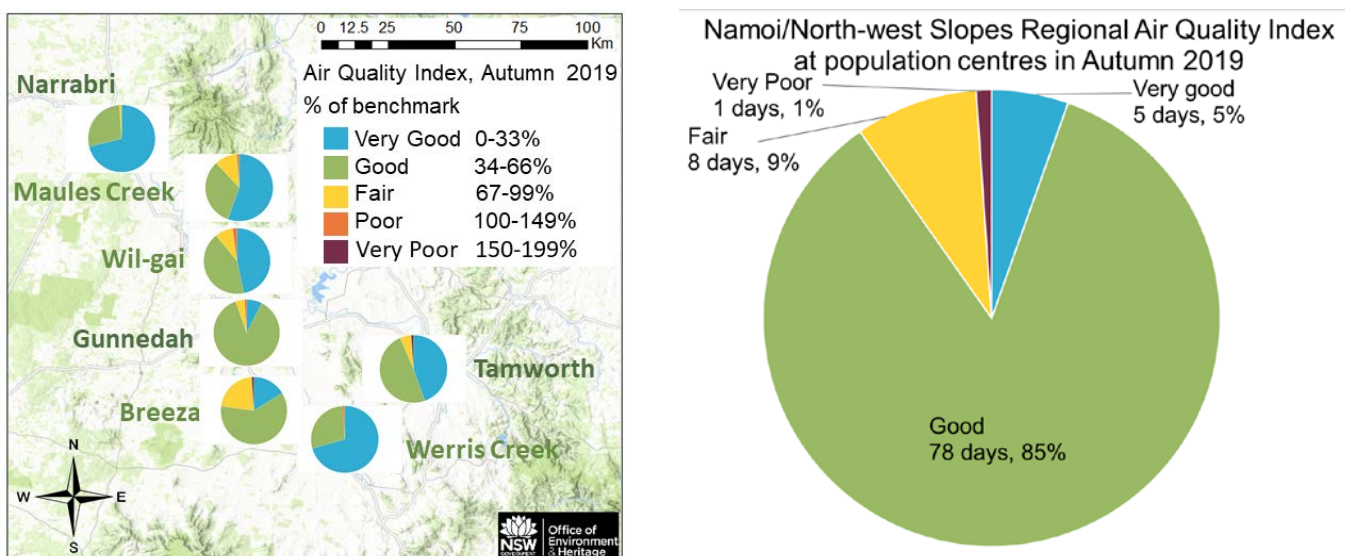


## Air quality in the Namoi/North West Slopes Region

Air quality at regional population centres in the Namoi/North West Slopes met national benchmarks<sup>1</sup> on 99% of autumn days (91 days) from 1 March to 31 May 2019. The Air Quality Index<sup>2</sup> was good to very good for 90% of the season (83 days) and fair for 9% of the season (8 days) (Figure 1). Air quality in population centres was poor to very poor on one day, during a regional dust storm on 31 March 2019.

Seven air quality monitoring stations operate in the region (Figure 1)<sup>3</sup>. All stations continuously monitor airborne particles, measured as PM<sub>10</sub> and PM<sub>2.5</sub><sup>4</sup>. The Gunnedah monitoring station also continuously monitors gaseous air pollutants, nitrogen dioxide (NO<sub>2</sub>) and ozone (O<sub>3</sub>).



**Figure 1** Autumn air quality indices at monitoring stations (left) and regional air quality index (right), showing air quality met national standards at population centres for 99% of the season

## Days above benchmark concentrations, autumn 2019

No days above benchmark concentrations were recorded for PM<sub>2.5</sub>, NO<sub>2</sub> and O<sub>3</sub> (Table 1)<sup>1</sup>.

Daily average PM<sub>10</sub> levels across all sites were above the benchmark of 50 µg/m<sup>3</sup> (micrograms per cubic metre) on three days: 6, 12 and 31 March 2019. Air quality in March was affected by dust storms.

- On 6 March 2019, Wil-gai recorded poor air quality, with a PM<sub>10</sub> daily average of 62 µg/m<sup>3</sup>.
- On 12 March 2019, Maules Creek recorded poor air quality, with a PM<sub>10</sub> daily average of 66 µg/m<sup>3</sup>.
- On 31 March 2019, five of seven monitoring stations recorded poor to very poor air quality. PM<sub>10</sub> daily averages were: Tamworth 86 µg/m<sup>3</sup>, Breeza 80 µg/m<sup>3</sup>, 62 µg/m<sup>3</sup> at Wil-gai and Werris Creek, and 52 µg/m<sup>3</sup> Gunnedah.

<sup>1</sup> The National Environment Protection (Ambient Air Quality) Measure (Air NEPM) sets national standards for urban air pollutants. This report refers to the national standards as 'benchmarks' for reporting air quality.

<sup>2</sup> The NSW Air Quality Index uses colours and percentages, on a scale from very good to hazardous, to compare air pollution levels to national benchmarks.

<sup>3</sup> The Department of Planning, Industry and Environment (DPIE) operates the monitoring stations at Tamworth (from October 2000), Gunnedah and Narrabri (from December 2017). Data are reported in near-real time on the NSW air quality website. Industries operate the monitoring stations at Maules Creek, Wil-gai, Breeza and Werris Creek. Data are reported weekly on the NSW Environment Protection Authority Namoi air quality monitoring project website.

<sup>4</sup> PM<sub>10</sub> and PM<sub>2.5</sub> refer to airborne particles, less than or equal to 10 and 2.5 micrometres in diameter, respectively.

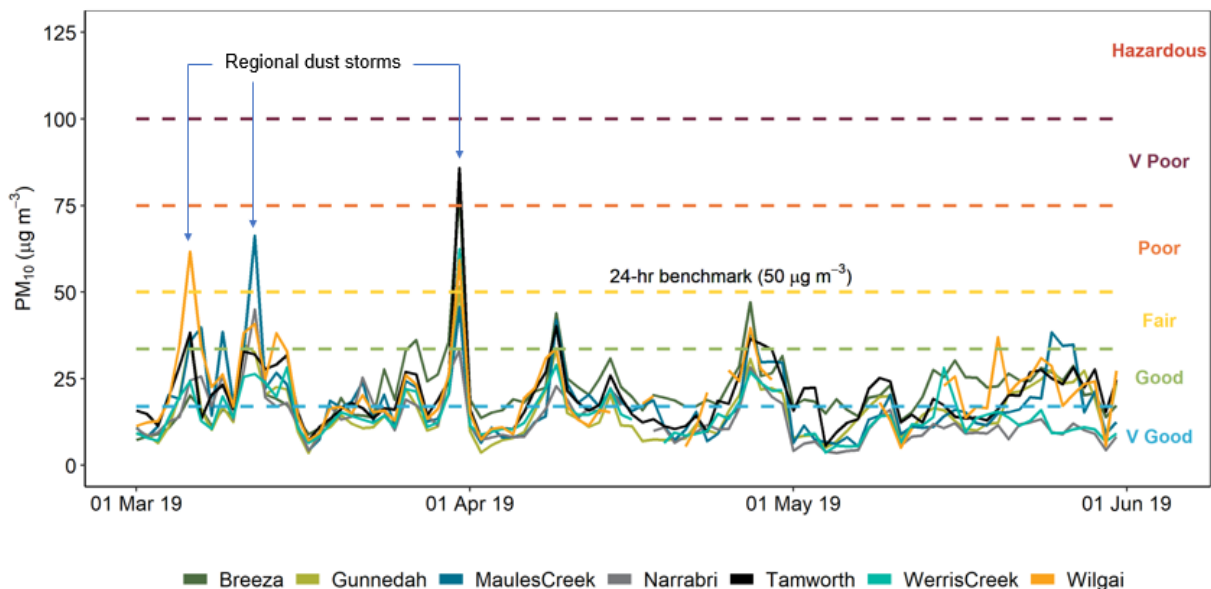
**Table 1** Number of days above the relevant benchmarks, by station, autumn 2019

Station type	Station	PM <sub>10</sub> daily benchmark [50 µg/m <sup>3</sup> ]	PM <sub>2.5</sub> daily benchmark [25 µg/m <sup>3</sup> ]	NO <sub>2</sub> hourly benchmark [12 pp hm]	O <sub>3</sub> hourly benchmark [10 pp hm]
DPIE	Narrabri	0	0	-	-
DPIE	Gunnedah	1	0	0	0
DPIE	Tamworth	1	0	-	-
Industry	Maules Creek	1	0	-	-
Industry	Wil-gai	2	0	-	-
Industry	Breeza	1	0	-	-
Industry	Werris Creek	1	0	-	-

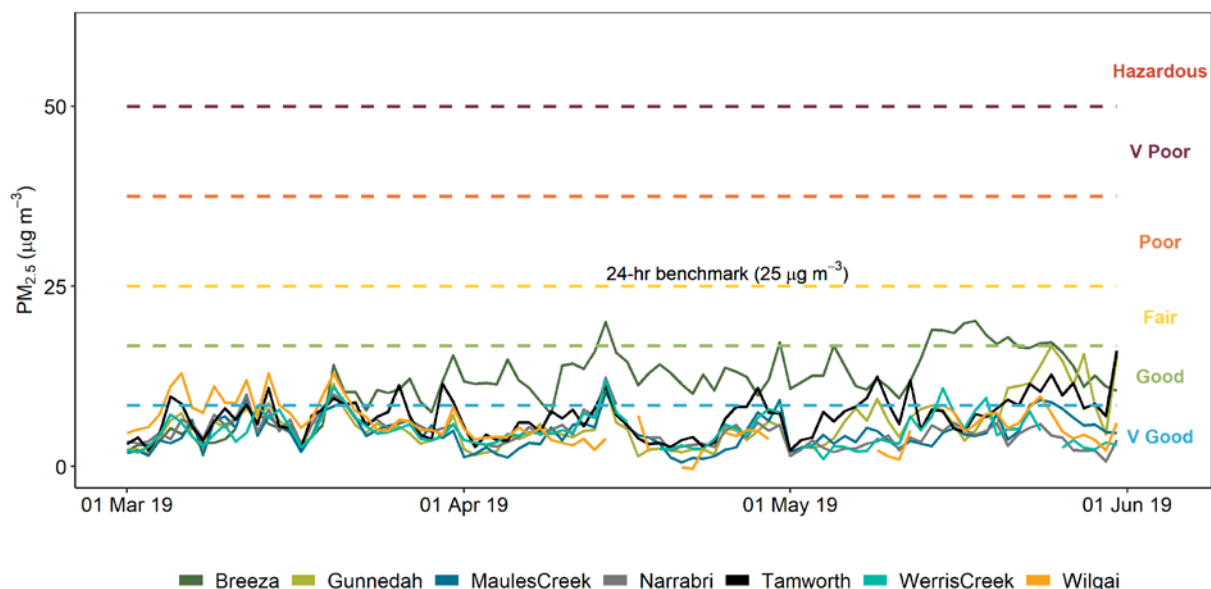
µg/m<sup>3</sup> = microgram per cubic metre; - = not monitored;  
pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air)

### Air quality trends: particle time series, autumn 2019

Time series of daily average particle concentrations show PM<sub>10</sub> levels generally below the benchmark, with peaks observed during regional dust storms (Figure 2). PM<sub>2.5</sub> levels were consistently below the benchmark (Figure 3).



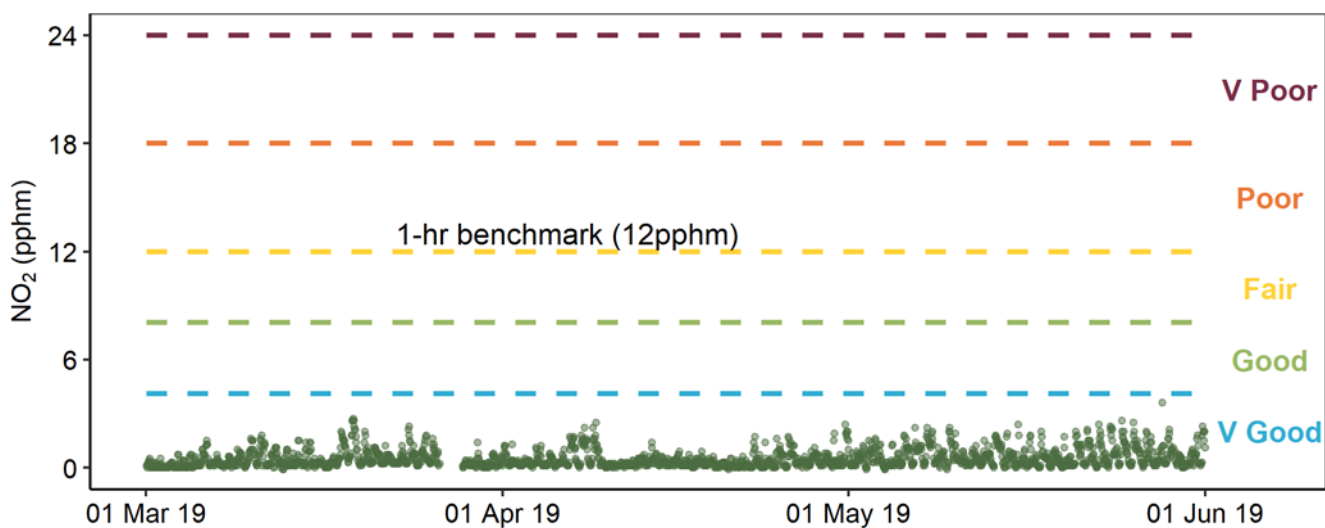
**Figure 2** Daily average PM<sub>10</sub>, during autumn 2019, showing levels generally below the national benchmark, except during regional dust storms



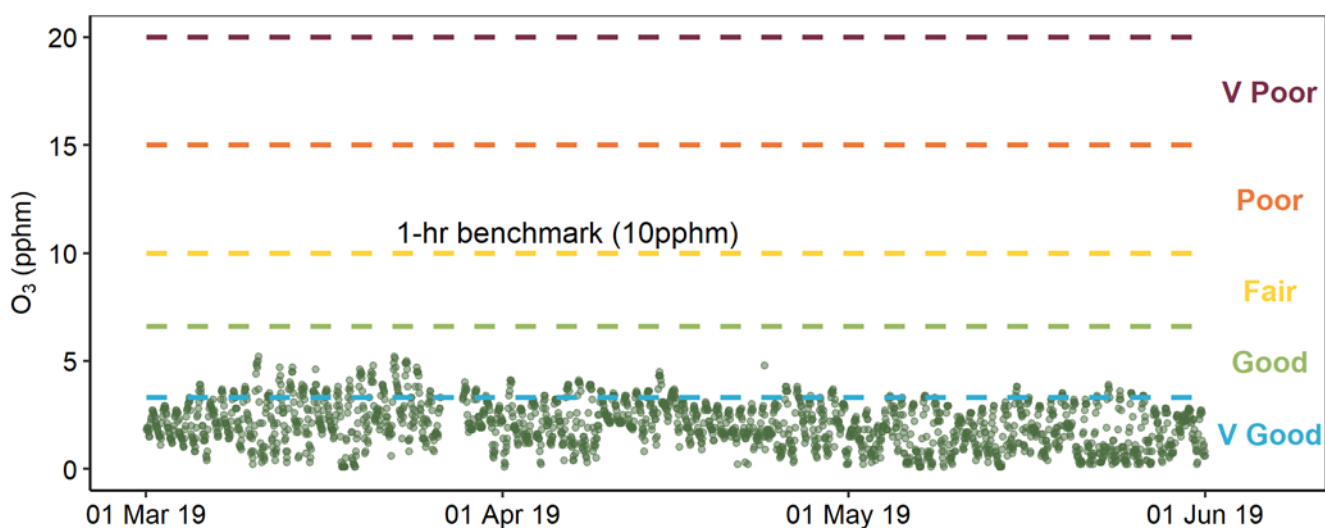
**Figure 3** Daily average PM<sub>2.5</sub>, during autumn 2019, showing levels below the national benchmark

## Air quality trends: gaseous pollutants time series, Gunnedah, autumn 2019

Figure 4 and Figure 5 show daily maximum one-hour average concentrations of NO<sub>2</sub> and O<sub>3</sub> were below national benchmark concentrations during autumn 2019.



**Figure 4** Daily Maximum 1-hour Nitrogen Dioxide, at Gunnedah during autumn 2019, showing levels below the national benchmark concentration



**Figure 5** Daily Maximum 1-hour Ozone, at Gunnedah during autumn 2019, showing levels below the national benchmark concentration

## Seasonal weather and climate

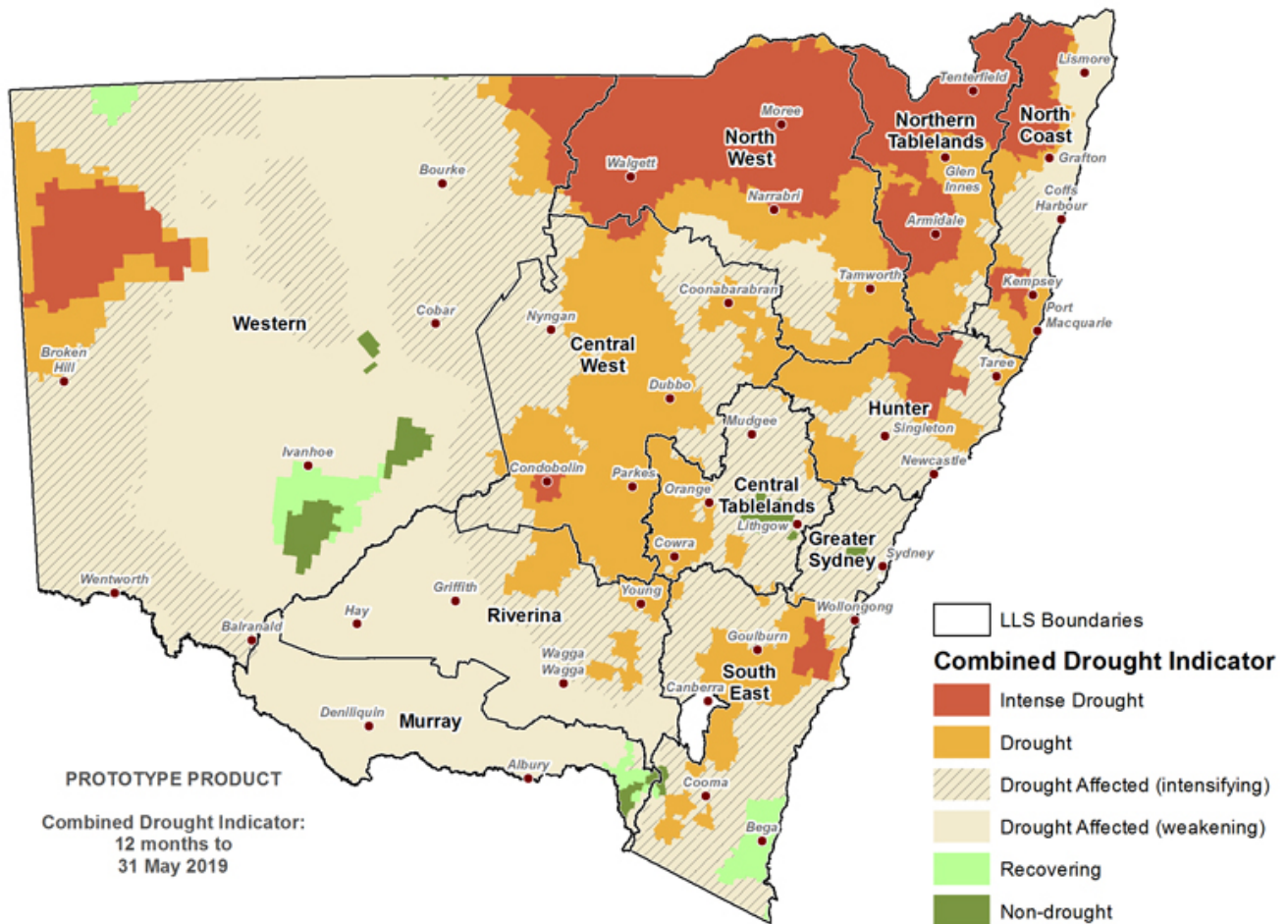
Autumn 2019 was the fourth-warmest on record in New South Wales. Autumn began with very warm temperatures and ended with cool temperatures in late May. Autumn rainfall was 32% below the long term average. Cold fronts and thunderstorms in late March and early May generated very heavy rainfall<sup>5</sup>.

### Drought conditions

Drought management remained ongoing across New South Wales in autumn, although conditions eased during May, following thunderstorms and heavy rainfall. Some areas, including parts of the Namoi region, moved from the intense drought category to drought or drought-affected categories<sup>6</sup> (Figure 6).

DustWatch<sup>7</sup> reported that dust activity in March 2019 was the highest for any March since records began in 2005. Dust was associated with very low groundcover across much of the State and stronger than average wind conditions. Groundcover was the lowest for any March since MODIS<sup>8</sup> records began in 2001. Dust storms occurred throughout the month. (For more information on PM<sub>10</sub> levels associated with a regional dust storm in March 2019, see below, pages 8–10).

Dust activity fell in April 2019, as rainfall increased groundcover levels and the frequency of strong winds fell to 30% below the 10-year average. Thunderstorms and rainfall in early May further improved groundcover and reduced dust activity<sup>7</sup>.



**Figure 6** Department of Primary Industries NSW Combined Drought Indicator to 31 May 2019<sup>6</sup>, showing drought intensity in the Namoi/North West Region

<sup>5</sup> Bureau of Meteorology, [New South Wales Climate Summary Autumn 2019](#), accessed July 2019

<sup>6</sup> Sourced from Department of Primary Industries [NSW State seasonal update - May 2019](#) (accessed July 2019).

<sup>7</sup> [DustWatch Report March 2019](#), [DustWatch Report April 2019](#), [DustWatch Report May 2019](#) (accessed July 2019)

<sup>8</sup> MODIS (Moderate Resolution Imaging Spectroradiometer) is a satellite instrument operated by NASA (United States of America's National Aeronautics and Space Administration). MODIS tracks changes in vegetation, dust and cloud cover.

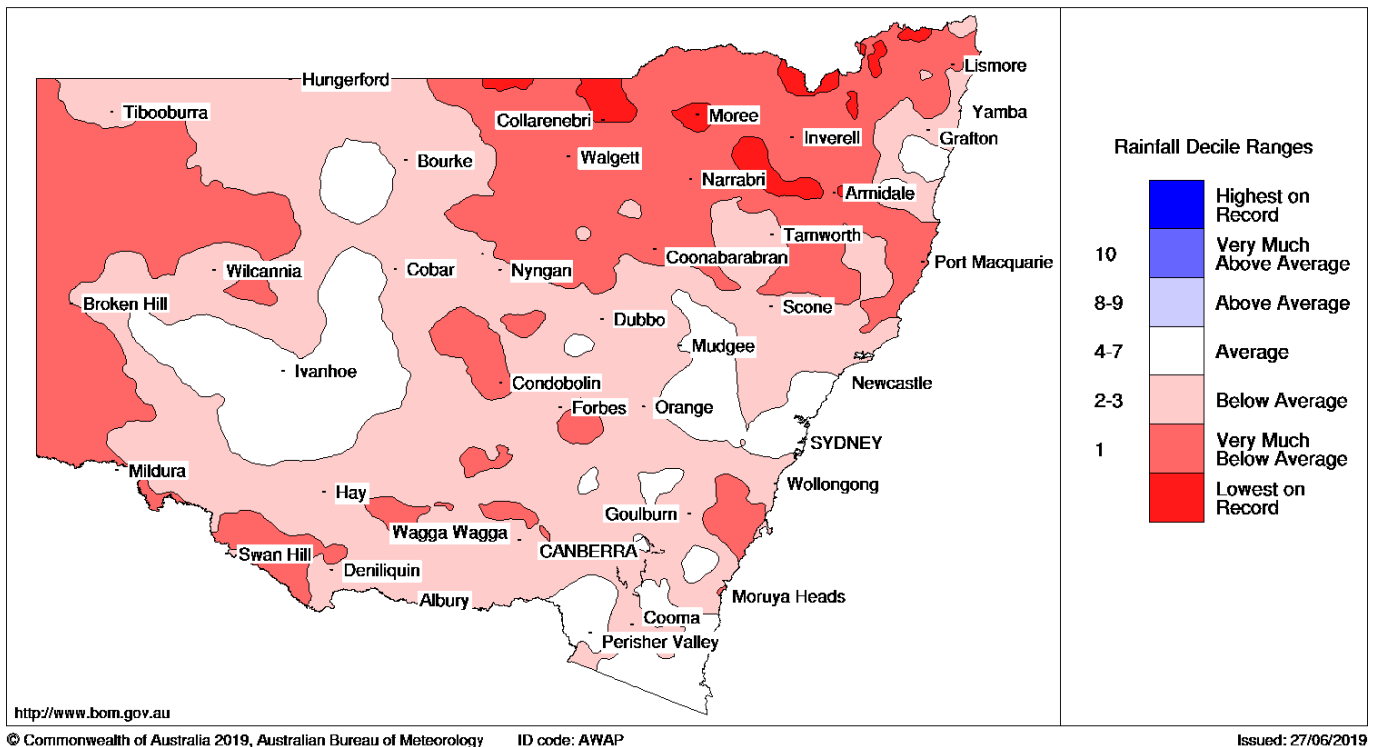
## Rainfall and temperature<sup>9</sup>

The Namoi/North West Slopes Region received rainfall at levels very much below average for the 12-months to 31 May 2019, compared with long term records. Some areas in the north west received the lowest rainfall on record (Figure 7).

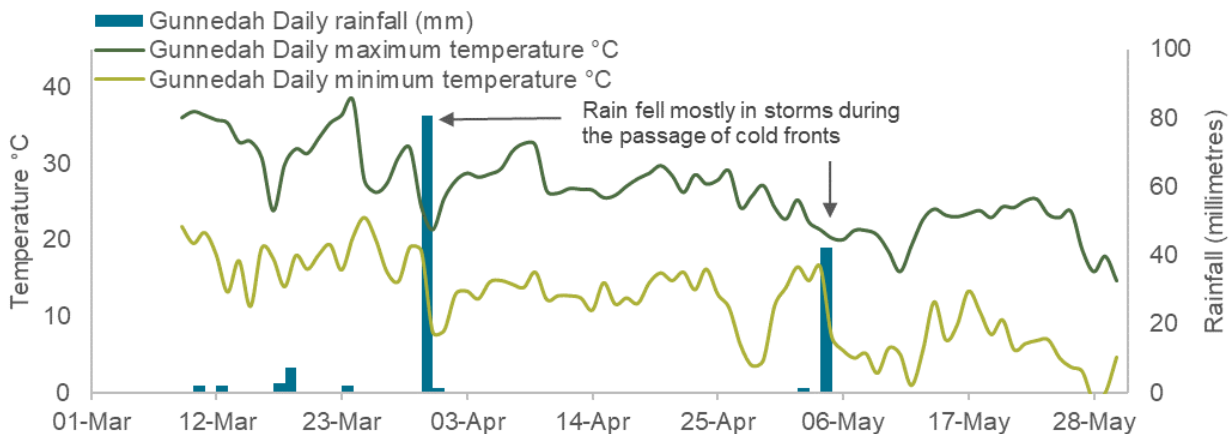
Rainfall totals were 50 to 200 millimetres (mm) across the region. Autumn 2019 rainfall was 25 to 100 mm higher than autumn 2018; 25 to 100 mm lower than autumn in 2017 and up to 25 mm lower than 2016. Autumn rain fell mostly in thunderstorms associated with cold fronts in late March and early May<sup>5</sup> (Figure 8).

Maximum autumn temperatures in the region were 1–2°C above average. Minimum temperatures were 0–2°C above average.

New South Wales Rainfall Deciles 1 June 2018 to 31 May 2019  
Distribution Based on Gridded Data  
Australian Bureau of Meteorology



**Figure 7** NSW rainfall deciles for 12-months, 1 June 2018 to 31 May 2019, showing rainfall levels from below and very much below average, to the lowest on record in the Namoi/North West Slopes



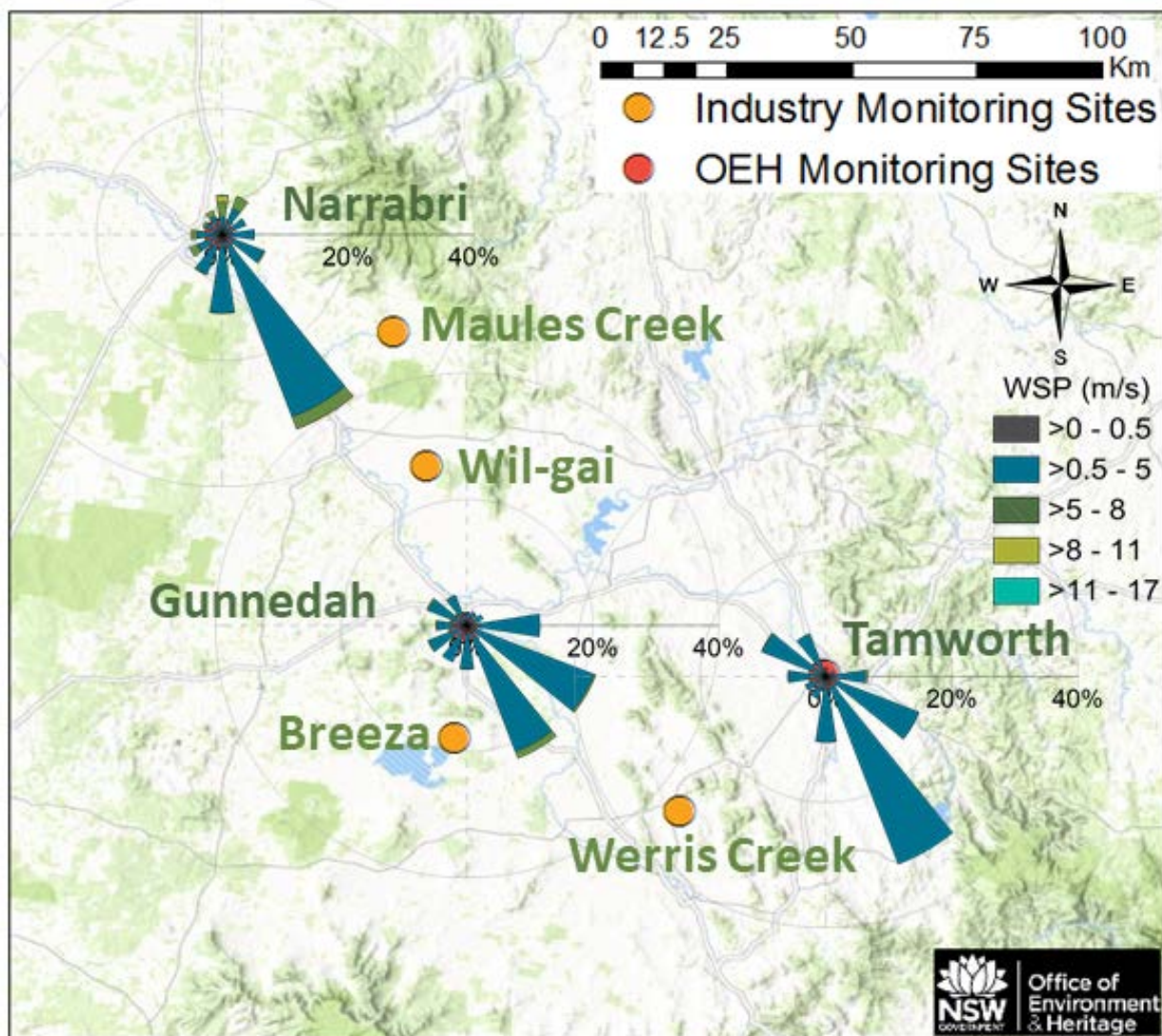
**Figure 8** Gunnedah daily maximum and minimum temperatures and rainfall, autumn 2019

<sup>9</sup> Rainfall and temperature maximum and minimum information is from the Bureau of Meteorology Climate Data Online, New South Wales Climate Summary Autumn 2019 and climate maps for autumn 2019 and previous autumns (accessed July 2019)

## Wind

During autumn, the Namoi/North West Slopes Region generally experienced light to moderate south-easterly winds (0.5 to 7.9 metres per second, m/s, or two to 28 kilometres per hour, km/hr) (Figure 9).

Periods of stronger winds at Narrabri were generally from the north to north-northeast (to 13 m/s or 47 km/hr) and associated with cold fronts and thunderstorms<sup>9</sup>.

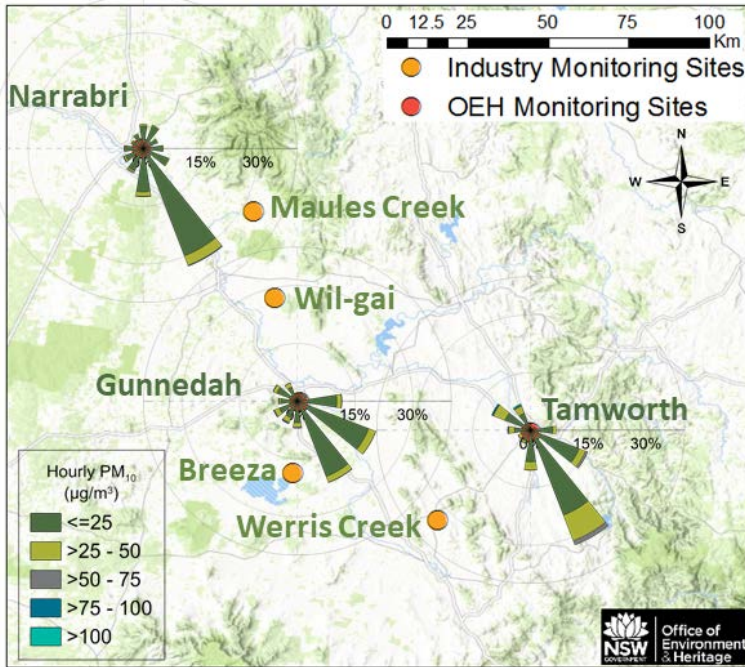


**Figure 9** Wind rose map<sup>10</sup> for the Namoi/North West Slopes Region during autumn 2019, showing winds were predominantly from the south east, with more frequent southerly winds at Narrabri and Tamworth than at Gunnedah (WSP m/s: wind speed in metres per second)

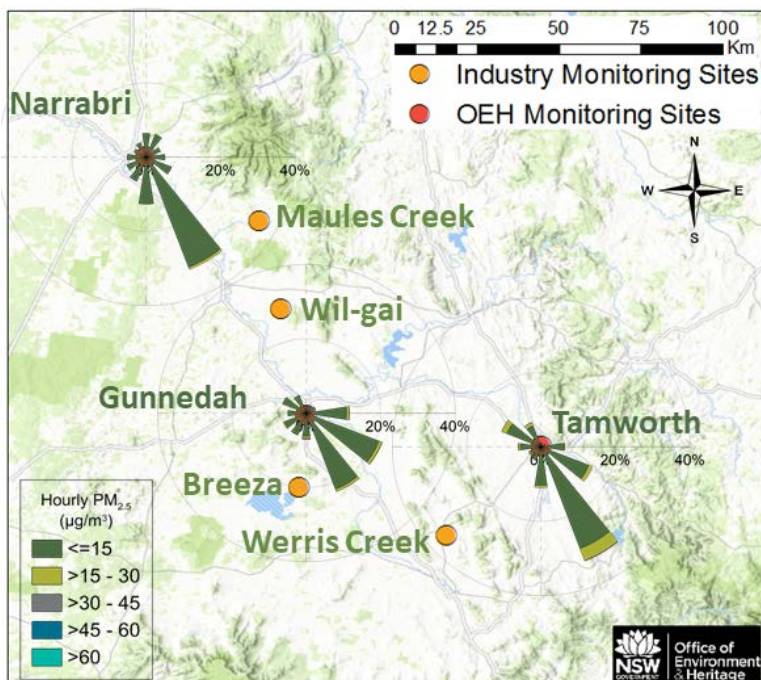
<sup>10</sup> Wind roses show the wind direction and speed at a location. The length of each bar around the circle in these wind roses show the percentage of time that the wind blows from a particular direction. The colours along the bars indicate the wind speed categories.

## Pollution roses

The pollution roses<sup>11</sup> show higher hourly PM<sub>10</sub> and PM<sub>2.5</sub> levels were associated most frequently with south-easterly winds (Figure 10, Figure 11). Hourly PM<sub>10</sub> levels above 25 µg/m<sup>3</sup> were associated with more variable wind directions at Gunnedah and Tamworth, than at Narrabri. Highest hourly PM<sub>10</sub> levels (greater than 75 µg/m<sup>3</sup>)<sup>12</sup> were associated with north-westerly winds at Tamworth. (For detail on PM<sub>10</sub> levels associated with a regional dust storm, see below, pages 8-10). Higher hourly PM<sub>2.5</sub> levels were recorded from more variable wind directions at Tamworth than at Narrabri and Gunnedah.



**Figure 10** Hourly PM<sub>10</sub> pollution roses for autumn 2019, showing highest PM<sub>10</sub> levels generally associated with south to south-easterly winds at Narrabri and more variable wind directions at Gunnedah and Tamworth



**Figure 11** Hourly PM<sub>2.5</sub> pollution roses for autumn 2019, showing higher PM<sub>2.5</sub> levels associated with predominantly south to south-easterly winds at Narrabri and more variable wind directions at Gunnedah and Tamworth

<sup>11</sup> Pollution roses show the wind direction and particle levels at a location. The length of each bar around the circle shows the percentage of time the wind blows from that direction. The colours along the bars indicate the concentration of particle levels.

<sup>12</sup> There are no standards for hourly PM<sub>10</sub> or PM<sub>2.5</sub> in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM).  
Air quality in the Namoi/North West Slopes Region: Autumn 2019

# Widespread dust storm, North West Slopes, 31 March 2019

## Synopsis

On 31 March 2019, the Namoi/North West Slopes region experienced poor to very poor air quality<sup>2</sup> (Figure 12). Information gathered from air quality and weather observations indicated that a widespread dust storm, associated with a cold front, travelled from west to east across the region on 30-31 March 2019. Strong and turbulent north to south-westerly winds, associated with the cold front, raised loose soil particles across western and north-western parts of the State, which were experiencing prolonged drought and loss of groundcover<sup>7</sup>. Light to moderate westerly to south-westerly winds behind the front transported suspended dust particles across the North West Slopes, during the afternoon and evening of 30 March and early morning of 31 March 2019. Particle levels exceeded the PM<sub>10</sub> daily benchmark of 50 µg/m<sup>3</sup> at five of seven monitoring stations across the region, with levels ranging from 86 µg/m<sup>3</sup> at Tamworth to 52 µg/m<sup>3</sup> at Gunnedah (Figure 12). The maximum hourly PM<sub>10</sub> level reached 213 µg/m<sup>3</sup> at Tamworth, at 5am on 31 March (Figure 14). On 1 April 2019, very good air quality across the region accompanied showers and thunderstorms associated with the cold front (Table 2, Figure 14).

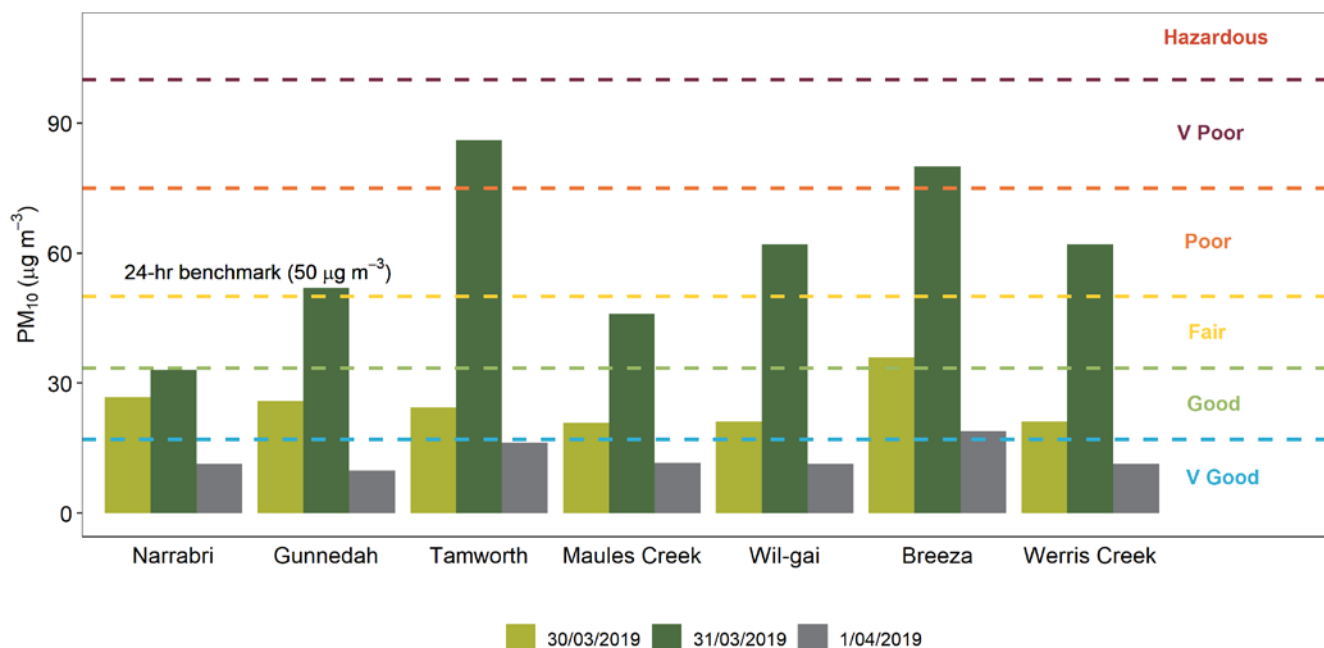


Figure 12 PM<sub>10</sub> 24-hour averages for Namoi/North West Slopes Region, 30 March to 1 April 2019

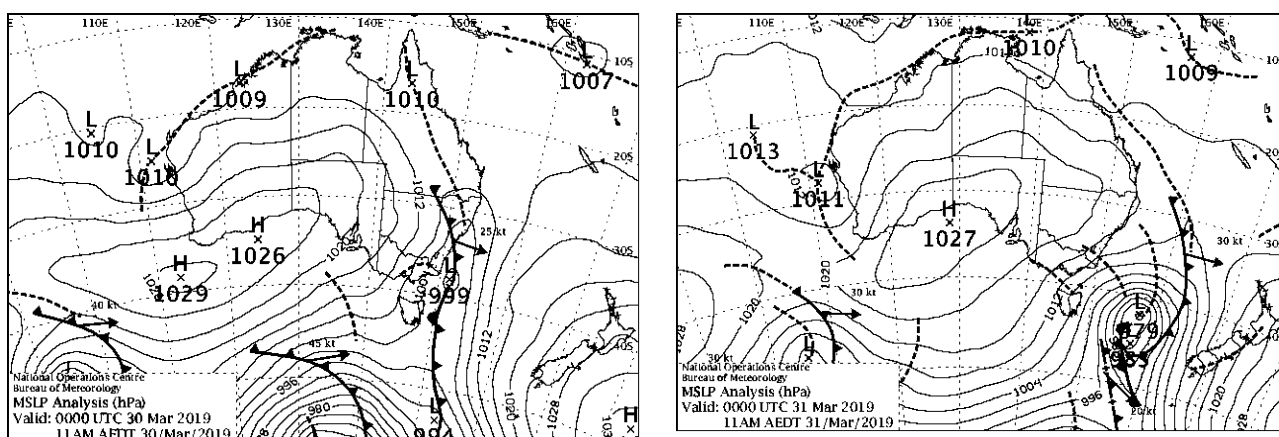


Figure 13 Synoptic weather charts<sup>13</sup> for 11am on 30 March (left) and 11am on 31 March 2019 (right), showing a cold front travelling from west to east across New South Wales

<sup>13</sup> Synoptic chart sourced from the [Bureau of Meteorology Analysis Chart Archive website](#) (accessed July 2019)



## Episode analysis

### Air quality and weather conditions in population centres in the Namoi/North West Slopes region, 30 March to 1 April 2019

This section describes in more detail the build-up of the PM<sub>10</sub> air pollution episode during 30-31 March 2019 and the return to very good air quality on 1 April 2019. Information is presented in a range of formats (table, text and annotated graphs) to appeal to a diverse audience, with a range of reading preferences.

**Table 2** PM<sub>10</sub> concentrations, maximum winds, temperatures and rainfall, 30 March to 1 April 2019

Date	Station	PM <sub>10</sub>	Max PM <sub>10</sub>	Max wind gust <sup>14</sup>			Max temp	Rainfall (mm)	
		24-hr av (µg/m <sup>3</sup> )	1-hr av (µg/m <sup>3</sup> )	Time (hr)	Direction	Speed m/s (km/hr)	Time (hr: min)		1-hr av (°C)
<b>Day 1</b> 30 Mar	Narrabri	27	61	9&10pm	N	17 (61)	4:36am	24	39
	Gunnedah	25	109	Midnight	WSW	13 (47)	5:04am	24	81
	Tamworth	25	100	Midnight	NW	18 (65)	11:51am	25	46
<b>Day 2</b> 31 Mar	Narrabri	33	70	9am	n.d.	n.d.	n.d.	22	0.4
	Gunnedah	52	129	2am	WSW	12 (43)	2:32pm	21	1.2
	Tamworth	86	213	5am	W	9 (32)	11:51am	20	5
<b>Day 3</b> 1 Apr	Narrabri	11	20	4pm	n.d.	n.d.	n.d.		26
	Gunnedah	10	20	6&7pm	SSE	11 (40)	7:48pm		26
	Tamworth	16	24	7pm	n.d.	n.d.	n.d.		26

#### Day 1, Saturday, 30 March 2019:

During the morning, wind speeds increased to gale force (17 to 18 m/s) and winds changed direction, from generally northerly to west-south-westerly, marking the arrival of a cold front (Figure 13, Table 2 and Figure 14). Highest wind speeds were recorded in the early morning at Narrabri and Gunnedah and around mid-day at Tamworth (Table 2). Mid-morning temperatures fell by 2-4 °C (Figure 14). Winds eased in the afternoon (5 to 8 m/s) and evening (0 to 5 m/s). Hourly average PM<sub>10</sub> levels increased rapidly in the afternoon as wind speeds increased, raising dust particles across the region. PM<sub>10</sub> levels continued rising, especially in the late evening at Gunnedah and Tamworth, as wind speeds eased. Although hourly PM<sub>10</sub> levels increased in the afternoon and evening, the daily average air quality across the region was good. Narrabri recorded a PM<sub>10</sub> 24-hour average of 27 µg/m<sup>3</sup> and Gunnedah and Tamworth recorded 25 µg/m<sup>3</sup> (Table 2). Rain fell in thunderstorms associated with the cold front, to 39 mm at Narrabri, 81 mm at Gunnedah and 46 mm at Tamworth.

#### Day 2, Sunday, 31 March 2019:

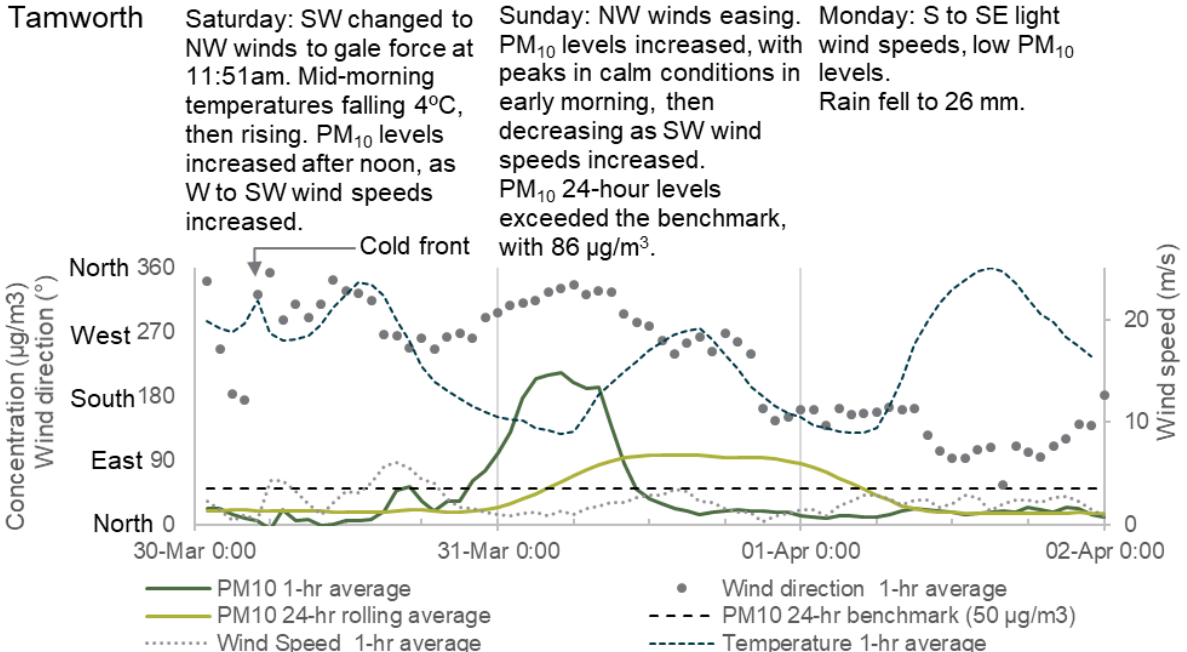
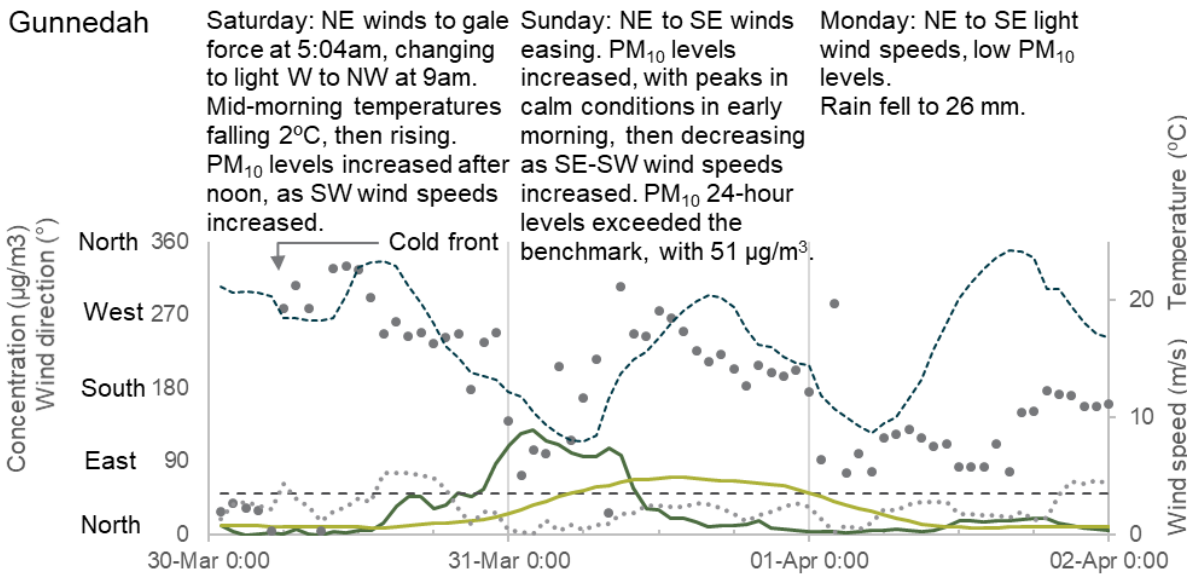
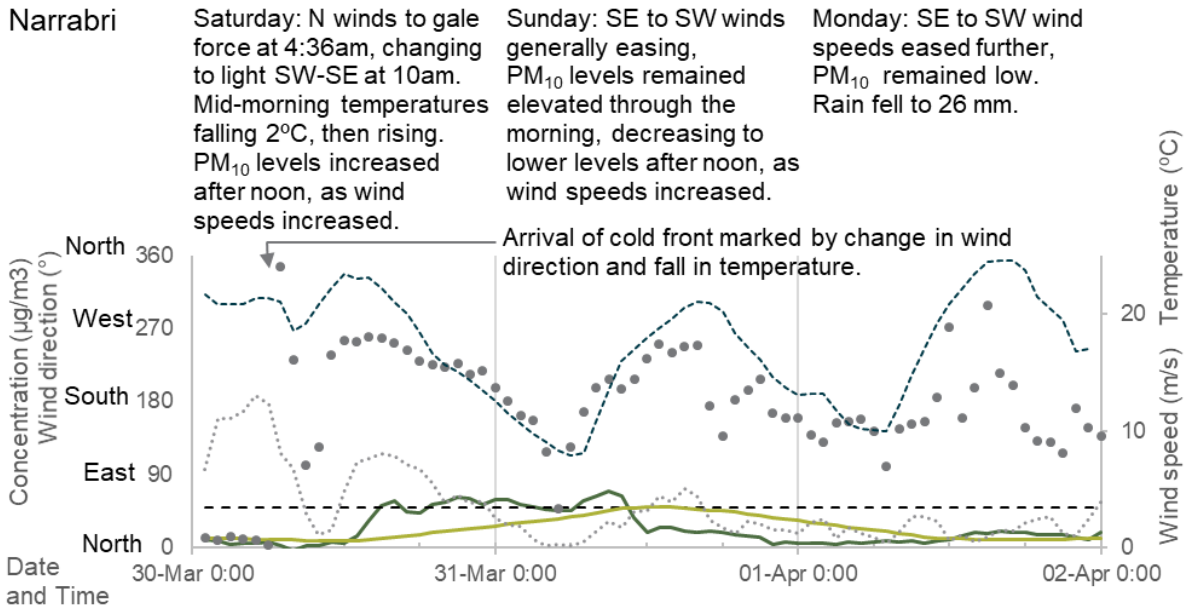
In the early morning, hourly PM<sub>10</sub> levels at Gunnedah and Tamworth continued rising. Winds were very light to near-calm (0-6 m/s), from the south east to south west at Narrabri and Gunnedah and north west to south west at Tamworth. Hourly PM<sub>10</sub> levels peaked, with 70 µg/m<sup>3</sup> at Narrabri at 9am, 129 µg/m<sup>3</sup> at Gunnedah at 2am and 213 µg/m<sup>3</sup> at Tamworth at 5am. Rural dust reports<sup>15</sup>, combined with these conditions, suggest that light westerly winds transported suspended dust particles from western parts of the State across to the North West Slopes. Hourly PM<sub>10</sub> levels decreased from mid-morning, as wind speeds increased and light rain fell across the region, to five mm (Table 2). The region recorded poor to very poor daily air quality in two population centres. PM<sub>10</sub> 24-hour levels exceeded the benchmark of 50 µg/m<sup>3</sup>, with 52 µg/m<sup>3</sup> at Gunnedah and 86 µg/m<sup>3</sup> at Tamworth, due to the high hourly levels recorded in the morning (Figure 14).

#### Day 3, Monday, 1 April 2019:

Narrabri, Gunnedah and Tamworth each recorded rainfall to 26 mm. The region recorded very good air quality and light to moderate south-west to south-easterly winds (0 to 5 m/s). Daily PM<sub>10</sub> levels were below 17 µg/m<sup>3</sup> in all population centres (Table 2 and Figure 14).

<sup>14</sup> Bureau of Meteorology data, Daily Weather Observations for [Narrabri](#), [Gunnedah](#) and [Tamworth](#) accessed July 2019

<sup>15</sup> The NSW rural air quality monitoring network recorded elevated levels of suspended particles in western and north-western parts of the state during 29-31 March 2019.



**Figure 14** PM<sub>10</sub> 1-hour and 24-hour average concentrations, 1-hour wind direction, wind speed and temperature, at Narrabri, Gunnedah and Tamworth 30 March –1 April 2019

## Online performance of monitoring stations

The target performance for air quality monitoring at Department of Planning, Industry and Environment monitoring sites is at least 95% available data for all parameters. The maximum online time attainable for gases, NO<sub>2</sub>, and O<sub>3</sub>, is 96%, due to daily calibrations.

Table 3 presents online performance of monitoring stations at Gunnedah, Narrabri and Tamworth, from 1 March to 31 May 2019:

- All stations met online targets for monitoring of meteorology, PM<sub>10</sub> and PM<sub>2.5</sub>.
- Instrument faults and associated calibrations reduced the online time for monitoring of NO<sub>2</sub> and O<sub>3</sub> at Gunnedah.

**Table 3** Online performance (%) from 1 March to 31 May 2019

Station	Particles PM <sub>10</sub> daily	Particles PM <sub>2.5</sub> daily	Gases NO <sub>2</sub> hourly	Gases O <sub>3</sub> hourly	Meteorology Wind hourly
Gunnedah	100	100	94	94	100
Narrabri	99	99	-	-	100
Tamworth	100	100	-	-	100

- not monitored

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This report was prepared by Leanne Graham and Md-Mahmud Rahman.

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