Air quality in Newcastle: Summer 2016-17

Air quality in Newcastle from 1 December 2016 to 28 February 2017 was generally good.

- Levels of fine particulate matter $PM_{2.5}$ (particles less than or equal to 2.5 microns in diameter), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ammonia (NH_3) were all below benchmark concentrations.
- Daily average levels for particulate matter PM_{10} (particles less than or equal to 10 microns in diameter) were above the 50 µg/m^3 benchmark on 27 days during summer 2016–17 (2, 10, 12, 14, 18, 20, 26–31 December, 11, 13–15, 18–19, 22–24 January and 6, 9–10, 21–23 February).
  - Carrington recorded elevated levels on three days (11 January, 14 January and 6 February) with daily averages up to 51.5 µg/m^3 on these days. Particle levels were also over the benchmark at Stockton on these days. NSW was in a high fire danger period during the January events.
    - On 11 January, elevated hourly PM_{10} levels mainly occurred in the early morning under very light northerly winds, with an additional spike in the afternoon during a south-westerly change.
    - On 14 January, elevated hourly PM_{10} levels occurred in the morning under very light northerly winds, following a period of southerly winds. These coincided with an increase in hourly $PM_{2.5}$ levels, which is often indicative of smoke. A fire[1] was burning at Morisset, about 25 kilometres south-west from 13 January, which may have impacted the region.
    - On 6 February, elevated PM_{10} levels occurred in the morning under light northwest winds.
  - Stockton recorded elevated levels on all 27 days. Daily averages ranged from 51.0 to 80.3 µg/m^3 and averaged 57.5 µg/m^3 on these days. During this time, elevated levels mainly occurred, about 78% of the time, under onshore easterly winds. Stockton particle levels are influenced by sea salt from onshore winds[2], which are typical during summer.

Days above benchmark concentrations

Daily PM_{10} levels were over the benchmark on three days at Carrington and 27 days at Stockton during summer 2016–17.

Table 1: Number of days above the relevant benchmarks – summer 2016-17

Station	PM_{10} daily [50 µg/m^3 benchmark]	$PM_{2.5}$ daily [25 µg/m^3 benchmark]	SO_2 hourly [20 pphm benchmark]	SO_2 daily [8 pphm benchmark]	NO_2 hourly [12 pphm benchmark]	NH_3 hourly [46 pphm benchmark]
Beresfield	0	0	0	0	0	-
Carrington	3	0	0	0	0	-
Mayfield	0	0	0	0	0	-
Newcastle	0	0	0	0	0	-
Stockton	27	0	0	0	0	0
Wallsend	0	0	0	0	0	-

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

[1] Rural Fire Service ICON database: Lake Macquarie 366ha fire ("Stockdale Fire") with 117ha burnt by morning on 14 January
[2] Lower Hunter Particle Characterisation Study

Daily time series plots

Daily average $PM_{2.5}$ and one hour maximum concentrations of NO_2, SO_2 and NH_3 remained below the benchmarks during summer 2016-17.

Daily average PM_{10} concentrations were above the benchmark on 27 days during summer 2016–17, predominantly at Stockton which is influenced by sea salt spray under onshore winds. More information on the elevated particle levels at Stockton are included in a section below.

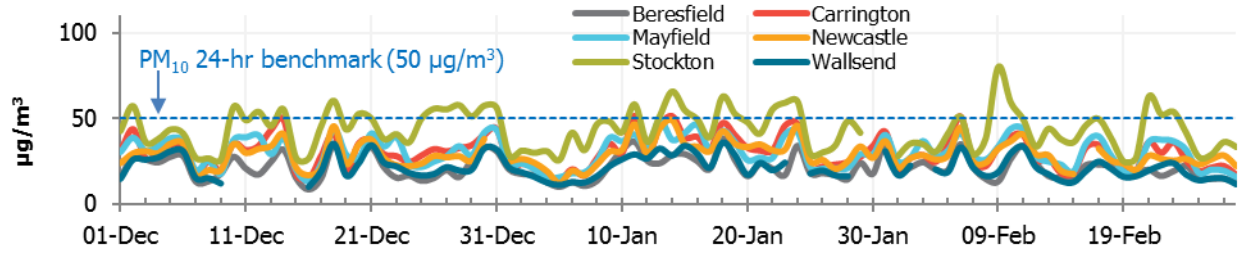

Figure 1: Daily average PM_{10} during summer 2016–17

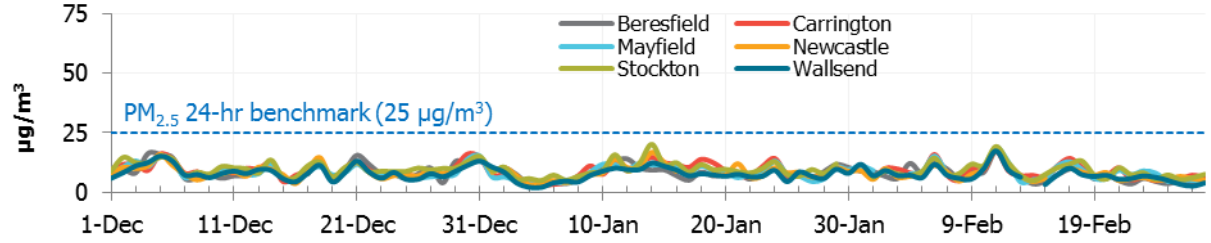

Figure 2: Daily average $PM_{2.5}$ during summer 2016–17

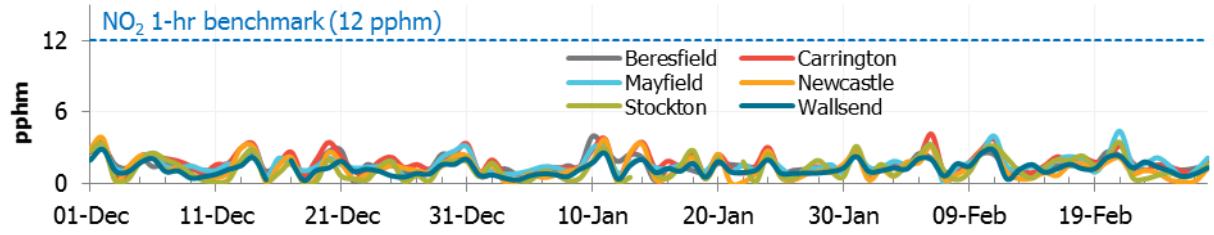

Figure 3: Daily 1-hr maximum NO_2 during summer 2016–17

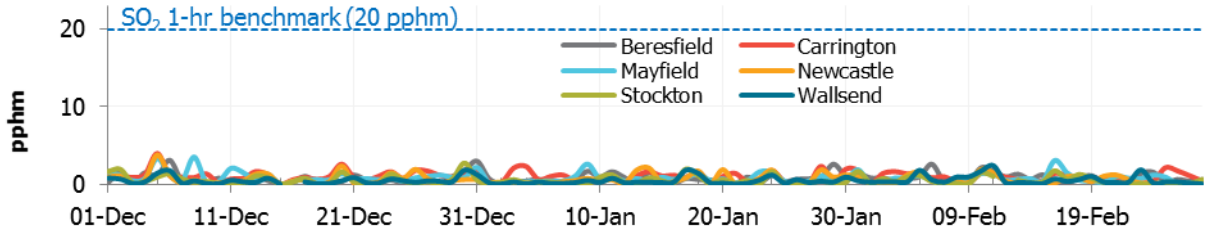

Figure 4: Daily 1-hr maximum SO_2 during summer 2016–17

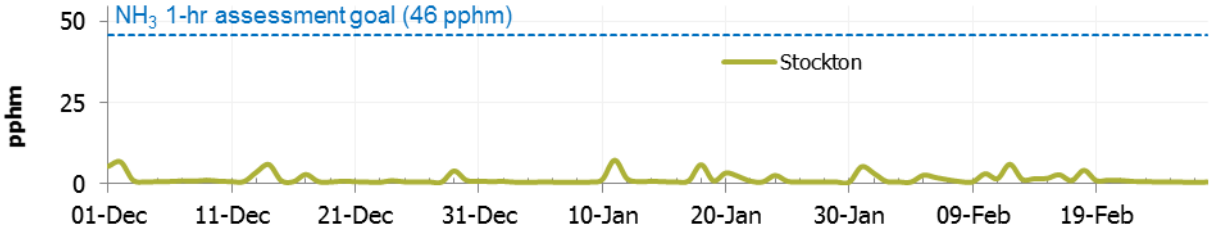

Figure 5: Daily 1-hr maximum NH_3 during summer 2016–17

Pollution roses

The seasonal pollution rose maps[3] show that elevated hourly PM_{10} levels (>75 µg/m^3)[4] predominantly occurred at Stockton under northeast winds. Hourly $PM_{2.5}$ levels generally remained low during the season.

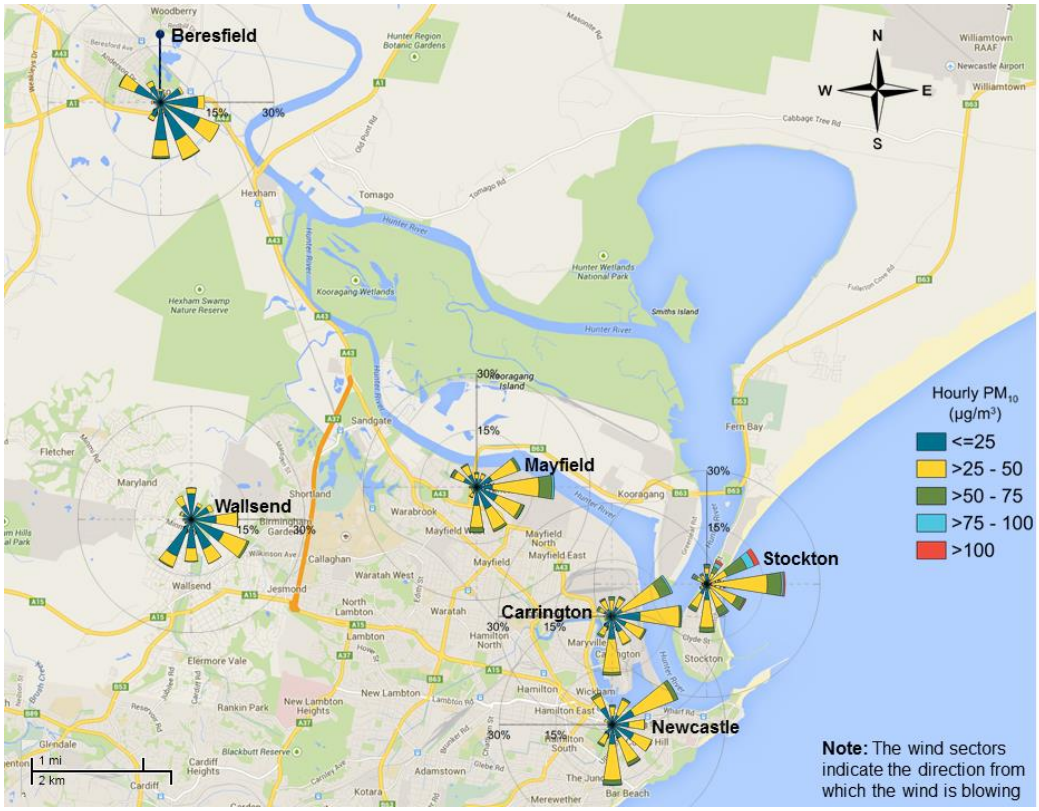

Figure 6: Hourly PM_{10} pollution roses for the Newcastle region for summer 2016–17

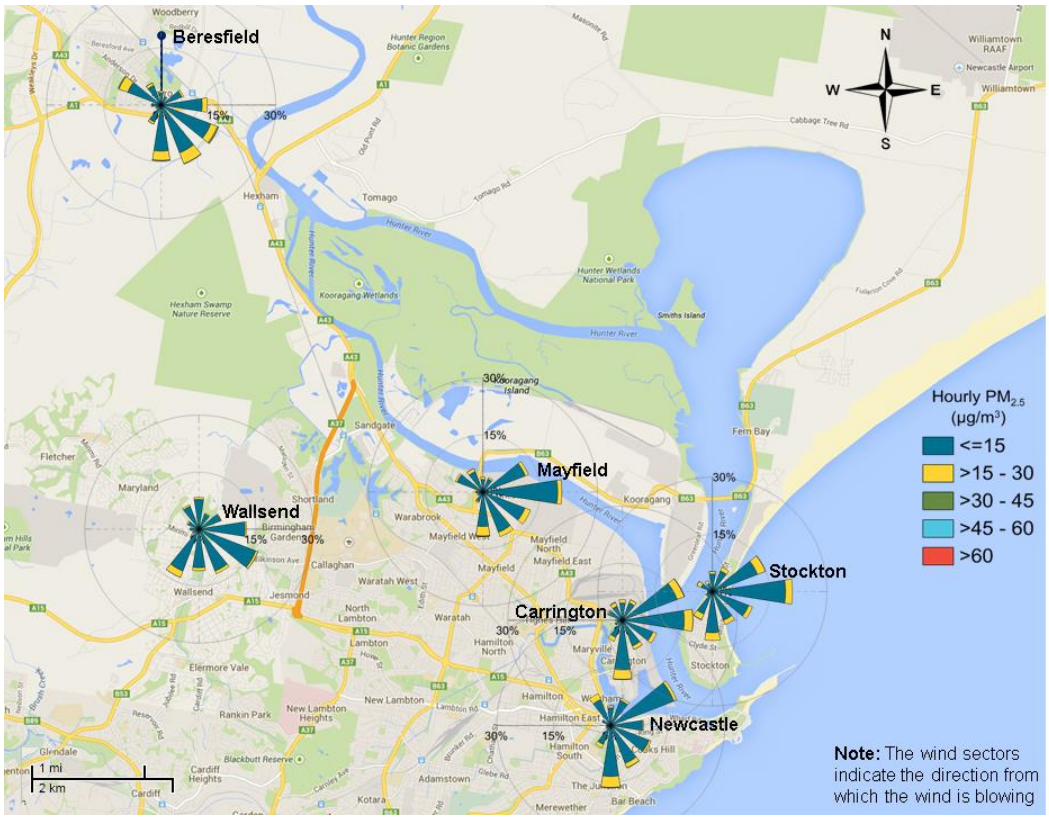

Figure 7: Hourly $PM_{2.5}$ pollution roses for the Newcastle region for summer 2016–17

[3] 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 that the wind blows from a particular direction. The colours along the bars indicate categories of particle levels.

[4] Note: There are no standards for hourly PM_{10}/$PM_{2.5}$ in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM)

Particulate matter annual averages

PM_{10} and $PM_{2.5}$ rolling annual averages as at the end of summer 2016–17 provide an indication of particle levels during the previous 12 months. They are not intended to be compared to the annual benchmarks, which are based on a calendar year.

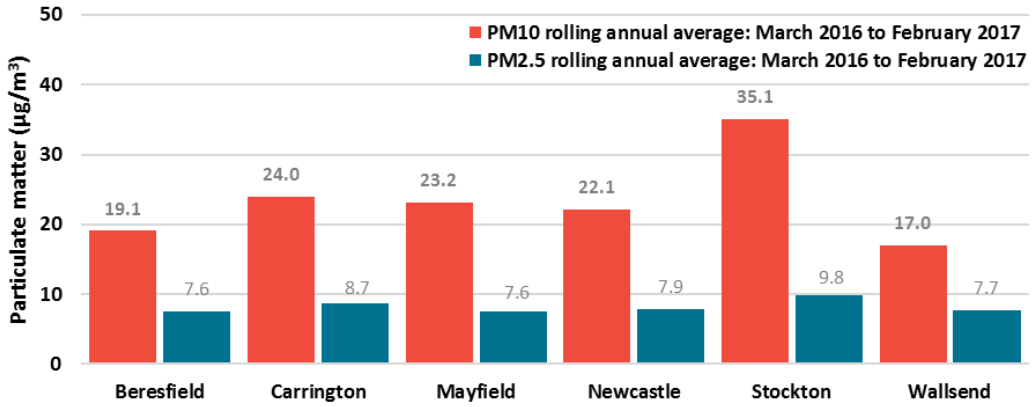

Figure 8: PM_{10} and $PM_{2.5}$ rolling annual averages to the end of summer 2016–17

Seasonal comparisons

This section compares air quality levels in summer 2016–17 with previous summer seasons, where data were available. Monitoring at Stockton commenced in October 2012[5] and at Mayfield and Carrington in August 2014. Monitoring of $PM_{2.5}$ at Newcastle commenced in December 2013.

All days were below benchmark concentrations for NO_2 and SO_2 in summer during the past five years at Beresfield, Newcastle, Stockton and Wallsend and since monitoring began at Carrington and Mayfield. There were no days above the NH_3 assessment criterion at Stockton for the past five summer seasons.

There were no days above the $PM_{2.5}$ benchmark in the region during summer 2016–17. In earlier years, Mayfield recorded one day above the $PM_{2.5}$ benchmark during summer 2015–16.

Carrington recorded three days above the PM_{10} benchmark in summer 2016–17 and Stockton recorded 27 days. Overall, this is similar to the preceding summer seasons, with Stockton recording 27 days over the benchmark in summer 2015–16 and 30 days in summer 2014–15.

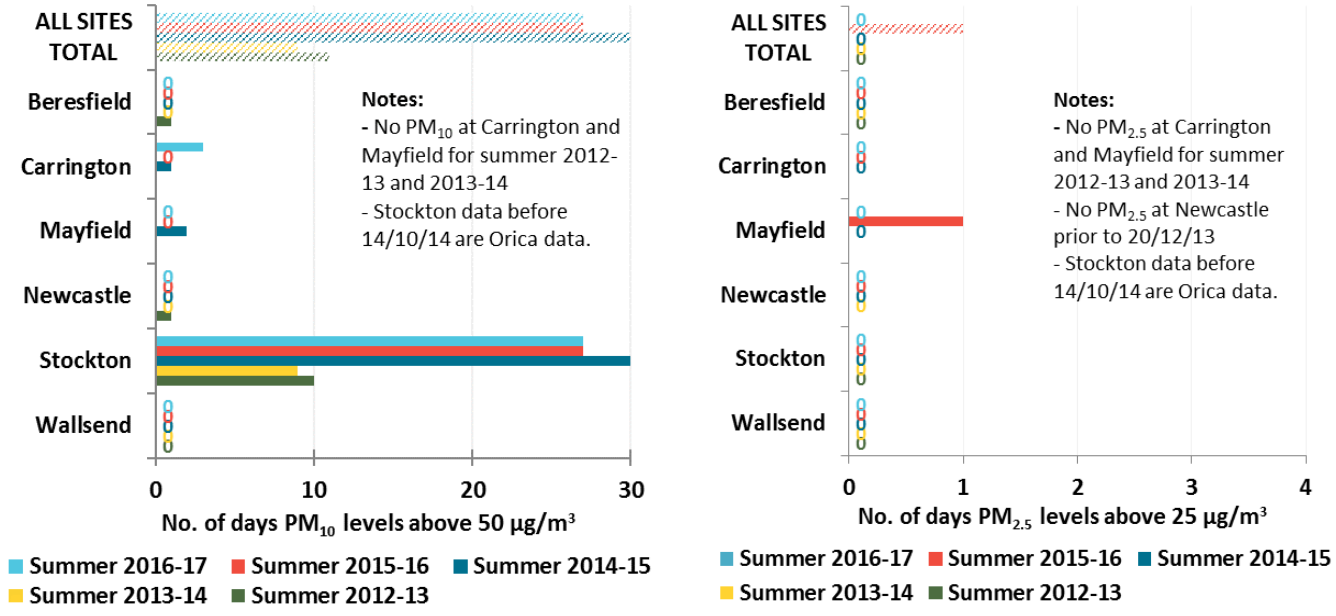

Figure 9: Number of days above the PM_{10} and $PM_{2.5}$ benchmarks: summer 2016–17, 2015–16, 2014–15, 2013–14 and 2012–13

[5] Orica originally undertook Stockton air quality monitoring; from October 2014 it was undertaken by the Office of Environment and Heritage as part of the Newcastle Local Air Quality Monitoring Network.

Meteorological summary

Rainfall and temperature[6]

The Newcastle region generally experienced average rainfall during summer 2016–17 compared to the long term records. Summer 2016–17 was drier that the previous two summers. Summer 2016–17 rainfall was around 200 to 400 millimetres less compared to summer 2015–16 and 100 to 200 millimetres less than summer 2014–15, while up to 50 to 100 millimetres more compared to summer 2013–14. Summer 2016–2017 was reported as the warmest on record for NSW, with Newcastle amongst the sites with a record number of days of 35°C or above. Maximum temperatures in Newcastle were 'very much above average' to 'highest on record' and minimum temperatures were 'highest on record' during the season.

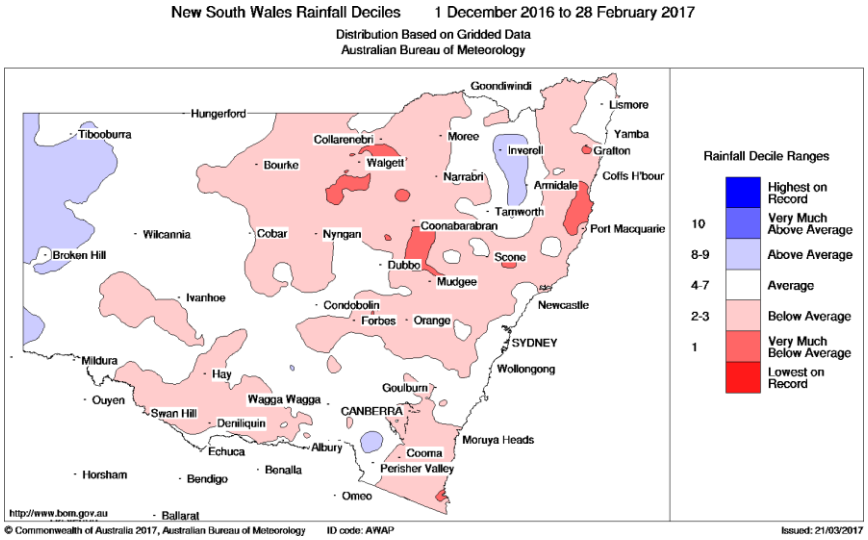

Figure 10: NSW rainfall deciles – summer 2016-17

Wind

The winds were predominantly from the north-east to south in the region during summer 2016–17, which is typical during this warmer period. As an example, Figure 11 shows that at Stockton, easterly component winds prevailed 59% of the time and these were moderate (above five metres per second) 5% of the time.

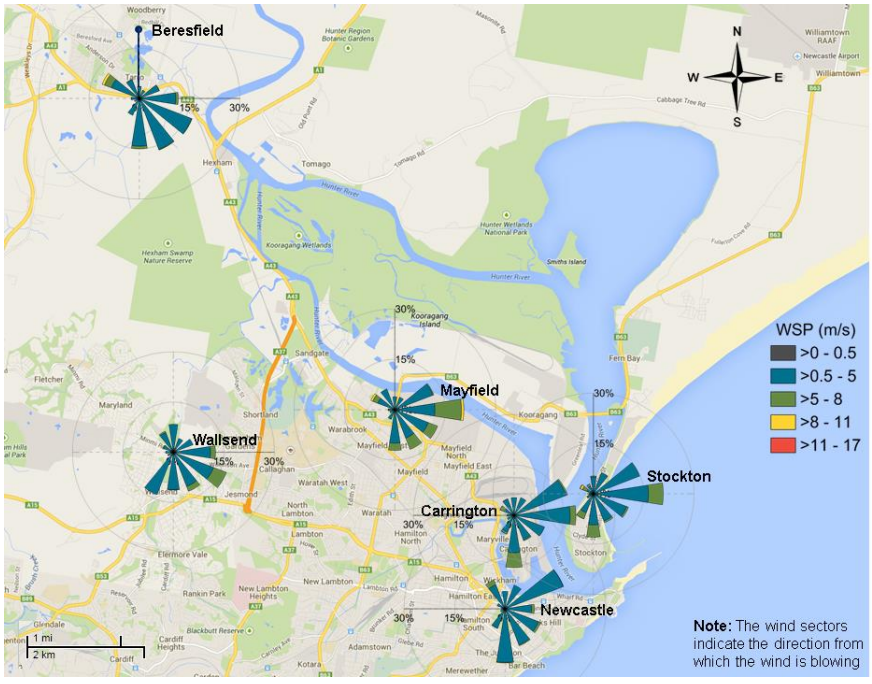

Figure 11: Wind rose map[7] for the Newcastle region for summer 2016-17

[6] Rainfall and temperature information are from the Bureau of Meteorology New South Wales summer 2016–17 climate statement, Special Climate Statement 61—exceptional heat in southeast Australia in early 2017 and climate maps (accessed May 2017).

[7] 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.

Stockton

The Stockton monitoring site continued to record a higher number of days over the PM_{10} benchmark compared to other sites in the region.

In summer 2016–17, elevated hourly PM_{10} levels (>75 µg/m^3)[8] occurred 9.1% of the time. The majority of these, approximately 78% of the time, occurred under onshore easterly winds (Figure 12). This indicates the potential contribution of sea salt, with the Lower Hunter Particle Characterisation Study finding sea salt to be a major contributor of particles at the site.

Elevated hourly PM_{10} levels were from the northwest sector less than 1% of time during the season.

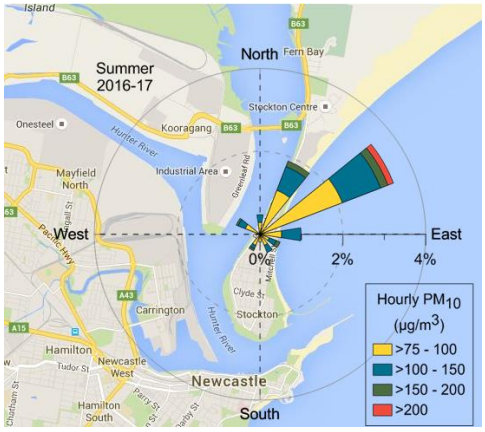

Figure 12: Stockton summer 2016–17 pollution rose – proportion of hourly averaged PM_{10} levels >75 µg/m^3 by wind direction

Network performance

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

Table 2: Online performance (%) during summer 2016-17

Station	Particles PM_{10} daily	Particles $PM_{2.5}$ daily	Gases SO_2 hourly	Gases NO_2 hourly	Gases NH_3 hourly	Meteorology Wind hourly
Beresfield	100	99	95	95	-	70
Carrington	100	100	95	95	-	100
Mayfield	100	98	94	94	-	100
Newcastle	98	96	93	93	-	98
Stockton	98	98	94	93	95	99
Wallsend	90	99	94	93	-	100

- = not monitored

The reduced online times were mainly due to:

- Wallsend PM_{10} – intermittent instrument and communications problems (7 days)
- Beresfield wind – sensor damaged by birds on two occasions (27 days)

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[8] 75 µg/m^3 was chosen as a lower cut-off point to highlight only those hours with relatively elevated hourly PM_{10} levels. There is no standard for hourly PM_{10} in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM).