Hazelwood Coal Mine Fire - Air Quality Monitoring Report

Information Bulletin

Publication number XXXX April 2014
Authorised and published by EPA Victoria, 200 Victoria Street, Carlton

Summary

The Hazelwood coal mine fire generated very large quantities of smoke during February and March 2014, significantly affecting the residents of Morwell and surrounding towns.

Figure 1. Smoke in Wallace St, Morwell, 22nd Feb 2014

This report describes EPA Victoria's air monitoring during the incident, and presents preliminary findings. Analysis of the results is ongoing, and further updates are anticipated.

Air quality monitoring in the region will continue for at least a year, and some additions have been made to the program.

This report covers data collected at the five continuous monitoring stations shown in Table 1. Other sampling conducted for minor contaminants (trace gases, metals, and volatile hydrocarbons) are not described here but can be viewed at the EPA web site http://www.epa.vic.gov.au/air-quality-latrobe-valley-mine-fire, and will be the subject of a separate publication.

All data presented in this report covers the period from 9th February (the day the fire started) until 31st March (well past the date the fire was declared safe. Air monitoring for smoke using visibility reduction measurements commenced at Morwell South and Morwell East on the13th February 2014.

Background

What was being monitored?

EPA has been monitoring for a range of air pollutants and weather information in the Latrobe Valley since 1979.

Current air monitoring includes airborne particles ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), visibility reduction (smoke intensity), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3). For more information on each of these pollutants, see Appendix A

During the Hazelwood mine fire, monitoring was focused on the pollutants of most concern for human health in relation to the fire, which are $PM_{2.5}$ and carbon monoxide. Visibility reduction is also monitored closely, as this provides a good measure of current smoke intensity levels.

Where did the EPA monitor?

EPA is currently monitoring air quality using national standard air monitoring methods with fully calibrated equipment in Traralgon and two locations in Morwell.

EPA is also monitoring additional indicative particle concentrations in air using instruments in Morwell, Moe, and Churchill.

Table 1 shows the locations of air monitoring equipment as of April 2014. Sites in **bold font** are fully calibrated monitoring stations using standard air monitoring methods; the other sites are used to obtain indicative information about particle concentrations.

Table 1: EPA monitoring locations in Latrobe valley (as of 1st April 2014). See map on following pages.

Site	Address	What is measured
Morwell South	Morwell Bowling Club, 52 Hazelwood Rd, Morwell	$PM_{2.5}$, CO, Ozone, NO_2, SO_2, Visibility Reduction
Morwell East	70 Hourigan Rd, Morwell	$PM_{2.5}$, CO, SO_2, and Visibility Reduction
Traralgon	130 Kaye St, Traralgon	PM_{10}, CO, Ozone, NO_2, Visibility Reduction,
Morwell Bowling Club	52 Hazelwood Rd, Morwell (*60 m from Morwell South site*)	DustTrak DRX Indicative PM_{10}, $PM_{2.5}$
Morwell UCA	Uniting Church, 281 Princes Drive, Morwell	DustTrak DRX Indicative PM_{10}, $PM_{2.5}$

During the early stages of the incident, EPA also monitored air pollution for short periods of time at other locations around the fire. At two of these locations, in Moe and Churchill, simpler monitors were installed. These recorded indicative particle concentrations.

Also, throughout the incident, the CFA (Country Fire Authority) monitored carbon monoxide (CO) at a range of locations around Morwell.

Results from this extra CO monitoring are also presented in this report, although EPA calibrations were not performed and these data should be taken as indicative.

What types of instruments were used?

A range of instruments were used, and some of these are illustrated below.

The Morwell South Monitoring Station

BAM – Standard $PM_{2.5}$ instrument

CO and SO2 – standard instruments

ADR 1500 – Indicative particle concentrations

DustTrak DRX – Indicative particle concentrations

How did the EPA assess the monitoring results?

Air pollution levels were compared against national air quality standards (Table 2). The standards are set at levels that are designed to protect human health and wellbeing.

Table 2: Assessment criteria for key pollutants.

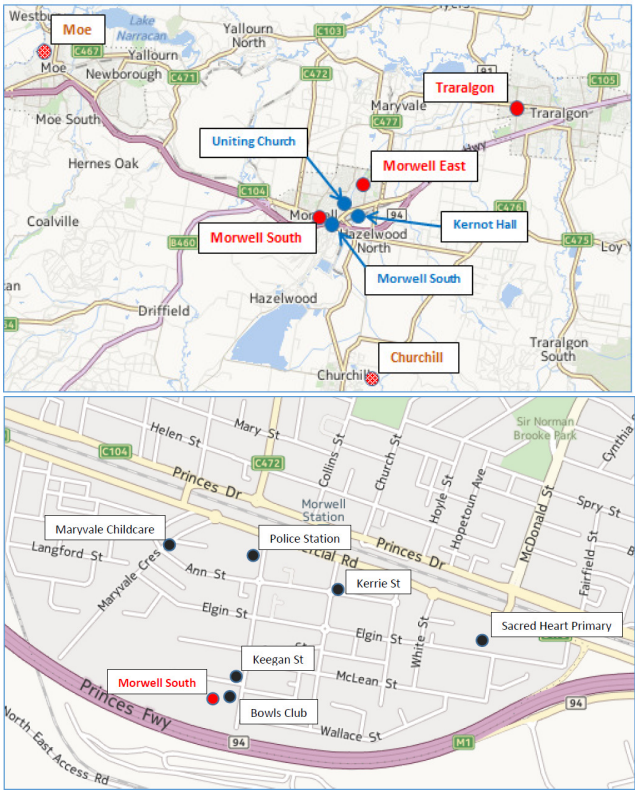
Pollutant	Averaging time	Standard	Origin
Particles as $PM_{2.5}$	24 hours	25 µg/m^3	Air NEPM (advisory)
Particles as PM_{10}	24 hours	50 µg/m^3	Air NEPM
Carbon monoxide	8 hours	9 ppm	Air NEPM

Note that each pollutant has a specific averaging time. "Air NEPM" refers to the Australian National Environment Protection (Ambient Air Quality) Measure.

During the Hazelwood Coal mine fire all results were forwarded to the Department of Health to inform their health effects assessments.

Maps

Maps: EPA standard sites ( ), EPA indicator sites ( ), EPA other sites ( ), CFA CO sites ( ).



Discussion

These data summaries have been provided as a general report on the measurements made at and around Morwell over the period of the Hazelwood mine fire incident. These include all air quality data monitored around the vicinity that was impacted by smoke from the fire. The record from Traralgon goes through the entire period, as this station is a long term air monitoring station that was already established and running before the fire. Records from the other sites start at various dates after the fire started, as these were installed specifically to monitor the smoke impacts. These sites were set-up as soon as equipment and resources allowed.

Most of the data summarised here were displayed on the EPA web site, within an hour of the measurement being made. Some of the data were not, especially the earlier measurements that were made before the automatic web-site update could be set-up. However in this report everything is included. Note that the estimated particle data (dotted lines on the graphs) have a greater degree of uncertainty than the primary particle measurements. They were not available earlier and hence could not be posted on the web site. These estimated results are presented here for the first time, since it has taken additional detailed analysis, modelling and calibrations to produce.

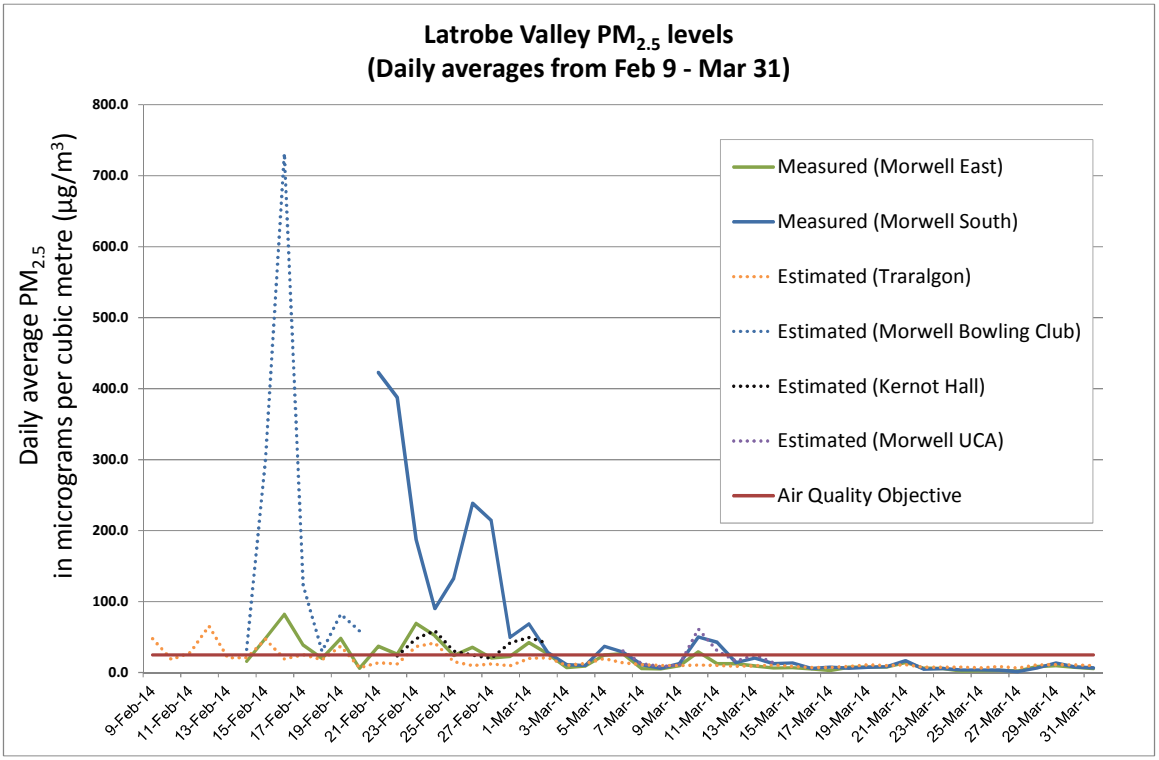
Particle monitoring

There were five different kinds of particle monitors used, using three different methodologies. Some sites measured just PM_{10}, some just $PM_{2.5}$, and some both. A good deal of calibration and analysis has been conducted to achieve equivalent measurements from all these monitors, but the accuracy of each kind is not the same. Users of these datasets should be aware of certain factors that are relevant.

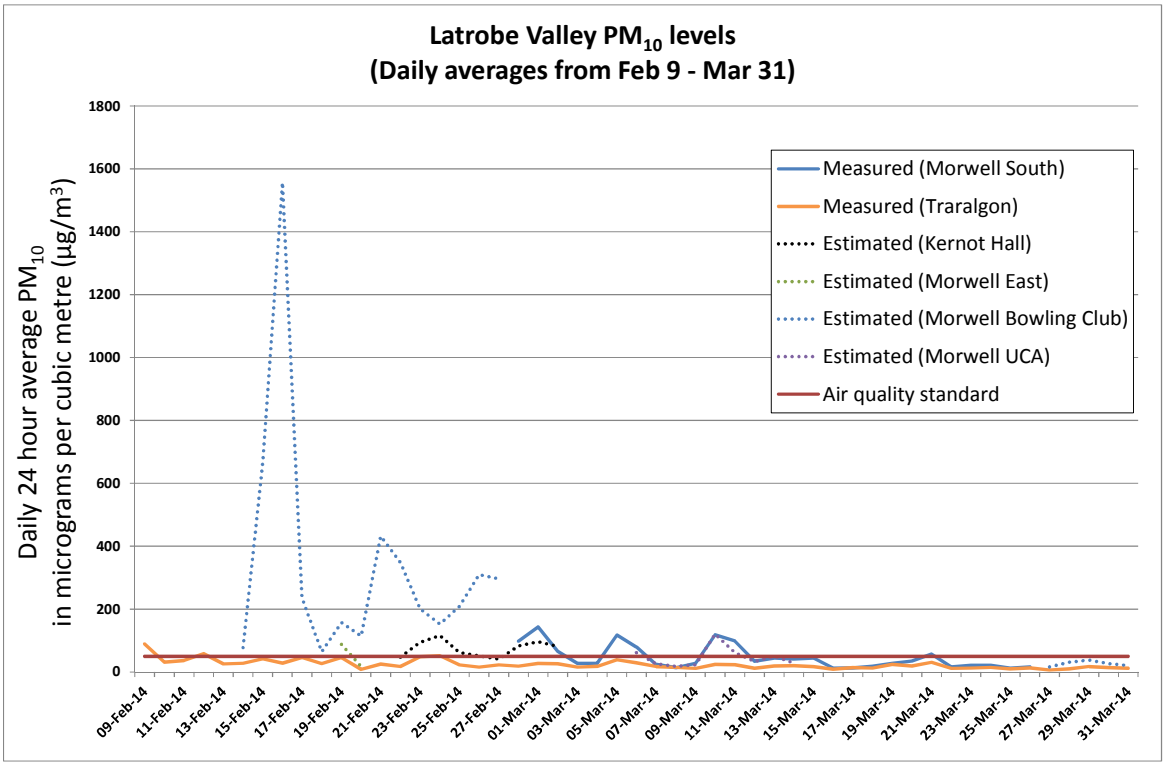
1. Traralgon PM_{10} was measured with a TEOM (transverse element oscillating microbalance). This is a common and standard instrument used throughout the EPA network. It is well correlated with the reference standard for PM_{10} and with corrections gives an accurate measure.
2. Morwell South and Morwell East $PM_{2.5}$ were each measured with a BAM (beta attenuation monitor). This is a new generation type of particle monitor that will become the EPA standard. It also correlates well with the reference standard, a Partisol PM_{10} which was also run at Morwell South. Partisol data is included as Measured (Morwell South) for the PM_{10} graph and table.
3. Kernot Hall, Uniting Church and another Morwell South site used smaller and simpler DustTrak optical instruments. These measure both PM_{10} and $PM_{2.5}$ simultaneously, but need to be specially calibrated. They provide an indicative particle measure which is not as accurate as the standard instrument but nevertheless correlates adequately with the TEOM and BAM measurements. An exact uncertainty has not been determined, and thus the concentration values will be 'indicative'. However this instrument still gives a very good measure of exceedence, especially those resulting from high particle concentrations.
4. Moe and Churchill used smaller and simpler ADR 1500 optical instruments. These also measure both PM_{10} and $PM_{2.5}$ simultaneously. This equipment is undergoing quality verification process. These instruments will be replaced with BAMs to be consistent with other $PM_{2.5}$ air monitoring.

Results (Graphs)

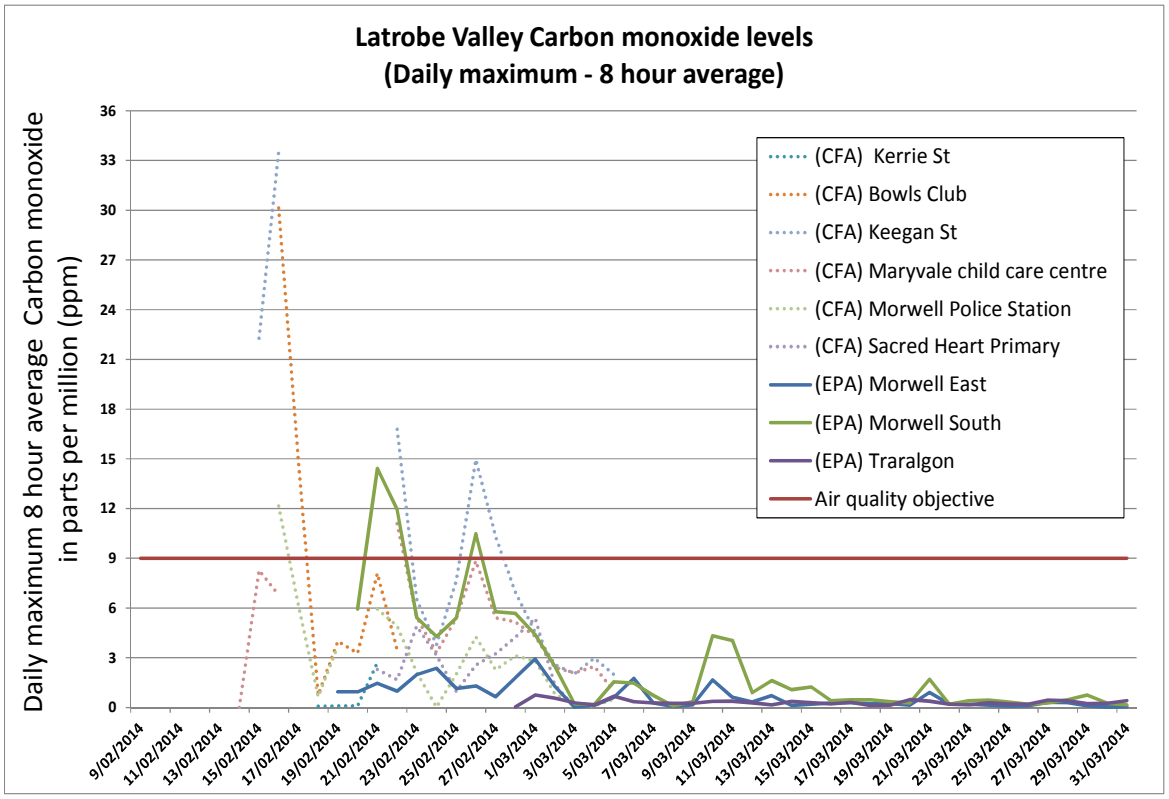
Particles ($PM_{2.5}$)



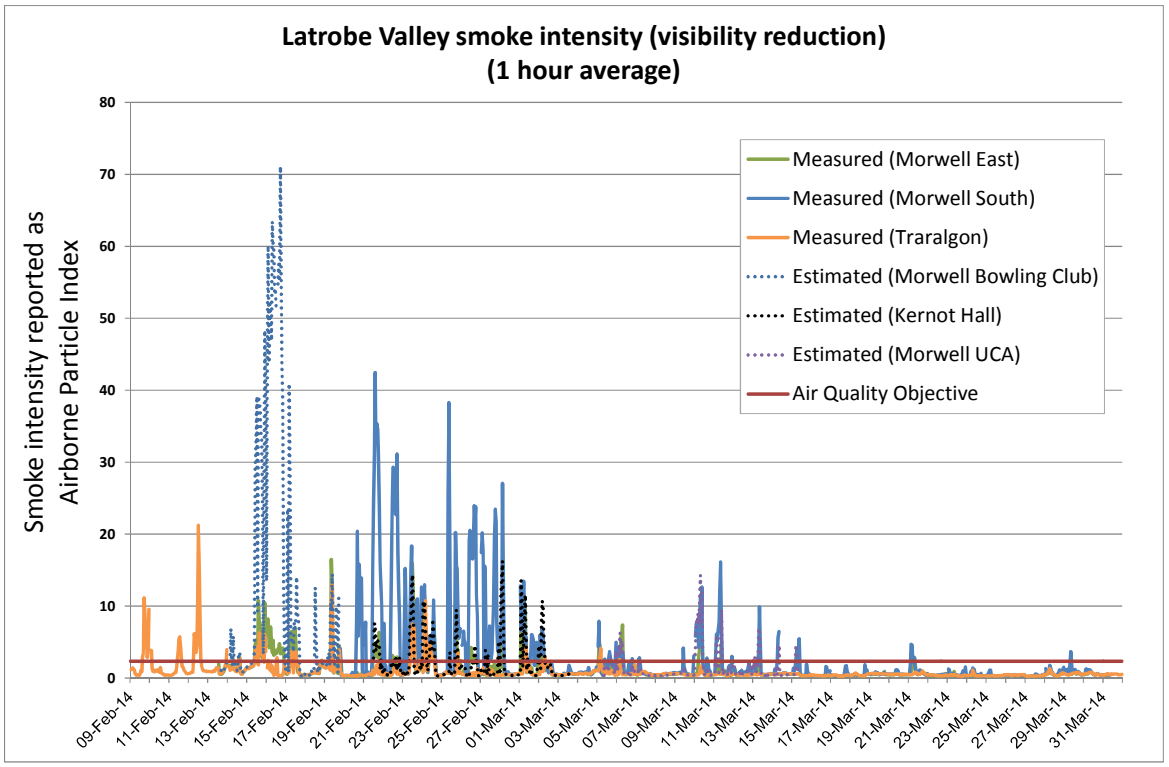
Particles (PM_{10})



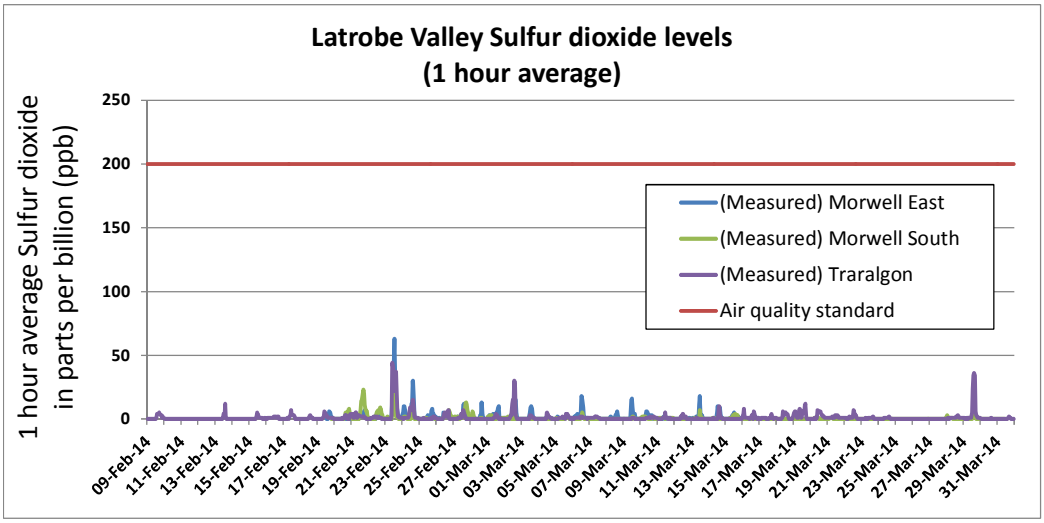
Carbon monoxide (CO)



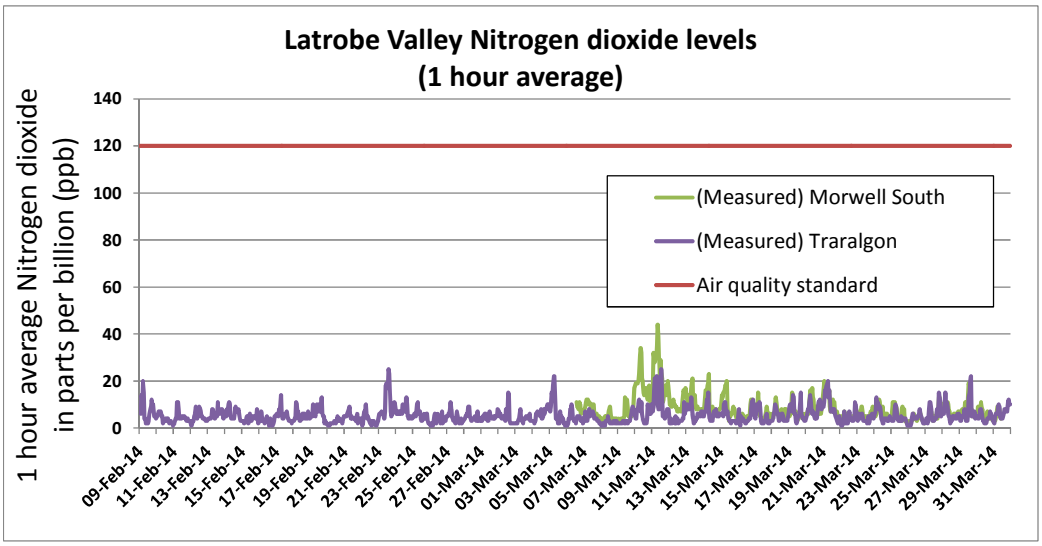
Visibility



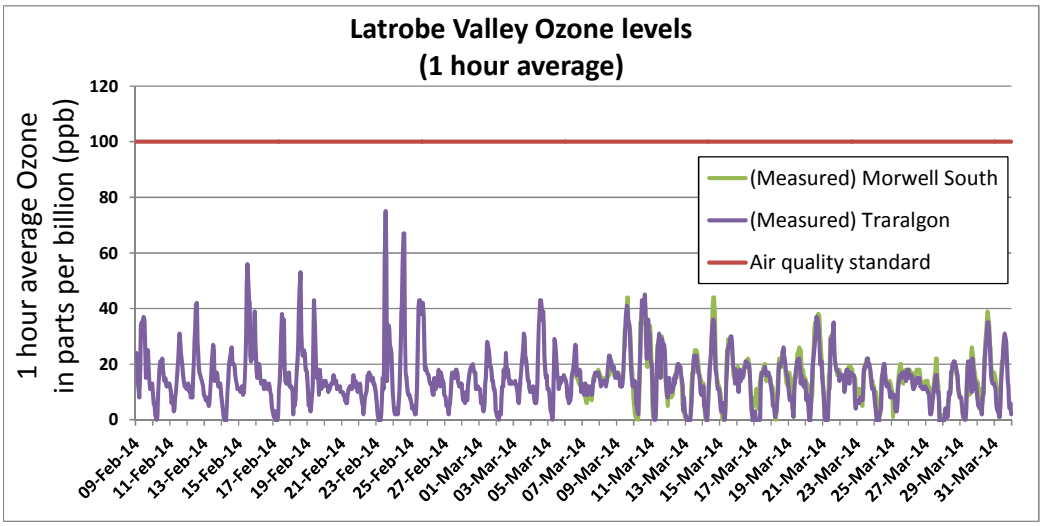
Sulphur dioxide (SO_2)



Nitrogen dioxide (NO_2)



Ozone (O_3)



Results (Tables)

Particles ($PM_{2.5}$)

Data is daily average $PM_{2.5}$ in $\mu g/m^3$. NEPM advisory reporting standard is 25 $\mu g/m^3$. Days exceeding the advisory reporting standard have been highlighted in red.

	Measured		Estimated						
Date	**Morwell East**	**Morwell South**	***Kernot Hall, Morwell***	***Morwell Bowling Club***	***Morwell UCA***	***Churchill***	***Helen St, Morwell***	***Moe***	***Traralgon***
9-Feb									*47.7*
10-Feb									*18.4*
11-Feb									*28.1*
12-Feb									*65.6*
13-Feb									*20.7*
14-Feb	15.8			*32.7*					*20.9*
15-Feb	48.2			*300.6*					*47.0*
16-Feb	82.2			*731.3*					*19.1*
17-Feb	38.9			*122.8*					*25.3*
18-Feb	19.9			*29.9*					*18.1*
19-Feb	48.2			*82.2*					*37.2*
20-Feb	6.2			*58.6*					*7.1*
21-Feb	37.1	422.9					*57.8*		*13.7*
22-Feb	25.6	387.6	*23.3*				*29.6*		*12.3*
23-Feb	69.3	187.5	*47.7*				*94.4*		*36.5*
24-Feb	51.9	90.3	*58.9*				*81.6*		*41.7*
25-Feb	24.2	133.3	*30.2*				*40.2*		*15.3*
26-Feb	35.5	238.5	*24.6*				*39.8*		*9.7*
27-Feb	20.8	214.2	*19.9*						*12.2*
28-Feb	22.8	49.7	*41.9*						*9.6*
1-Mar	42.1	68.7	*49.3*					*14.5*	*19.9*
2-Mar	26.3	28.4	*41.3*					*8.8*	*20.9*
3-Mar	7.1	11.2						*13.0*	*10.1*
4-Mar	9.3	10.1						*21.4*	*12.9*
5-Mar	24.8	36.9						*19.5*	*19.7*
6-Mar	26.6	28.9			*30.5*			*15.7*	*13.8*
7-Mar	5.6	11.2			*12.6*	*9.6*		*10.5*	*11.1*
8-Mar	5.3	6.0			*8.6*	*5.3*		*8.3*	*10.0*
9-Mar	9.7	12.6			*11.0*	*7.6*		*13.3*	*9.8*
10-Mar	29.2	50.3			*61.2*	*9.2*		*13.2*	*10.8*
11-Mar	12.6	42.8			*30.8*	*13.4*		*13.6*	*10.0*
12-Mar	12.5	14.1			*16.2*	*6.6*		*9.8*	*8.8*
13-Mar	9.2	20.5			*25.0*	*7.4*		*11.1*	*9.6*
14-Mar	6.4	12.4			*13.8*	*10.0*		*14.6*	*10.6*
15-Mar	7.0	13.6				*8.0*		*9.5*	*8.9*
16-Mar	5.3	6.0				*4.7*		*6.5*	*7.2*
17-Mar	2.9	7.8				*4.6*		*4.9*	*7.1*
18-Mar	7.6	6.2				*7.2*		*7.7*	*8.7*
19-Mar	7.7	7.4				*10.6*		*13.7*	*11.0*
20-Mar	7.7	8.3				*8.1*		*11.8*	*9.8*
21-Mar	14.3	16.6				*9.4*		*12.5*	*11.2*
22-Mar	6.0	4.5				*3.4*		*7.6*	*7.5*
23-Mar	5.8	6.0				*1.8*		*5.5*	*7.3*
24-Mar	1.9	3.8				*2.5*		*3.8*	*7.8*
25-Mar	2.3	3.8				*2.5*		*4.5*	*6.7*
26-Mar	3.0	3.5				*4.8*		*8.1*	*8.4*
27-Mar	2.3	1.2				*1.3*		*2.5*	*6.3*
28-Mar	8.6	6.3				*6.7*		*13.3*	*11.0*
29-Mar	9.9	13.4				*10.5*		*14.7*	*11.0*
30-Mar	7.4	7.9				*14.9*		*14.9*	*10.8*
31-Mar	5.7	6.6				*7.8*		*14.2*	*9.8*
No. of days	46	39	*9*	*7*	*9*	*25*	*6*	*31*	*51*
No. of days exceeding standard	13	14	*6*	*7*	*3*	*0*	*6*	*0*	*8*

Particles (PM_{10})

Data is daily average PM_{10} in $\mu g/m^3$. NEPM advisory reporting standard is 50 $\mu g/m^3$. Days exceeding the advisory reporting standard have been highlighted in red.

	Measured		*Estimated*			
Date	**Morwell South**	**Traralgon**	***Kernot Hall***	***Morwell East***	***Morwell Bowling Club***	***Morwell UCA***
9-Feb		89.1				
10-Feb		31.0				
11-Feb		36.3				
12-Feb		58.0				
13-Feb		25.8				
14-Feb		27.2			*77.7*	
15-Feb		41.6			*666.9*	
16-Feb		28.1			*1556.4*	
17-Feb		46.2			*234.6*	
18-Feb		26.9			*64.0*	
19-Feb		45.3		*88.0*	*157.1*	
20-Feb		8.2		*16.6*	*113.9*	
21-Feb		24.9			*431.8*	
22-Feb		17.1	*47.4*		*348.3*	
23-Feb		48.6	*94.1*		*200.5*	
24-Feb		51.5	*116.2*		*152.2*	
25-Feb		22.5	*61.6*		*207.9*	
26-Feb		15.4	*50.8*		*309.6*	
27-Feb		22.9	*40.6*		*296.0*	
28-Feb	98.0	18.5	*82.9*			
1-Mar	143.4	26.7	*96.3*			
2-Mar	66.3	26.3	*81.0*			
3-Mar	26.7	15.4				
4-Mar	27.4	17.6				
5-Mar	117.4	38.9				
6-Mar	79.0	29.4				*61.4*
7-Mar	23.6	17.2				*25.6*
8-Mar	13.6	14.2				*17.8*
9-Mar	27.2	11.4				*22.9*
10-Mar	118.4	24.2				*120.0*
11-Mar	98.7	23.1				*61.6*
12-Mar	34.0	11.8				*32.7*
13-Mar	43.9	19.0				*49.6*
14-Mar	41.6	19.4				*28.2*
15-Mar	44.3	17.1				
16-Mar	12.0	8.9				
17-Mar	13.3	13.6				
18-Mar	18.0	12.5				
19-Mar	26.7	23.7				
20-Mar	34.5	19.3				
21-Mar	56.7	30.4				
22-Mar	15.9	11.3				
23-Mar	21.1	12.5				
24-Mar	20.9	14.0				
25-Mar	11.7	10.2				
26-Mar	15.8	12.9				
27-Mar		6.3			*15.8*	
28-Mar		10.0			*31.3*	
29-Mar		17.0			*37.9*	
30-Mar		13.6			*26.1*	
31-Mar		11.7			*20.5*	
No. of days	27	51	*9*	*2*	*19*	*9*
No. of days exceeding standard	8	3	*7*	*1*	*14*	*3*

Carbon Monoxide (CO)

Data is daily max (8 hour average) CO in ppm. NEPM air quality standard is 9ppm. Days exceeding the air quality standard have been highlighted in red. (Note that the CFA measurements have not been calibrated by the EPA).

	EPA measurements			*CFA measurements*					
Date	**Morwell East**	**Morwell South**	**Traralgon**	***Kerrie St***	***Bowls Club***	***Keegan St***	***Maryvale Childcare Centre***	***Morwell Police Station***	***Sacred Heart Primary***
9-Feb									
10-Feb									
11-Feb									
12-Feb									*0.6*
13-Feb									
14-Feb							*0.0*		
15-Feb						*22.3*	*8.3*		
16-Feb				*20.5*	*30.1*	*33.5*	*6.8*	*12.2*	*19.3*
17-Feb					*14.9*			*6.2*	
18-Feb				*0.1*	*0.8*			*0.6*	*2.8*
19-Feb	0.9			*0.1*	*4.0*			*3.7*	
20-Feb	0.9	5.9		*0.1*	*3.3*				
21-Feb	1.5	14.4		*2.7*	*8.1*			*5.9*	*2.3*
22-Feb	1.0	11.9			*3.5*	*16.8*	*11.1*	*4.9*	*1.7*
23-Feb	2.0	5.4				*6.5*	*5.4*	*2.1*	*4.9*
24-Feb	2.4	4.3				*3.8*	*3.3*	*0.0*	*3.2*
25-Feb	1.1	5.4				*7.7*	*5.4*	*2.0*	*1.0*
26-Feb	1.3	10.5				*15.0*	*8.9*	*4.3*	*2.6*
27-Feb	0.6	5.8				*10.3*	*5.4*	*2.3*	*3.3*
28-Feb	1.8	5.7	0.0			*7.0*	*5.2*	*3.1*	*4.2*
1-Mar	2.9	4.4	0.8			*4.5*	*4.3*	*2.8*	*5.4*
2-Mar	1.3	2.5	0.6			*2.6*	*2.4*	*0.8*	*1.4*
3-Mar	0.0	0.2	0.3			*2.0*	*2.1*	*0.1*	*0.0*
4-Mar	0.1	0.2	0.2			*3.0*	*2.5*	*0.1*	
5-Mar	0.6	1.5	0.7			*2.0*	*1.0*	*0.5*	
6-Mar	1.8	1.5	0.4						
7-Mar	0.3	0.7	0.3						
8-Mar	0.1	0.1	0.3						
9-Mar	0.2	0.4	0.3						
10-Mar	1.7	4.3	0.4						
11-Mar	0.6	4.1	0.4						
12-Mar	0.3	0.9	0.3						
13-Mar	0.7	1.6	0.2						
14-Mar	0.1	1.1	0.4						
15-Mar	0.2	1.2	0.3						
16-Mar	0.3	0.4	0.2						
17-Mar	0.3	0.5	0.3						
18-Mar	0.2	0.5	0.1						
19-Mar	0.2	0.4	0.1						
20-Mar	0.1	0.3	0.5						
21-Mar	0.9	1.7	0.4						
22-Mar	0.2	0.2	0.2						
23-Mar	0.2	0.4	0.2						
24-Mar	0.1	0.4	0.3						
25-Mar	0.1	0.3	0.2						
26-Mar	0.1	0.2	0.2						
27-Mar	0.3	0.3	0.5						
28-Mar	0.3	0.5	0.4						
29-Mar	0.1	0.8	0.2						
30-Mar	0.0	0.3	0.3						
31-Mar	0.1	0.2	0.4						
No. of days	41	40	32	*5*	*7*	*14*	*15*	*17*	*14*
No. of days exceeding standard	0	3	0	*1*	*2*	*5*	*1*	*1*	*1*

Appendix A – Air pollutants

Air can be polluted by various types of gases and particles. The most common air pollutants are monitored in large cities all around the world. These pollutants are described below.

Particles (PM)

Particles come in all different shapes and sizes, and can be measured in a number of ways. Particles include dust, dirt, soot and smoke.

The most common scientific measures of particles are

- **PM_{10}** (particles smaller than 0.010 mm),
- **$PM_{2.5}$** (particles smaller than 0.0025 mm) and
- **Visibility reduction** (measured with an optical device).

Very small particles can get into the lungs, causing a range of health problems, especially for young children and those with existing lung or heart disease.

$PM_{2.5}$ measurements cover the smallest particles – these are about 1/30th the width of an average human hair. These are believed to have the highest health risks, because they can lodge deeply in the lungs.

PM_{10} measurements include slightly larger ones, often called "coarse" particles. Such particles can include wind-blown dust, road dust, industry and natural sea-salt.

The 'PM' in these two measures refers to 'Particulate Matter'. This simply means that it's a measure of how much solid or liquid material is present in the air, in the form of small particles.

Visibility reduction measurements provide a good indicator of the current level of smoke intensity. The optical instrument used for this measure is very sensitive to very fine smoke particles. This allows the very latest information on smoke to be reported on an hourly basis.

Carbon monoxide (CO)

Carbon monoxide is a gas that is often produced when fuels are burnt. In Australian towns and cities, low levels of carbon monoxide are always present, resulting from the use of fuels for energy and transport. The most common source of carbon monoxide is exhaust from petrol cars. Some carbon monoxide is also produced by large fires.

Carbon monoxide is odourless and colourless, and can get into the bloodstream where it displaces oxygen. It can cause heart problems, especially in the elderly.

Sulfur dioxide (SO_2)

This gas can irritate the lungs, and is particularly harmful for people with asthma. Most of the sulfur dioxide in the air comes from coal-fired power stations and metal smelting operations.

Nitrogen dioxide (NO_2)

This gas is produced by the burning of fuels such as natural gas, petrol or diesel. It is harmful to health, especially for children, the elderly and those with asthma.

Ozone (O_3)

A gas like oxygen (O_2), but with an extra atom making it very reactive. Ozone is not directly emitted into the air, instead it forms when other air pollutants combine together on warm summer days. Ozone is harmful to the lungs, especially for the elderly and those with asthma.

Appendix B – Averaging times

Each pollutant is reported using a specific averaging time, as prescribed in regulations. For some pollutants, there is more than one averaging time.

Except for visibility reduction, all these averaging times are determined by health research, which has found specific links between the period of pollution exposure and human health effects.

The averaging times for each of the common pollutants are described in Table A.1. The key pollutants for this incident have been highlighted in bold font.

Table A.1: Averaging times

Pollutant	Averaging period
Particles as $PM_{2.5}$	**24 hours**
Particles as PM_{10}	**24 hours**
Visibility reduction	**1 hour**
Carbon monoxide	**8 hours**
Sulfur dioxide	1 hour, 24 hours and 1 year
Nitrogen dioxide	1 hour and 1 year
Ozone	1 hour and 4 hours

When air pollution levels are reported via EPA's website (hourly updates), sometimes a 'rolling' average is needed. Rolling averages are used on EPA's website for carbon monoxide and $PM_{2.5}$ readings.

A rolling average means that a pollution reading is updated every hour, based on an averaging time that is longer than one hour.

For example, if pollution readings need to be averaged over 24 hours, a rolling average up to say 4 pm would include 24 hours of data from the same time yesterday.

This allows data to be presented using the correct averaging time, whilst also providing the most up to date information.