figure 4 to identify the wind sectors from which the highest concentrations are derived.

The most dominant hourly mean concentrations above 27.37 µg/m^3 (98th percentile value) at Camden monitoring site during daytime period were recorded from south-west, west-south-west and south-south-west sectors. The most dominant hourly mean concentrations above 4.38 µg/m^3 (98th percentile) at Camden monitoring site during night-time period were recorded from south-east, west-north-west, east-south-east and south-south-east sectors.

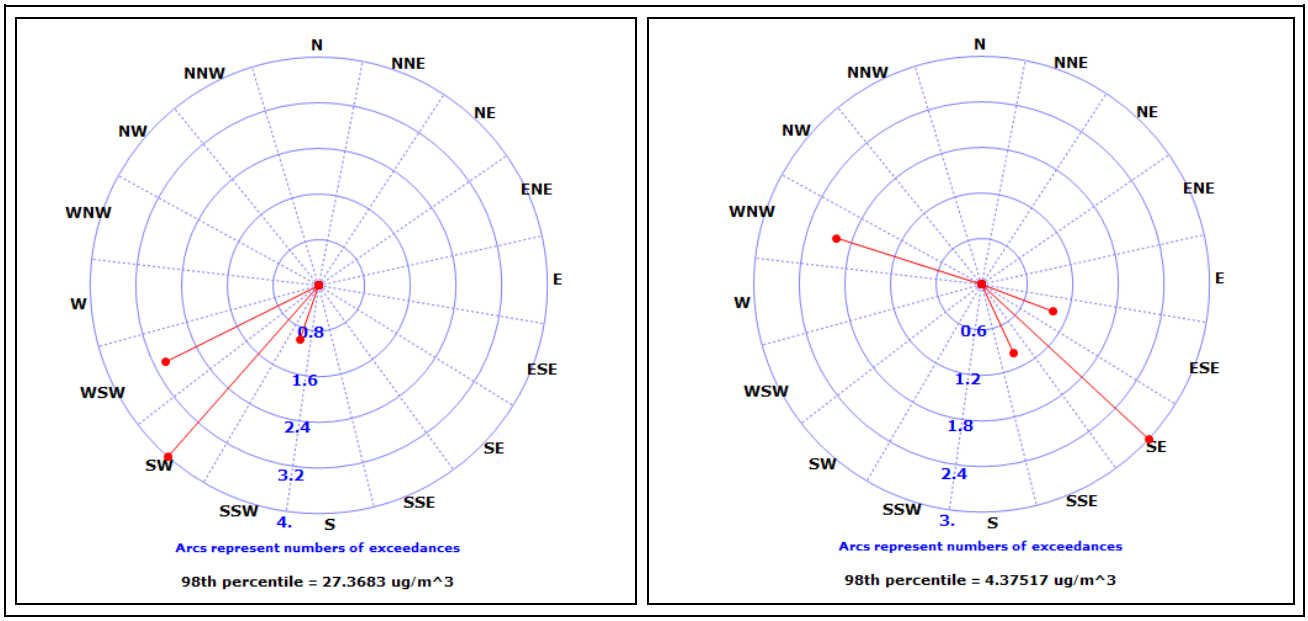

Figure 4: $PM_{2.5}$ hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 4: $PM_{2.5}$ daytime hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	1	4	3	0	0	0	0
%	0	0	0	0	0	0	0	0	0	12.5	50	37.5	0	0	0	0

Table 5: $PM_{2.5}$ night-time hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	1	3	1	0	0	0	0	0	2	0	0
%	0	0	0	0	0	14.29	42.86	14.29	0	0	0	0	0	28.57	0	0

6.3. SULPHUR DIOXIDE (SO_2)

6.3.1. Source identification by SO_2 diurnal variations

Figure 5 shows the SO_2 hourly mean diurnal variation. The graph shows that SO_2 levels are low in the morning, increase from 09:00 and reach a maximum peak at 13:00 and another minor peak at 17:00 in the afternoon with concentrations dropping throughout the afternoon and evening. This is a typical signature of contribution of emissions from both tall stack sources and other industries operating during the day, on ambient concentrations.

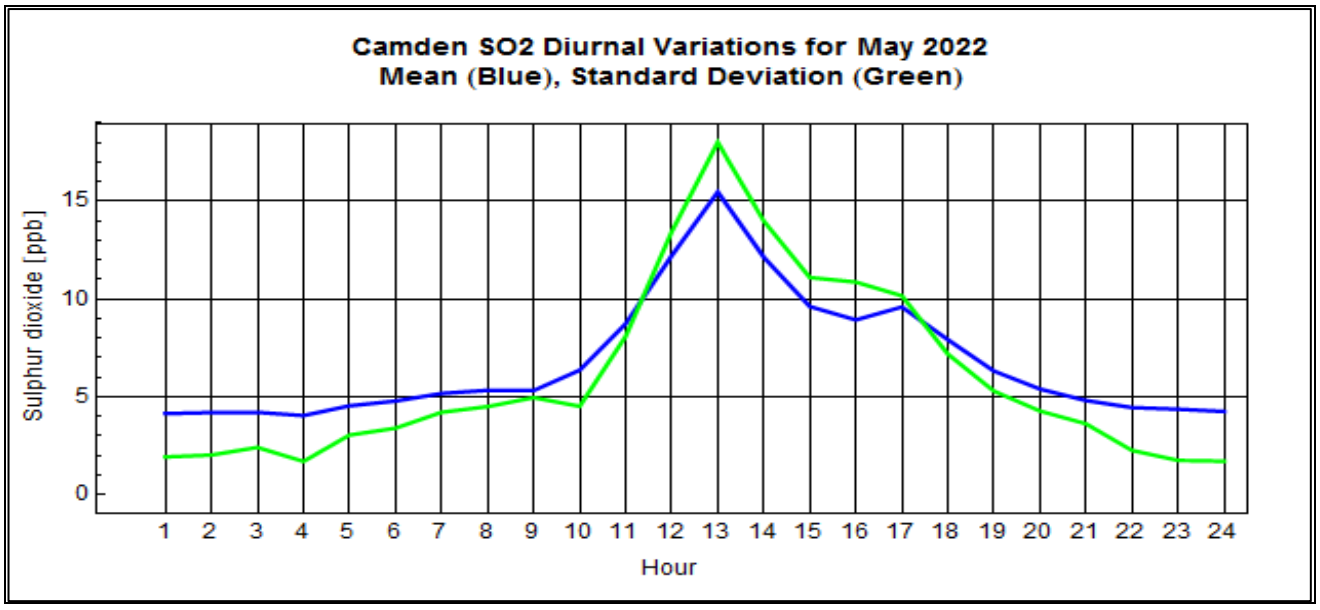

Figure 5: SO_2 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line)

6.3.2. SO_2 hourly mean event roses and tables

The 98th percentile event roses are presented in Figure 6 to identify the wind sectors from which the highest concentrations are derived.

The most dominant daytime concentrations above 51.55 ppb (98th percentile value) were from west, north-west and south-west sectors. The most dominant night-time concentrations above 14.39 ppb (98th percentile value) were from north-north-west, north-west, west and west-north-west sectors.

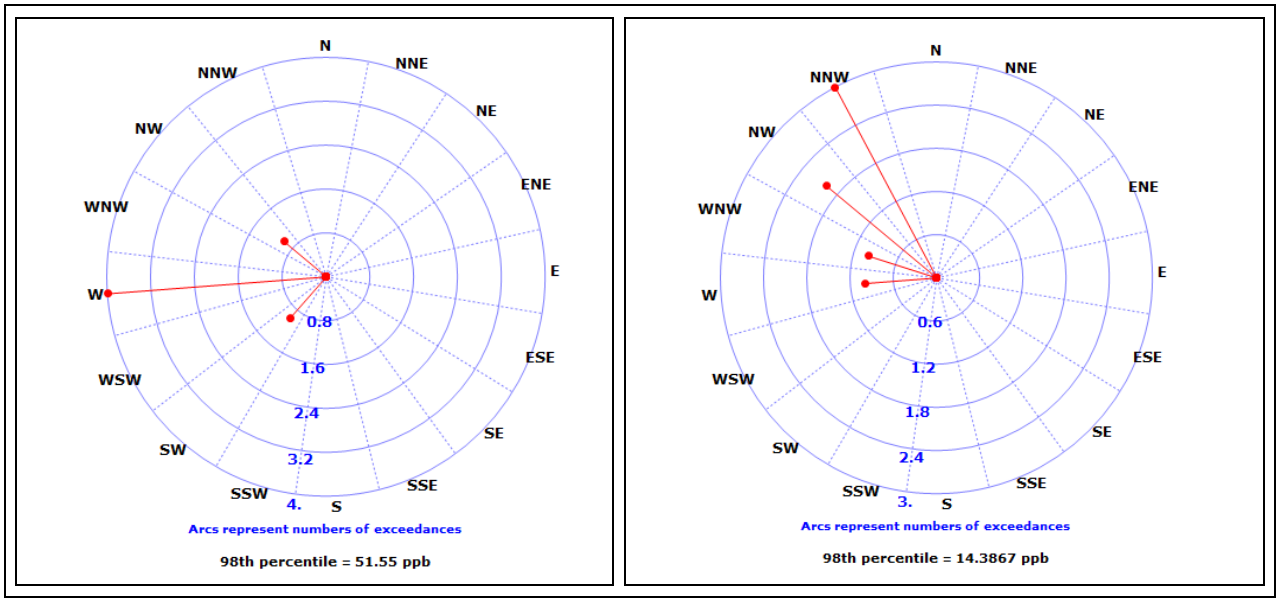

Figure 6: SO_2 hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 6: SO_2 daytime hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	1	0	4	0	1	0
%	0	0	0	0	0	0	0	0	0	0	16.67	0	66.67	0	16.67	0

Table 7: SO_2 night-time hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3
%	0	0	0	0	0	0	0	0	0	0	0	0	14.29	14.29	28.57	42.86

6.4. NITROGEN DIOXIDE (NO_2)

6.4.1. Source identification by NO_2 diurnal variations

The NO_2 diurnal variation is presented in Figure 7. Contribution of emissions from tall stack emitters, other industrial activities and low level sources is shown on the ambient NO_2 concentrations with a series of concentration peaks recorded in the morning, throughout the afternoon and in the evening.

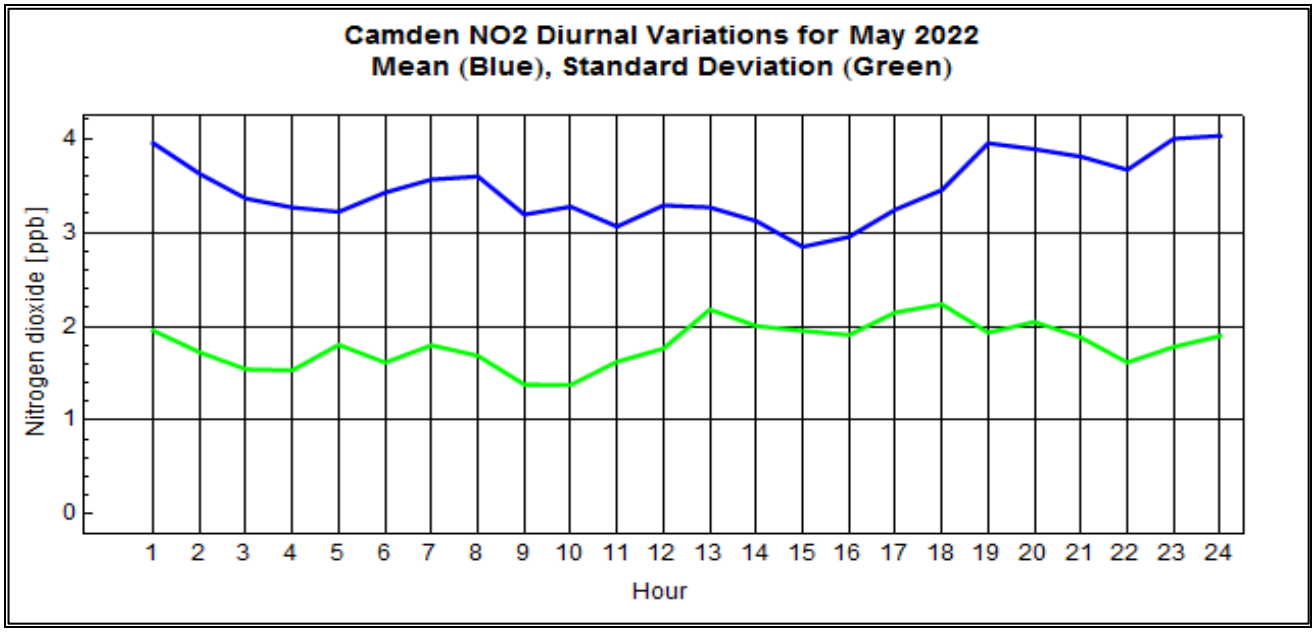

Figure 7: NO_2 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line)

6.4.2. NO_2 hourly mean event roses and tables

The 98th percentile daytime and night-time event roses are presented in Figure 8 to identify the wind sectors from which the highest concentrations are derived. The NO_2 national ambient air quality hourly limit of 106 ppb was not exceeded during the period under review.

The most dominant daytime concentrations above 8.17 ppb (98th percentile value) were from west and north-west sectors. The most dominant night-time concentrations above 8.30 ppb (98th percentile value) were from north-west, north-north-west and west-north-west sectors.

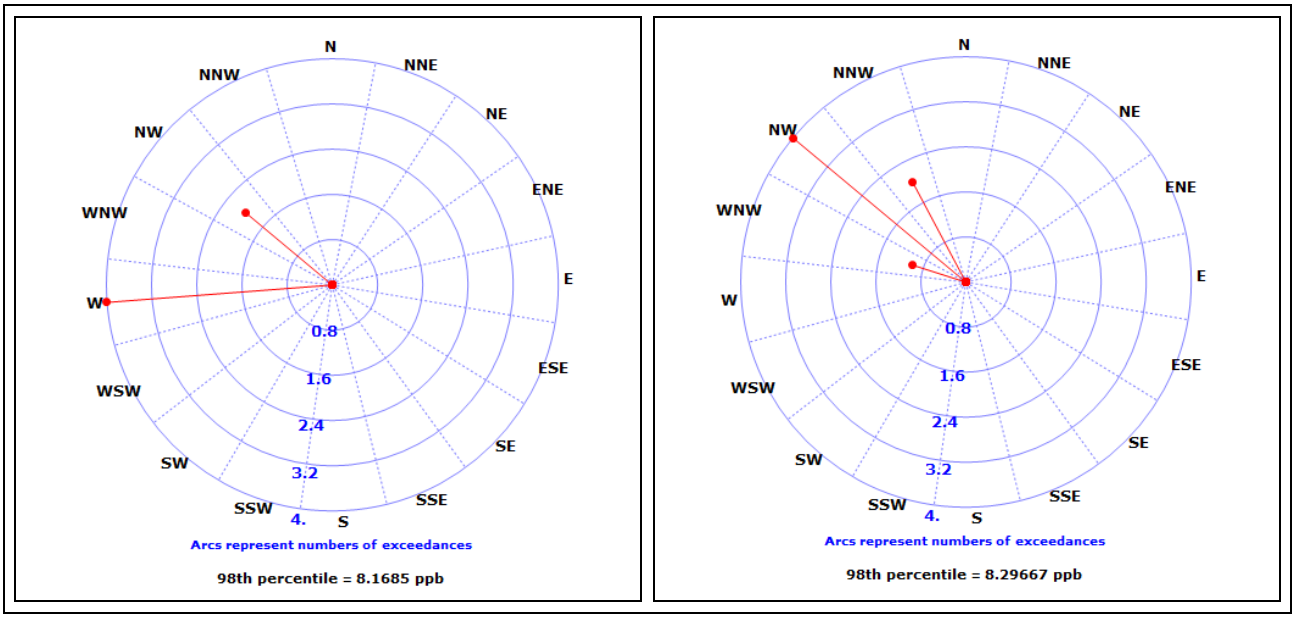

Figure 8: NO_2 hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 8: NO_2 daytime hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0
%	0	0	0	0	0	0	0	0	0	0	0	0	66.67	0	33.33	0

Table 9: NO_2 night-time hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	2
%	0	0	0	0	0	0	0	0	0	0	0	0	0	14.29	57.14	28.57

6.5. OZONE (O_3)

6.5.1. Source identification by O_3 diurnal variations

Figure 9 shows the O_3 hourly mean diurnal variation. The highest O_3 concentration levels are recorded during the afternoon and the lowest in the morning and in the evening. The concentrations are increasing throughout the day from 08:00 in the morning because of photochemical reactions and reaching maximum peak between 13:00 and 16:00 in the afternoon before dropping off to background levels for the rest of the evening due to lack of sunlight which is required for the O_3 formation.

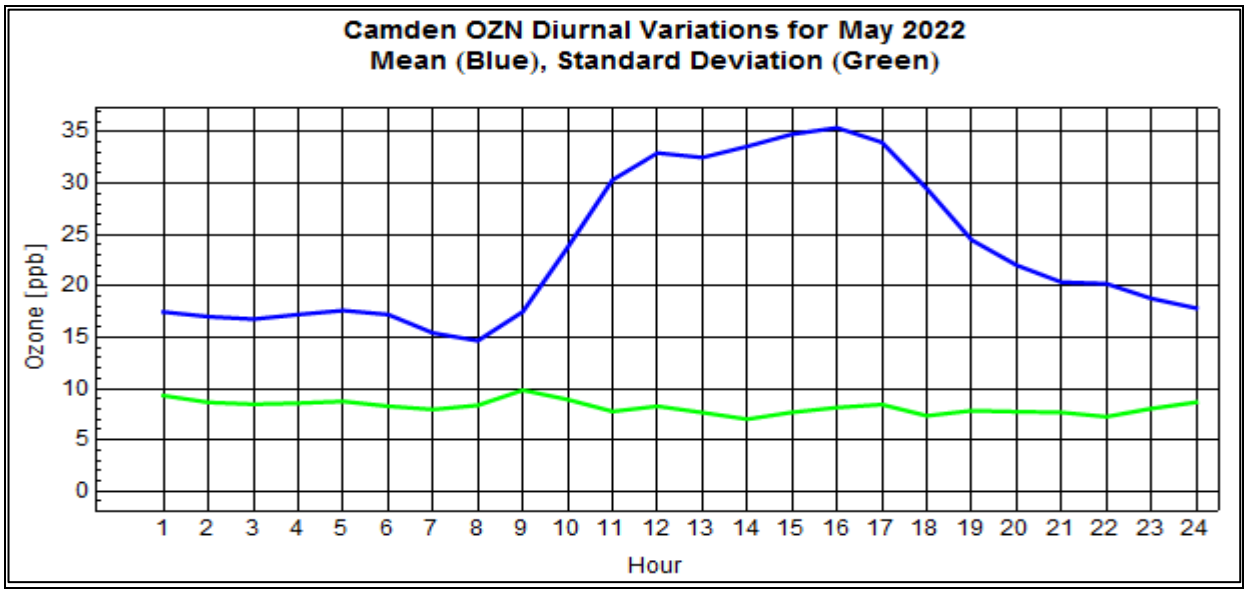

Figure 9: O_3 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line)

6.5.2. O_3 8 hour Moving Average

There were no exceedances of the ozone 8-hourly moving average limit during the period under review.

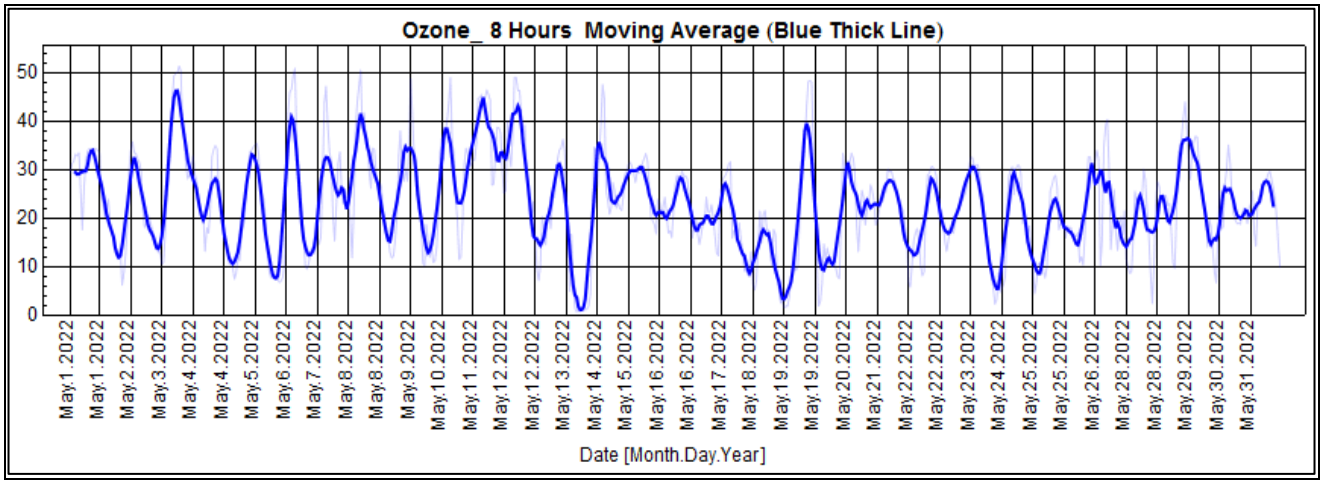

Figure 10: O_3 8 hour Moving Average

6.5.3. O_3 hourly mean event roses and tables

As there are no ambient O_3 hourly limits, the 98th percentile daytime and night-time event roses are presented in Figure 11 to indicate the wind sectors from which the highest concentrations are derived.

The most dominant daytime concentrations above 49.67 ppb (98th percentile value) were from south-west sector. The most dominant night-time concentrations above 35.78 ppb (98th percentile value) were from west-north-west, north, east-south-east, south-east, south-south-west and south-west sectors.

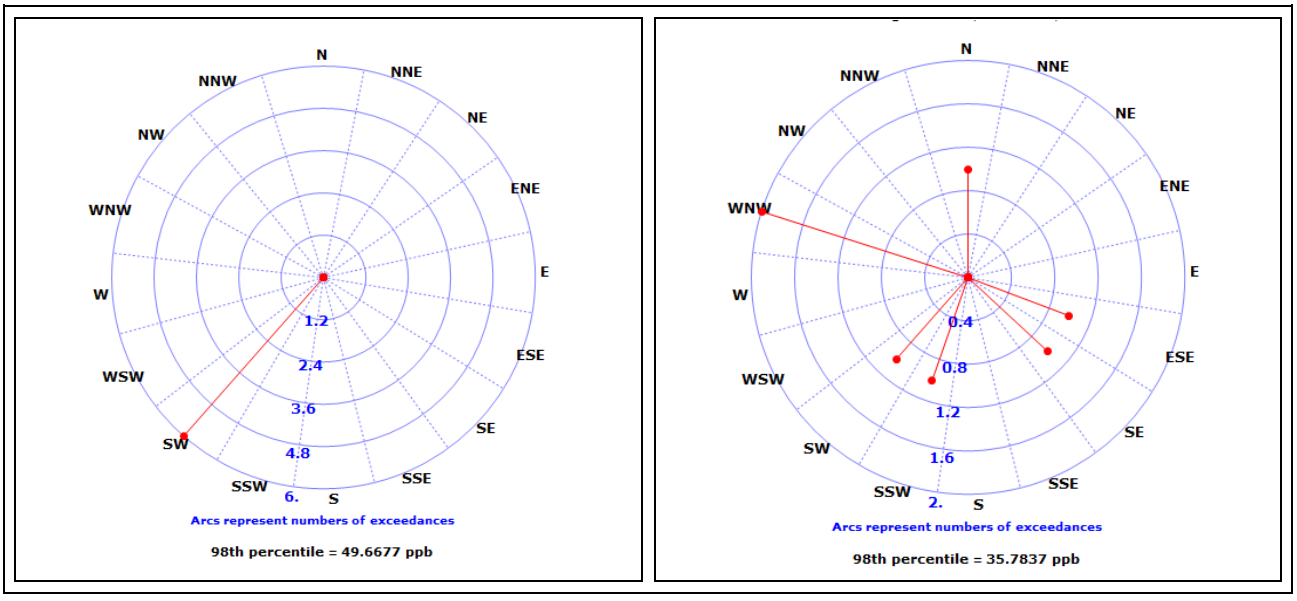

Figure 11: O_3 hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 10: O_3 daytime hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
%	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0

Table 11: O_3 night-time hourly mean 98th percentile event table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	1	0	0	0	0	1	1	0	0	1	1	0	0	2	0	0
%	14.29	0	0	0	0	14.29	14.29	0	0	14.29	14.29	0	0	28.57	0	0

7. HISTORICAL CONCENTRATIONS

7.1. RECENT TRENDS

Time series graphs for each pollutant with respect to the National Ambient Air Quality Standards are represented from the beginning of the previous year until the end of the current reporting period or since inception of the monitors. The resultant period may vary for each analyser, depending on when it was installed. The trends show that SO_2 and PM_{10} concentrations are low in summer months compared to winter.

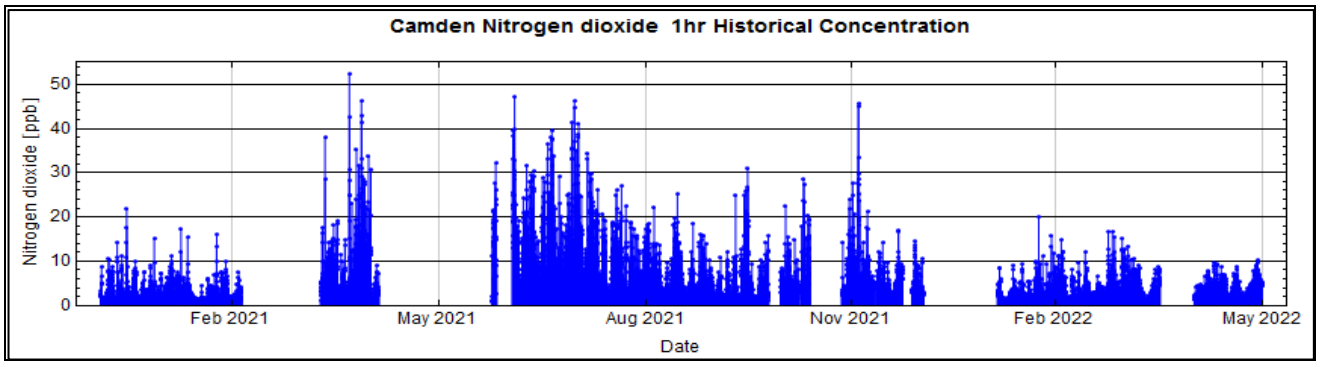

Figure 12: Historical Trends of NO_2 Hourly Mean Concentrations

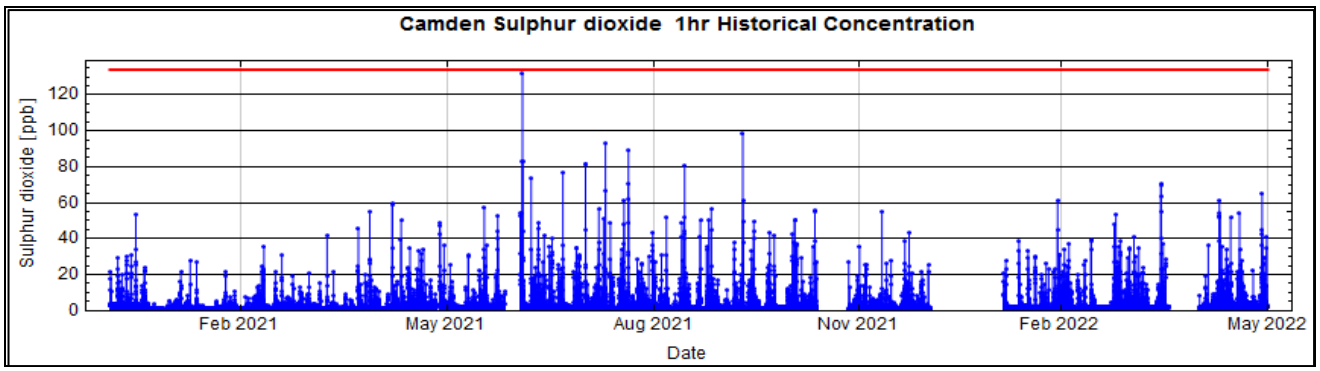

Figure 13: Historical Trends of SO_2 Hourly Mean Concentrations

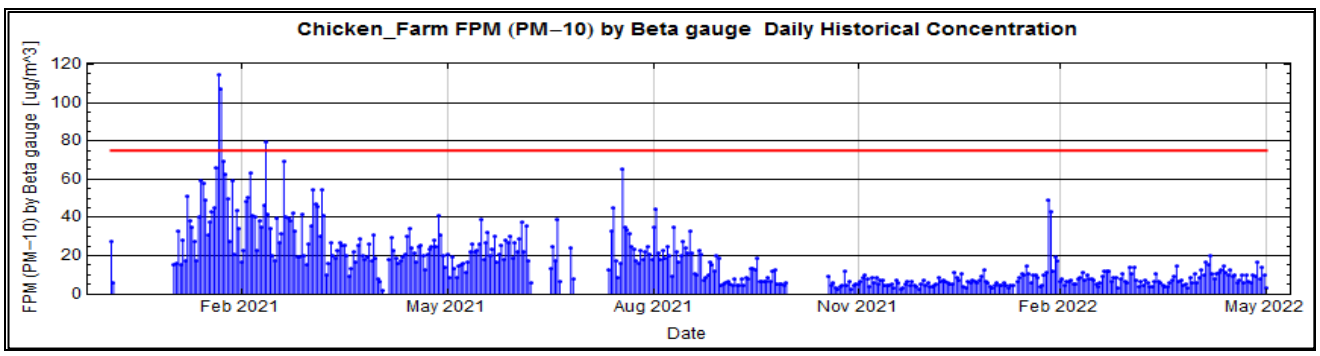

Figure 14: Historical Trends of PM_{10} Daily Mean Concentrations

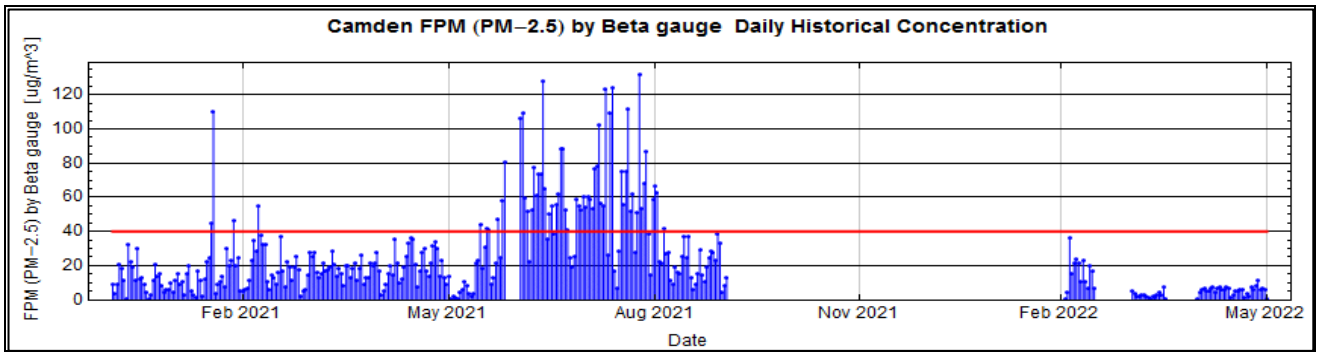

Figure 15: Historical Trends of $PM_{2.5}$ Daily Mean Concentrations

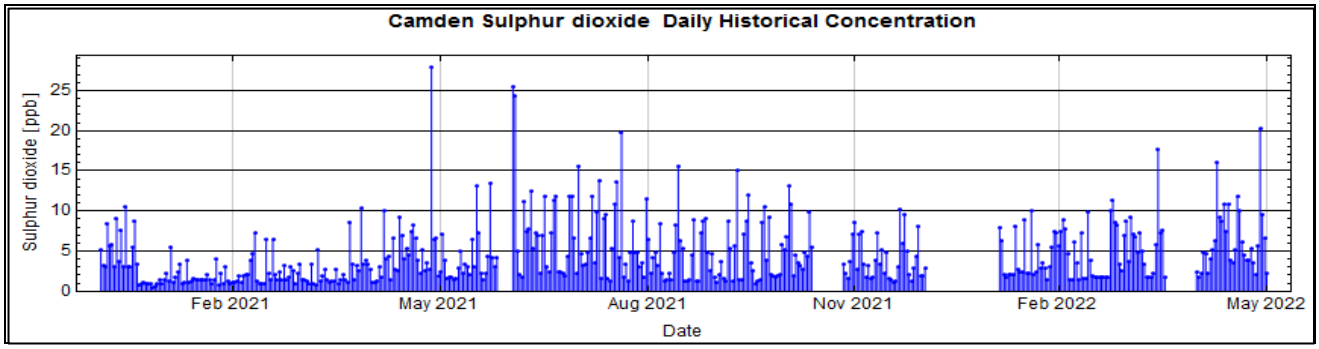

Figure 16: Historical Trends of SO_2 Daily Mean Concentrations

7.2. MONTHLY MEANS FOR 2022

Table 12: Monthly Means for 2022

Parameter measured	Jan	Feb	Mar	Apr	May
$PM_{2.5}$ (µg/m^3)	ND	ND	16.9	2.7	5.5
PM_{10} (µg/m^3)	1.9	2.2	11.2	24.5	ND
NO_2 (ppb)	ND	2.6	3.4	3.4	3.5
O_3 (ppb)	23.4	30.7	29.5	27.2	23.2
SO_2 (ppb)	ND	4.1	4.7	5.6	6.7

ND = no data recorded

7.3. NUMBER OF EXCEEDANCES OF NATIONAL AIR QUALITY LIMITS

Table 13: Number of exceedances of the National Ambient Air Quality Limits

Months	SO_2 10 minute	SO_2 hourly	SO_2 daily	NO_2 hourly	PM_{10} daily	$PM_{2.5}$ daily	O_3 8-hourly
Jan 2022	ND	ND	ND	ND	0	ND	ND
Feb 2022	0	0	0	0	ND	ND	0
Mar 2022	0	0	0	0	0	ND	5
Apr 2022	0	0	0	0	0	0	0
May 2022	0	0	0	0	0	0	0
TOTAL	**0**	**0**	**0**	**0**	0	**0**	**5**
Allowed no of exceedances	526	88	4	88	4	4	11

ND = No Data recorded

8. CONCLUSIONS

There were no exceedances recorded for all the parameters monitored during the period under review. Emissions from tall stack emitters and other industrial activities taking place during the day have shown to be impacting on ambient $PM_{2.5}$ and SO_2 concentrations. Emissions from both low level sources and stack emitters are shown to be impacting on ambient NO_2 concentrations.

Report Compiled by:
Abram Segopa

Reviewed and Authorised by: Date of Issue: 15 Jun 2022

Bontle Moiloa
Air Quality, Climate Change & Ecosystem Management CoE
Research, Testing and Development (RT&D)

9. ABBREVIATIONS

DFFE	Department of Forestry, Fisheries and the Environment
FPM	Fine particulate matter
HUM	Humidity
NO1	Nitric oxide
NO2	Nitrogen dioxide
NOX	Oxides of nitrogen
OZN / O_3	Ozone
SGT	Sigma theta
TMP	Ambient temperature
WDR	Wind direction from true North
WSP	Wind speed
WVL	Wind velocity
N	North
NNE	North-north-east
NE	North-east
ENE	East-north-east
E	East
ESE	East-south-east
SE	South-east
SSE	South-south-east
S	South
SSW	South-south-west
SW	South-west
WSW	West-south-west
W	West
WNW	West-north-west
NW	North-west
NNW	North-north-west
deg	Degree
deg C	Degree Celsius
ug/m^3	Microgram per cubic meter
m/s	Meters per second
$PM_{2.5}$	Particulate matter < 2.5 microns in diameter
PM_{10}	Particulate matter < 10 microns in diameter
ppb	Parts per billion
ppm	Parts per million
MWP	Megawatt Park

RT&D	Research, Testing and Development

10. DISTRIBUTION LIST

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