

## Air quality in the Upper Hunter: Spring 2020

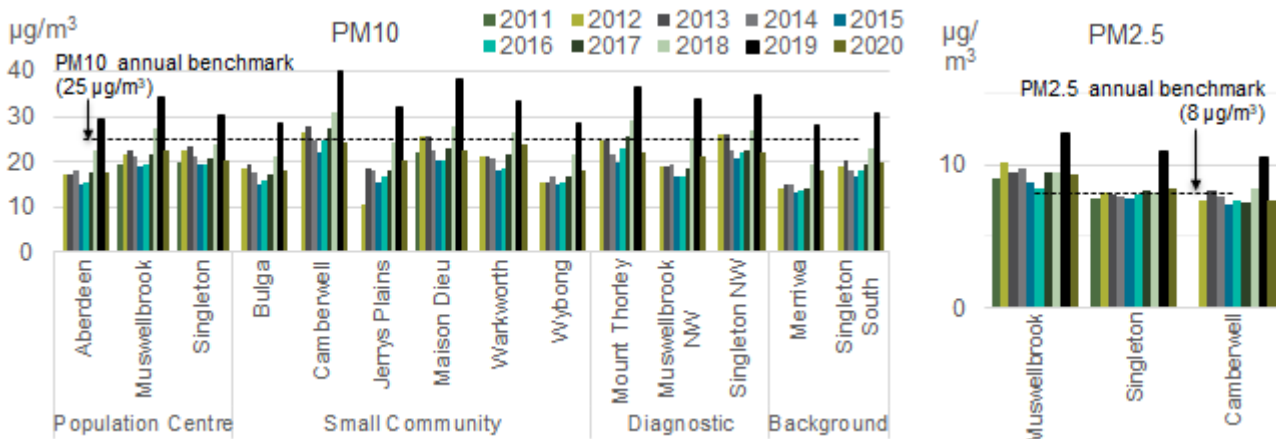
Air quality in the Upper Hunter was generally good during spring 2020. Daily particle levels were within national benchmarks 99% of the time at Muswellbrook and Singleton. Hourly particle levels were in the good to fair air quality categories 99.5% and 99.9% of the time at Muswellbrook and Singleton, respectively. Regional air quality was greatly improved compared to 2019.

- Levels of fine particle matter PM<sub>2.5</sub> (particles less than or equal to 2.5 microns in diameter), nitrogen dioxide (NO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>) were good, remaining below national benchmarks.
- Daily average levels of PM<sub>10</sub> (particles less than or equal to 10 microns in diameter) were above the 50 µg/m<sup>3</sup> benchmark on four days (3 September and 27–29 November). Regional maximum daily PM<sub>10</sub> levels on these days ranged from 53.2 to 105.4 µg/m<sup>3</sup>.
  - No days over the PM<sub>10</sub> benchmark were recorded at Aberdeen, Bulga, Merriwa and Wybong. The Muswellbrook and Singleton larger population centres recorded one day over the benchmark. There was one to two days over the benchmark at each of the eight remaining stations (Table 1).
  - The most widespread event occurred on 29 November when 10 sites recorded daily PM<sub>10</sub> levels over the benchmark, including the Muswellbrook and Singleton larger population centres. Elevated dust occurred under moderate to strong north-westerly winds followed by a further spike with a southerly change.

## Annual air quality trends in the Upper Hunter

A comparison of annual average PM<sub>10</sub> and PM<sub>2.5</sub> levels shows the long-term trends. The national annual average benchmarks are 25 µg/m<sup>3</sup> for PM<sub>10</sub> and 8 µg/m<sup>3</sup> for PM<sub>2.5</sub>, based on a calendar year.

Figure 1 shows the PM<sub>10</sub> and PM<sub>2.5</sub> annual averages from 2011 to 2020.



**Figure 1 PM<sub>10</sub> and PM<sub>2.5</sub> annual averages: 2011 to 2020**

The comparison in Figure 1 shows a large decrease in particle levels throughout the region in 2020 compared to 2019. PM<sub>10</sub> and PM<sub>2.5</sub> particle levels in 2020 were comparable to earlier years 2011 to 2017.

The improved particle levels in 2020, compared to 2019, resulted from comparatively cooler, wetter conditions in 2020 and reduced impact from dust storms and bushfires. At the end of spring 2020, most of New South Wales was not affected by drought (Figure 2), compared to 100% of the state drought declared by the end of 2019 (with more than half in intense drought).

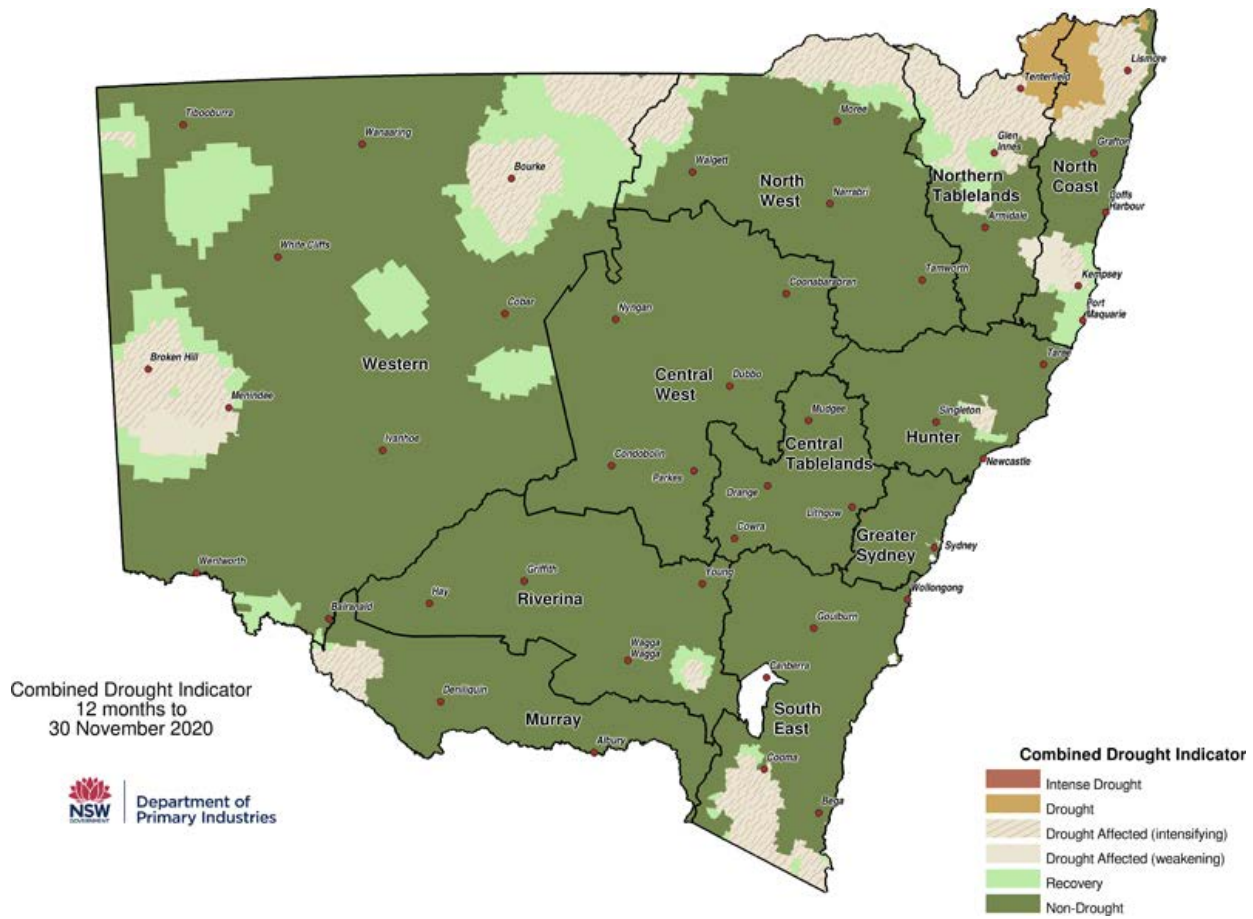


Figure 2 Department of Primary Industries NSW Combined Drought Indicator to 30 November 2020<sup>1</sup>

<sup>1</sup> Sourced from Department of Primary Industries [NSW State seasonal update – November 2020](#) (accessed January 2021)

## Days above benchmark concentrations

There were four days over the PM10 daily benchmark in spring 2020. PM2.5 levels remained below the daily benchmark throughout the season.

**Table 1** Number of days above the relevant national benchmarks – spring 2020

Station type*	Station	PM10 daily [50 µg/m <sup>3</sup> benchmark]	PM2.5 daily [25 µg/m <sup>3</sup> benchmark]	SO <sub>2</sub> hourly [20 pphm benchmark]	SO <sub>2</sub> daily [8 pphm benchmark]	NO <sub>2</sub> hourly [12 pphm benchmark]
Population centre	Aberdeen	0	-	-	-	-
Population centre	Muswellbrook	1	0	0	0	0
Population centre	Singleton	1	0	0	0	0
Smaller community	Bulga	0	-	-	-	-
Smaller community	Camberwell	2	0	-	-	-
Smaller community	Jerrys Plains	2	-	-	-	-
Smaller community	Maison Dieu	2	-	-	-	-
Smaller community	Warkworth	1	-	-	-	-
Smaller community	Wybong	0	-	-	-	-
Diagnostic	Mount Thorley	2	-	-	-	-
Diagnostic	Muswellbrook NW	1	-	-	-	-
Diagnostic	Singleton NW	1	-	-	-	-
Background	Merriwa	0	0	0	0	0
Background	Singleton South	1	-	-	-	-

µg/m<sup>3</sup> = micrograms per cubic metre

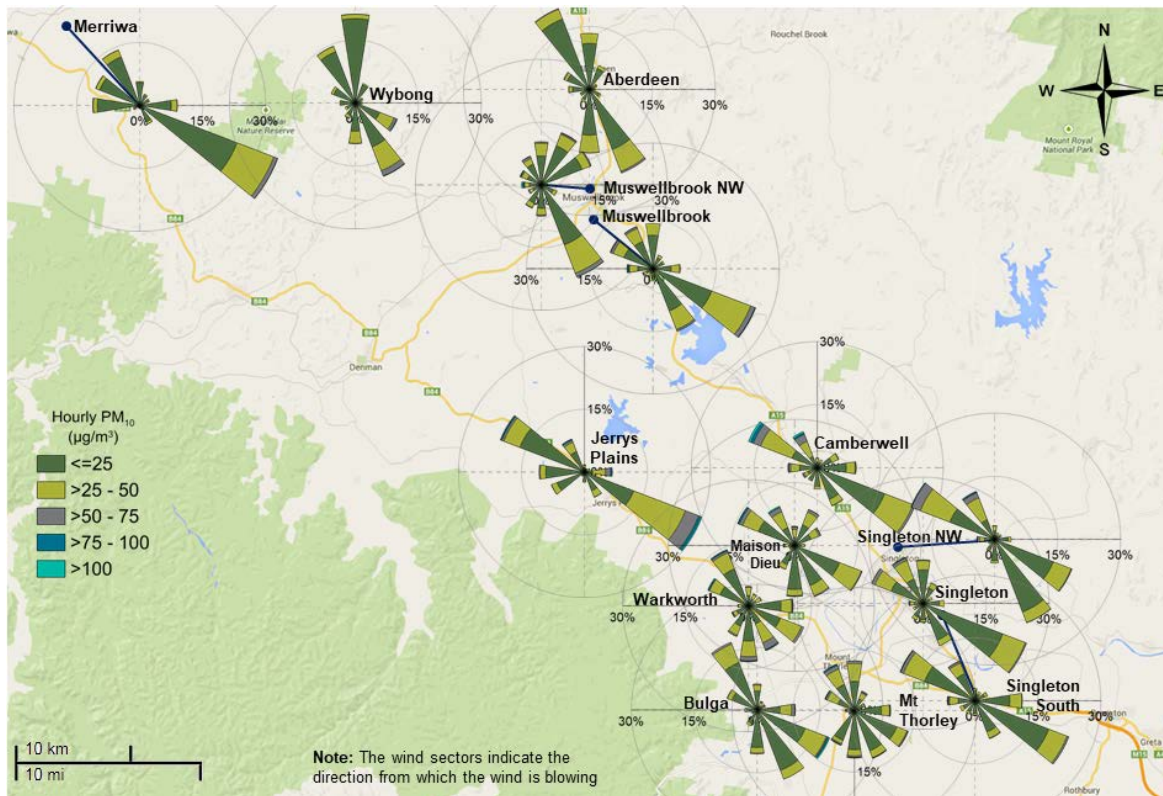
pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air)

- = not monitored

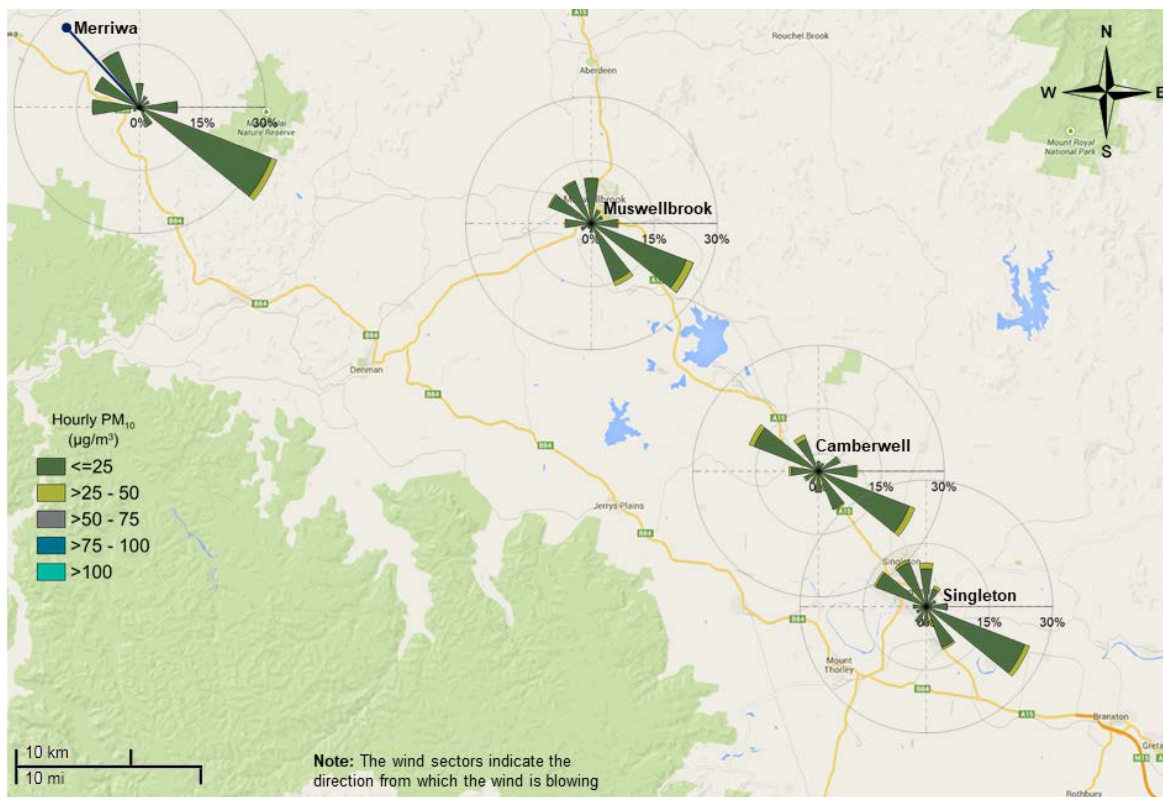
\* For explanation, refer to the end of the report **Definitions: Upper Hunter monitoring station types**

## Pollution roses from hourly particle data

The seasonal pollution rose maps<sup>2</sup> (Figure 3 and Figure 4) show that hourly PM10 and PM2.5 levels<sup>3</sup> were generally low during the season.



**Figure 3** Hourly PM10 pollution rose map for the Upper Hunter region for spring 2020



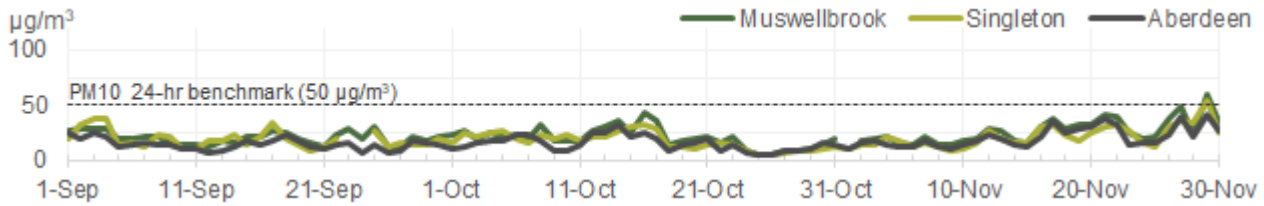
**Figure 4** Hourly PM2.5 pollution rose map for the Upper Hunter region for spring 2020

<sup>2</sup> Pollution roses show 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 a particular direction. The colours along the bars indicate categories of particle levels.

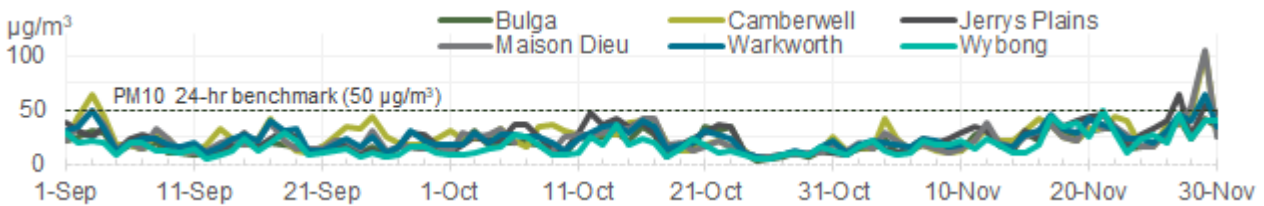
<sup>3</sup> There are no standards for hourly PM10 or PM2.5 in the National Environment Protection (Ambient Air Quality) Measure.

## Daily time series plots

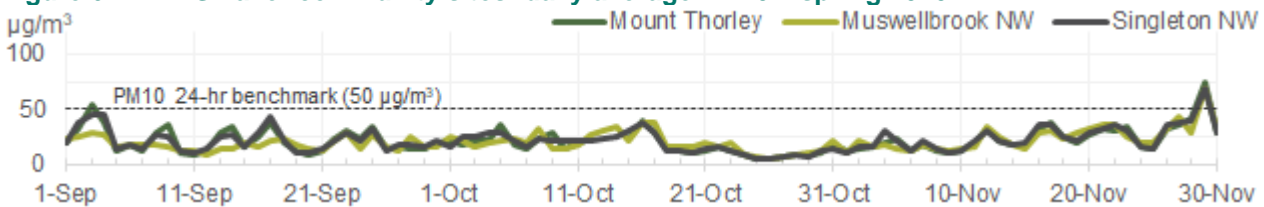
Daily average time series plots for PM10 and PM2.5 and daily one-hour maximum plots for NO<sub>2</sub> and SO<sub>2</sub> show the concentrations throughout spring (Figure 5 to Figure 11). PM2.5, NO<sub>2</sub> and SO<sub>2</sub> remained below the benchmarks. PM10 levels remained below the benchmark for most of the season. Elevated PM10 levels were observed throughout the region on 29 November 2020, with elevated dust occurring under moderate to strong north-westerly winds followed by a southerly change.



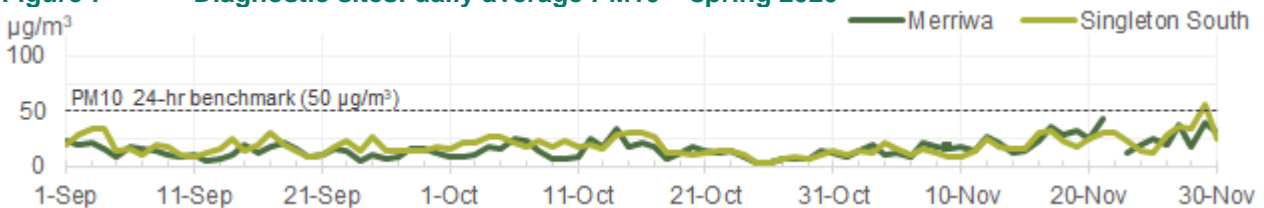
**Figure 5** Population centre sites: daily average PM10 – spring 2020



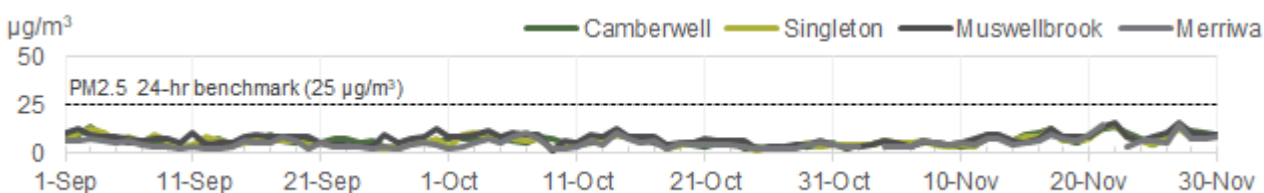
**Figure 6** Smaller community sites: daily average PM10 – spring 2020



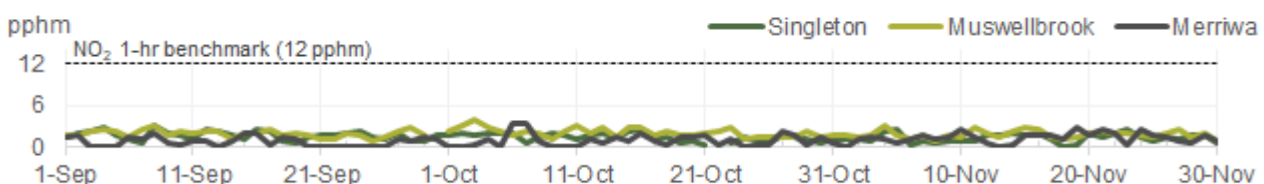
**Figure 7** Diagnostic sites: daily average PM10 – spring 2020



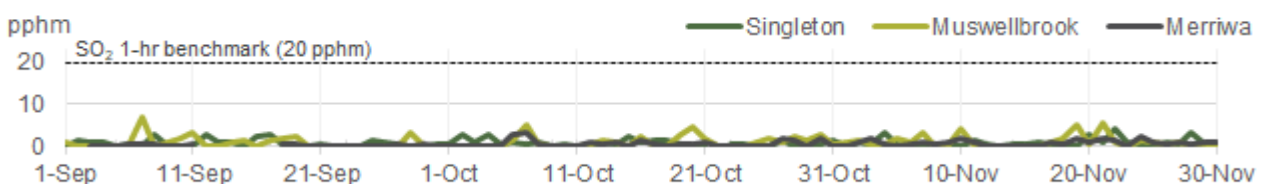
**Figure 8** Background sites: daily average PM10 – spring 2020



**Figure 9** Daily average PM2.5 – spring 2020



**Figure 10** Daily 1-hr maximum NO<sub>2</sub> – spring 2020



**Figure 11** Daily 1-hr maximum SO<sub>2</sub> – spring 2020

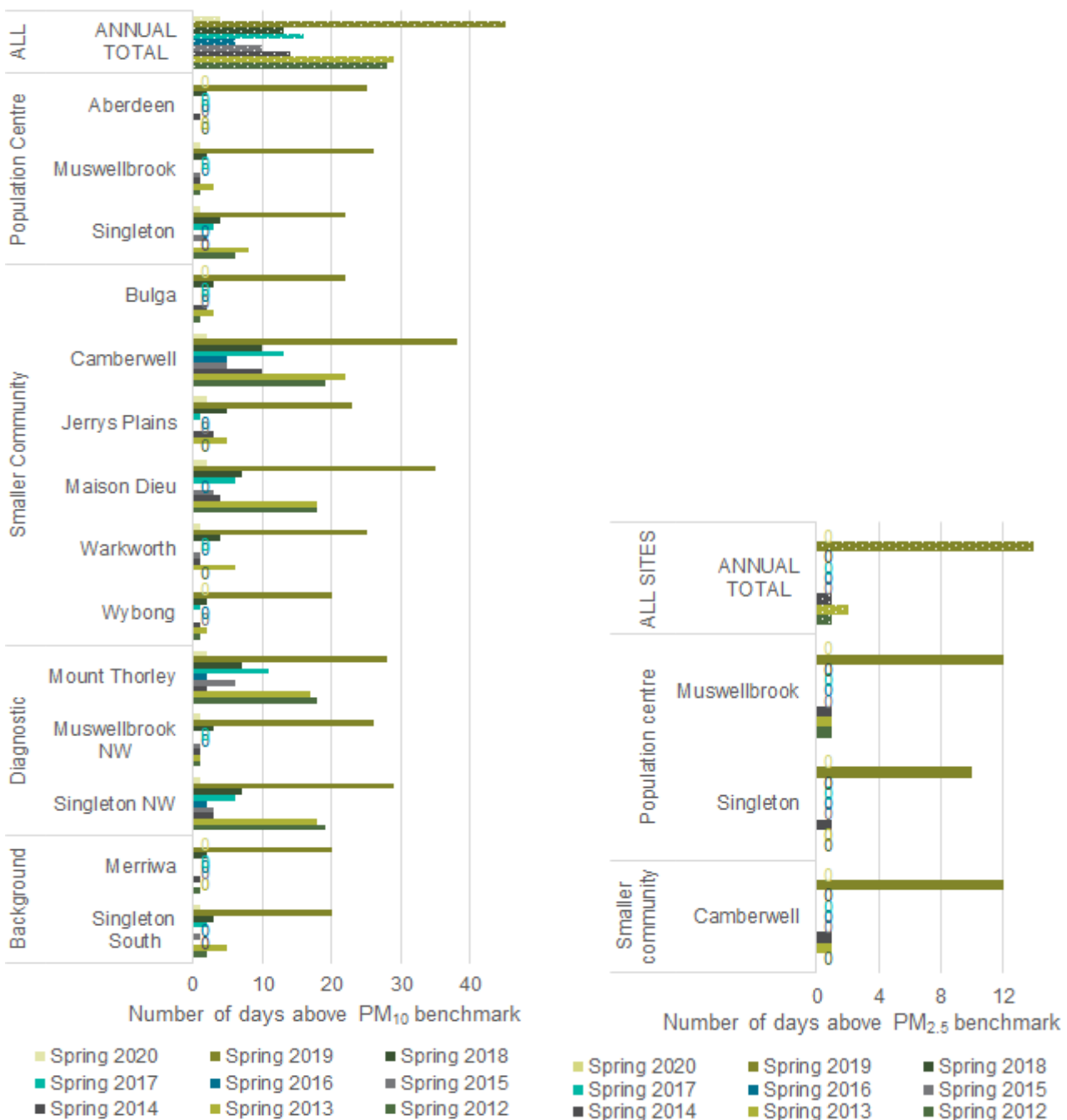
## Seasonal comparisons

This section compares air quality in spring 2020 with previous spring seasons (Figure 12).

All spring days were below national benchmark concentrations for NO<sub>2</sub> and SO<sub>2</sub> in the past nine years.

There were large decreases in the number of days over the particle benchmarks in spring 2020, especially compared to spring 2019.

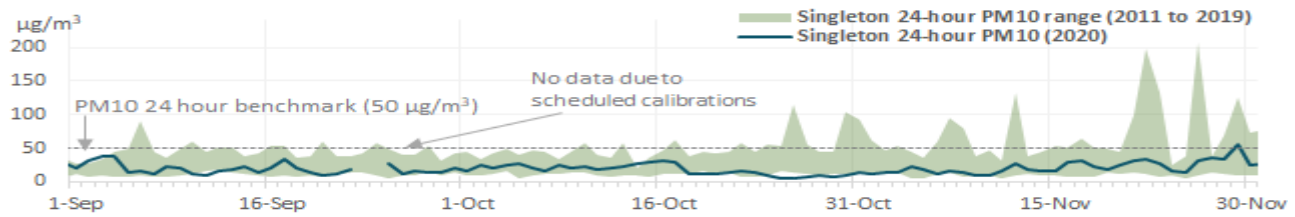
- There were four days over the PM<sub>10</sub> daily benchmark during spring 2020, with the number of days ranging from zero to two days at individual stations. In spring 2019, the region recorded 45 days over the PM<sub>10</sub> benchmark due to intense drought conditions and extreme bushfires. From 2012 to 2018, the region recorded between six days (spring 2016) and 29 days (spring 2013) over the PM<sub>10</sub> benchmark.
- There were no days over the PM<sub>2.5</sub> daily benchmark during spring 2020. In spring 2019, the region recorded 14 days over the PM<sub>2.5</sub> benchmark, due to extreme bushfires. From 2012 to 2018, the region recorded between zero days (springs 2015 to 2018) and two days (spring 2013) over the PM<sub>2.5</sub> benchmark.



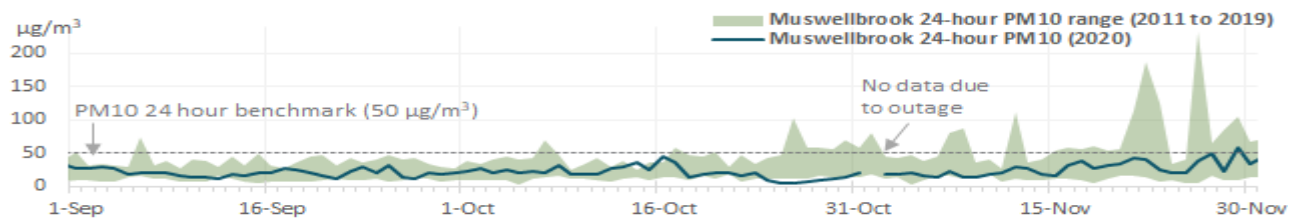
**Figure 12** Number of days above the PM<sub>10</sub> and PM<sub>2.5</sub> daily benchmarks – spring 2012 to 2020

## Particle air quality trends in the Upper Hunter

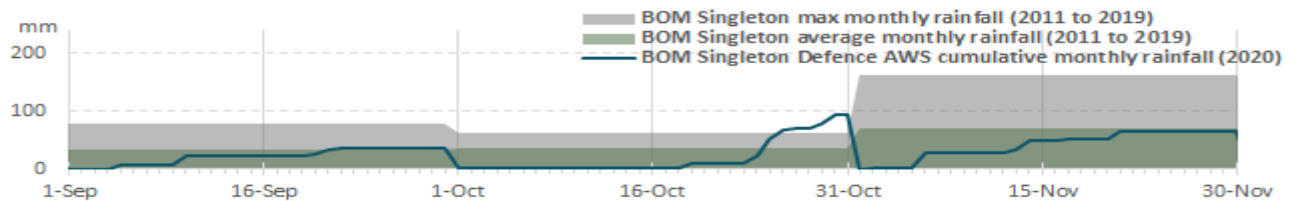
Figure 13 and Figure 14 show daily average PM10 levels during spring 2020, compared to the daily maximum and minimum levels (i.e. shaded range) for spring periods from 2011 to 2019, at Singleton and Muswellbrook. Daily PM10 levels were within the historical range throughout the season. Regional rainfall levels were average, with particularly good falls at Singleton during late October (Figure 15), corresponding with low particle levels.



**Figure 13** Singleton daily average PM10 during spring 2020 plotted against the daily maximum and minimum PM10 levels from 2011 to 2019

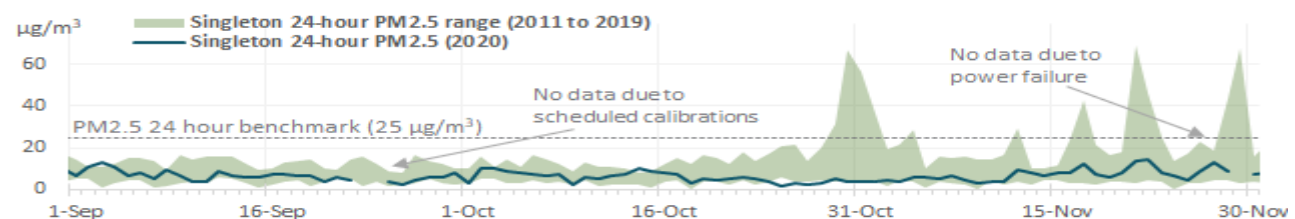


**Figure 14** Muswellbrook daily average PM10 during spring 2020 plotted against the daily maximum and minimum PM10 levels from 2011 to 2019

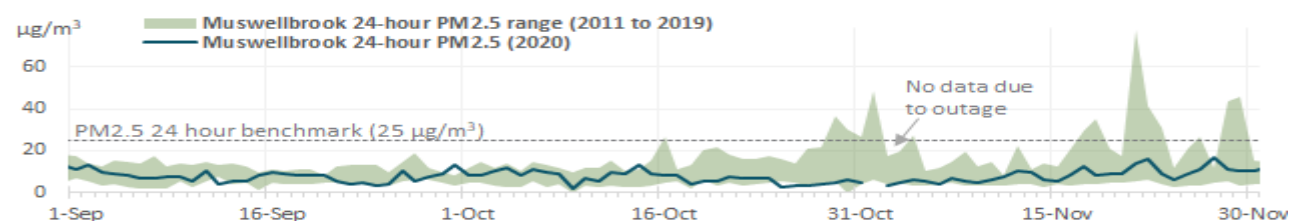


**Figure 15** Bureau of Meteorology Singleton Defence AWS<sup>4</sup> cumulative monthly rainfall in spring 2020 against maximum and average monthly rainfall from 2011 to 2019<sup>5</sup>

Figure 16 and Figure 17 show daily average PM2.5 levels during spring 2020, compared to the daily maximum and minimum levels (shaded range) for spring periods from 2011 to 2019, at Singleton and Muswellbrook. Daily PM2.5 levels were within the historical range throughout the season.



**Figure 16** Singleton daily average PM2.5 during spring 2020 plotted against the daily maximum and minimum PM2.5 levels from 2011 to 2019



**Figure 17** Muswellbrook daily average PM2.5 during spring 2020 plotted against the daily maximum and minimum PM2.5 levels from 2011 to 2019

<sup>4</sup> Data obtained from the Bureau of Meteorology [Singleton Defence AWS monthly rainfall data](#) (accessed January 2021).

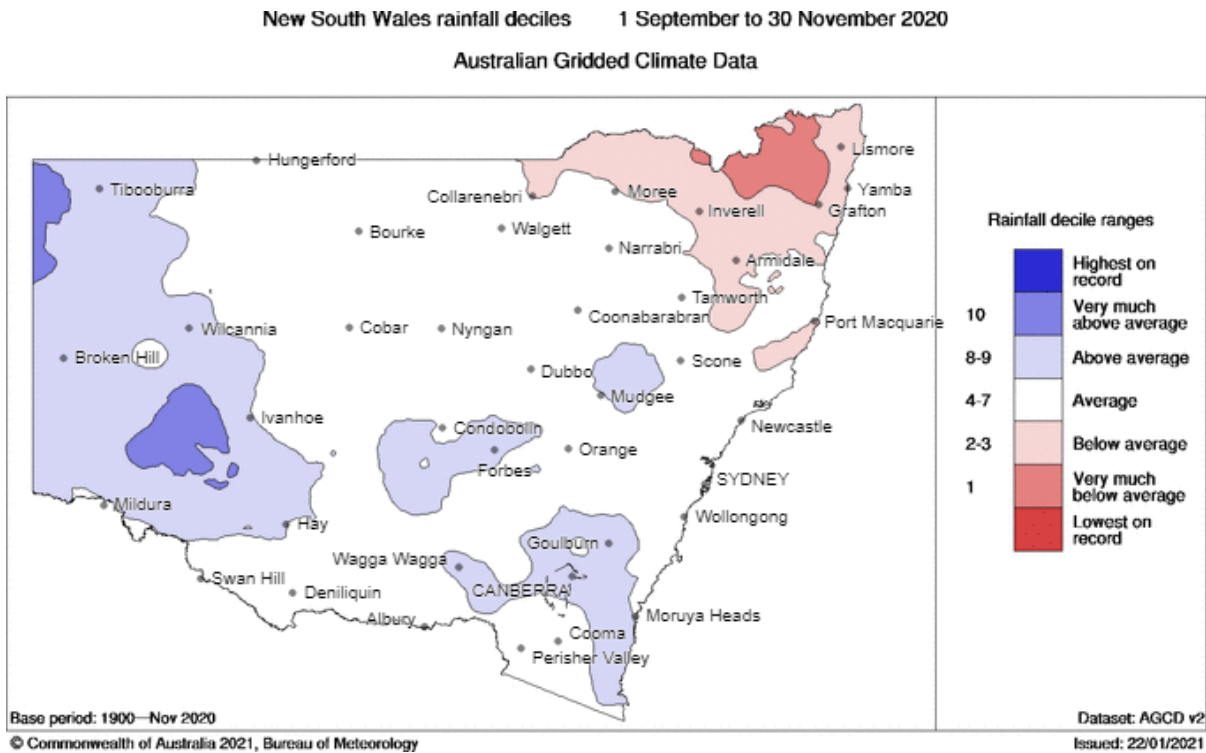
<sup>5</sup> The Bureau of Meteorology STP station was decommissioned in January 2019. Therefore, statistics have been calculated from a combination of the [Singleton STP monthly rainfall data](#) (accessed March 2020) from January 2011 to March 2017 and [Singleton Defence AWS monthly rainfall data](#) from April 2017.

# Meteorological summary

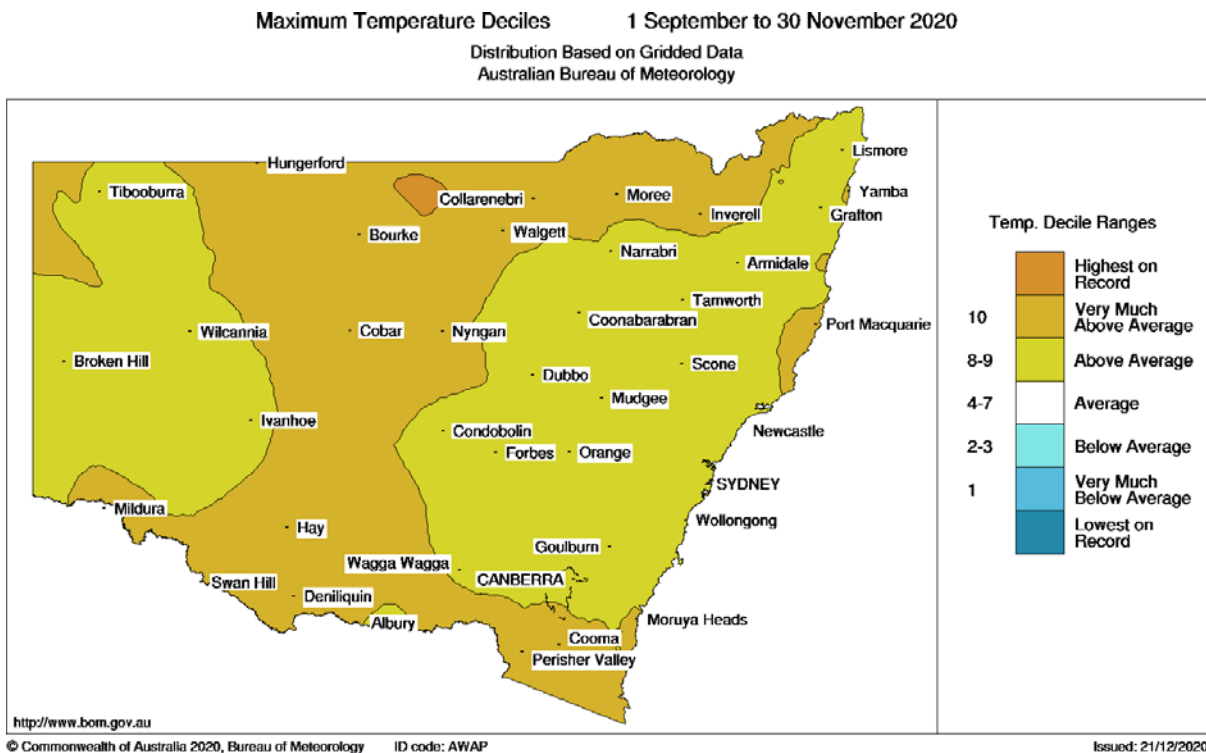
## Rainfall and temperature<sup>6</sup>

The Upper Hunter experienced average rainfall during spring 2020 (Figure 18). Spring 2020 was wetter than the past three springs. There was 50 to 200 millimetres more rain in spring 2020 than spring 2019 and spring 2017, and up to 100 millimetres more in some parts than spring 2018.

Maximum temperatures were above average (Figure 19) and minimum temperatures were very much above average during the season.



**Figure 18** NSW rainfall deciles – spring 2020



**Figure 19** NSW maximum temperature deciles – spring 2020

<sup>6</sup> Rainfall and temperature information is from the Bureau of Meteorology [New South Wales spring 2020 climate statement](#) (access January 2021) and [climate maps](#) (accessed January 2021)



## Wind

The winds were variable in the region during spring 2020 (Figure 20), which was typical for this transitional season. Winds typically change from north-westerly in winter to south-easterly in summer. Overall, regional wind speeds in spring 2020 were lower compared to spring 2019.

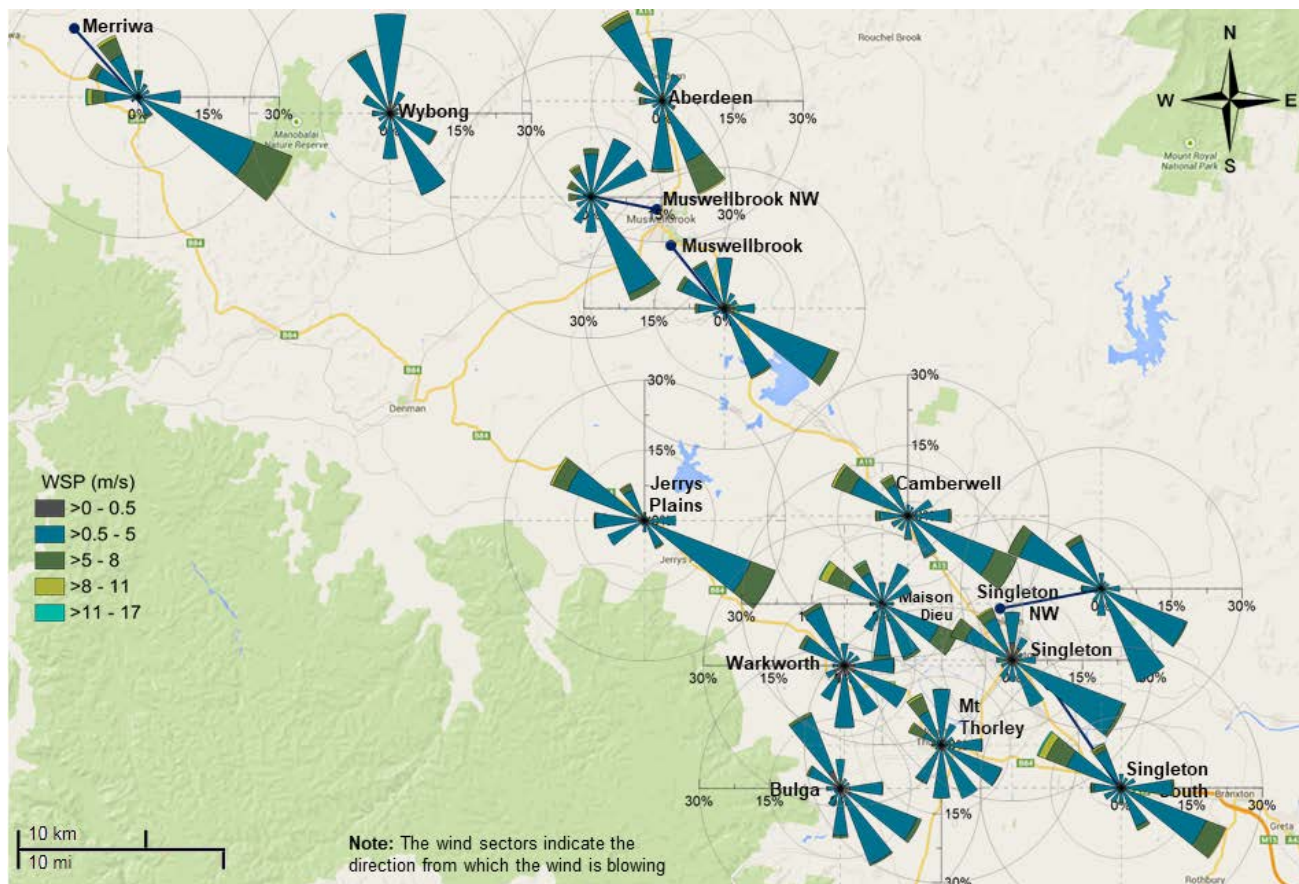


Figure 20 Wind rose map<sup>7</sup> for the Upper Hunter region for spring 2020

<sup>7</sup> Wind roses show the wind direction and speed at a location. The length of each bar around the circle show the percentage of time that the wind blows from a particular direction. The colours along the bars indicate the wind speed categories.

## Network performance

The target network performance is at least 95% available data for all parameters. The maximum online time that can be attained for NO<sub>2</sub> and SO<sub>2</sub> is 96%, due to daily calibrations.

**Table 2** Online performance (%) during spring 2020

Station	Particles PM10 daily	Particles PM2.5 daily	Gases SO <sub>2</sub> hourly	Gases NO <sub>2</sub> hourly	Meteorology Wind hourly
Aberdeen	100	-	-	-	100
Bulga	100	-	-	-	100
Camberwell	100	99	-	-	100
Jerrys Plains	98	-	-	-	98
Maison Dieu	98	-	-	-	98
Merriwa	99	98	85	95	98
Mount Thorley	98	-	-	-	99
Muswellbrook	99	99	92	93	100
Muswellbrook NW	100	-	-	-	100
Singleton	98	97	93	92	99
Singleton NW	100	-	-	-	99
Singleton South	100	-	-	-	100
Warkworth	98	-	-	-	100
Wybong	100	-	-	-	100

- = not monitored

The overall reduced online times were mainly due to:

- Merriwa SO<sub>2</sub> – communications fault (two days) and instrument fault (seven days).

## Definitions: Upper Hunter monitoring station types

The 14 monitoring stations in the Upper Hunter serve different purposes:

**Larger population:** stations near the larger population centres monitor the air quality in these centres.

**Smaller communities:** stations near smaller communities monitor the air quality at those locations.

**Diagnostic:** provide data that can help diagnose the likely sources and movement of particles across the region as a whole; they do not provide information about air quality at population centres.

**Background:** the stations near Merriwa and Singleton South are at both ends of the valley and provide background data, measuring the quality of air entering and leaving the Upper Hunter Valley under predominant winds (south-easterlies and north-westerlies).

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