Air Quality Monitoring Network Newcastle Autumn 2024 seasonal newsletter

Newcastle Autumn 2024

Air quality in the Newcastle region[1] was generally good[2] during autumn 2024.

- Daily average levels of PM2.5[3] remained below the 25 µg/m^3 benchmark[4] at all stations.
- Daily average levels of PM10 exceeded the 50 µg/m^3 benchmark on 10 days. These occurred on 9 days at Stockton (6, 9, 11–13, 19 March, and 13, 15, 17 April) and one day at Mayfield (1 March). As a result, daily average particle levels were within national benchmarks 89% of the time at Stockton, 99% at Mayfield, and 100% of the time at all other sites.
- Levels of nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ammonia (NH_3) were good, remaining below national benchmarks and assessment goals.
- Stockton exceeded the PM10 daily benchmark most often in March (6 days). Elevated PM10 levels at Stockton are influenced by sea salt spray transported by onshore winds, which prevail during the warmer months[6]. See Stockton section for details.
- Hourly particle levels were in the 'good to fair' air quality categories between 97% of hours at Stockton, ranging to 100% of the time at Wallsend and Beresfield.
- The region experienced very-much-above-average rainfall and above-average maximum and minimum temperatures during autumn.

Annual air quality trends

The national annual average benchmarks are 25 µg/m^3 for PM10 and 8 µg/m^3 for PM2.5, based on a calendar year. Long-term trends in annual average PM10 and PM2.5 levels are compared in Figure 1 and in Figure 2, showing the PM10 and PM2.5 rolling annual averages[5]. The rolling annual averages are based on the 12-month periods to the end of autumn, for 2015 to 2024.

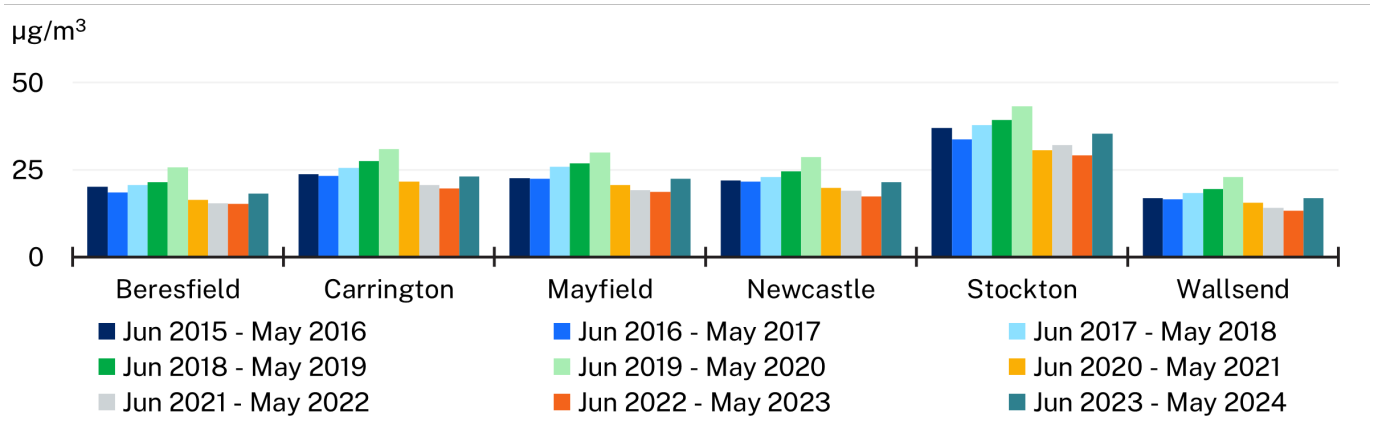

Figure 1 PM10 rolling annual averages[5] to the end of autumn 2015 to 2024

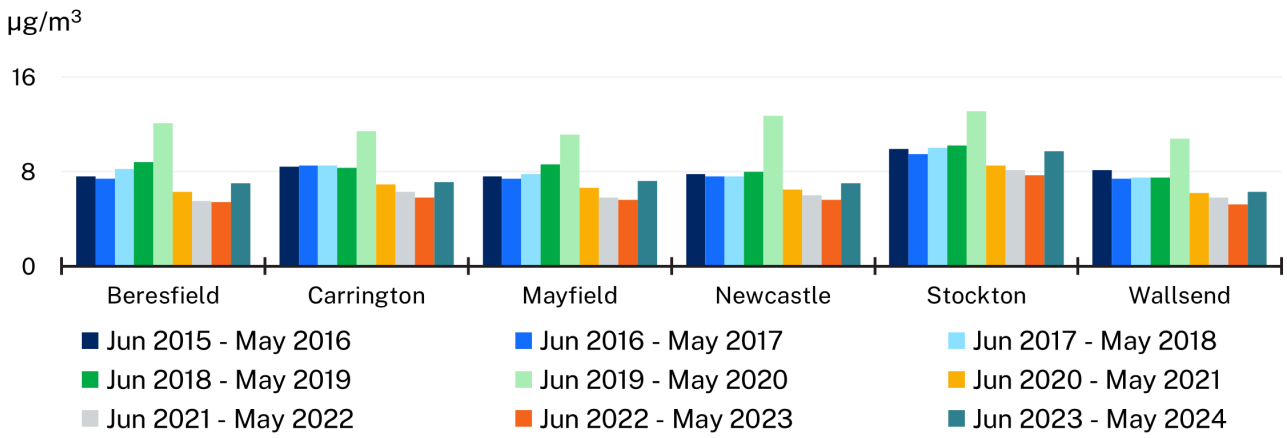

Figure 2 PM2.5 rolling annual averages[5] to the end of autumn 2015 to 2024

The comparisons in Figure 1 and Figure 2 show that particle levels at all stations (except for PM10 at Stockton) have risen for the first time since the 12 months to the end of autumn 2020, during which New South Wales was affected by significant bushfires. Rolling annual averages were below the PM10 and PM2.5 benchmarks respectively for all stations except Stockton in the 12 months to the end of autumn 2024.

The higher PM10 and PM2.5 annual averages at Stockton are consistent with the Lower Hunter Particle Characterisation Study[6]. This study found PM10 levels at Stockton were 2.5 times higher than Mayfield, mainly due to fresh sea salt. It also found 40% more PM2.5 at Stockton compared to Mayfield, Beresfield and Newcastle. This was due to more sea salt in onshore winds, and primary ammonium nitrate in north-west winds, particularly in winter (and very likely due to Orica's ammonium nitrate manufacturing facility on Kooragang Island).

At the end of autumn 2024, 34% of New South Wales was in one of the 4 drought categories (Figure 3)[7], compared to 1% at the end of autumn 2023[8], and 5% at the end of autumn 2022[9].

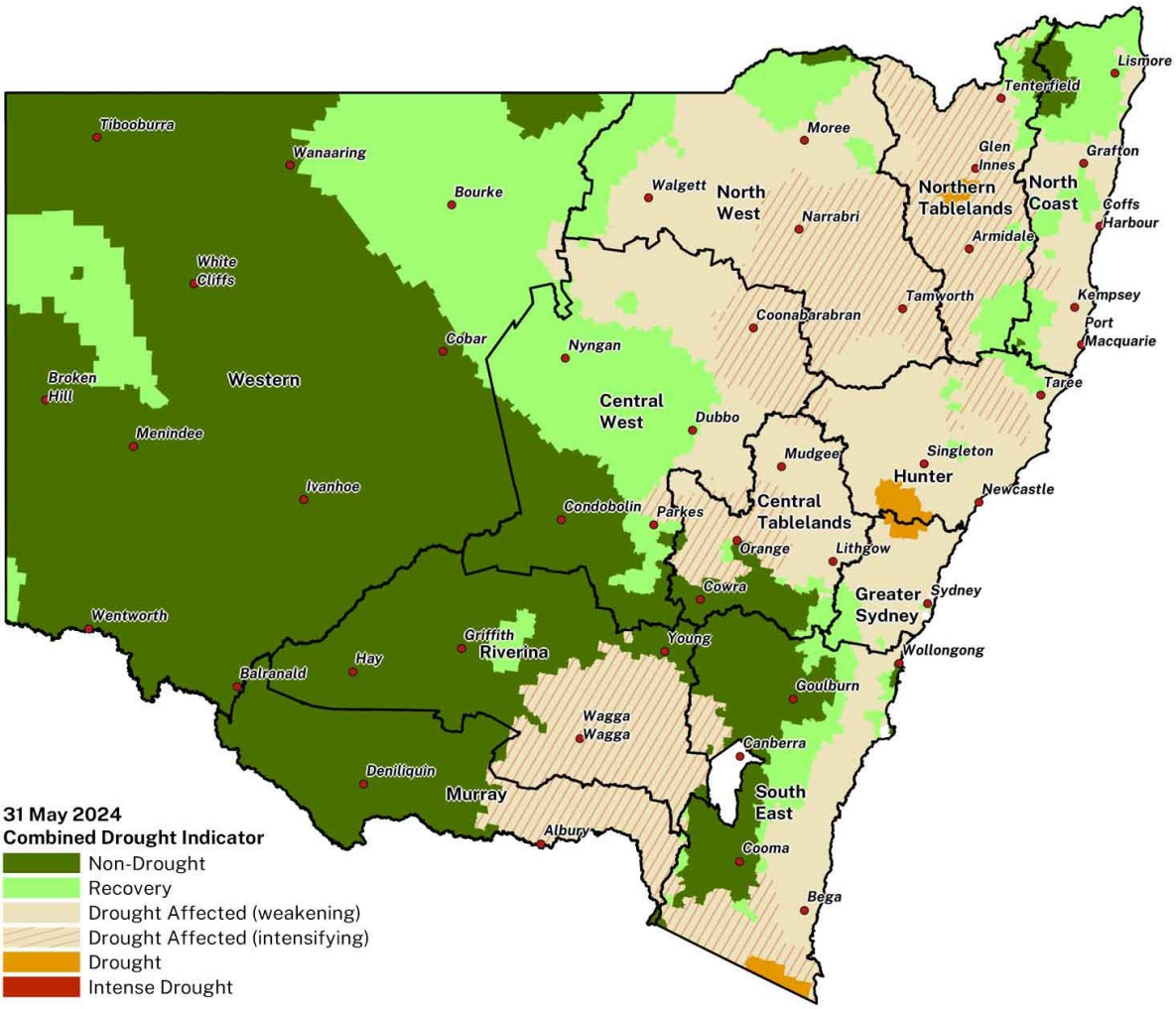

Figure 3 **NSW combined drought indicator to 31 May 2024**[7]

Credit: NSW Department of Primary Industries © State of New South Wales EDIS v2.2

Days above benchmark concentrations

Concentrations of particles as PM2.5, and SO_2, NO_2 and NH_3 were below benchmark at all stations. Particles as PM10 was the only exceeding pollutant during autumn 2024 at 2 stations (Table 1). Stockton recorded 9 days over the PM10 daily benchmark, followed by one day at Mayfield.

Table 1 **Number of days above the relevant benchmarks – autumn 2024**

Station	PM10 daily[3] [50 µg/m³ benchmark]	PM2.5 daily[3] [25 µg/m³ benchmark]	SO_2 hourly[3] [10 pphm benchmark]	SO_2 daily[3] [2 pphm benchmark]	NO_2 hourly[3] [8 pphm benchmark]	NH_3 hourly[3] [46 pphm benchmark]
Beresfield	0	0	0	0	0	–
Carrington	0	0	0	0	0	–
Mayfield	1	0	0	0	0	–
Newcastle	0	0	0	0	0	–
Stockton	9	0	0	0	0	0
Wallsend	0	0	0	0	0	–

'– ' = not monitored

Seasonal trends

There were no days above NO_2 and SO_2 benchmarks in autumn during the past 12 years at Beresfield, Newcastle, Stockton and Wallsend, or since monitoring began in 2014 at Carrington and Mayfield.

At Stockton, there have been no days over the NH_3 assessment criterion in autumn during the past 10 years.

Figure 4 to Figure 7 compare particle trends in autumn 2024 with previous autumn seasons where data were available[10].

In autumn 2024, the region had 10 days over the PM10 daily benchmark (Figure 4). This is less than autumn 2023, which had 12 days over the benchmark. Historically, days over the PM10 daily benchmark in autumn have ranged from one day (autumn 2013) to 21 days (autumn 2016).

The region recorded no days over the PM2.5 daily benchmark during autumn 2024, the same as previous 10 autumns (Figure 6). The only autumn day over the PM2.5 daily benchmark occurred at Wallsend in 2013 (Figure 7).

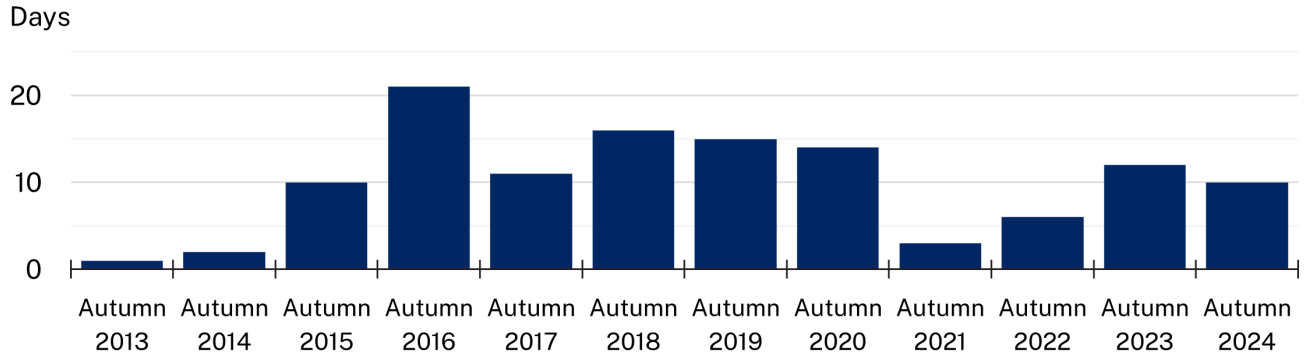

Figure 4 **Number of days above the PM10 daily benchmark in the Newcastle region: autumn 2013 to 2024**

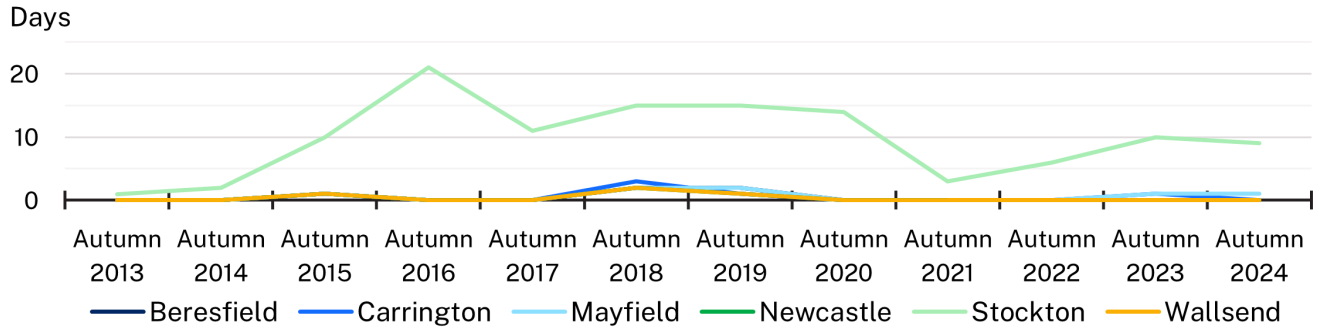

Figure 5 **Number of days above the PM10 daily benchmark at each station: autumn 2013 to 2024**

Note: There are no PM10 data for Carrington and Mayfield prior to August 2014. Data from Stockton prior to 14 October 2014 came from Orica[10].

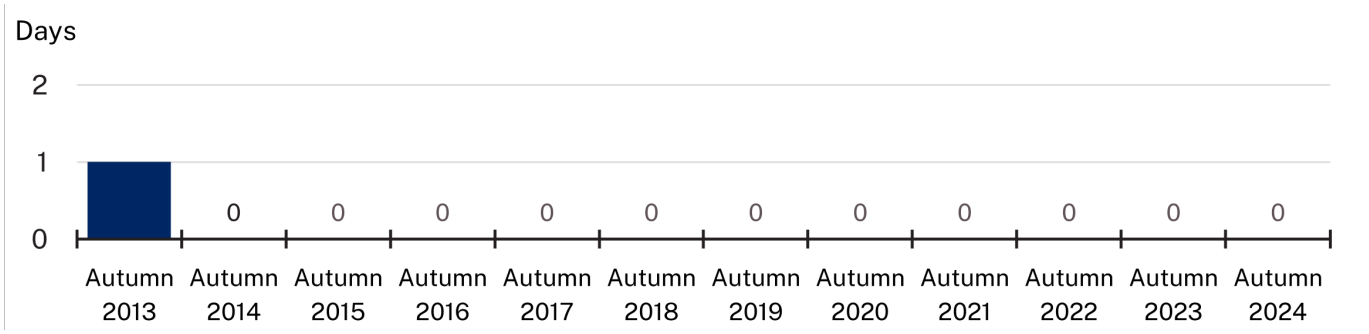

Figure 6 **Number of days above the PM2.5 daily benchmark in the Newcastle region: autumn 2013 to 2024**

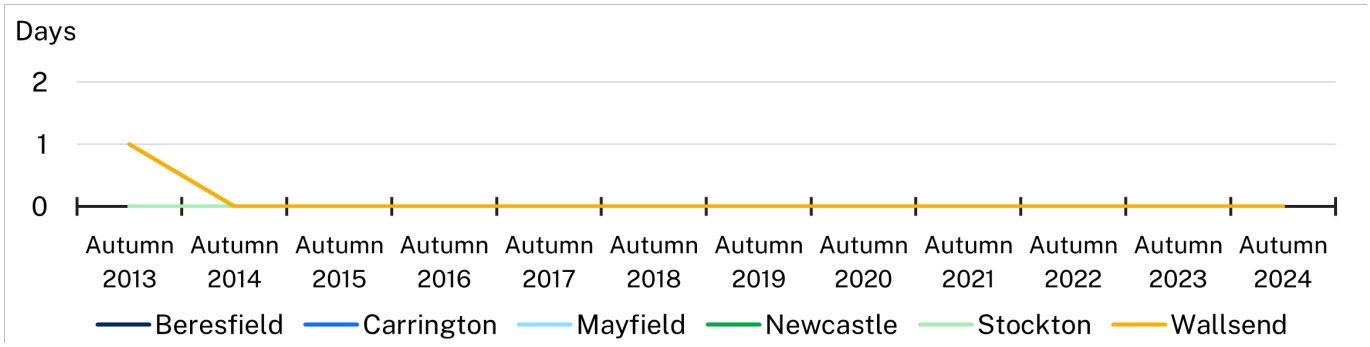

Figure 7 **Number of days above the PM2.5 daily benchmark at each station: autumn 2013 to 2024**

Note: There are no PM2.5 data for Carrington and Mayfield prior to August 2014, or Newcastle prior to December 2013. Data from Stockton prior to 14 October 2014 came from Orica[10].

Daily time series plots

Daily average time series plots for PM10 and PM2.5 and daily 1–hour maximum plots for NO_2, SO_2 and NH_3 are shown from Figure 8 to Figure 12 for autumn 2024. Except for PM10 at Stockton and Mayfield, all other parameters remained below the benchmarks and assessment criteria.

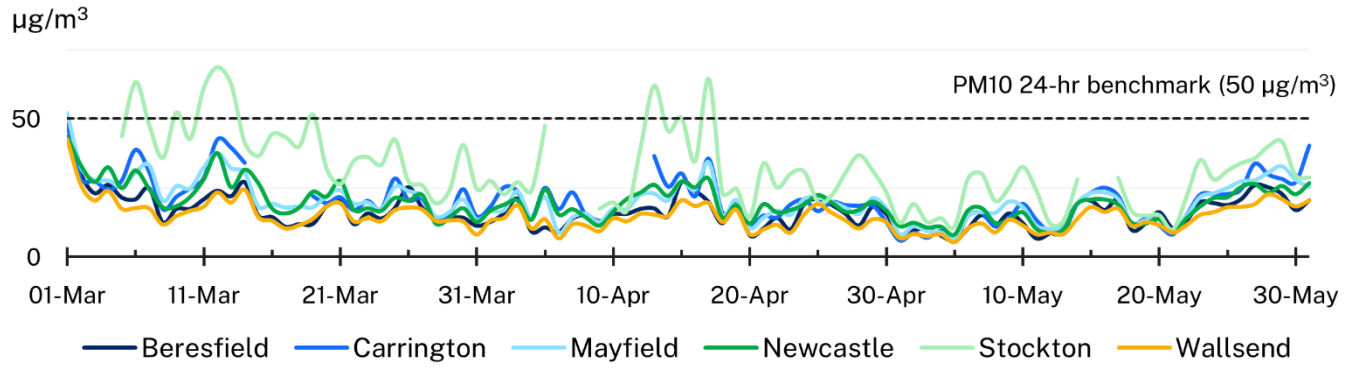

Figure 8 **Daily average PM10 during autumn 2024[11]**

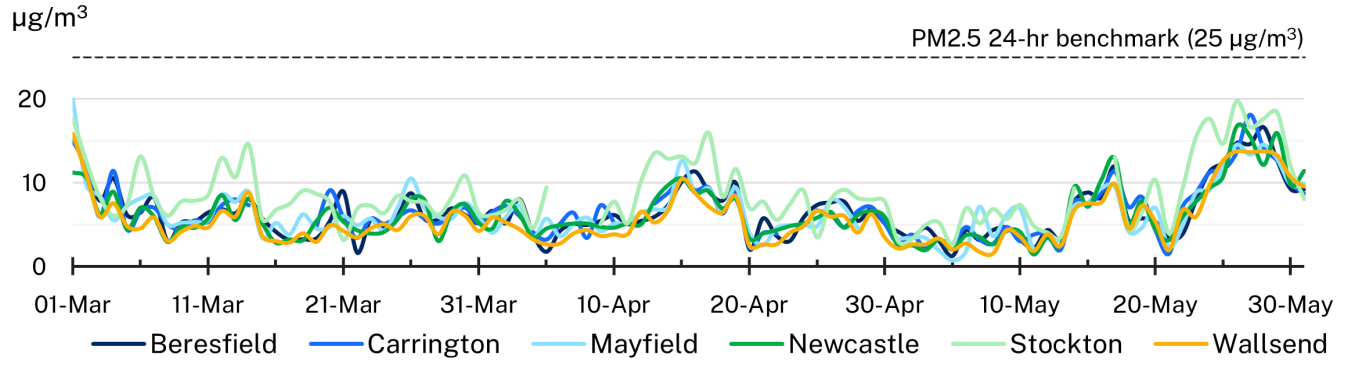

Figure 9 **Daily average PM2.5 during autumn 2024**[11]

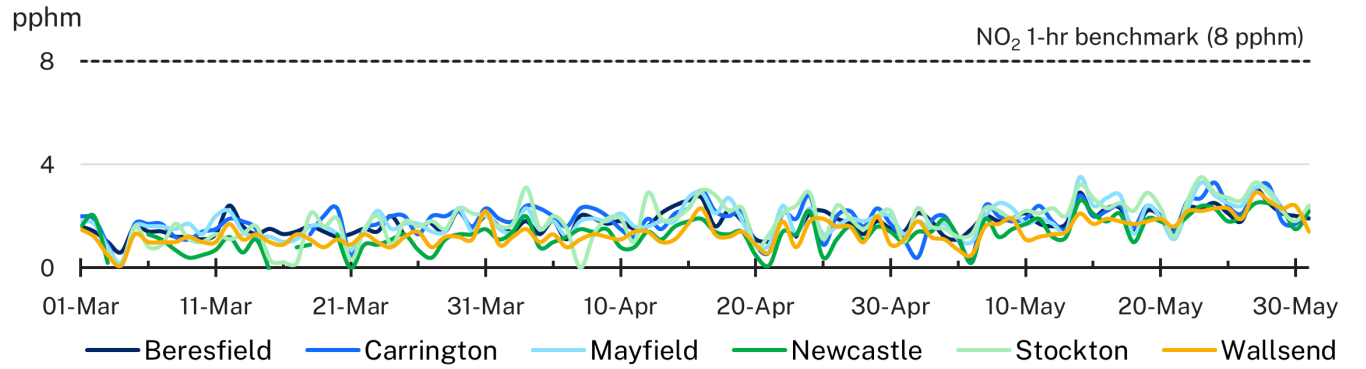

Figure 10 **Daily maximum 1-hr NO_2 during autumn 2024**[11]

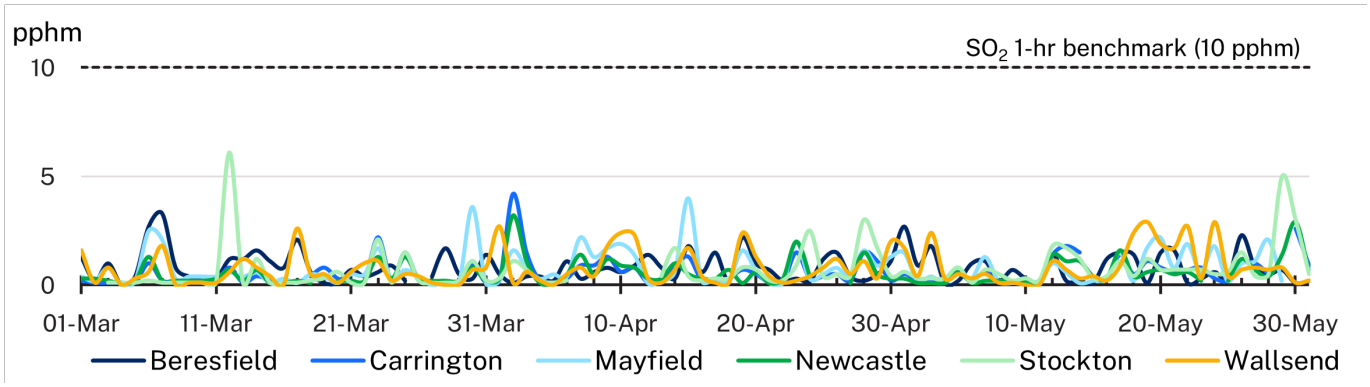

Figure 11 **Daily maximum 1-hr SO_2 during autumn 2024**[11]

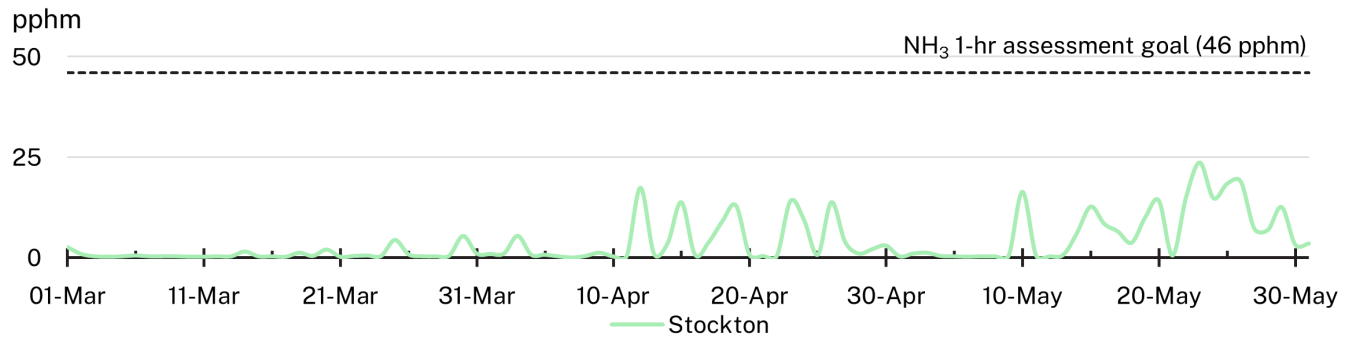

Figure 12 **Daily maximum 1-hr NH_3 during autumn 2024**

Pollution roses from hourly particle data

The seasonal pollution rose maps[12] (Figure 13 and Figure 14) show hourly PM10 and PM2.5 levels for the region's stations during autumn 2024, and the associated wind directions when these concentrations were observed.

Hourly PM10 levels were in the 'good to fair' categories (<100 µg/m^3) for 98% of hours at Stockton, ranging to 100% of hours at Wallsend and Beresfield (Figure 13). Elevated PM10 at Stockton was predominantly recorded during onshore easterly winds (north-east to south-east), indicative of sea salt influence (see Stockton section below for more detail).

Hourly PM2.5 levels were in the 'good to fair' categories[2] (< 50 µg/m^3) at all stations, 100% of the time. (Figure 14).

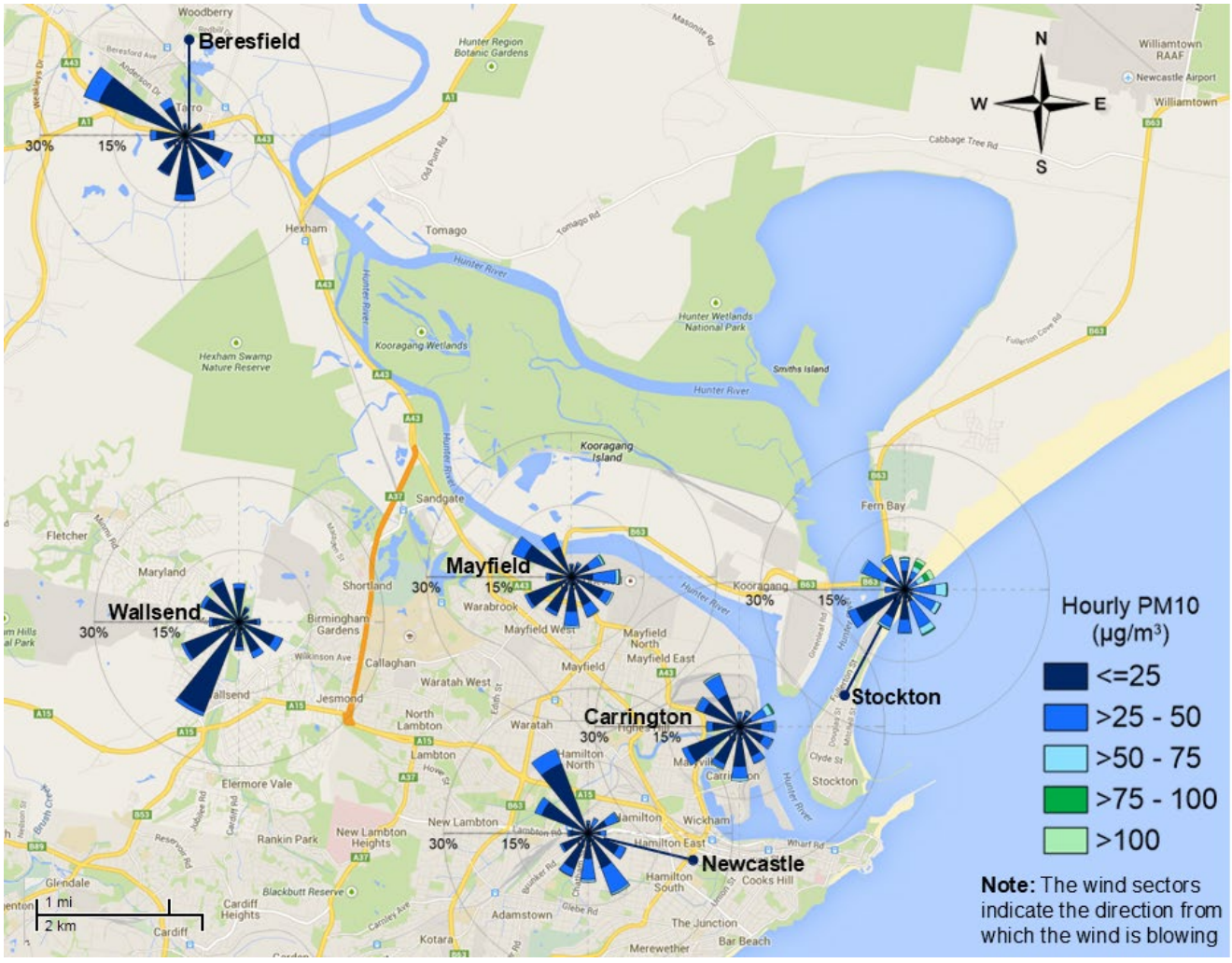

Figure 13 **Hourly PM10 pollution roses for the Newcastle region for autumn 2024**

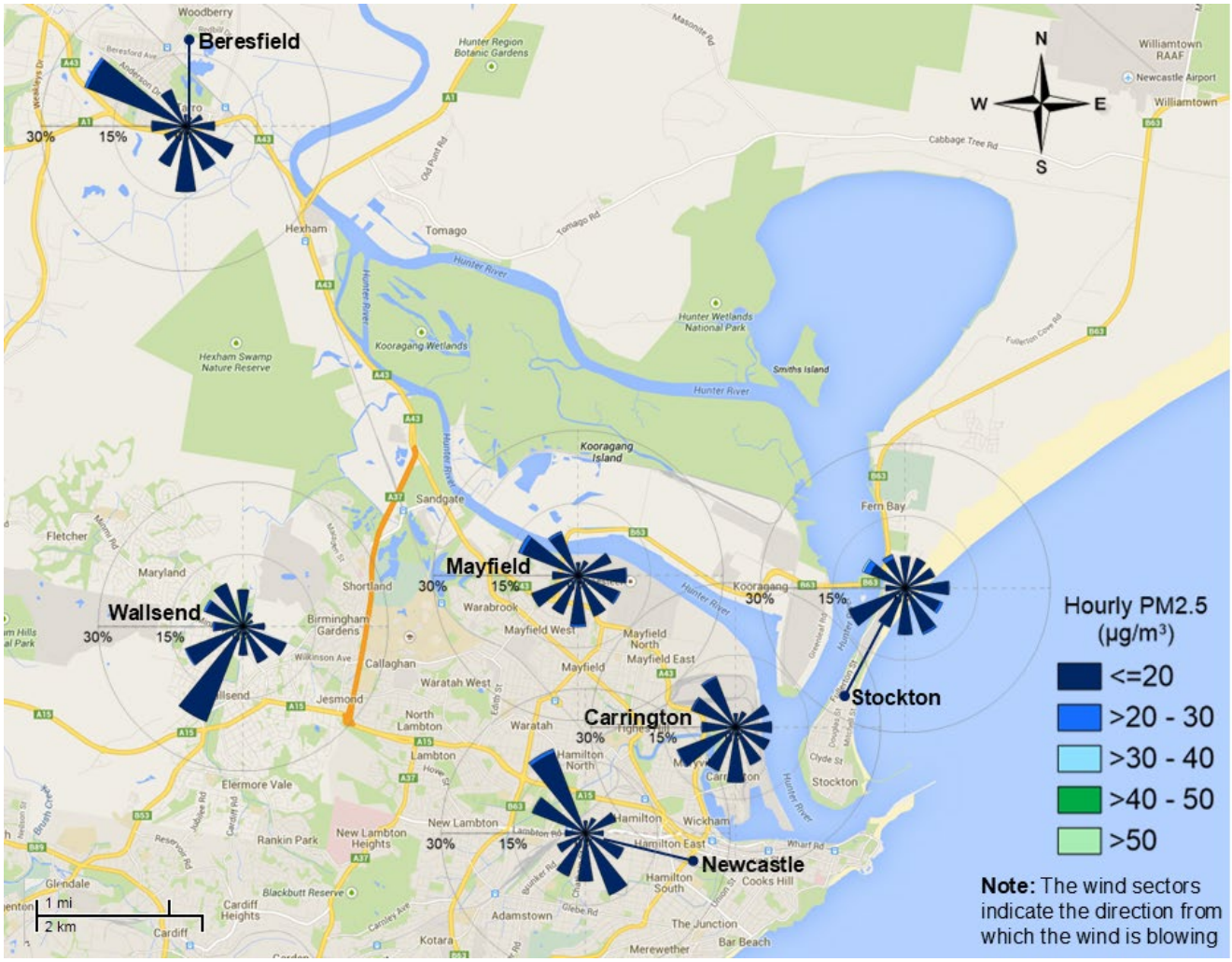

Figure 14 **Hourly PM2.5 pollution roses for the Newcastle region for autumn 2024**

Particle air quality trends

Figure 15 and Figure 16 compare daily average PM10 levels during autumn 2024, with historical PM10 levels (shaded blue) at Newcastle and Stockton stations. Both stations were generally within historical ranges, however, higher levels were seen in March and April at Stockton during onshore breezes indicative of sea salt (Figure 15).

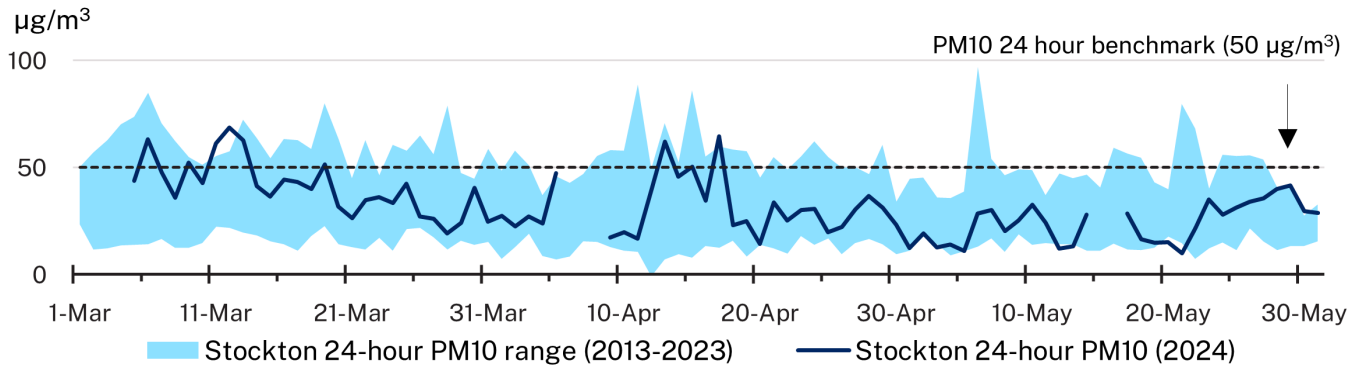

Figure 15 **Stockton daily average PM10 during autumn 2024 plotted against the daily maximum and minimum PM10 levels from 2013 to 2023**[11]

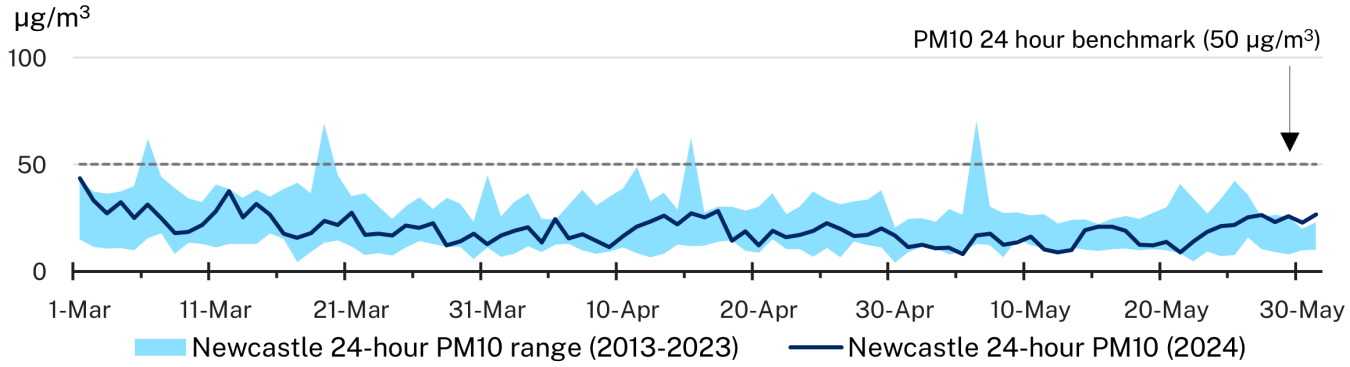

Figure 16 **Newcastle daily average PM10 during autumn 2024 plotted against the daily maximum and minimum PM10 levels from 2013 to 2023[11]**

Newcastle's Nobbys Signal Station Automatic Weather Station[13] recorded below-average rainfall for March 2024, above average in April 2024 and very much above average in May 2024 (Figure 17).

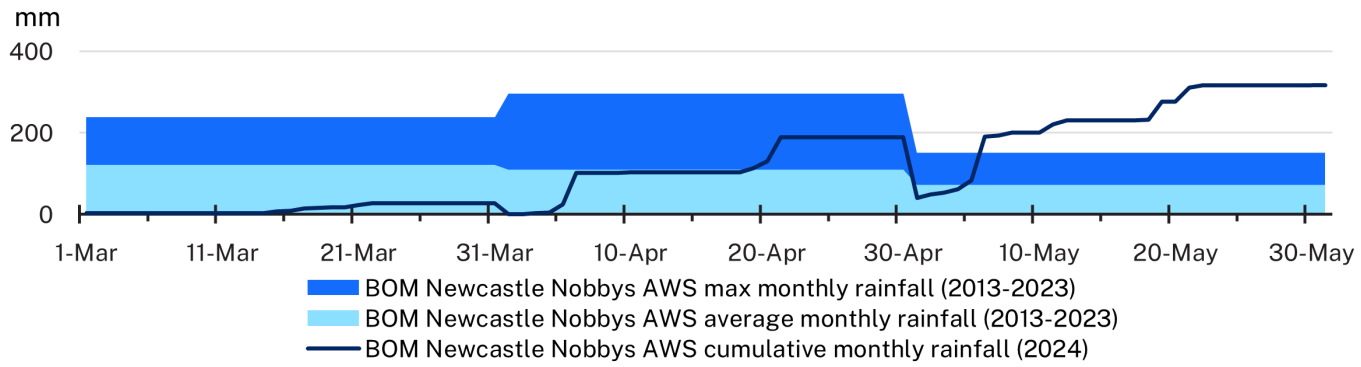

Figure 17 **Bureau of Meteorology Newcastle Nobbys Signal Station Automatic Weather Station[13] cumulative rainfall during autumn 2024 plotted against maximum and average rainfall from 2013 to 2023**

Figure 18 and Figure 19 compare daily average PM2.5 levels during autumn 2024 to historical levels (shaded blue) at Newcastle and Stockton stations. Both stations were mostly within historical ranges during autumn 2024.

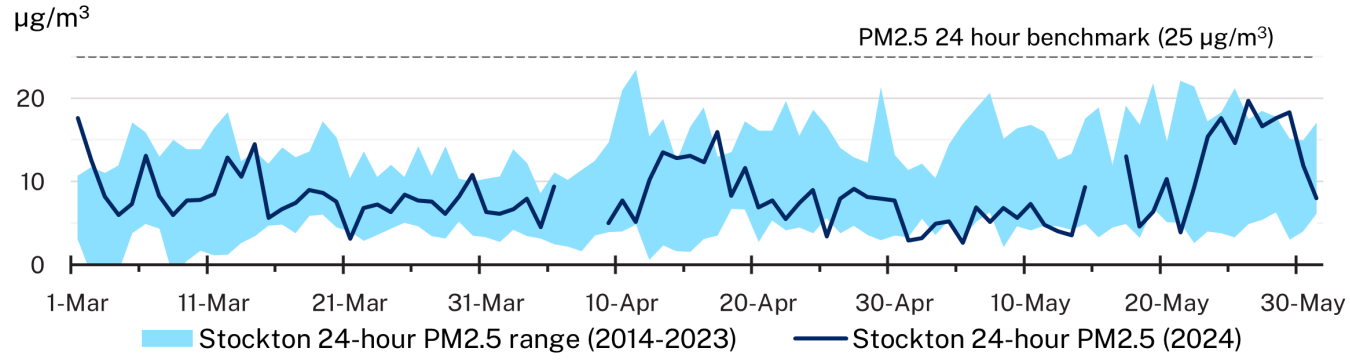

Figure 18 **Stockton daily average PM2.5 during autumn 2024 plotted against the daily maximum and minimum PM2.5 levels from 2014 to 2023[11]**

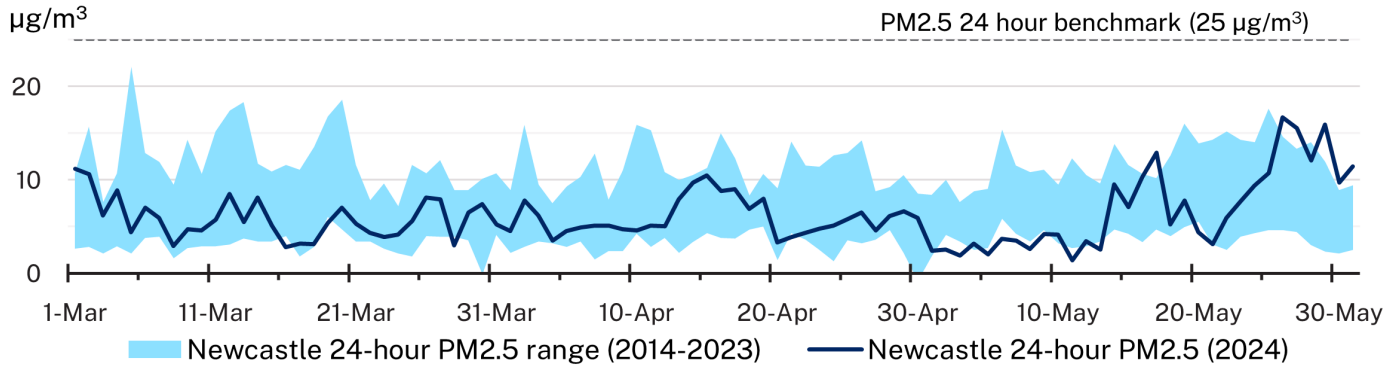

Figure 19 **Newcastle daily average PM2.5 during autumn 2024 plotted against the daily maximum and minimum PM2.5 levels from 2014 to 2023**[11]

Meteorological summary

Rainfall and temperature[14]

The Newcastle region experienced very-much-above-average rainfall during autumn 2024 compared to long-term records (Figure 20).

Maximum (Figure 21) and minimum (not shown) temperatures were above average during the season.

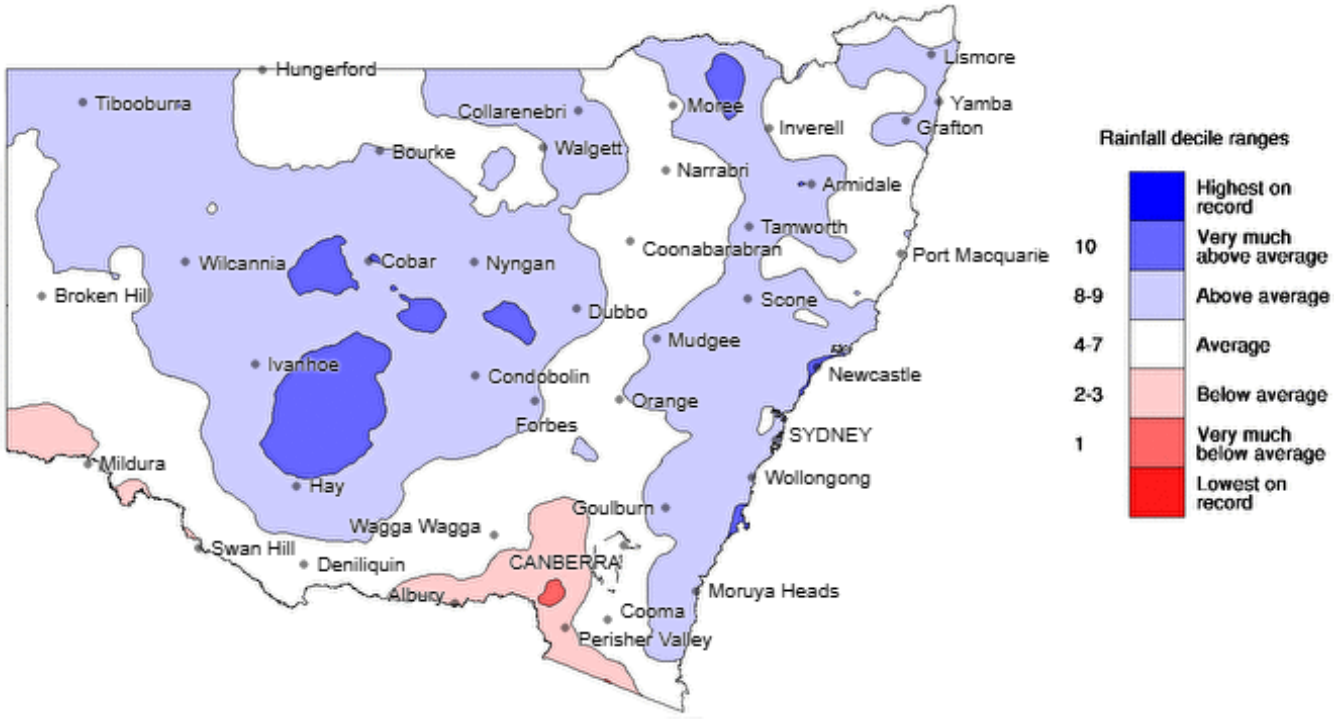

Figure 20 **NSW rainfall deciles autumn 2024**

Credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. Base period: 1900-Nov 2023. Dataset: AGCD v2. Issued 20/09/2024

Figure 21 NSW maximum temperature deciles autumn 2024

Credit: ©Commonwealth of Australia 2024, Bureau of Meteorology. ID code: AWAP. Issued 29/05/2024

Wind

Winds were variable in the region during autumn 2024 (Figure 22), with an increasing percentage of north-westerly winds. Winds typically shift from onshore easterly flows during the warmer months to offshore westerly flows as temperatures cool.

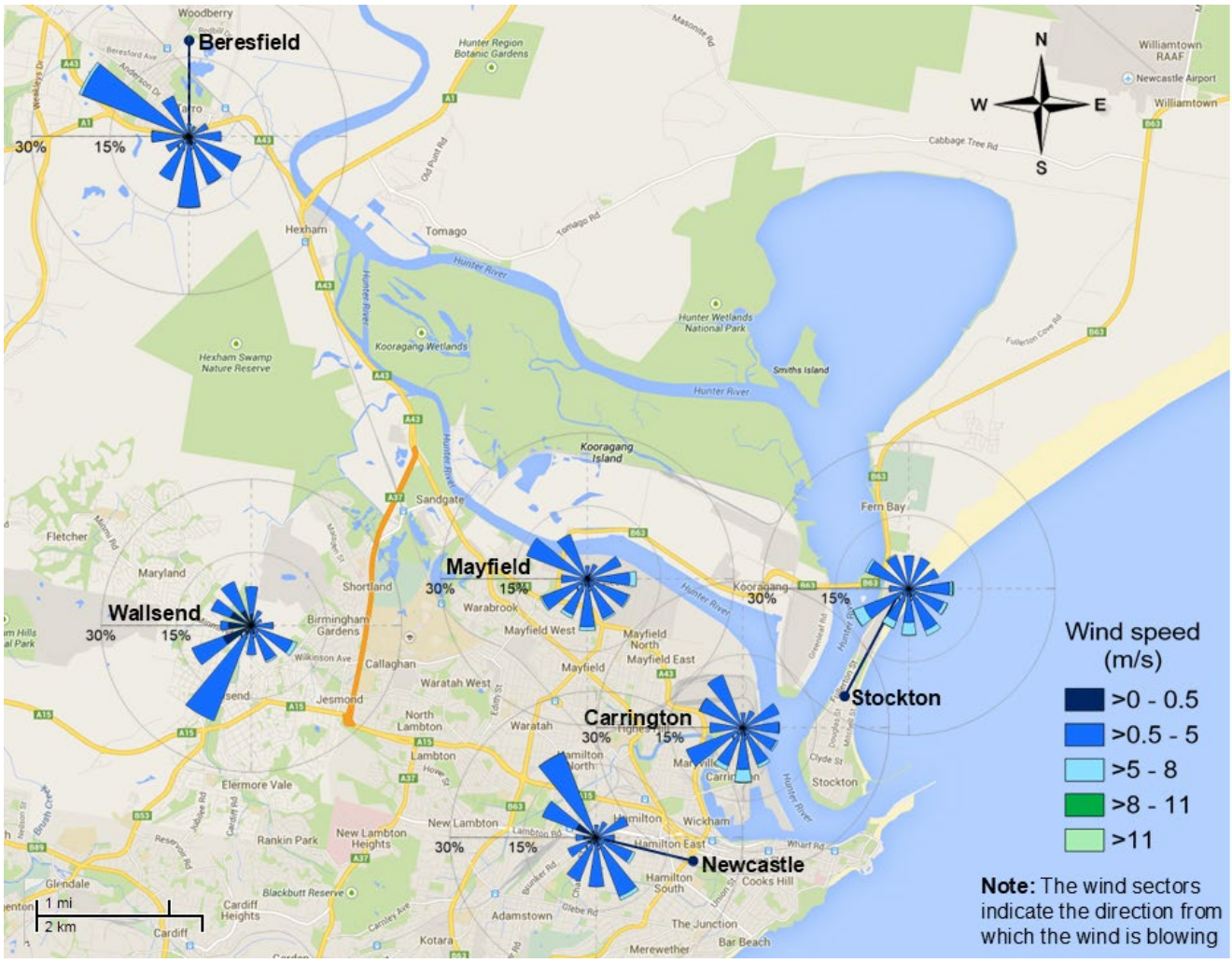

Figure 22 **Wind rose map for the Newcastle region autumn 2024**

Stockton

The Stockton monitoring station recorded 9 days over the PM10 daily benchmark during autumn 2024, one day less than autumn 2023. From 2013 to 2024, the station recorded between one day (autumn 2013) and 21 days (autumn 2016) over the PM10 daily benchmark (Figure 5).

In autumn 2024, elevated hourly PM10 levels (>100 µg/m^3) were recorded at Stockton 2.1% of the time (43 hours). These elevated hours above a 100 µg/m^3 occurred under onshore north-easterly to south-easterly winds 98% of the time (42 hours) (Figure 23). Elevated PM10 levels under predominant onshore winds at Stockton indicate the likely contribution of sea salt. The Lower Hunter Particle Characterisation Study[6] found sea salt was a major contributor of particles at the station under onshore winds.

The Stockton monitoring station did not record any days over the PM2.5 daily benchmark during autumn 2024. This was the same as all previous years during autumn (Figure 7).

There were 2 hours with elevated hourly PM2.5 levels (>40 µg/m^3) during autumn 2024 (pollution rose not shown). The maximum hourly PM2.5 level was 40.5 µg/m^3, one which occurred under north-easterly winds and the other under north-westerly winds.

There were no days with elevated NH_3 during autumn 2024 (pollution rose not shown).

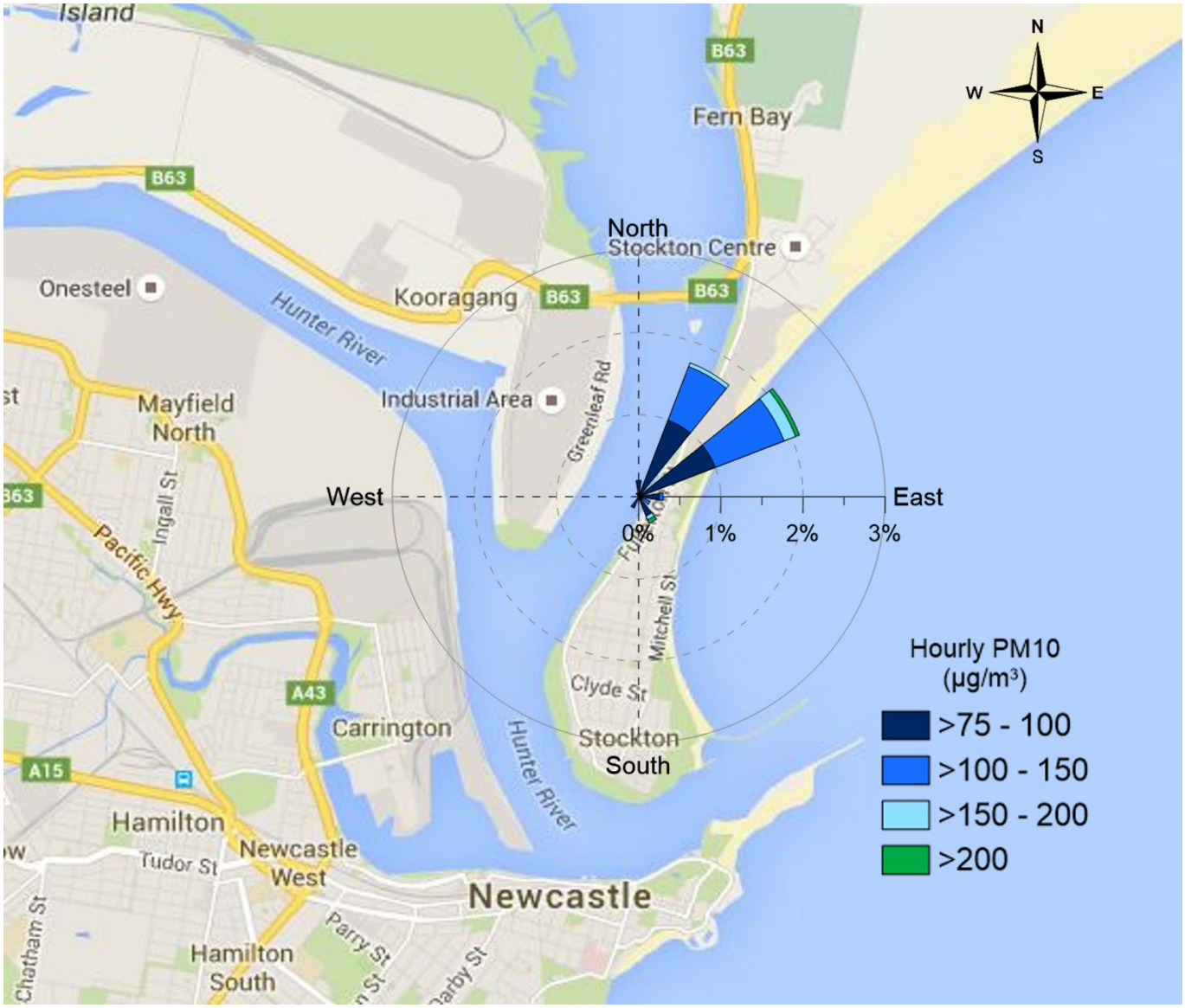

Figure 23 **Stockton PM10 pollution rose for hourly PM10 levels over 75 µg/m^3 autumn 2024**

Network performance

The target network performance is at least 95% available data. Due to daily calibrations for the gaseous parameters NO_2, SO_2 and NH_3, the maximum online time that can be attained is 96%.

Table 2 Network performance (%) during autumn 2024

Station	Particles daily PM10	Particles daily PM2.5	Gases hourly SO_2	Gases hourly NO_2	Gases hourly NH_3	Meteorology hourly
Beresfield	100	100	94	91	–	100
Carrington	94	91	89	90	–	99
Mayfield	100	98	94	94	–	100
Newcastle	100	100	88	86	–	100
Stockton	90	95	87	92	93	95
Wallsend	100	100	95	95	–	100

'– ' = not monitored

The reduced online time for Carrington, Newcastle, Stockton NO_2 and SO_2 was due to instrument faults and scheduled maintenance:

Carrington PM10, PM2.5, SO_2: scheduled maintenance and instrument faults

Newcastle SO_2, NO_2: scheduled maintenance and instrument faults

Stockton PM10, SO_2, meteorology: scheduled maintenance, and new installation of WDR/WSP sensors.

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[1] 'Newcastle region' includes the 3 Lower Hunter air quality region stations (Beresfield, Newcastle, Wallsend), and 3 stations in the Newcastle local air quality region (Carrington, Mayfield, Stockton) located nearby the Port of Newcastle.

[2] Air quality categories

[3] PM2.5 and PM10 refer to airborne particles, less than or equal to 2.5 and 10 micrometres in diameter respectively, measured in micrograms per cubic metre ($\mu g/m^3$). NO_2 refers to nitrogen dioxide and O_3 refers to ozone, both of which are measured in parts per hundred million by volume or parts of pollutant per hundred million parts of air (pphm).

[4] Most benchmarks can be found at National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) standards. Data from Stockton, Mayfield and Carrington are presented for comparison purposes and not for the purposes of assessing compliance against the AAQ NEPM. There are no hourly standards for PM10 or PM2.5, nor is there a NEPM standard for ammonia (NH_3), whose assessment goal is given as an hourly average of 46 pphm.

[5] Rolling annual averages use 12 months of data to the end of the season. These are used indicatively to assess long-term trends using the most up-to-date monitoring data and are not intended for comparison to the calendar year annual benchmarks of 25 $\mu g/m^3$ for PM10 and 8 $\mu g/m^3$ for PM2.5.

[6] Lower Hunter Particle Characterisation Study found sea salt contributes significantly to PM10 levels at Stockton station during the warmer months.

[7] Sourced from Department of Primary Industries NSW State seasonal update – May 2024 (accessed September 2024).

[8] Sourced from Department of Primary Industries NSW State seasonal update – May 2023 (accessed September 2023).

[9] Sourced from Department of Primary Industries NSW State seasonal update – May 2022 (accessed July 2022).

[10] Monitoring at Stockton commenced in October 2012 and at Mayfield and Carrington in August 2014. Monitoring of PM2.5 at Newcastle commenced in December 2013. Stockton air quality monitoring was undertaken by Orica from October 2012 to October 2014. From October 2014 it was undertaken by the NSW Government as part of the Newcastle Local Air Quality Monitoring Network.

[11] Data gaps at Newcastle region stations this season were predominantly due to data logger and power issues, on top of maintenance checks.

[12] 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 a particular direction. The colours along the bars indicate categories of particle levels.

[13] Data from Bureau of Meteorology Newcastle Nobbys Signal Station AWS monthly rainfall page (accessed January 2024).

[14] Rainfall and temperature information is from the Bureau of Meteorology New South Wales Autumn 2024 climate statement (accessed February 2023) and climate maps (accessed January 2024).