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NSW Minerals Council

Via Email: lplayer@nswmining.com.au

26 February 2025

Upper Hunter Air Quality Monitoring Network Analysis Project – Annual Review for 2024

Dear Lisa,

1 Introduction

Zephyr Environmental Pty Ltd (Zephyr) has been commissioned by the NSW Minerals Council (NSWMC) Upper Hunter Mining Dialogue (UHMD) to provide an updated air quality analysis, now incorporating the calendar year (CY) 2024, for the Upper Hunter following continued interest in air quality in the region.

The analysis of CY2024 air quality data follows on from the previous work prepared on air quality trends across NSW namely:

- Air Quality Monitoring Data Analysis Project ('the AQ Data Analysis Project', dated 16 November 2020).
- Upper Hunter Air Quality Monitoring Network Analysis Project ('*0012 UHMD UHAQMN Annual Data Review L1 Final Update'*, dated 9 December 2021)
- Upper Hunter Air Quality Monitoring Network Analysis Project – Annual Review for 2021 and 2022 (*'0130 NSWMC UHAQMP Annual Data Review Final,* dated 26 October 2023)
- Upper Hunter Air Quality Monitoring Network Analysis Project – Annual Review for 2023 ('*0205 NSWMC UHAQMP CY23 Annual Data Review Final*, dated 26 April 2024)

Section 1 of the AQ Data Analysis Project provides background and context to this work, and confirms that the original project was designed to answer two specific air quality questions:

1. Has the air quality in the Upper Hunter Valley changed since monitoring began? and

2. Is the air quality in the Upper Hunter Valley measured at the monitoring stations different from air quality measured at other locations in NSW?

Section 2 of the AQ Data Analysis Project provides an overview of particulate matter size fractions and ambient air quality criteria, including definitions of the terms PM_{10} and $PM_{2.5}$ (particulate matter less than 10 and 2.5 micrometres in aerodynamic diameter, respectively).

Section 3 of the AQ Data Analysis Project provides detail on the 14 air quality monitoring stations that comprise the Upper Hunter Air Quality Monitoring Network (UHAQMN) and their grouping to reflect the following purposes:

- Larger populations
- Smaller communities

- Diagnostic
- Background

Table 1-1 presents a summary of station and the purpose of the stations within the UHAQMN.

Table 1.1: Summary of stations / purpose within the UHAQMN

Station type	Purpose	Stations
Larger populations	Monitoring air quality in the larger population centre	- Muswellbrook - Singleton - Aberdeen
Smaller communities	Monitoring air quality in the smaller communities	- Bulga - Camberwell - Jerrys Plains - Maison Dieu - Warkworth - Wybong
Diagnostic	Providing data that can help to 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	- Mount Thorley - Muswellbrook NW - Singleton NW
Background	Provide background data; located at both ends of the valley they measure the quality of air entering and leaving the Upper Hunter Valley under predominant winds (south-easterlies and north-westerlies)	- Merriwa - Singleton South

Section 4 and Section 5 of the AQ Data Analysis Project provide a summary of the air quality monitoring data collected to date and their analysis respectively.

The focus of this letter is to provide an update to the AQ Data Analysis Project, now including data from CY2024.

2 Monitoring Data Update

The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW), formerly NSW Department of Planning and Environment (DPE), makes available ambient air quality monitoring data for NSW via their data download facility. Data has been gathered for the most recent complete calendar year of CY2024.

This section provides a summary of annual and period average PM_{10} and $PM_{2.5}$ monitoring results (respectively) that have been averaged into regions/groups for comparison. The data has been provided in Table 2-1 and Table 2-2.

Results have been shaded using a green to red colour relative gradient scheme with lowest values shown in green, and highest values shown in red, with the median value shown in yellow. This gradient scheme has been applied to the annual data and 'all years' groups separately.

For the average across all years, the highest concentrations of PM_{10} are measured at the UHAQMN Diagnostic stations, with the next highest observed at the Lower Hunter & Central Coast stations. The highest concentrations of $PM_{2.5}$ are measured at the UHAQMN Large Population stations, with the next highest observed at the Sydney north-west stations. The lowest concentrations are measured at the Central Tablelands for PM_{10} and Illawarra for $PM_{2.5}$, respectively.

There has been a mixture of increases and decreases in the annual average PM_{10} concentrations from CY2023 to CY2024. There have been increases in the annual average PM_{10} concentrations at the Central Tablelands, the Illawarra, South West slopes, Sydney east and Sydney south west. There have been decreases in the annual average PM_{10} concentrations at North West slopes, Sydney north-west and all the UHAQMN locations (background, diagnostic, large populations and smaller communities). At the Lower Hunter and Central Coast, the concentrations are the same for CY2023 and CY2024. The CY2024 averages for PM_{10} remain below the 'all years' average for all regions/groups with the exceptions of the Illawarra (CY2024 = 18.2 µg/m^3 and 'all Years' = 17.6 µg/m^3) and Sydney south-west slopes (CY2024 = 19.5 µg/m^3 and 'all Years' = 18.3 µg/m^3).

There has been a mixture of increases and decreases in the annual average $PM_{2.5}$ concentrations from CY2023 to CY2024. There have been increases in the annual average $PM_{2.5}$ concentrations at the Illawarra, South West slopes, and UHAQMN large populations. There have been decreases in the annual average $PM_{2.5}$ concentrations at all other locations. The CY2024 average $PM_{2.5}$ concentrations remain below the 'all years' average for all regions/groups.

Table 2.1: Annual and period average PM_{10} concentrations by region/group and year (µg/m³)

Region / Group	Year												All years
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Central tablelands	15.1	14.6	13.4	13.3	14.1	18.8	27.4	17.0	11.4	8.7	12.5	12.6	14.9
Illawarra	16.9	17.1	16.2	17.4	18.0	20.1	22.5	19.1	15.3	13.2	16.9	18.2	17.6
Lower Hunter & Central Coast	20.2	18.2	21.7	22.0	22.9	25.2	29.1	22.3	19.2	17.6	20.9	20.9	21.7
North-west slopes	16.6	15.8	14.1	15.3	15.3	20.1	33.7	16.8	12.7	10.6	15.1	13.3	16.6
South-west slopes	10.0	18.3	17.3	17.9	18.2	23.6	29.4	21.7	16.0	12.4	15.5	19.5	18.3
Sydney east	17.9	17.3	16.8	17.2	18.3	20.2	23.6	19.2	15.9	13.5	16.1	17.0	17.7
Sydney north-west	17.5	16.6	15.1	17.0	17.0	20.3	24.9	18.7	15.7	11.9	17.8	16.3	17.4
Sydney south-west	16.3	16.0	14.8	15.6	16.1	18.9	23.3	17.2	13.8	11.1	15.2	15.3	16.1
UHAQMN - BG	17.6	16.8	15.1	15.8	16.8	21.1	29.3	19.0	14.1	12.6	16.8	16.0	17.6
UHAQMN - DG	23.2	21.1	19.1	20.4	22.2	29.0	34.9	21.7	16.7	14.6	21.9	19.2	22.0
UHAQMN - LP	21.1	20.1	17.9	18.0	20.0	24.5	31.3	20.3	16.2	14.5	18.8	17.1	20.0
UHAQMN - SC	21.4	20.1	17.7	18.6	20.7	25.4	33.4	21.2	16.4	14.2	21.3	19.6	20.8

Note: UHAQMN – upper hunter air quality monitoring network, BG - background, DG – diagnostic, LP – larger populations, SC – smaller communities

Colour Coding by Percentile

0% (min.)	10%	20%	30%	40%	50% (median)	60%	70%	80%	90%	100% (max.)

Note: colour coding is applied to annual data by region (horizontally), whereas 'All years' colour coding is applied vertically, to allow comparison of data between regions.

Table 2.2: Annual and period average $PM_{2.5}$ concentrations by region / group and year (µg/m³)

Region / Group	Year												All years
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Illawarra	7.7	7.0	7.0	7.3	6.9	7.1	11.1	7.2	5.3	4.3	5.3	5.7	6.8
Lower Hunter & Central Coast	7.5	7.0	7.5	7.8	7.7	8.2	17.3	7.6	6.3	5.5	6.8	6.5	8.0
South-west slopes	7.9	7.5	7.6	7.4	8.1	8.4	11.3	10.9	6.3	5.3	6.6	7.4	7.9
Sydney east	8.2	8.4	8.3	8.1	8.4	8.2	16.5	8.0	6.9	5.2	7.1	6.6	8.3
Sydney north-west	8.3	6.7	8.0	8.3	7.4	8.3	20.5	8.2	6.9	5.1	7.1	6.9	8.5
Sydney south-west	8.0	7.5	7.4	7.6	7.8	8.7	18.9	7.9	7.0	5.0	6.8	6.1	8.2
UHAQMN - LP	8.7	8.8	8.2	8.2	8.8	8.8	18.0	8.9	6.8	5.7	7.1	7.3	8.8
UHAQMN - SC	8.2	7.8	7.2	7.5	7.4	8.4	17.3	7.5	5.7	4.8	6.1	5.9	7.8

Note: UHAQMN – upper hunter air quality monitoring network, LP – larger populations, SC – smaller communities

Colour Coding by Percentile

0% (min.)	10%	20%	30%	40%	50% (median)	60%	70%	80%	90%	100% (max.)

Note: colour coding is applied to annual data by region (horizontally), whereas 'All years' colour coding is applied vertically, to allow comparison of data between regions.

3 Analysis Update

Provided below are revisions of some of the key data tables and figures from the AQ Data Analysis Project, updated to include data from CY2024. Additional commentary is provided as it relates to the inclusion of the CY2024 data.

3.1 Comparison of UHAQMN and remainder of NSW

This section presents a comparison of annual average PM_{10} and $PM_{2.5}$ concentrations measured across the UHAQMN versus the remainder of NSW. The aim of the comparison is to identify if trends experienced across the UHAQMN are also being experienced across the rest of NSW.

Table 3.1 presents a comparison of average PM_{10} concentrations measured across NSW, with the UHAQMN and the remainder of NSW shown separately. Annual data have also been presented as a percentage of the respective 2013-2024 average.

This relationship has also been shown for $PM_{2.5}$, which has a lesser association with mechanically generated particulate emissions such as those from mining. Figure 3.1 provides a graphical representation of these data.

As noted within the AQ Data Analysis Project and reinforced with the inclusion of CY2021 - CY2024 data, the consistency of temporal trends in the UHAQMN and 'Remainder of NSW' monitoring subsets show that the changes in PM_{10} concentrations within the Upper Hunter are generally consistent with changes experienced across the rest of NSW.

It is noted that the 'Remainder of NSW' PM_{10} concentrations have increased by 2% from CY2023 to CY2024 (17.2 µg/m³ to 17.6 µg/m³). However, the UHAQMN PM_{10} concentrations have decreased by 9% from CY2023 to CY2024 (20.4 µg/m³ to 18.7 µg/m³). This differs from what has been seen for other years, where both data sets follow the same trend between years. The 'Remainder of NSW' values do still remain below the 'all years' average.

It was identified that the South West slopes grouping of monitoring stations showed an anomalous (26%) increase in concentrations from CY2023 to CY2024. The reason for this increase in the annual data from South West slopes is unclear; however it was apparent at both stations – Albury showing a 27% increase, and Wagga Wagga North showing a 24% increase. When the South West slopes data point is removed, a decrease in the 'Remainder of NSW' concentration is shown from CY2023 to CY2024, consistent with the UHAQMN data set.

This in turn indicates that the changes in annual average PM_{10} concentrations are consistent with regional particulate sources and that the contribution of mining operations on the UHAQMN to these trends is not discernible.

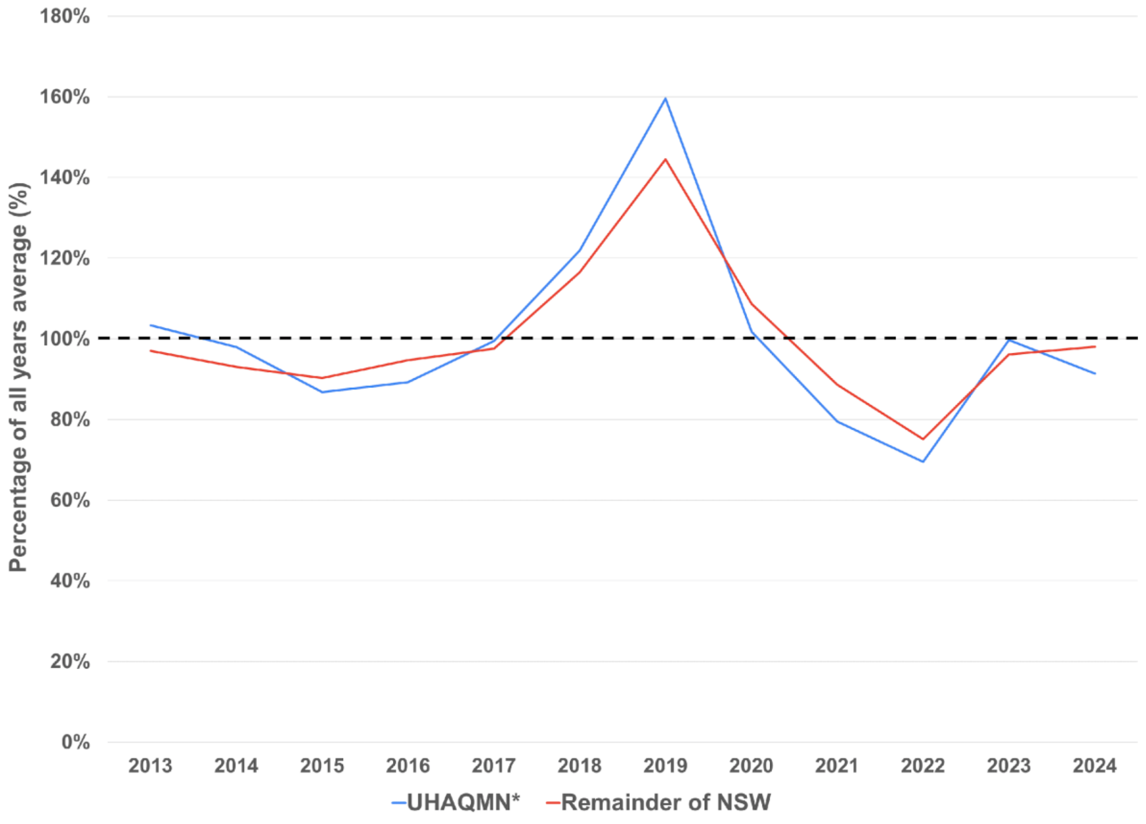
For $PM_{2.5}$, 'Remainder of NSW' annual average concentrations have reduced from CY2023 to CY2024 but only by 0.1 µg/m³, whereas concentrations from the UHAQMN have remained the same

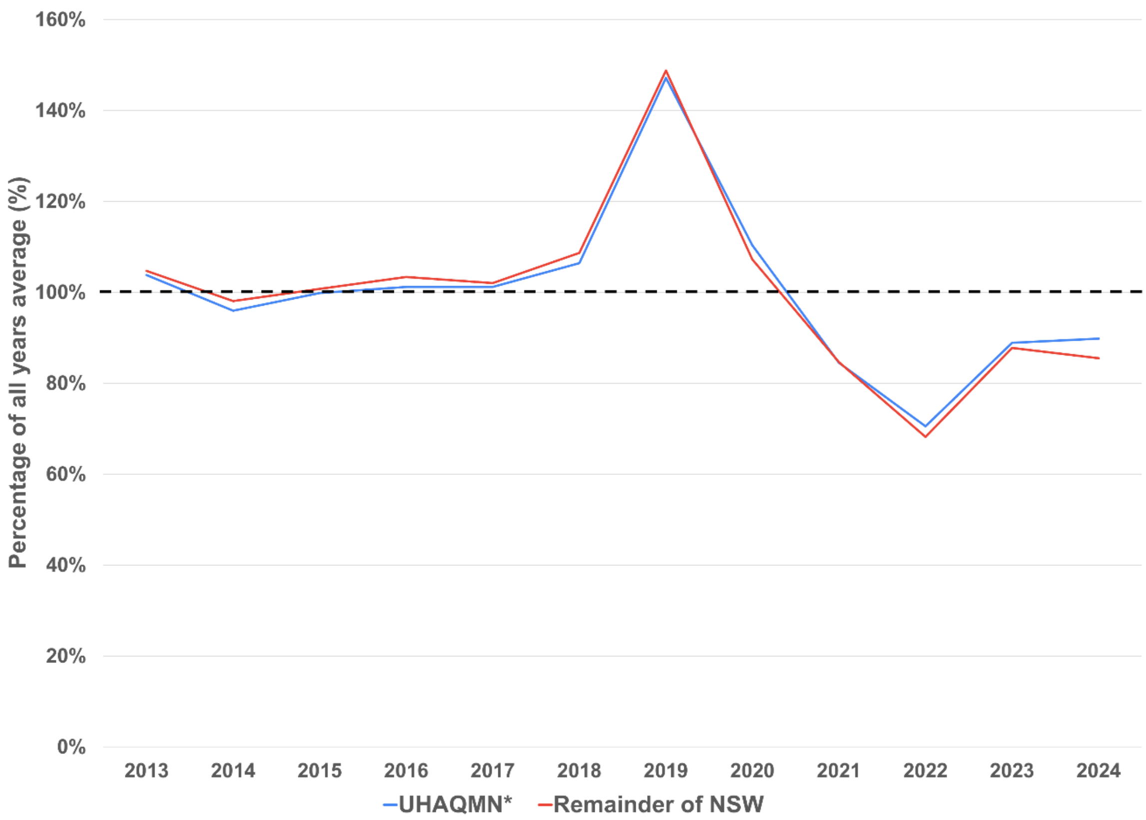
Notably, the CY2024 PM_{10} data for the UHAQMN is below the 'all years' average. The recorded concentrations are higher than values recorded in the particularly high rainfall years of CY2021 and CY2022. The recorded concentrations are lower than values recorded in CY2020, CY2023 and substantially lower than the anomalously high CY2019 value associated with the 'Black Summer' bushfire event. A similar pattern is also observed in $PM_{2.5}$, indicating that changes in $PM_{2.5}$ (less likely to be attributed to mining operations) are generally consistent with those observed elsewhere in NSW. As with the PM_{10} data set, the values for CY2024 emphasise that the annual average for CY2019 was anomalously high.

Table 3.1: Comparison of PM_{10} and $PM_{2.5}$ variability – UHAQMN vs remainder of NSW regions

Monitoring subset	Parameter	Year												All Years
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
PM_{10}														
UHAQMN*	Concentration (µg/m³)	21.2	20.1	17.8	18.3	20.4	25.0	32.7	20.9	16.3	14.3	20.4	18.7	20.5
	% of average (all years)	103%	98%	87%	89%	99%	122%	160%	102%	79%	69%	100%	91%	-
Remainder of NSW	Concentration (µg/m³)	17.4	16.7	16.2	17.0	17.5	20.9	25.9	19.5	15.9	13.5	17.2	17.6	17.9
	% of average (all years)	97%	93%	90%	95%	98%	116%	144%	109%	89%	75%	96%	98%	-
$PM_{2.5}$														
UHAQMN*	Concentration (µg/m³)	7.9	7.3	7.6	7.7	7.7	8.1	11.2	8.4	6.4	5.4	6.8	6.8	7.6
	% of average (all years)	104%	96%	100%	101%	101%	106%	147%	110%	85%	71%	89%	90%	-
Remainder of NSW	Concentration (µg/m³)	7.9	7.4	7.6	7.8	7.7	8.2	11.2	8.1	6.4	5.1	6.6	6.5	7.5
	% of average (all years)	105%	98%	101%	103%	102%	109%	149%	107%	85%	68%	88%	86%	-

Note: UHAQMN – upper hunter air quality monitoring network, * - Larger Populations and Smaller Communities station groups.





Note: UHAQMN data relates to Larger Populations and Smaller Communities station groups.

Figure 3.1: Comparison of PM_{10} (top) and $PM_{2.5}$ (bottom) variability – UHAQMN vs remainder of NSW regions

3.2 Comparison across sub-divisions of the UHAQMN

This section reviews the data for the four-station group sub-divisions to understand if trends are similar across the groups. For this review, the annual variance (i.e., the current year annual average minus the 'all years' annual average) has been provided for each station group. Table 3.2 presents the annual PM_{10} variance against the CY2013 – CY2024 average PM_{10} concentration for that station group. This is instructive in showing changes in the difference between station groups across the study period, into CY2024. The same data is shown graphically in Figure 3.2.

Table 3.2: Annual variance against CY2013 – CY2024 station group average (µg/m³)

Station Group	Year											
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Larger Population	1	0	-2	-2	0	5	11	0	-4	-6	-1	-3
Smaller Communities	0	-1	-3	-2	0	4	12	0	-5	-7	0	-1
Diagnostic	1	-1	-3	-2	0	5	13	0	-5	-7	0	-3
Background	1	0	-2	-1	0	4	12	2	-3	-4	0	-2

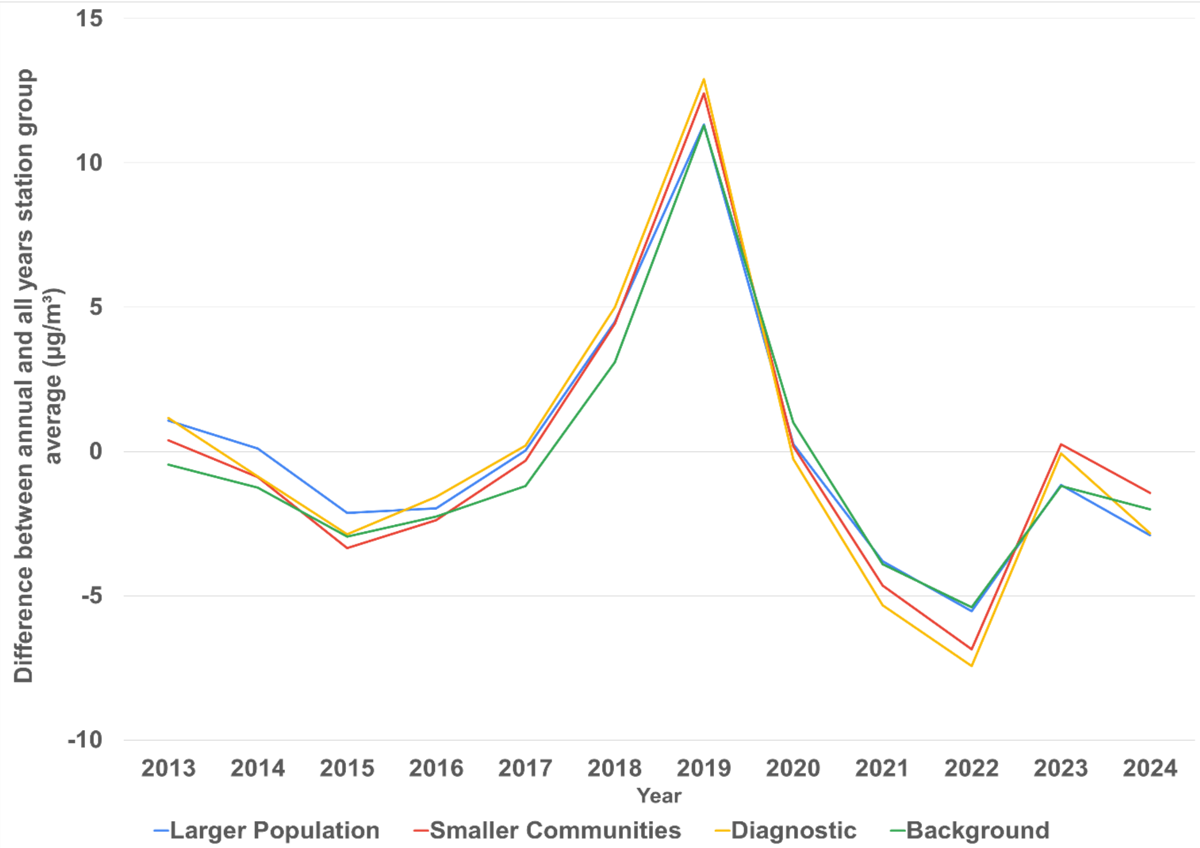


Figure 3.2: Comparison of trends between each UHAQMN station group

Figure 3.2 shows that the differences between PM_{10} concentrations at Background stations and Diagnostic stations are near identical across CY2013-CY2024 (up to 1 µg/m³ variability), while the range in annual average PM_{10} concentrations across this period is 22 µg/m³. This reinforces that changes in Upper Hunter PM_{10} concentrations are associated with regional conditions and are indicative of a minimal change in the contribution from local emission sources inclusive of mining.

3.3 Comparison of UHAQMN and Bulga, Mount Thorley, Warkworth stations

A comparison of the UHAQMN against the Bulga, Mount Thorley and Warkworth stations has been included following a request from members of the Working Group to understand how the air quality compares across these specific locations. As identified earlier, Bulga and Warkworth are within the smaller community station grouping and Mount Thorley is within the diagnostic grouping. The annual average PM_{10} concentrations measured across the Bulga, Mount Thorley and Warkworth monitoring stations have been compared against the UHAQMN for 2018 to 2024. These three stations and the UHAQMN show concentrations increasing from 2018 to 2019 associated with the 'Black Summer' bushfire events. All three sites show a reduction in concentrations year on year from 2019 through to 2022, due to higher-than-average rainfall volumes particularly in CY21-CY22, and then an increase in concentrations from 2022 to 2023. For CY2024, the concentrations have reduced when compared with CY2023. The UHAQMN follows the same trend.

Figure 3.3 presents a comparison of trends between Bulga / Mount Thorley / Warkworth average and the UH average.

Figure 3.4 presents a comparison of trends between each of the individual stations of Bulga, Mount Thorley and Warkworth and the UH average.

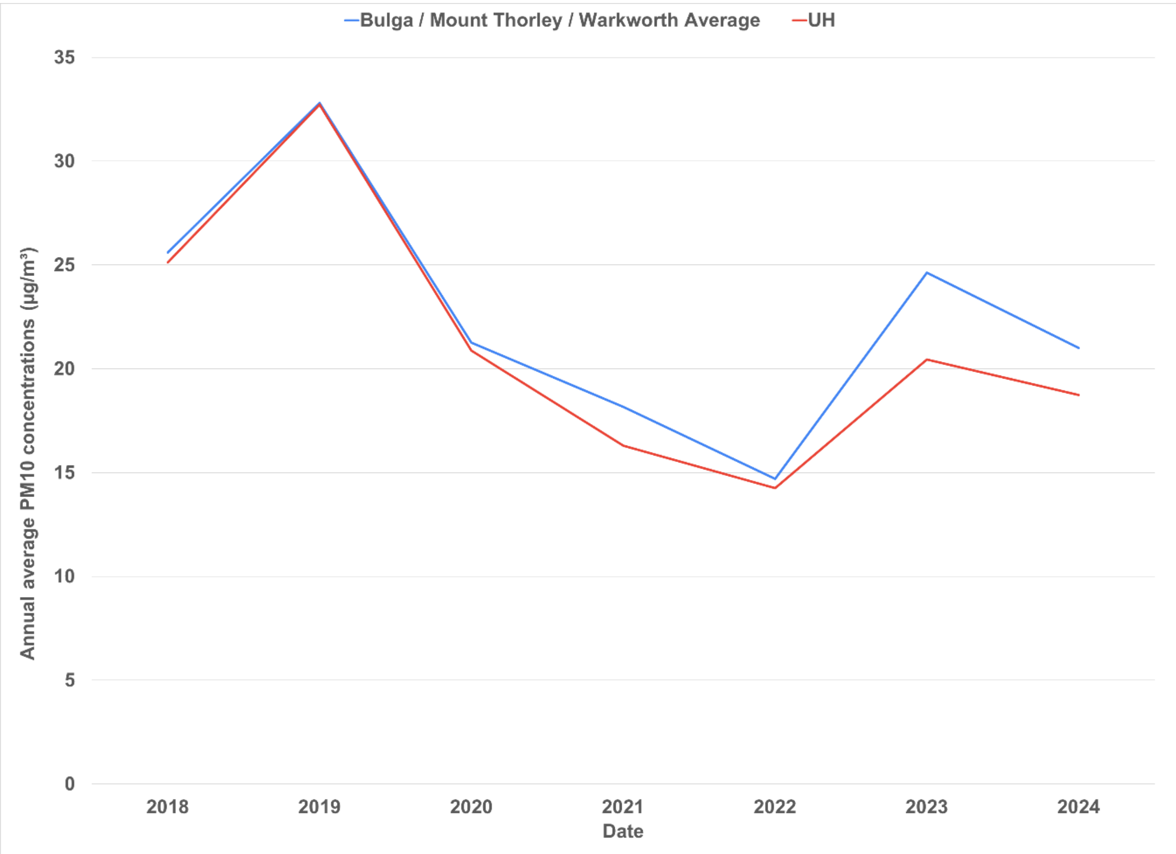


Figure 3.3: Comparison of trends between average of Bulga / Mount Thorley / Warkworth and UH average

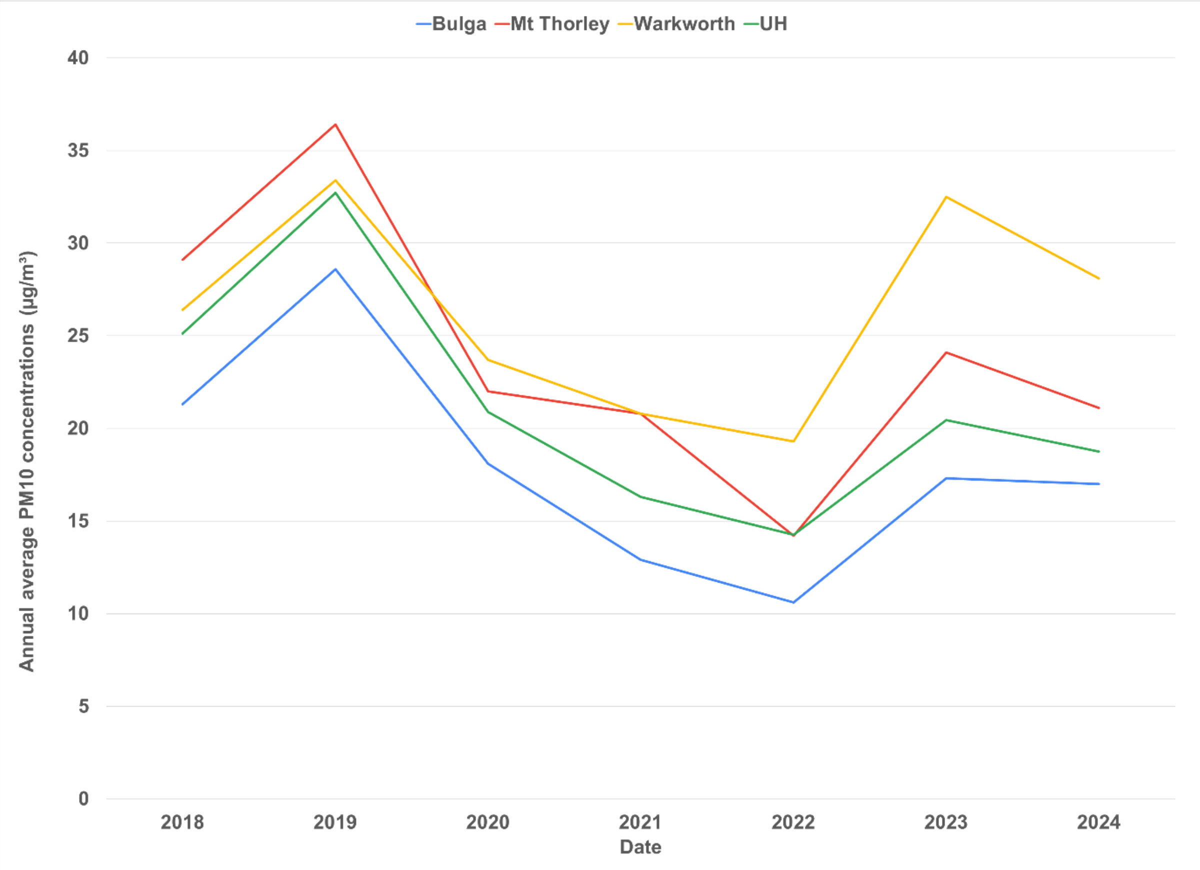


Figure 3.4: Comparison of trends between Bulga, Mount Thorley, Warkworth and UH

3.4 Comparison of exceedances of 24-hour average PM_{10} criterion

This section provides a comparison of the number of exceedances of the 24-hour average PM_{10} criterion for each region / group for the last 12 years of monitoring. In contrast to a review of annual data, the review of 24-hour average exceedances provides an understanding of the short-term peaks in PM_{10}, where these are located and the frequency that measurements are above NSW EPA criterion.

Data for exceedances of 24-hour average PM_{10} criterion has been gathered for the most recent complete calendar year of CY2024 and all previous years. Table 3.3 presents a summary of the number of exceedances of the 24-hour average PM_{10} criterion that have been averaged into regions/groups. Results have been shaded using a green to red colour relative gradient scheme with lowest values shown in green, and highest values shown in red, with the median value shown in yellow. This gradient scheme has been applied to the annual data and 'all years' groups separately.

For the average across all years, the highest number of exceedance days have been recorded at UHAQMN Diagnostic stations, with the next highest observed at UHAQMN Smaller communities, followed by Lower Hunter & Central Coast stations and South West slopes stations.

For CY2024, all locations recorded exceedance days below the 'all years' average. Of the 12 station groupings, there are six station groupings that show exceedance days and two of these only have one exceedance day for the entirety of 2024 (Illawarra and UHAQMN Background stations). When compared against CY2023, all locations in CY2024 showed the same or less exceedance days than

2023 with the exception of South West slopes which showed an additional four exceedance days in 2024.

Figure 3.5 presents a comparison of the number of exceedance days of the 24-hour average PM_{10} criterion at the grouped UHAQMN stations for 2013 to 2024. The figure shows that these grouped locations show generally the same trend. Figure 3.6 presents a comparison of the average number of exceedance days of the 24-hour average PM_{10} criterion for the 'Remainder of NSW' and 'UHAQMN'. Again, the figure shows that these grouped locations show generally the same trend, regardless of the location.

Table 3.3: Number of exceedances of 24-hour average PM_{10} criterion by region / group (µg/m³)

Region / Group	Year												All years
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Central tablelands	3	0	2	0	0	8	40	14	0	0	2	0	6
Illawarra	4	0	0	2	2	6	17	13	0	0	3	1	4
Lower Hunter & Central Coast	3	1	12	9	11	20	39	14	4	5	8	7	11
North-west slopes	0	1	1	1	2	9	52	8	0	0	0	0	6
South-west slopes	9	10	5	9	5	21	44	22	4	0	1	5	11
Sydney east	3	0	1	1	1	5	19	8	0	0	1	0	3
Sydney north-west	4	0	1	3	1	8	26	10	1	0	0	0	4
Sydney south-west	3	0	1	3	2	6	25	9	2	0	2	0	4
UHAQMN - BG	3	2	2	0	1	8	46	12	1	0	1	1	6
UHAQMN - DG	18	3	4	3	11	22	63	14	2	0	9	4	13
UHAQMN - LP	5	1	2	0	3	10	50	11	0	0	1	0	7
UHAQMN - SC	15	6	4	2	8	19	60	15	2	0	10	7	12

Note: UHAQMN – upper hunter air quality monitoring network, BG - background, DG – diagnostic, LP – larger populations, SC – smaller communities

Colour Coding by Percentile

0% (min.)	10%	20%	30%	40%	50% (median)	60%	70%	80%	90%	100% (max.)

Note: colour coding is applied to annual data by region (horizontally), whereas 'All years' colour coding is applied vertically, to allow comparison of data between regions.

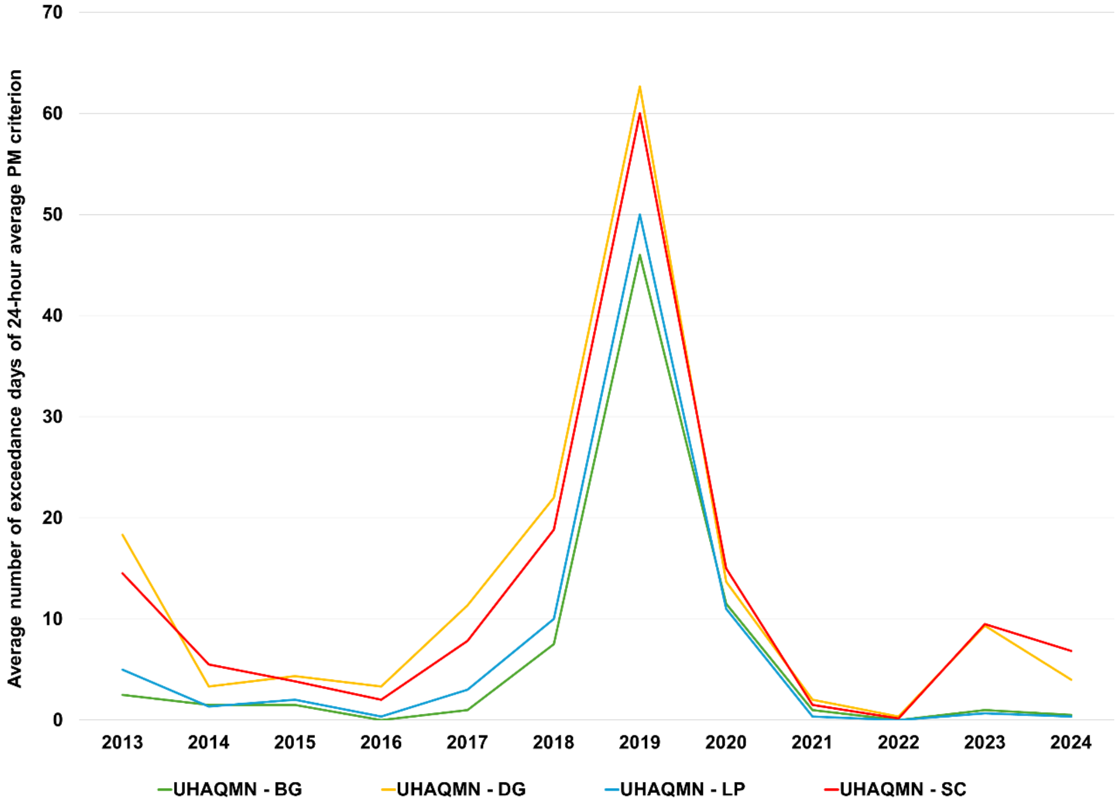


Figure 3.5: Comparison of the number of exceedance days of the 24-hour average PM_{10} criterion at the grouped UHAQMN stations for 2013 to 2024

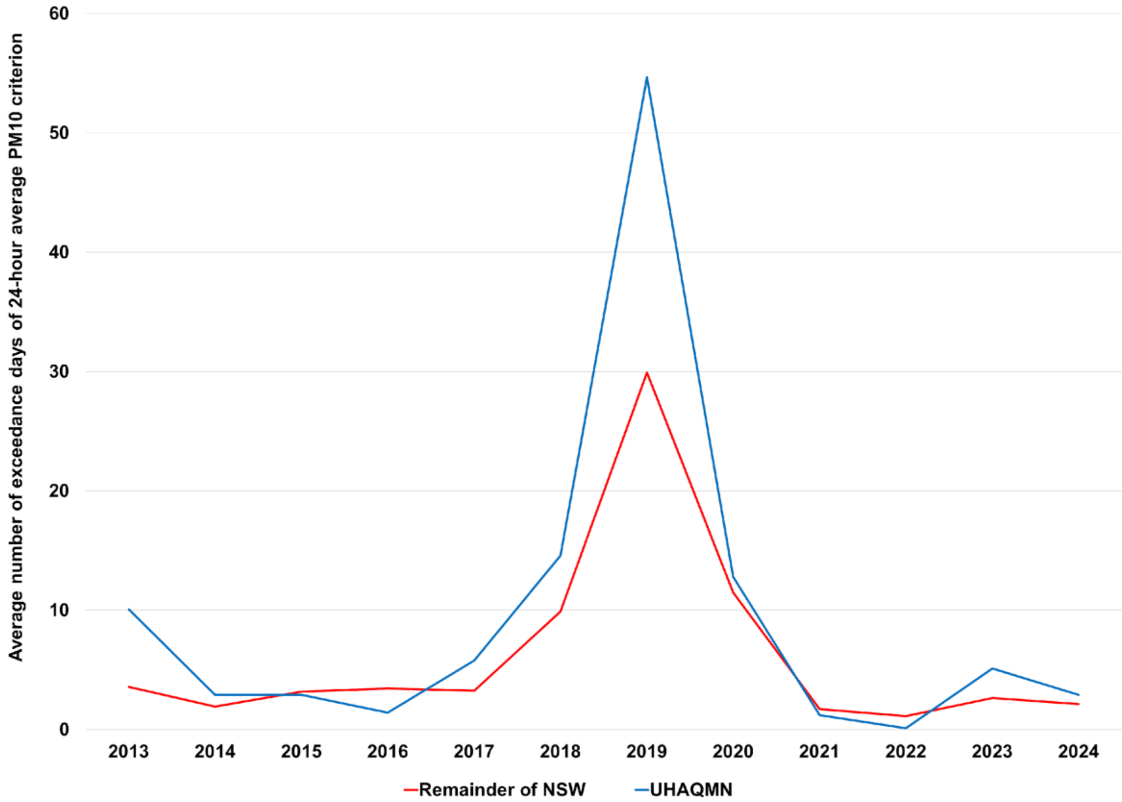


Figure 3.6: Comparison of the average number of exceedance days of the 24-hour average PM_{10} criterion for the 'Remainder of NSW' and 'UHAQMN'.

3.5 Comparison of UHAQMN annual average PM_{10} and NSW/ACT rainfall

Rainfall (or the lack of) is a key component when discussing particulate matter concentrations. This section compares annual average PM_{10} concentrations and annual rainfall totals with the aim of understanding the strength of the relationship between the two.

In Appendix A1.4 of the AQ Data Analysis Project, the conclusion is that there is a statistically significant relationship between NSW mean annual rainfall and annual average PM_{10}. Table 3.4 presents NSW/ACT annual rainfall and UHAQMN annual average PM_{10} over the period CY2013-CY2024. These data are shown in Figure 3.5.

Table 3.4: NSW/ACT annual rainfall and UHAQMN annual average PM_{10}

Parameter	Year											
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
UHAQMN PM_{10} (µg/m³)	21	20	18	18	20	25	33	21	16	14	20	18
NSW Rainfall (mm)	464	467	541	661	453	333	250	639	721	864	429	579

Figure 3.7 clearly shows that there is a negative correlation between rainfall and particulate matter concentrations across the UHAQMN. Given the consistency between PM_{10} trends across NSW and the UHAQMN (refer Figure 3.1), this relationship also holds for NSW PM_{10} concentrations more broadly.

CY2024 data reinforces this negative correlation. PM_{10} shows a moderate decrease in line with a moderate increase in rainfall, compared to very high rainfall conditions and corresponding low PM_{10} during CY2021-CY2022 (La Niňa climatic conditions). A correlation coefficient (R^2) of -0.85 has been calculated for the dataset. A perfect positive correlation is +1 and a perfect negative correlation is -1.

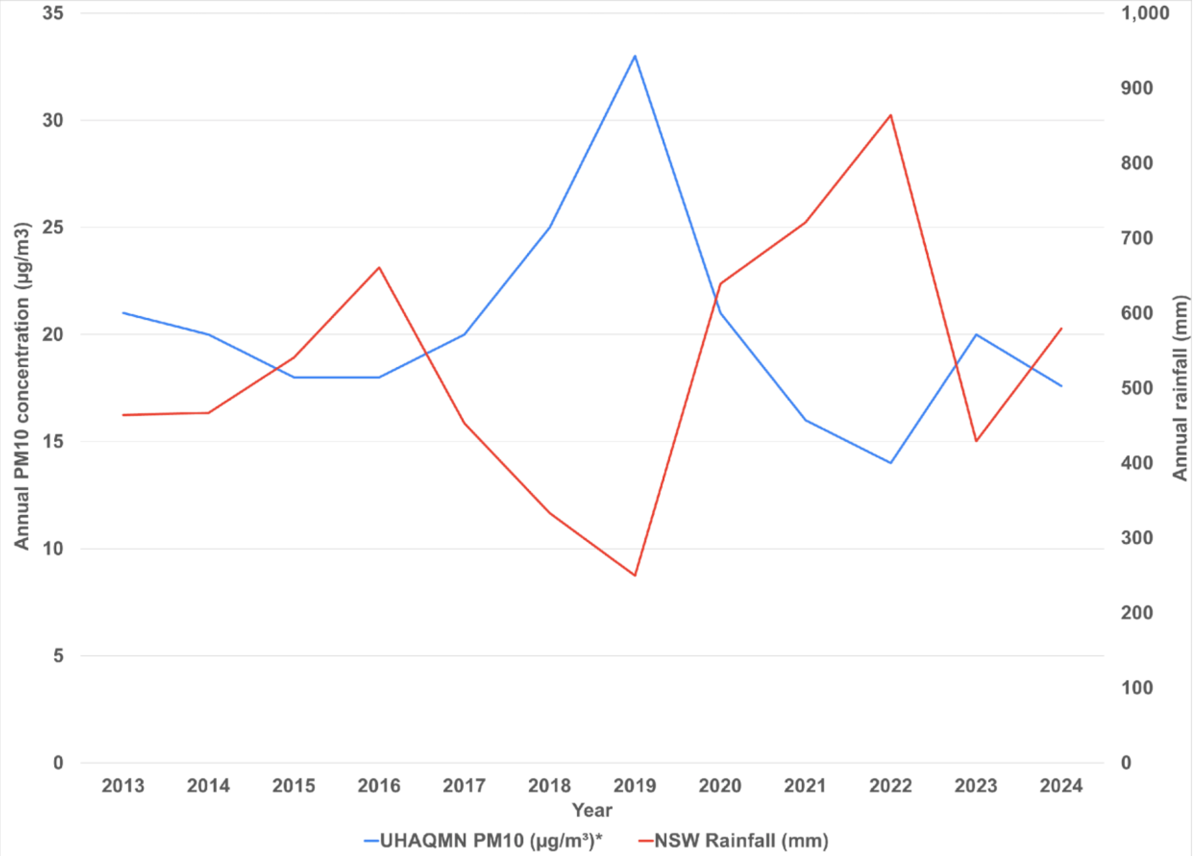


Figure 3.7: NSW/ACT annual rainfall and UHAQMN annual average PM_{10}

3.6 Comparison of UHAQMN annual average PM_{10} and Hunter Valley Coal Production

This section compares annual average PM_{10} concentrations and annual raw coal production across the Hunter Valley with the aim of understanding the strength of the relationship between the two.

Appendix A1.1 of the AQ Data Analysis Project demonstrated that, over the period 2013-2019, the relationship between annual coal production and annual average PM_{10} is not statistically significant. Similarly, Appendix A1.2 of the AQ Data Analysis Project showed that the relationship between annual National Pollutant Inventory (NPI) reported PM_{10} emissions and annual average PM_{10} concentrations is not statistically significant. This update now presents a comparison of Hunter Valley coal production data and PM_{10} concentrations measured by the UHAQMN including data for CY2024. Table 3.5 presents the Hunter Valley raw coal production between CY2013 and CY2024.

Table 3.5: Hunter Valley raw coal production (2013-2024)

Year	Hunter Valley Raw Coal Production (Mt)	Percentage of 2013 Raw Coal Production (%)
2013	158	100%
2014	160	102%
2015	146	92%
2016	145	92%
2017	146	92%
2018	151	96%
2019	155	99%
2020	146	92%
2021	142	90%
2022	126	80%
2023	136	86%
2024	141	89%

CY2013 has been nominated as a reference year to show the relative scale of coal production since the beginning of the monitoring study period. As shown in Table 3.5, the annual Hunter Valley raw coal production rates have been generally consistent over the period CY2013-CY2021, ranging between 90% and 102% of the 2013 value. However, production levels have been decreasing year on year from CY2019 through to CY2022, before increasing again in CY2023 and CY2024. Annual coal production rates for CY2024 are higher than CY2022 and CY2023 but lower than all other previous years.

Figure 3.8 presents the comparison of Hunter Valley coal production data and UHAQMN annual average PM_{10} concentrations.

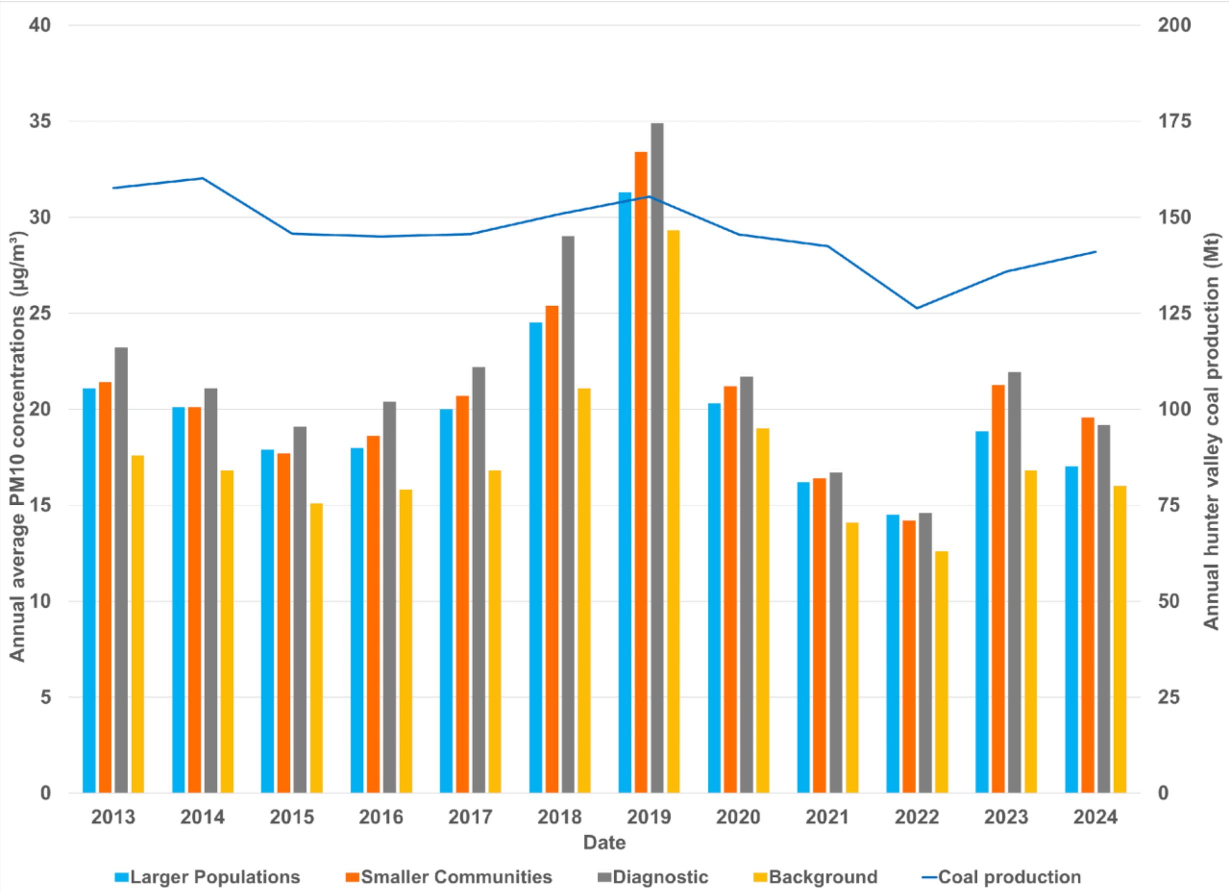


Figure 3.8: Comparison of Hunter Valley coal production data and UHAQMN annual average PM_{10} concentrations

As shown in these data, there is no visually apparent correlation between raw coal production and ambient PM_{10} concentrations measured by the UHAQMN between 2013 and 2019. Correlation coefficients (R^2) for the station groupings ranged between +0.33 and +0.41. Figure 3.8 shows inconsistency in the scale of variability in each metric across 2013 – 2019, with minor proportional variability in coal production relative to significant proportional variability in annual average PM_{10}.

From 2019 to 2022, both coal production and annual average PM_{10} concentrations have reduced year on year. In 2023, coal production was higher than in 2022, while PM_{10} concentration increased across the UHAQMN. In 2024, coal production has increased from 2023, whilst PM_{10} concentrations have reduced. Correlation coefficients (R^2) for the station groupings ranged between +0.55 and +0.64. Whilst the correlation coefficients have increased over time, the fluctuations in annual average PM_{10} concentrations are anticipated to be related to ambient temperatures and the amount of rainfall during each of these years, rather than changes in coal production. It is recommended that relationships between PM_{10} concentrations, coal production and rainfall continue be reevaluated annually.

4 Conclusion

Overall, as noted within the previous annual reviews and reinforced with the inclusion of CY2024 data, the temporal trends in the UHAQMN and 'Remainder of NSW' monitoring subsets show that the changes in PM_{10} concentrations within the Upper Hunter are generally consistent with changes experienced across the rest of NSW.

Annual average PM_{10} and $PM_{2.5}$ concentrations measured across the UHAQMN have been compared with the remainder of NSW, with the aim to identify if trends experienced across the UHAQMN are also being experienced across the rest of NSW. It is noted that the 'Remainder of NSW' PM_{10} concentrations have increased by 2% from CY2023 to CY2024. However, the UHAQMN PM_{10} concentrations have decreased by 9% from CY2023 to CY2024. This differs from what has been seen for other years, where both data sets follow the same trend between years. The 'Remainder of NSW' values do still remain below the 'all years' average. It was identified that the South West slopes grouping of monitoring stations showed an anomalous 26% increase in concentrations from CY2023 to CY2024. When the South West slopes data point is removed, a decrease in the 'Remainder of NSW' concentration is shown from CY2023 to CY2024, consistent with the UHAQMN data set.

This in turn indicates that the changes in annual average PM_{10} concentrations are consistent with regional particulate sources and that the contribution of mining operations on the UHAQMN to these trends is not discernible.

For $PM_{2.5}$, 'Remainder of NSW' annual average concentrations have reduced from CY2023 to CY2024 but only by 0.1 $\mu g/m^3$, whereas concentrations from the UHAQMN have remained the same.

The annual variance has been reviewed in further detail for the four-station group sub-divisions to understand if trends are similar across the groups. The differences between PM_{10} concentrations at Background stations and Diagnostic stations are near identical across CY2013-CY2024 (up to 1 $\mu g/m^3$ variability), while the range in annual average PM_{10} concentrations across this period is 22 $\mu g/m^3$. This reinforces that changes in Upper Hunter PM_{10} concentrations are associated with regional conditions and are indicative of a minimal change in the contribution from local emission sources inclusive of mining.

A data review for the number of exceedances of the 24-hour average PM_{10} criterion for each region / group has been completed to understand the short-term peaks in PM_{10}, where these are located and the frequency that these are above NSW EPA criteria. For the average across all years, the highest number of PM_{10} exceedance days have been recorded at UHAQMN Diagnostic stations, with the next highest observed at UHAQMN Smaller communities, followed by Lower Hunter & Central Coast stations and South West slopes stations.

For CY2024, all locations recorded exceedance days below the 'all years' average. Of the 12 station groupings, there are six station groupings that show exceedance days and two of these only have one exceedance day for the entirety of 2024 (Illawarra and UHAQMN Background stations). When compared against CY2023, all locations in CY2024 showed the same or less exceedance days than 2023 with the exception of South West slopes which showed an additional four exceedance days in 2024.

A comparison of the number of exceedance days of the 24-hour average PM_{10} criterion at the grouped UHAQMN stations for 2013 to 2024 shows that these grouped locations show generally the same trend. A comparison of the average number of exceedance days of the 24-hour average PM_{10} criterion for the 'Remainder of NSW' and 'UHAQMN' shows that these grouped locations show generally the same trend, regardless of the location.

With the inclusion of CY2024 data for both rainfall and particulate matter concentrations, it continues to be seen that there is a negative correlation between the two across the UHAQMN. This is supported by a correlation coefficient (R value) of -0.85 which has been calculated for the dataset. Given the consistency between PM_{10} trends across NSW and the UHAQMN, this relationship also holds for NSW PM_{10} concentrations more broadly.

A comparison of the annual average PM_{10} concentrations recorded across the UHAQMN versus the amount of raw coal production across the Hunter Valley shows that there is no visually apparent correlation between raw coal production and ambient PM_{10} concentrations measured by the UHAQMN between CY2013 and CY2024. The correlation coefficient (R^2) for the station groupings ranged between +0.55 and +0.64. Whilst the correlation coefficients have increased over time, the fluctuations in annual average PM_{10} concentrations are anticipated to be related to ambient temperatures and the amount of rainfall during each of these years, rather than changes in coal production. It is recommended that relationships between PM_{10} concentrations, coal production and rainfall continue be reevaluated annually.

We trust that the above provides an appropriate level of detail to meet your requirements. Do not hesitate to contact the undersigned if you have any queries on the above.

Yours sincerely

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