

Latrobe Valley Air Monitoring Network

REVIEW OF ECOTECH AIR MONITORING 2013

LVAMN Air Monitoring Report 2013

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Executive Summary

Overview

Ecotech operated and maintained the Jeeralang Hill and Rosedale South 'rural' air monitoring stations on behalf of the Latrobe Valley Air Monitoring Network Incorporated (LVAMN) during 2013.

Ecotech conducted Quality Assurance checks on the monitoring data in accordance with NATA procedures. Ecotech provided monthly monitoring data and reports to Jacobs and LVAMN for review, setting out details such as equipment and monitoring specifications, and data capture rates.

The purpose of this report is to provide an independent review of Ecotech's LVAMN 2013 air quality monitoring data acquired from the Jeeralang Hill and Rosedale South stations, the focus being on data interpretation. A limited amount of Environment Protection Authority (EPA) monitoring data, obtained at Traralgon and Morwell East in the central parts of the Latrobe Valley, were used to assist with interpretation of the Ecotech results.

The EPA operated an air monitoring station at Traralgon in all months of 2013, and Morwell East over January–May, 2013. While some EPA results have been used for this report, analysis of the EPA data was not included in the scope of works.

Sulfur Dioxide (Jeeralang Hill and Rosedale South)

Data capture rates for the SO₂ data were 84% of hourly averages for Jeeralang Hill and 87% for Rosedale South. There were no exceedences of the *State Environment Protection Policy (Ambient Air Quality)* objective for hourly average SO₂ (200 ppb), in these data.

The highest hourly average SO₂ concentration in 2013 was 187 ppb, measured at 17/12/13 3:00–4:00, at Jeeralang Hill in the Strzelecki Ranges. About 95% of all SO₂ in the Latrobe Valley originates from industrial sources. The highest values can usually be attributed to power station emissions; e.g., Aurecon (2013). In the case of the 17/12/13 data, the wind had swung from the northwest to easterly, so the high SO₂ readings are likely to have been due to the Loy Yang complex.

At Rosedale South the highest hourly average SO₂ concentration was 97 ppb (17/12/13, 12:00–13:00).

The EPA measured SO₂ in the Latrobe Valley at Traralgon (all months of 2013), and Morwell East (January–May 2013 only). The maximum hourly average SO₂ concentration at Traralgon was 70 ppb; and 44 ppb at Morwell East.

Ozone (Jeeralang Hill and Rosedale South)

In 2013 there were no detected exceedences of the SEPP(AAQ) objective for hourly average O₃ (100 ppb) at Jeeralang Hill and Rosedale South. The four highest hourly average O₃ concentrations were measured at Jeeralang Hill during on 21/1/13 (12:00–16:00; 76, 67, 63 and 61 ppb). The two highest hourly average O₃ concentrations measured at Rosedale South also occurred on 21/1/13 (11:00–13:00, 84 and 76 ppb).

A maximum O₃ concentration of 92 ppb was recorded at the EPA's Traralgon station in 2013.

Nitrogen Dioxide (Rosedale South)

In 2013 there were no recorded exceedences of the SEPP(AAQ) objective for maximum hourly average nitrogen dioxide (NO₂, 120 ppb), at Rosedale South. The highest hourly average (NO₂) concentration recorded at Rosedale South was 22 ppb. It was noted however that data capture at Rosedale South was low, at 68%. Comparisons with EPA results for Morwell East and Traralgon indicate the conclusion for Rosedale South (no exceedences of the NO₂ standard), probably wouldn't change if the data capture rate had been higher.

Comparisons with data from EPA Victoria's 2013 summaries for Morwell East and Traralgon show that similar NO₂ results were obtained from the EPA stations. The maximum hourly average NO₂ concentration at Traralgon was 34 ppb (all months of 2013). A value of 34 ppb was recorded at Morwell East (January–May 2013 only).

Particulate Matter

The SEPP(AAQ) PM₁₀ objective is a maximum 24-hourly concentration of 50 µg/m³ with a goal of not more than 5 exceedences in one year. Data capture rates for PM₁₀ were high at Jeeralang Hill and Rosedale South, greater than 97%.

In 2013 there was one exceedence of the 50 µg/m³ standard at Jeeralang Hill (77 µg/m³ on 10/5/13), therefore no exceedences of the objective. The single exceedence was due to smoke from planned burns (EPA, 2013).

At Rosedale South, in 2013 the five highest PM₁₀ results occurred on: 10/5/13 (139 µg/m³), 11/5/13 (77 µg/m³), 30/04/2013 (61 µg/m³), 9/5/13 (53 µg/m³), and 12/5/13 (43 µg/m³), therefore there were no exceedences of the PM₁₀ 5-day objective at Rosedale South. Although Rosedale South is approximately 20 kilometres east of Traralgon, probably these high results in May 2013 were due to smoke from the planned burns that EPA (2013) described as affecting monitoring data in Morwell East and Traralgon.

The EPA Victoria's 2013 summaries show that 4 exceedences of the PM₁₀ standard were recorded at Traralgon (all months of 2013), therefore no exceedences of the 5 day goal; and 6 exceedences were recorded at Morwell East (Jan.-May only). Therefore there was one exceedence of the 5 day goal at Morwell East. The exceedences recorded at the EPA's Morwell East air monitoring station were due to smoke from a bushfire in the Aberfeldie region and planned burns (EPA, 2013).

Local Visual Distance (Rosedale South)

The Rosedale South measurements of the atmospheric light scattering coefficient were affected by a technical fault throughout 2013, as such no results for Local Visual Distance (LVD) are provided in this Executive Summary. In any case, in Victoria, the determination of LVD is severely limited by nephelometer measurements. The calculated results for LVD have high uncertainties, even if using high quality measurements of the atmospheric light scattering coefficients (B_{sca}), which are obtained in situ.

Summary of Results

A summary of results for each of the air pollutants and objectives with respect to the relevant Victorian ambient air quality standards and goals is set out in the table below. In the right-hand columns of the table, results are provided for maximum concentrations (ppb) and exceedences of the goals for exceedences [days per year], for: Jeeralang Hill (JH); Rosedale South (RS); Traralgon (T); and Morwell East (ME).

Indicator	Average	Objective	Goal*	JH	RS	T	ME
SO ₂	Max. 1 hour	200 ppb	1 day/year	187 [0]	97 [0]	70 [0]	44 [0]
	Max. 1 day	80 ppb	1 day/year	35 [0]	18 [0]	7 [0]	9 [0]
	Annual	20 ppb	None	4 [0]	3 [0]	1 [0]	1 [0]
O ₃	Max. 1 hour	100 ppb	1 day/year	76 [0]	84 [0]	92 [0]	--
	Max. 4 hour	80 ppb	1 day/year	67 [0]	69 [0]	86 [0]	--
NO ₂	1 hour	120 ppb	1 day/year	--	22 [0]	34 [0]	34 [0]
	1 year	30 ppb	None	--	3 [0]	6 [0]	6 [0]
Particles as PM ₁₀	1 day	50 µg/m ³	5 days/year	77 [0]	139 [0]	105 [0]	112 [1]

Technical and data quality issues are mentioned in the next section ('Important note about your report'), and further details about these issues are provided in the main body of the report.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide data interpretation for Ecotech's 2013 ambient air quality monitoring data for LVAMN, in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

Many of the data obtained in 2013 from the LVAMN Jeeralang Hill and Rosedale South monitoring stations were unable to be validated due to a variety of technical problems and the causes were detailed in Ecotech's 2013 monthly reports. Discussions with Ecotech indicated that the majority of the data affected were considered to be of sufficient quality to be used. Some further data removed from the analysis are described in this report. The main assumption of this review was that all the ambient air monitoring data provided by Ecotech, minus the additional data deletions just mentioned, were of sufficient accuracy for data interpretation.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Background

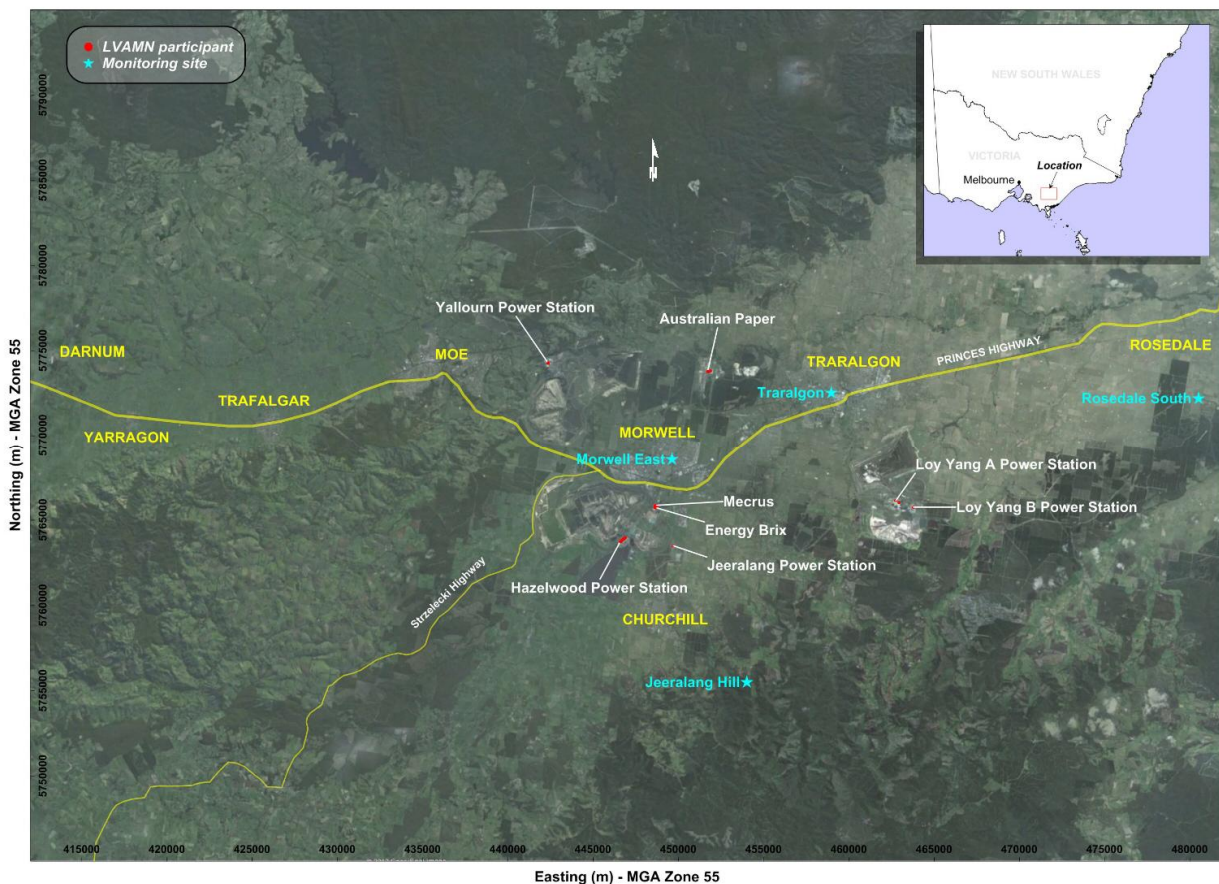
The Latrobe Valley Air Monitoring Network (LVAMN) has undertaken ambient air quality monitoring in the Latrobe Valley since the 1980s. CSIRO (1989) provides a summary of the air quality monitoring undertaken in the Latrobe Valley in the 1980s, and associated studies. Aurecon (2012) reviews some key monitoring statistics for monitoring data acquired over 1980–2011. Historically LVAMN summary reports have been published on an annual basis; e.g., Aurecon (2011).

In 2012, Ecotech Pty Ltd was commissioned by LVAMN Incorporated to provide monitoring and data reporting for the LVAMN stations Jeeralang Hill and Rosedale South. The LVAMN monitoring station locations for calendar year 2013 were:

- (1) Jeeralang Hill, a rural site in the Strzelecki Ranges; and
- (2) Rosedale South, a rural site south of the town of Rosedale.

A map of the Latrobe Valley is provided in Figure 1-1 (see also Appendix B), showing the locations of towns, the larger industrial facilities; i.e. participants in the Latrobe Valley Air Monitoring Network (LVAMN), and four monitoring stations used for collecting information on air quality and meteorological conditions. The Traralgon and Morwell East stations are operated by Victoria's Environment Protection Authority (EPA).

Figure 1-1 Map of Latrobe Valley and Locations of Air Quality Monitoring Stations



1.2 Report Overview

The monthly air monitoring reports for 2013 are detailed in the series of reports; Ecotech (2013a–2013l) and Ecotech (2014); see Appendix A. The reports include details such as:

- Monitoring equipment, methods, and measured parameters
- Data collection methods and compliance with monitoring standards
- Data capture rates and key statistics for the measurement parameters
- Recording of measured exceedences of ambient air quality standards and levels

1.3 Report Purpose

The purpose of this report was to review LVAMN ambient air monitoring data for 2013, for the Ecotech-operated sites Jeeralang Hill and Rosedale South. The Ecotech measurement parameters reviewed for this report focus on the air pollutants for which objectives and goals are listed in the State Environment Protection Policy (Ambient Air Quality) 'SEPP(AAQ)'; i.e., sulfur dioxide (SO₂); nitrogen dioxide (NO₂); ozone (O₃); particulate matter comprising particles with aerodynamic diameters less than 10 microns (µm) in size (PM₁₀); and visibility reducing particles (measured as Local Visual Distance).

2. Objectives and Goals

A purpose of the SEPP(AAQ) (VG, 1999), was to adopt National Environment Protection Council (NEPC) objectives and goals set out in the National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPC, 2003).

The SEPP(AAQ) objectives and goals used to review the air quality monitoring data for this report are listed in Table 2-1, but without the 8-hour average O₃ standards in accordance with the variation set out in the SEPP(AQM) (VG, 2001).

Table 2-1 SEPP(AAQ) Objectives and Goals Used in this Report

Environmental Indicator (Air Pollutant)	Averaging Period	Objective	Goal (exceedences)*
NO ₂ (maximum conc.)	1 hour	120 ppb	1 day/year
	1 year	30 ppb	None
O ₃ (maximum conc.)	1 hour	100 ppb	1 day/year
	4 hours [#]	80 ppb	1 day/year
SO ₂ (maximum conc.)	1 hour	200 ppb	1 day/year
	1 day	80 ppb	1 day/year
	1 year	20 ppb	None
Particles as PM ₁₀	1 day	50 µg/m ³	5 days/year
Visibility reducing particles (minimum visual distance)	1 hour	20 km	3 days/year

*Goals are maximum allowable exceedences of objective.

[#]Rolling averages based on 1 hour averages

"Day" and "Year" mean "calendar day" and "calendar year".

3. Measured Parameters

3.1 Sulfur Dioxide

The most significant sources of sulfur dioxide (SO₂) emissions in the Latrobe Valley are the brown coal-fuelled power stations, and the Maryvale Paper Mill. As a result the highest SO₂ concentrations detected at the LVAMN monitoring stations can usually attributed to SO₂ emissions from the larger power stations.

3.2 Oxides of Nitrogen

Oxides of nitrogen (NO_x) emissions produced by the burning of fuels; e.g., by road vehicle fleets associated with cities and larger towns including on the M1 Freeway, bushfires and planned burns, and power stations, comprise mostly nitric oxide (NO), and smaller amounts of NO₂. In the atmosphere, NO may be oxidised to NO₂; e.g., through the following reaction with ozone (O₃):



3.3 Ozone

The significant source of ozone (O₃) in the atmosphere is the photolysis of NO₂ in sunlight involving ultraviolet photons (hν) with wavelengths less than 424 nanometres; i.e. via the following pair of reactions:



Information about sources and concentrations of NO_x and reactive hydrocarbons are important for understanding the formation of photochemical O₃. In the Latrobe Valley, local sources of NO_x and hydrocarbons would include the power stations, road vehicle traffic including on the M1 Freeway, and 'natural' sources of hydrocarbons such as forested areas. Also, air pollution transported into the Valley from the Melbourne airshed would affect the Valley's O₃ levels.

3.4 Particulate Matter

Potential local sources of Particulate Matter 10 (PM₁₀) in the Latrobe Valley include: open cut coal mining and vehicle wheel generated dust on unpaved roads; road vehicle traffic on the M1 Freeway (locomotives would be a minor source), domestic wood heaters and open fireplaces, planned burns and bushfires; and industry; e.g., power stations and paper mills. Measurements of PM₁₀ in the Latrobe Valley would also include components transported from outside the region, such as sea salt aerosols from Bass Strait and beyond.

3.5 Local Visual Distance

Air pollution can impact on amenity by forming a visibility-reducing haze, which is caused by light scattering by small particles in the atmosphere (aerosols). The sources of such aerosols are similar to those for particulate matter e.g. open cut coal mining; domestic wood heaters and open fireplaces; planned burns and bushfires; and photochemical smog. In humid conditions, fog and mist (essentially low cloud), also reduce visibility. The SEPP(AAQ) sets out an objective for minimum visibility of 20 km (Section 2). In Victoria, compliance with the visibility objective is determined by measuring light scattering properties of ambient air conditioned to a relative humidity of 70%, using a nephelometer. The Victorian Government Gazette No. 120 (VG, 1982), sets out the following equation for determination of the Local Visual Distance (LVD) from a nephelometer-measured light scattering parameter:

$$\text{LVD} = 47 \times (10,000 \times B_{\text{sca}})^{-1}, \quad (3)$$

where B_{sca} is the atmospheric scattering coefficient (units per metre), measured by an integrating nephelometer. For example, using an extinction coefficient of $4.7 \times 10^{-5} \text{ m}^{-1}$, the calculated LVD is 100 km. In the Latrobe Valley, results for LVD were calculated from measurements of B_{sca} by a MRI 1550B analyser at the Rosedale South monitoring station; e.g., see Ecotech (2013g). However, unfortunately the majority of the B_{sca} measurements were affected by a malfunctioning relative humidity probe. Data were provided 'for reference only'. Analysis of the results showed that only a small amount of useful B_{sca} results were obtained.

4. Ecotech LVAMN Operations 2013

4.1 Overview

Measurements of air pollutants, winds and other meteorological parameters were undertaken by Ecotech at Jeeralang Hill and Rosedale South in 2013. This section sets out key results from the measurements by a review of Ecotech's monthly reports. Further details about equipment, specifications and data capture, may be found in the monthly reports Ecotech (2013a) through to Ecotech (2013l), and Ecotech (2014). Many of the data obtained in 2013 from Rosedale South and Jeeralang Hill were unable to be validated due to a variety of technical non-compliances. The causes were detailed in Sections 2.3.1 of the Ecotech monthly reports. While many non-compliant data were recorded in the reports, discussions with Ecotech indicated that the majority of the affected data were considered to be of sufficient quality to be usable for analysis.

Further checks led to the removal of the following hourly average data from the datasets for processing for this report, which Ecotech had provided 'for reference only': Jeeralang Hill, SO₂ measurements 1/8–11/9 inclusive; and Rosedale South: NO_x data 2/7–1/8; NO_x data 3/11–13/12 (inclusive). Rosedale South SO₂ data for 3/7–1/8 had already been removed. The technical issues associated with these data are detailed in Ecotech's monthly reports. An assumption of this report was that the datasets provided by Ecotech, with these data deletions as specified above, were of sufficient quality for inclusion in the data analysis for this report.

4.2 Ecotech LVAMN Data Capture for In Situ Measurements

A statistical summary of the hourly average data for the air pollutants and wind parameters measured at Jeeralang Hill for 2013 is provided in Table 4-1, and similarly for Rosedale South in Table 4-2. At Rosedale South the network minimum data capture requirement of 80% was not met by the NO_x components, due to instrumentation faults. The issues were resolved by equipment upgrades in January 2014.

Table 4-1 Summary of Jeeralang Hill Monitoring Data for 2013 (Hourly Averages)

Parameter (units of measure)	No. of hourly average records	Data Capture 2013
SO ₂ (ppb)	7371	84.1%
O ₃ (ppb)	8321	95.0%
PM ₁₀ (µg/m ³)	8559	97.7%
WS ^a (m/s)	8685	99.1%
WD ^b (deg)	8685	99.1%
σ _θ ^c (deg)	8685	99.1%

a. Wind Speed; b. Wind Direction; c. Sigma-theta, or standard deviation of the horizontal wind direction.

Table 4-2 Summary of Rosedale South Monitoring Data for 2013 (Hourly Averages)

Parameter (units of measure)	No. of hourly average records	Data Capture 2013
SO ₂ (ppb)	7605	86.8%
NO (ppb)	6652	75.9%
NO ₂ (ppb)	5962	68.1%
NO _x (ppb)	6652	75.9%
O ₃ (ppb)	8345	95.3%
PM ₁₀ (µg/m ³)	8639	98.6%
LVD ^d (km)	7993	91.2% [#]
WS ^a (m/s)	8718	99.5%
WD ^b (deg)	8718	99.5%
σ _θ ^c (deg)	8718	99.5%

a. Wind Speed; b. Wind Direction; c. Sigma-theta, or standard deviation of the horizontal wind direction; d. Local Visual Distance. [#]The LVD data were affected by an equipment fault; refer to Section 5.9 for further details.

5. LVAMN Results 2013

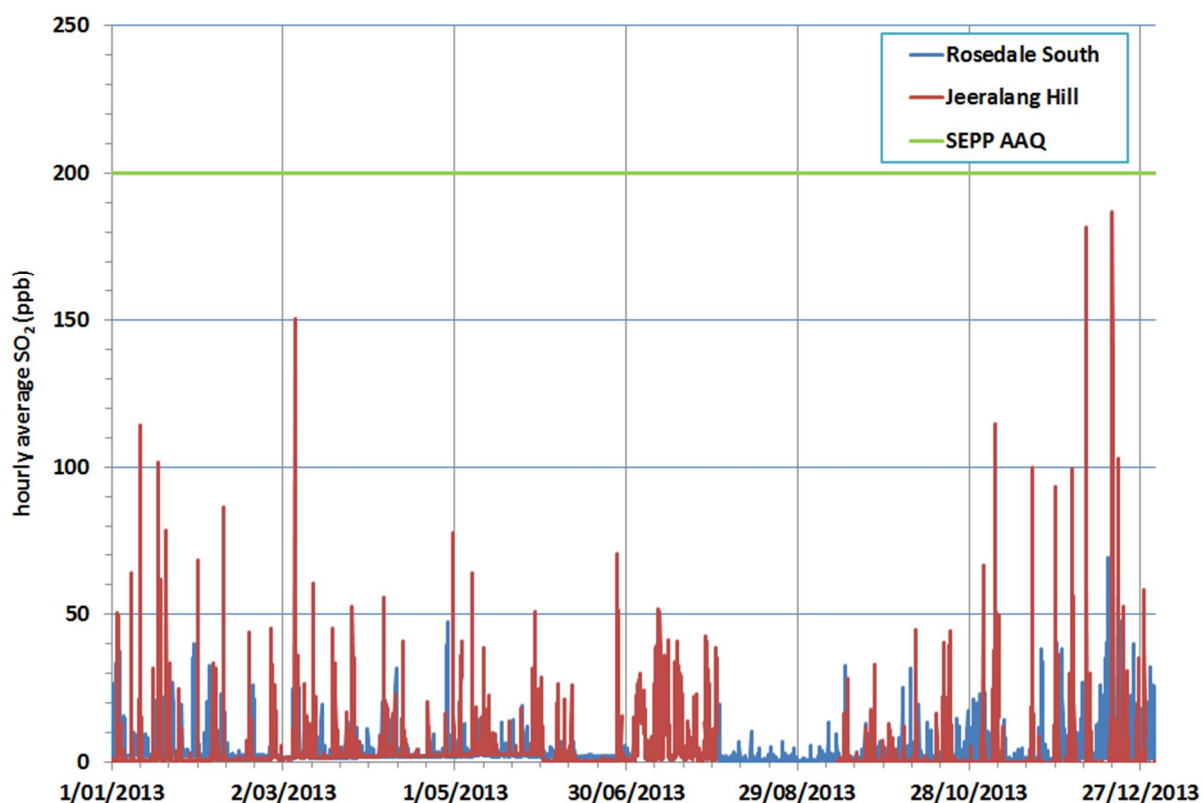
5.1 Overview

This section provides results of a review of the LVAMN air monitoring data acquired in 2013 at the air monitoring stations Jeeralang Hill and Rosedale South.

5.2 Sulfur dioxide (SO₂) – Jeeralang Hill and Rosedale South

The LVAMN 2013 results for hourly average SO₂ concentrations (ppb) are provided in Figure 5-1. At Jeeralang Hill, the higher SO₂ concentrations are indicative of plume strikes on higher ground in the Strzelecki Ranges, due to emissions from the coal-fired power stations. Analysis of the concurrent SO₂ and wind data showed that the higher SO₂ concentrations can occur with wind direction almost anywhere in the northern sector, highlighting the complexity of air pollutant dispersion in this region. In 2013, the highest SO₂ concentrations measured at Jeeralang Hill occurred during easterly winds with low wind speeds of approximately 1-3 m/s (further details are provided in Appendix B).

Figure 5-1 LVAMN Results for Hourly Average SO₂ Concentration (ppb)



A summary of results of the analysis of the hourly average SO₂ concentrations acquired from Jeeralang Hill in 2013 is set out in Table 5-1. For the purpose of data interpretation, daily averages were calculated only for days where 23 or 24 hourly average data were available for that day. (It is noted that Ecotech calculates data averages based on a minimum of 75% valid readings within the averaging period).

Table 5-1 Summary of Results: Jeeralang Hill SO₂ Concentrations

Parameter (Jeeralang Hill)	Hourly Averages	Daily Averages	Annual Average
Number of records	7371	304	–
Total records possible	8760	365	–
Data Capture	84.1%	83.3%	–
Median	1.0 ppb	2.0 ppb	–
Annual average	3.5 ppb	See col. 4.	3.5 ppb
70 th percentile	2.2 ppb	1.0 ppb	–
Maximum	187 ppb [#]	34.8 ppb	–
SEPP(AAQ) Objective	200 ppb	80 ppb	20 ppb
Percentage of time Objective met	100%	100%	100%
Exceedences of Objective	0	0	0
SEPP(AAQ) Goal	Exc. 1 day/year	Exc. 1 day/year	No exceedences
Exceedences of Goal	0	0	0

[#]The three highest hourly average SO₂ concentrations occurred during early morning hours in December: 17/12/14 3:00-4:00 (187 ppb); and 8/12/13 2:00-4:00 (187 ppb and 171 ppb).

A summary of results of the analysis of the hourly average SO₂ concentrations acquired at Rosedale South in 2013 is set out in Table 5-2.

Table 5-2 Summary of Results: Rosedale South SO₂ Concentrations

Parameter (Rosedale South)	Hourly Averages	Daily Averages	Annual Average
Number of records	7605	288	1
Total records possible	8760	365	1
Data Capture	86.8%	78.9%	100%
Median	1.8 ppb	2.1 ppb	–
Annual average	2.7 ppb	See col. 4.	2.7 ppb
70 th percentile	2.1 ppb	1.0 ppb	–
Maximum	97 ppb	18 ppb	–
SEPP(AAQ) Objective	200 ppb	80 ppb	20 ppb
Percentage of time Objective met	100%	100%	100%
Exceedences of Objective	0	0	0
SEPP(AAQ) Goal	Exc. 1 day/year	Exc. 1 day/year	No exceedences
Exceedences of Goal	0	0	0

[#]The six highest hourly average SO₂ concentrations occurred on several hours on 15th and 17th December: 17/12/14 12:00-15:00 (97, 87 & 63 ppb); 15/12/14 10:00-13:00 (60, 69 & 56 ppb). The time lag between the plume strike at Jeeralang Hill on 17/12/14 and the high SO₂ concentrations observed at Rosedale South was approximately 8-9 hours.

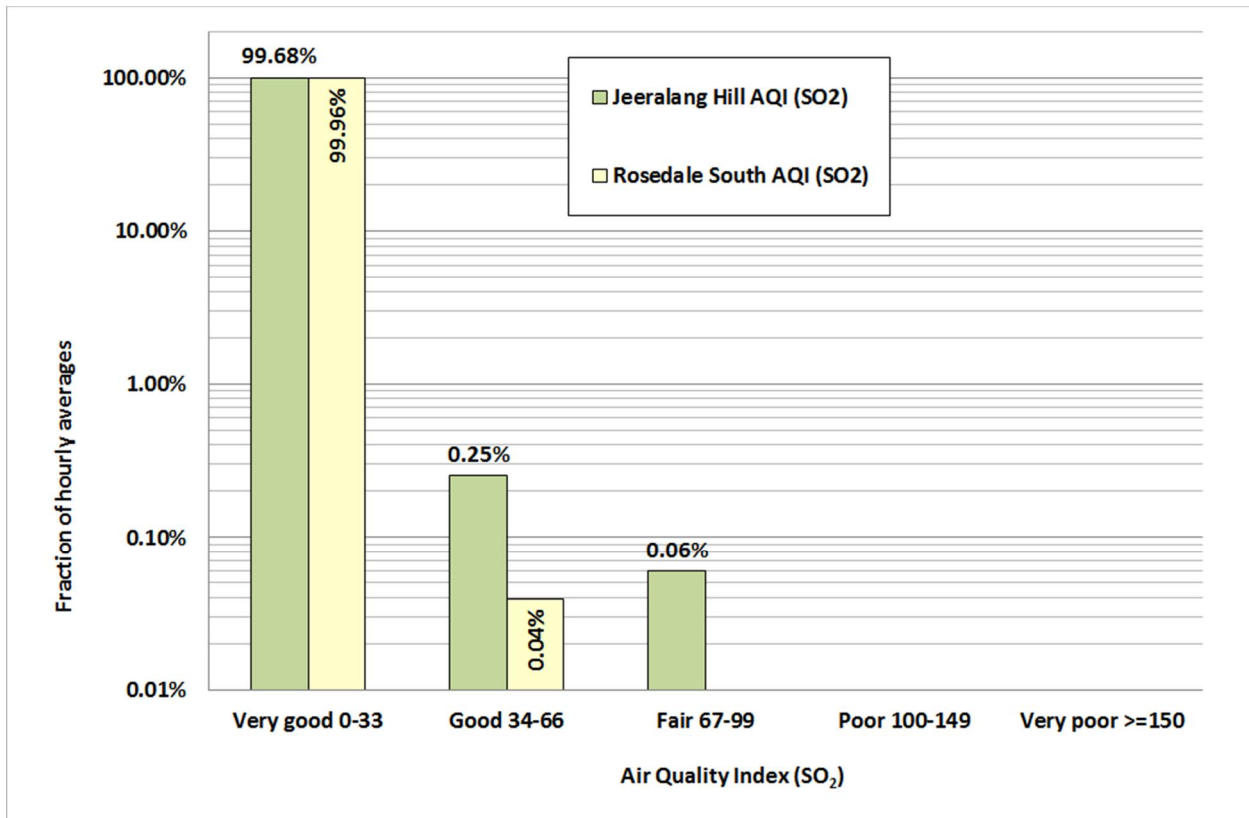
5.3 Air Quality Indices from SO₂ Concentrations

Air Quality Indices (AQI) based on EPA Victoria procedures were calculated using the Jeeralang Hill and Rosedale South SO₂ data. Simply, the AQI is a concentration expressed as a percentage of the relevant air quality standard (in this case, maximum hourly average 200 ppb). The Jeeralang Hill and Rosedale South SO₂ results are provided as frequency distributions in Figure 5-2; these are shown as logarithmic plots to better illustrate the results for poorer air quality, which were few.

Inspection of the results shown in Figure 5-2 clearly demonstrates that air quality due to SO₂ concentrations at Jeeralang Hill and Rosedale South was very good for the majority of the time; i.e., more than 99% of the time for both locations. As expected, air quality due to SO₂ was slightly worse at Jeeralang Hill due to the closer

proximity of the coal fuelled power stations, and the higher elevation of Jeeralang Hill, 510 metres above sea level, being more conducive to plume strikes (whereas Rosedale South is 52 metres above sea level).

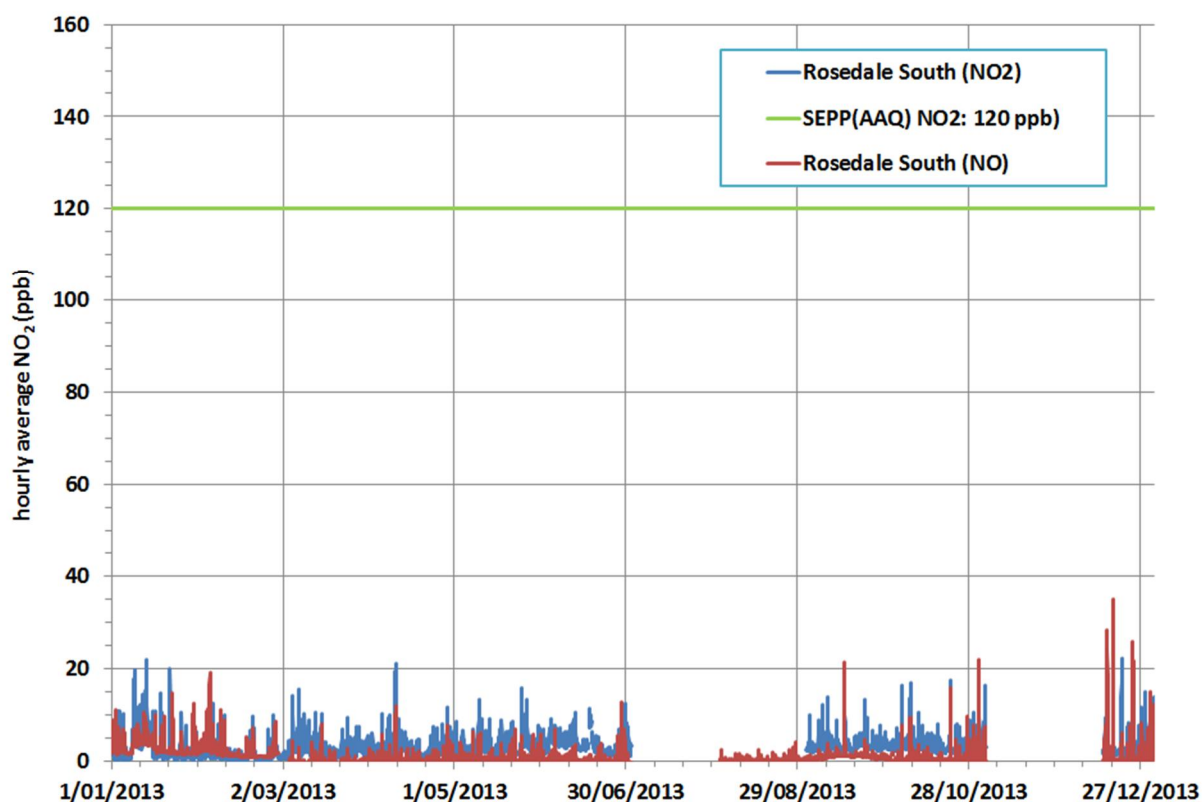
Figure 5-2 Frequency Distributions of Air Quality Indices – Hourly Average SO₂



5.4 Oxides of Nitrogen – Rosedale South

In 2013 oxides of nitrogen (NO_x) measurements were undertaken at Rosedale South (there was no NO_x equipment installed at Jeeralang Hill). The results for hourly average NO and NO_2 concentrations (ppb) are provided in Figure 5-3. There were no exceedences of the SEPP(AAQ) objective of 120 ppb for maximum hourly NO_2 concentration.

Figure 5-3 LVAMN Results for Hourly Average NO and NO_2 Concentration (ppb)



A summary of results of the analysis of the Rosedale South hourly average NO_2 concentrations is set out in Table 5-3. There were no exceedences of the SEPP(AAQ) objectives and goals for NO_2 .

Table 5-3 Summary of Results: Rosedale South NO_2 Concentrations

Parameter (Rosedale South)	Hourly Averages	Annual Average
No. records	5962	—
Total possible	8760	—
Data capture	68.1%	—
Median	2.7 ppb	—
Annual average	3.2 ppb	3.2 ppb
70 th percentile	3.7 ppb	—
Maximum	22 ppb	—
SEPP(AAQ) Objective	120 ppb	30 ppb
Percentage of time Objective met	100%	100%
Exceedences of Objective	0	0
SEPP(AAQ) Goal	Exc. 1 day/year	No exceedences
Exceedences of Goal	0	0

A statistical summary for all the NO_x components measured at Rosedale South is provided in Table 5-4.

Table 5-4 Statistical Summary for All NO_x Components – Rosedale South

Air Pollutant	Median Conc. (ppb)	Average Conc. (ppb)	70 th Percentile Conc. (ppb)	Maximum Conc. (ppb)
NO	0.4	1.0	1.1	34.9
NO ₂	2.7	3.2	3.7	22.2
NO _x	3.2	4.2	4.5	52.5

5.5 Analysis of NO₂/NO_x Ratios

Further analysis of the NO_x data was undertaken by an analysis of the ratios between the NO₂ and NO_x concentrations (NO₂/NO_x). This ratio is useful for interpretation of the NO_x data. Lower values of the ratio can be indicative of local NO_x sources, in cases where some NO has had insufficient time to convert to NO₂. A select few of the NO_x data were used in this analysis; i.e., only those records that led to calculated NO₂/NO_x ratios with reasonable certainties (results could be obtained only for the higher NO_x concentrations). Data selection was undertaken by the removal of hourly records by the following steps: (1) Negative and zero results for NO_x concentrations were removed; (2) NO₂/NO_x ratios greater than unity and ≤ zero were removed; and (3) Those records with NO concentrations less than 5 ppb were removed. The resulting NO₂/NO_x ratios are listed in Table 5-5.

Table 5-5 Summary of Calculated NO₂/NO_x Ratios for 2013 (Limited Dataset)

NO Concentration Range (ppb)	Median NO ₂ /NO _x Ratio	Number of Hourly NO _x Data	Percentage of Hourly Data Used for Ratio
5 ≤ [NO] < 10	54%	212	83%
10 ≤ [NO] < 20	40%	34	13%
[NO] ≥ 20	33%	10	4%

Inspection of the results listed in Table 5-5 indicates that as the NO concentrations increase the NO₂/NO_x ratios approach 30%, which is typical of NO_x emissions from the combustion of fossil fuels; e.g., due to road vehicle traffic emissions. There is a slight upwards trend in the NO₂/NO_x ratios as the NO concentrations decrease, which is indicative of NO_x that has been in the atmosphere for longer periods, allowing more time for NO₂ to form.

5.6 Ozone – Jeeralang Hill and Rosedale South

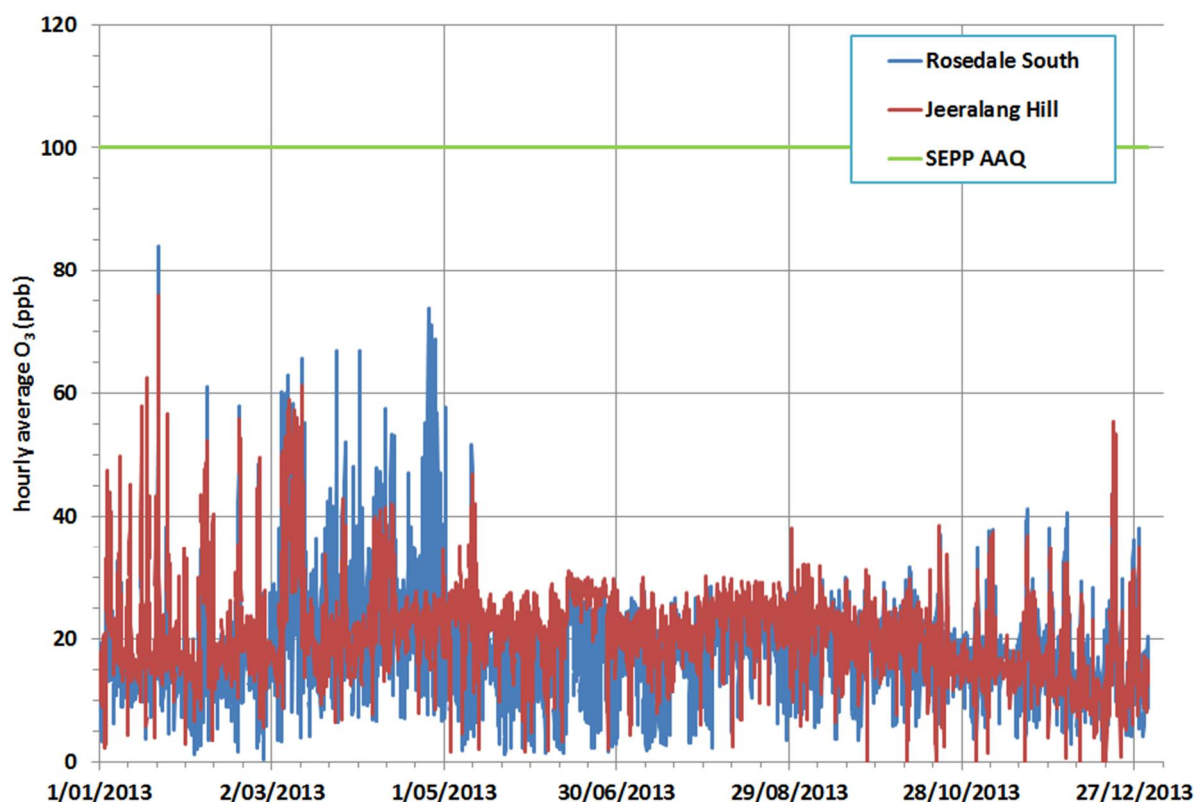
The Jeeralang Hill and Rosedale South results for hourly average O₃ concentrations (ppb) are provided in Figure 5-4. The results are shown with the relevant SEPP(AAQ) objective (100 ppb).

A summary of results of the analysis of the hourly average O₃ concentrations measured at Jeeralang Hill is set out in Table 5-6. There were no exceedences of the SEPP(AAQ) objectives.

Table 5-6 Summary of Results: Jeeralang Hill O₃ Concentrations

Parameter (Jeeralang Hill)	1h avg.	4h rolling avg.
No. records	8321	7200
Total possible	8760	8757
Data capture	95.0%	82.2%
Median (ppb)	21	21
Annual average (ppb)	22	22
70 th percentile (ppb)	24	24
Maximum (ppb)	76	67
SEPP(AAQ) Objective (ppb)	100	80

Parameter (Jeeralang Hill)	1h avg.	4h rolling avg.
Percentage of time Objective met	100%	100%
Exceedences of Objective	0	0
SEPP(AAQ) Goal	Exc. 1 day/year	Exc. 1 day/year
Exceedences of Goal	0	0

Figure 5-4 Ecotech LVAMN Results for Hourly Average O₃ Concentration (ppb)

A summary of results of the analysis of the hourly average O₃ concentrations acquired from Rosedale South is set out in Table 5-7.

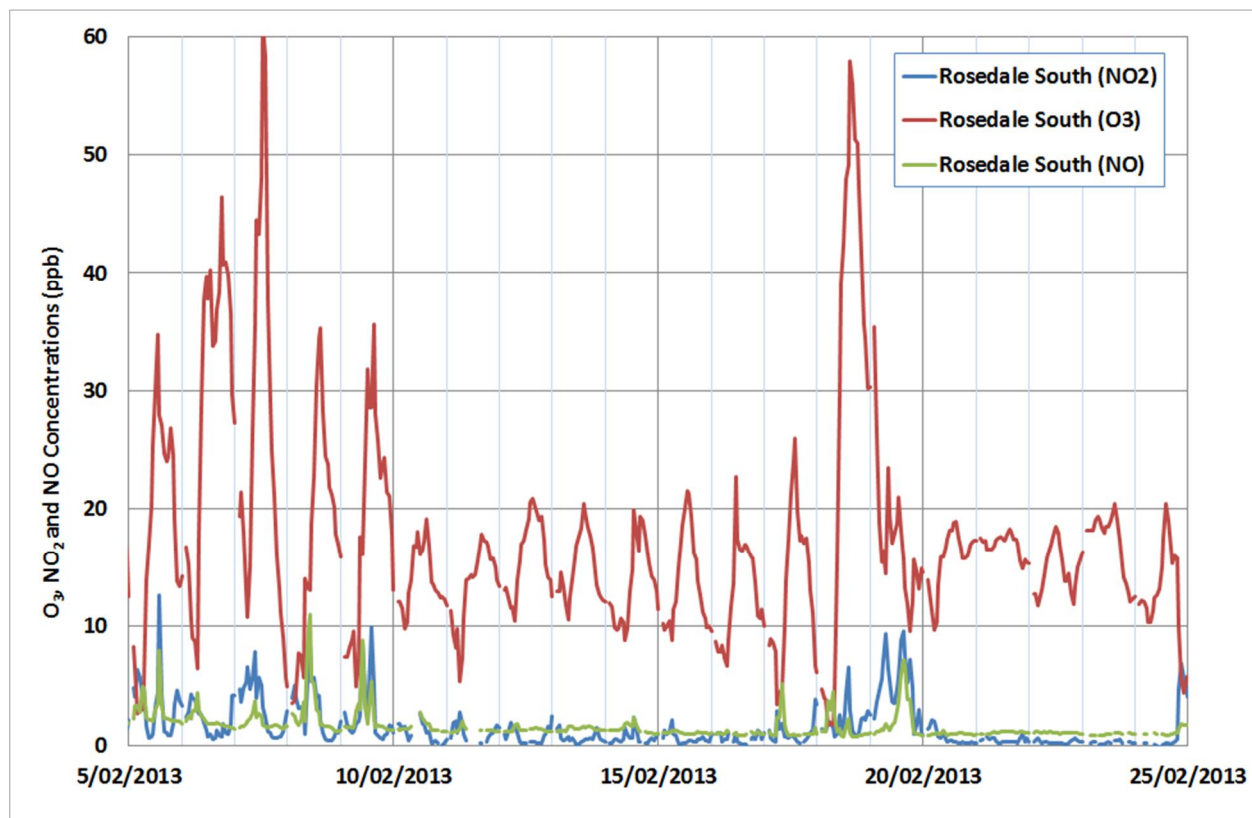
Table 5-7 Summary of Results: Rosedale South O₃ Concentrations

Parameter (Rosedale South)	1h avg.	4h avg.
No. records	8345	7202
Total possible	8760	8757
Data capture	95.3%	82.2%
Median	18	18
Annual average	18	19
70 th percentile	22	22
Maximum	84	69
SEPP(AAQ) Objective	100 ppb	80
Percentage of time Objective met	100%	100%
Exceedences of Objective	0	0
SEPP(AAQ) Goal	Exc. 1 day/year	Exc. 1 day/year
Exceedences of Goal [#]	0	0

5.7 Products of Photolysis – O₃ and NO₂ (Rosedale South)

This section provides some results for concurrent hourly average O₃ and NO₂ concentrations. In general the NO_x concentrations at Rosedale South were small and variable. However there was clear evidence of photolysis occurring at this rural site, with several well defined O₃ peaks occurring around midday during the summer; e.g., the results for 5/2/13–24/2/13 are shown in Figure 5-5. The NO₂ present earlier in the morning would have provided oxygen for formation of O₃ (see Section 3.3). The source of the NO_x at Rosedale South may have been local road vehicle traffic, or potentially emissions from further west in the Latrobe Valley.

Figure 5-5 Example of Concurrent O₃ and NO_x Measurements at Rosedale South: 5–25/2/13



*Note the relevant SEPP(AAQ) objectives are 100 ppb (O₃) and 120 ppb (NO₂).

5.8 Particulate Matter (as PM₁₀) – Jeeralang Hill and Rosedale South

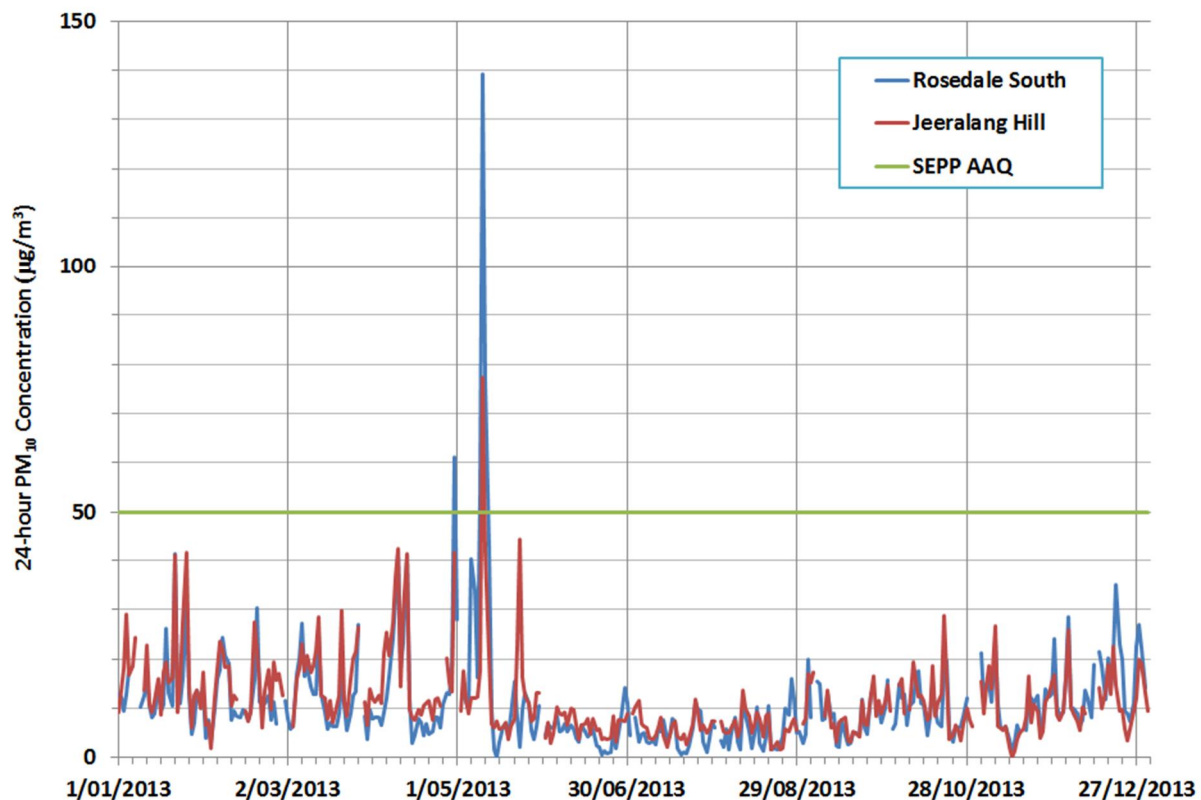
The Jeeralang Hill and Rosedale South results for daily average PM₁₀ concentrations (µg/m³) are provided in Figure 5-6. The relevant SEPP(AAQ) objective is also shown (50 µg/m³). The SEPP(AAQ) goal of not more than 5 exceedence (days) of this objective, was achieved at both sites. A summary of results for PM₁₀ data acquired at Jeeralang Hill and Rosedale South is set out in Table 5-8.

The good correlation between the PM₁₀ measurements at Jeeralang Hill and Rosedale South, (the linear correlation coefficient between the 24-hour averages is 0.79), indicates the PM₁₀ concentrations were due to regional influences rather than plumes caused by local sources, in the majority of cases.

EPA (2013) and EPA (2014) report that the PM₁₀ exceedences on 9-11 May 2013 were due to planned burns. A notice released by Department of Environment and Primary Industries and Parks Victoria on Monday 29th April 2013, advised that smoke would be visible across many parts of Gippsland on that day due to planned burning in many parts of the Baw Baw, Heyfield and Bairnsdale fire districts. Further analysis of completed burns data provided by the Department of Environment, Land, Water & Planning, indicated the high PM₁₀ concentration measured at Rosedale South on 30th April 2013 was most likely due to smoke from planned burns of large parts of state forest within 10 km of Rosedale.

Table 5-8 Summary of Results for PM₁₀ Concentrations (µg/m³) – Jeeralang Hill and Rosedale South

Parameter	Jeeralang Hill	Rosedale South
No. of hourly averages	8559	8639
Data capture (hourly data)	97.7%	98.6%
Median of hourly averages	9 µg/m ³	8 µg/m ³
Annual average of hourly averages	11.7 µg/m ³	11.1 µg/m ³
70 th percentile of hourly averages	13 µg/m ³	12 µg/m ³
Maximum hourly average	296 µg/m ³	390 µg/m ³
No. of daily averages	341	346
Fraction of possible daily averages	93.4%	94.8%
Maximum daily average	77 µg/m ³	139 µg/m ³
SEPP(AAQ) Objective	50 µg/m ³	50 µg/m ³
Percentage of time Objective met	99.7%	98.8%
Exceedences of Objective	1	4
Days of exceedences and values (µg/m ³)	10/05/2013 (77)	30/04/2013 (61), 9/5/13 (53), 10/5/13 (139), 11/5/13 (77)
SEPP(AAQ) Goal	Exceedences < 6 days	Exceedences < 6 days
Exceedences of Goal	0	0

Figure 5-6 LVAMN Results for 24-Hour Average PM₁₀ Concentration (µg/m³)

5.9 Local Visual Distance

The results for B_{sca} at Rosedale South in 2013 were affected by a malfunction in a relative humidity probe; e.g., see Ecotech (2013g). As such this section is provided for information only. A summary of the Local Visual Distance (LVD) results calculated from 7,994 hourly average B_{sca} measurements obtained by nephelometer is provided in Table 5-9 (the calculation was set out in Section 3.5).

Table 5-9 Summary of Nephelometer Results for Rosedale South 2013

Statistic	B_{sca} (Mm^{-1})	Calculated LVD (km)
Maximum hourly average B_{sca}	1548; ($1.55 \times 10^{-3} m^{-1}$)	3.0 km
70 th percentile hourly average B_{sca}	130.6; ($1.31 \times 10^{-4} m^{-1}$)	36 km
Median hourly average B_{sca}	39.0; ($3.90 \times 10^{-5} m^{-1}$)	121 km
Minimum hourly average B_{sca}	26.0; ($2.60 \times 10^{-5} m^{-1}$)	181 km

Analysis of the results showed that there were high uncertainties associated with calculated LVD values above approximately 50 km; and with 97% of the hourly average data above this value, most of the nephelometer's data could not be used.

Comparisons of the nephelometer data with the PM_{10} measurements at Rosedale South confirmed that very few of the B_{sca} data could be used.

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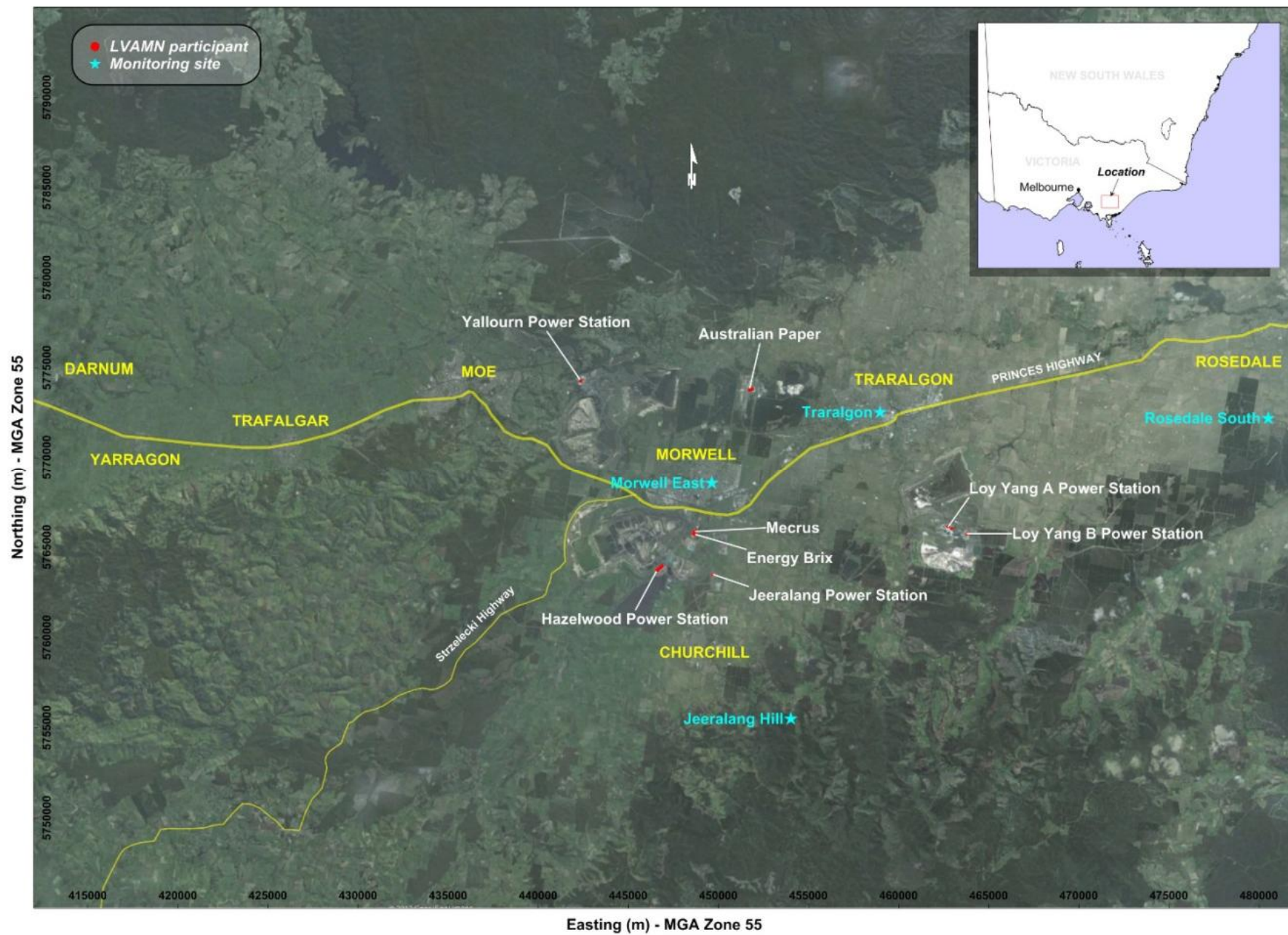
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Appendix B. Map of Latrobe Valley



Appendix C. Jeeralang Hill 2013: SO₂–Winds Map

The SO₂-winds map shows hourly average SO₂ concentrations (ppb) measured at Jeeralang Hill in 2013, versus concurrent hourly average wind direction (degrees True), and wind speed (m/s).

The results illustrated highlight the complexity of air pollutant dispersion in the Strzelecki Ranges of the Latrobe Valley; e.g., while there were no significant sources of SO₂ to the east of Jeeralang Hill, the highest SO₂ concentrations occurred during easterly winds. The most likely sources of the highest SO₂ concentrations observed in the sector ENE-to-E would have been the nearby Loy Yang power stations.

