DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Air quality monitoring plan for the Central Coast Region 2021–25

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Cover photo: Cafe in Terrigal, NSW. Don Fuchs/DPIE

Published by:

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ISBN 978-1-922493-78-1
EES 2021/0145
First published in December 2020; reprinted April 2021 with amendments.

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1. About this document

1.1 Purpose

The purpose of this document is to explain how the NSW Government intends to monitor ambient air quality in the Central Coast Region during the five-year period: 2021 to 2025.

This air quality monitoring plan meets the requirement of National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM), Part 4 Section 10, that each jurisdiction must have a plan setting how it proposes to monitor air quality for the purposes of this measure.

1.2 Target audiences

Concerned citizens and advocates

This document is for those who wish to learn about the methods and systems used to monitor air quality in their region so they can take informed action to reduce pollutants and populations' exposure to them. They can learn how certain types of pollutants, landforms and weather patterns might result in higher localised air pollution, and how nearby activities such as industry and traffic may affect amenity, and public and environmental health.

Industry

For businesses with activities subject to air quality regulation and licensing, this document explains how the NSW Government uses industry monitoring as part of an integrated and rigorous air quality monitoring system. Monitoring helps local industry understand the community's concerns.

NSW Government policymakers

This information can help Ministers and senior public servants to assess the adequacy of monitoring and pollution control for managing public health. Monitoring helps policymakers allocate and prioritise resources for air quality and make decisions about the adequacy of policies, programs and regulations to manage air pollution.

National Environment Protection Council

This regional plan describes monitoring in the Central Coast Region for the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM).

1.3 Plan update and review

This monitoring plan will be updated annually and reviewed every five years.

Table 1 Changes to the plan since 2001

Version	Release date	Purpose
Version 1.0 (original plan)	2001	Initial monitoring plan required under NEPM 1998.
Major periodic reviews 2017–18	2018	To evaluate how well NSW is meeting the AAQ NEPM requirements, what is monitored for non-NEPM purposes, and where available resources could best be deployed to gather required and additional information about air quality. The reviews identified extra monitoring requirements due to growing populations, new sources of air pollution, new technologies and specific community concerns.
Version 2.0	December 2020	Major plan update based on the 2017–18 major periodic reviews.
Version 2.01	April 2021	Minor corrections
Version 2.1	December 2021	Next scheduled annual update.
Version 3.0	December 2025	Next scheduled five-year review.

2. Recommended air quality monitoring plan for the Central Coast Region

Air quality is monitored to assess if the air we breathe poses a risk to human health. Monitoring information provides evidence to the public, health professionals and policymakers when choosing short-term and long-term actions to reduce harm. Risk of harm is a function of the number of people exposed (population), and the level of exposure – pollutant types, concentrations, and durations.

2.1 Region definition

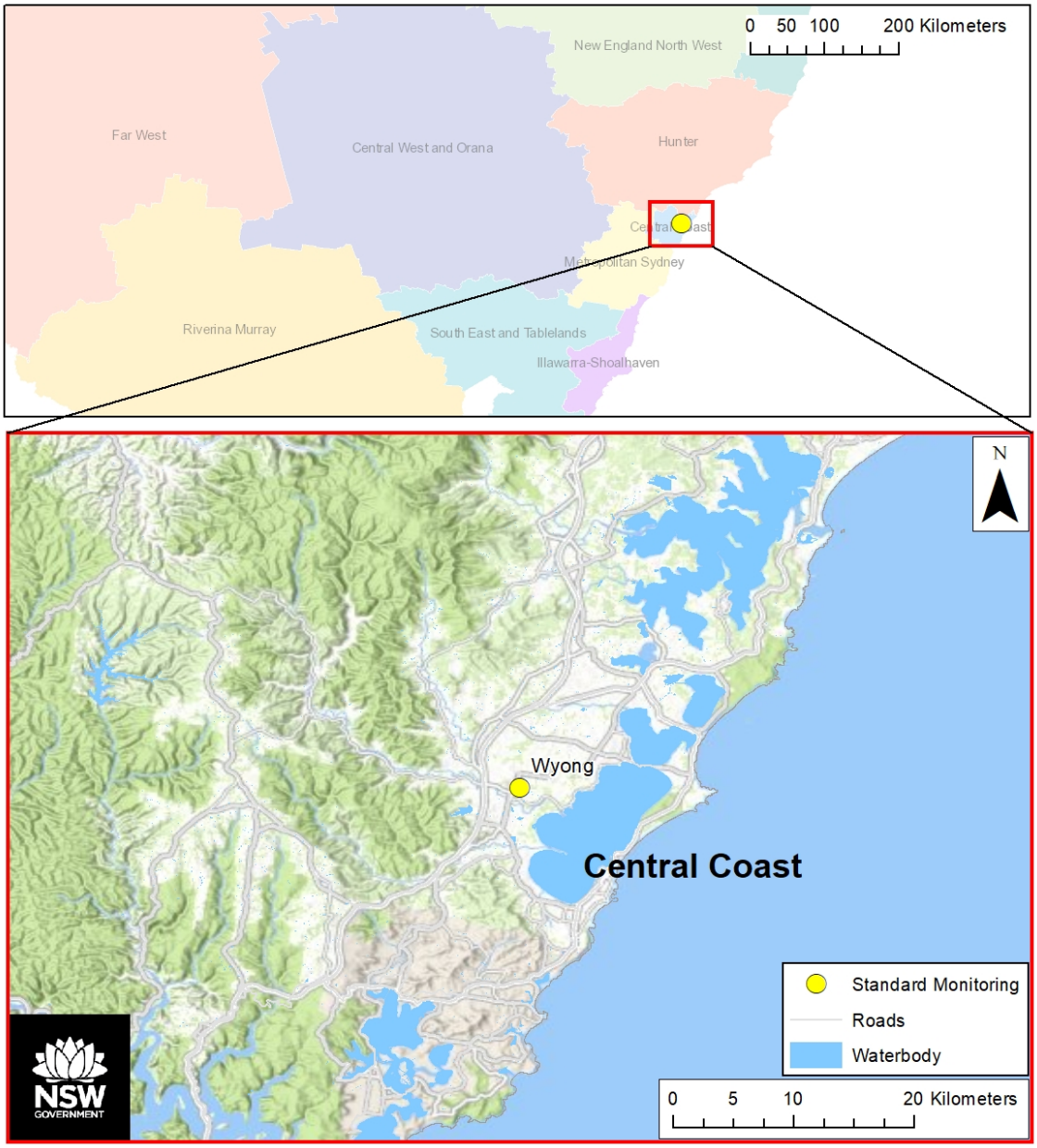

Figure 1 **Air quality monitoring in the Central Coast region (as of 1 January 2021)**

Shown in top insert is the Central Coast planning region.

This plan is presented by air quality monitoring region, based on NSW strategic planning regions, an administrative boundary determined by the Department of Planning, Industry and Environment, broadly in line with population centres and human land-uses. Human activities (such as burning fossil fuels for energy and transport) and land-use patterns (such as population density, travel patterns, location of polluting industries and their proximity to vulnerable types of people such as children, and urban heat-island effect) influence air quality and its effect on the population.

The Central Coast Significant Urban Area (SUA), as defined in 2016 by the Australian Bureau of Statistics (ABS), covers the major populated parts of the Central Coast Region. This SUA is bordered by the Newcastle–Maitland SUA to the north, and the smaller Morisset–Cooranbong SUA to the north-west.

The Morisset–Cooranbong SUA is included within the Central Coast air quality monitoring region. Within the NSW planning regions, it exists within the southern edge of the Hunter Region. Although the SUA contains slightly less than the 25,000 population threshold for screening, the NSW Government has decided it should be considered within either the Central Coast or Lower Hunter regions for various reasons:

- population growth will see it exceed this threshold in the next 10–15 years, or see it amalgamated into one of the bordering SUA regions
- it is located within the continuously populated coastal fringe between Gosford and Newcastle and shares the same continuous airshed
- air quality is likely affected by nearby power generation sources to a larger extent than the majority of the surrounding two regions.

In the 2001 monitoring plan, the Gosford part of the Central Coast Region was included as a subregion of the Greater Sydney air quality region, with Lake Macquarie and Tuggerah Lakes considered within the Lower Hunter Region. Since monitoring was established at Wyong in 2012, the Central Coast has been considered as a separate region.

Underlying atmospheric and pollution analysis is based on natural boundaries, mainly airshed which is a function of terrain and climate. Smoke, dust and gaseous chemical pollutants are moved by thermal currents and blown by the wind. Natural convection causes hot air to rise, taking pollution with it. Landscape features – such as hills and valleys – are natural barriers that limit the dispersal of pollutants, and can result in pollution pools with higher pollution concentrations. Winds and air movement patterns often follow a diurnal and seasonal pattern – for example, sea breezes in the afternoon. Changes to the climate mean historically typical meteorological patterns might change in future.

2.2 Regional monitoring plan 2021–25

AAQ NEPM compliance statement

The region requires two stations based on population considerations.

For NEPM compliance, the plan for 2021–25 sets two current sites to monitor ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, particles as PM2.5 and particles as PM10 (Table 2). Two sites are currently operational.

Monitoring outside NEPM compliance purposes

Currently, no monitoring outside that undertaken at NEPM compliance stations is undertaken or planned, other than possible normal emergency and incident monitoring consistent with *NSW Air Quality Monitoring Plan – Methods for creating plans* (DPIE 2020).

Table 2 Monitoring stations on the Central Coast

Station	Station type[†]	Year est.	O_3[§]	NOx	PM10	PM2.5[*]	Vis	CO	SO_2	Met
Morisset	P	2020	✓	✓	✓	✓(2020)	✓	✓	✓	✓
Wyong	P	2012	✓	✓	✓	✓(2012)	✓	✓	✓	✓

* Denotes the year in which beta attenuation monitors (BAM) were installed at monitoring sites to measure PM2.5.

§ O_3 = Ozone; NOx = oxides of nitrogen which includes nitrogen dioxide (NO_2); Vis = visibility as measured by nephelometer; Met = meteorology (such as wind, temperature)

† P = performance station; T = trend station.

Planned monitoring technologies

The current monitoring technologies, including instrumentation for each pollutant, are described in 'Schedule 2 – Register of NSW monitoring stations' of *NSW Air Quality Monitoring Plan – Methods for creating plans*, and this information is also accessible on the Sharing and Enabling of Environmental Data in NSW (SEED) portal. This schedule is updated regularly by the Department's Climate and Atmospheric Science Branch.

Planned reporting of air quality monitoring results

Table 3 Reporting plan 2021–25

Reporting type	Plan for 2021–25	Schedule
Current / live results by station and region	Publish live air quality monitoring results for the region on the Department's website. Website improvements are scheduled for release in 2020 and 2021.	Website upgrade Part 1 November 2020 Website upgrade Part 2 March 2021 Website upgrade Part 3 July 2022
NSW annual compliance with AAQ NEPM	Meet AAQ NEPM requirements to report annually on compliance with the goals and standard. Publish an annual compliance report on the Department's website.	2nd half of each calendar year
NSW annual air quality statement	Report annually on air quality over the past year. Publish air quality statement on the Department's website.	Annually in each January
Special air quality report	Publish special air quality analysis reports of selected air pollution episodes and events on the Department's website.	Quarterly when applicable
Inventory of pollution sources within GMR*	An inventory of pollution sources was published every five years but is now published as required.	To be determined

* GMR refers to the Greater Metropolitan Region, as defined for NSW air emissions inventory. This includes Greater Sydney, as well as Illawarra, Lower Hunter and Central Coast.

2.3 Changes since the 2001 monitoring plan

Key changes to monitoring stations since 2001

Regular monitoring of pollutants in the Central Coast was not undertaken in 2001. Plans were in place to establish pollutant monitoring, but the Central Coast stations were to be part of the broader Sydney and Lower Hunter monitoring regions.

The current site at Wyong was established in 2012, with monitoring for all NEPM-required pollutants undertaken (except lead).

Key changes to monitoring technologies since 2001

The AAQ NEPM legislation was updated in 2016, with monitoring of fine particles as PM2.5 now a mandated process. The high particle levels measured statewide during the bushfire crisis in the 2019–20 summer season has reinforced the necessity and the health benefits of

measuring PM2.5 routinely at multiple locations, with live reporting of those results helping people to actively manage their exposure.

The 2001 NSW Air Quality Monitoring Plan did not mention PM2.5 specifically. However, at the time PM2.5 was undertaken at up to eight stations within the Greater Metropolitan network using tapered element oscillating microbalance instruments (TEOM). This was based on available instrumentation, and in the absence of available standard methods at the time, these were run in accordance with United States Environmental Protection Agency (USEPA) equivalence methods. Since 2012 these have been gradually replaced in New South Wales with beta attenuation monitor (BAM) instruments. As the Wyong site was established in 2012, it has always used the BAM technology to measure PM2.5.

3. Key factors analysis

This regional monitoring plan has been prepared by analysing the following key factors, as defined in *NSW Air Quality Monitoring Plan – Methods for creating plans*.

3.1 Geographic extent and boundary

The Central Coast includes the region bounded by the Hawkesbury River in the south, the Watagan Mountains in the west, and the southern end of Lake Macquarie in the north. The region and its population density are shown in Figure 2.

3.2 Population

The population of the Central Coast significant urban area (SUA) is around 320,000 (ABS SUA 2016), making the Central Coast the third-largest urban area in New South Wales. The Morisset–Cooranbong SUA is located between the Central Coast and Newcastle SUA areas, and has a population of 24,000.

The Department publishes NSW population and household projections. The projection forecasts that by 2026, the Central Coast local government area (LGA), which comprises most of the equivalent Central Coast SUA, will have grown to 0.38 million people (DPIE 2019).

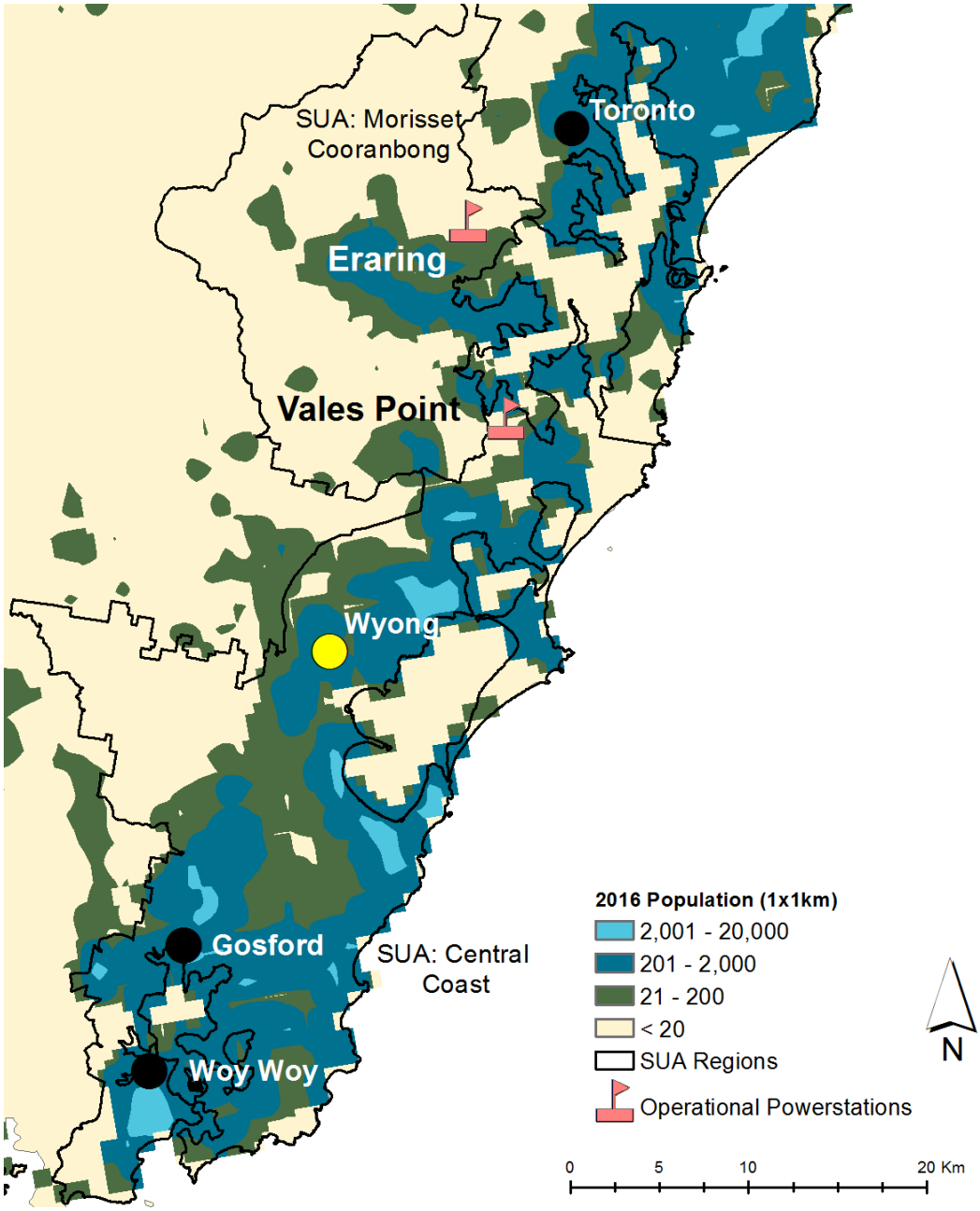

Figure 2 **Population density in the Central Coast Region**

Yellow dots indicate monitoring stations, black dots indicate towns without monitoring. Eraring and Vales Point power stations are indicated by red symbols.

NEPM requirements for monitoring based on population

Applying the formula in Clause 14(1) of the NEPM to the Central Coast air quality region, comprising the Central Coast and Morisset SUAs, at least two monitoring stations are required in the region based on current population. Based on NSW Planning Projections for the Central Coast region population alone in 2026, the two-station requirement will be maintained.

Table 4 Stations required according to population

Year and population calculation method	Population (millions)	Number of stations based on NEPM calculation[1]
2016 (ABS census data Central Coast)	0.320	1
2016 (ABS census data, Central Coast and Morisset)	0.345	2
2016 (NSW planning assumptions, Central Coast only)	0.34	2
2026 (NSW planning assumptions, Central Coast only)	0.38	2

The Morisset–Cooranbong SUA borders both the Central Coast and Lower Hunter SUAs. The latest plans associate this part of the overall region within the Central Coast for air quality monitoring purposes. A commitment was made to construct a new monitoring station in the Lake Macquarie area around Morisset, which was commissioned in November 2020.

Conclusions and recommendations for monitoring

The current number of monitoring stations meet the AAQ NEPM requirements for population.

3.3 Terrain

As shown in Figure 3, the key urban areas in the Central Coast region lie along the coastal strip, which is generally flat. The western boundary of the region is defined by the Watagan Mountains, which rise to an elevation of approximately 300–500 metres above sea level. As the significant topographic feature in the region, the Watagans are an influence on meteorology, and hence, on air quality in the region. Much like the Illawarra escarpment, the Watagans can steer or deflect winds. The Watagans are lower than the Illawarra escarpment, so their impact on local meteorology might not be as significant.

[1] Section 14(1) of the AAQ NEPM: (1) Subject to subclauses (2) and (3) below, the number of performance monitoring stations for a region with a population of 25,000 people or more must be the next whole number above the number calculated in accordance with the formula: 1.5P + 0.5, where P is the population of the region (in millions). (2) Additional performance monitoring stations may be needed where pollutant levels are influenced by local characteristics such as topography, weather, or emission sources. (3) Fewer performance monitoring stations may be needed where it can be demonstrated that pollutant levels are reasonably expected to be consistently lower than the standards mentioned in this measure.

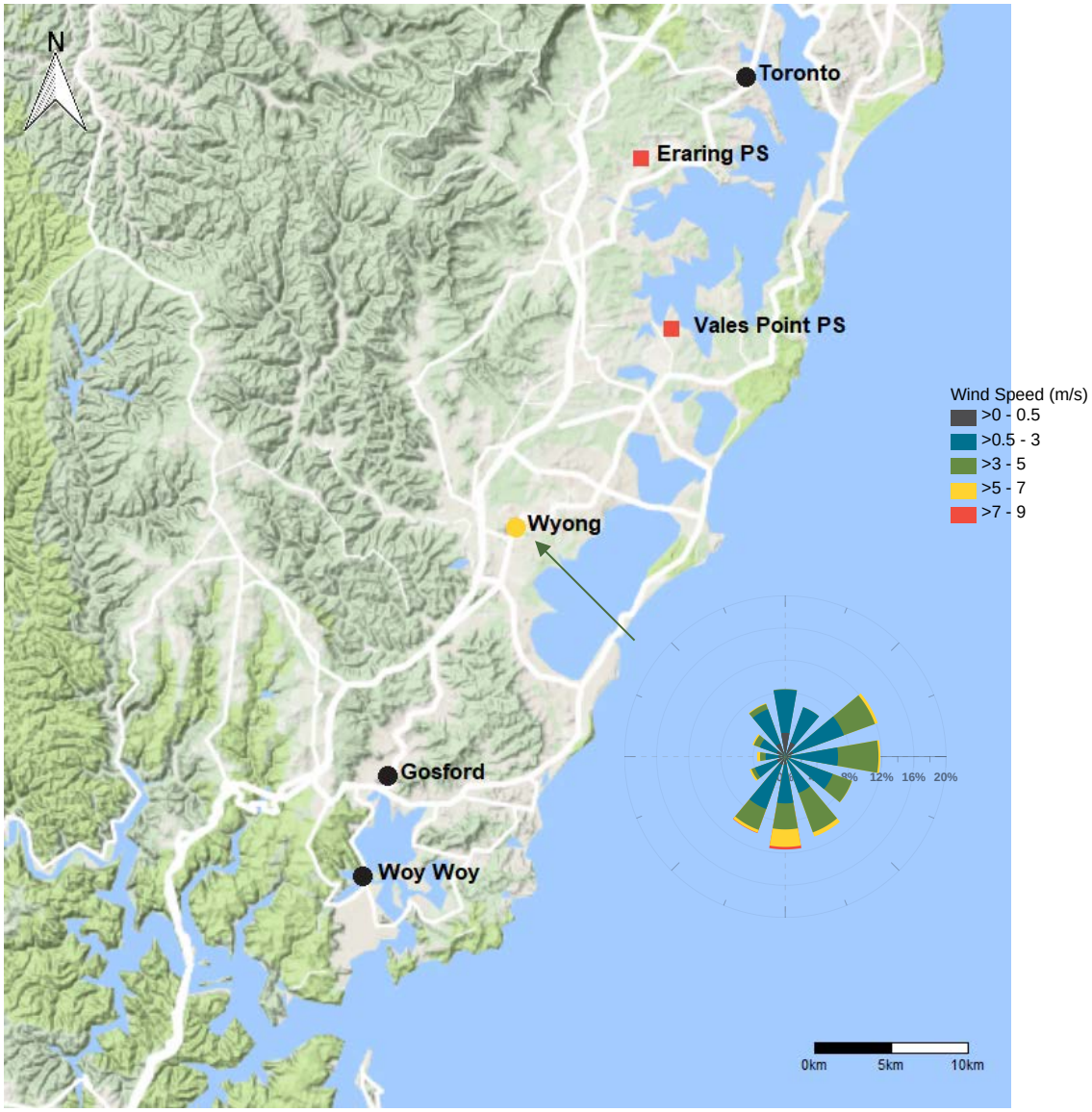

Figure 3 **Topography and an annual average wind rose map of the Central Coast Region[2]**

The yellow dot indicates the monitoring station; black dots indicate areas without monitoring. Eraring and Vales Point power stations are indicated by red symbols. The annual wind rose is also shown.

3.4 Regional climate and meteorology

Across the Central Coast, average temperatures range from summer maximums of between 26–28°C and winter minimums of 4–6°C with milder conditions along the coast. Along the coast, rainfall ranges between 1200–1600 mm, with lower totals further inland from the lakes. Higher rainfall totals are observed during the first half of the year in summer and autumn.

The terrain of the Central Coast region and the annual average wind rose at Wyong is shown in Figure 3. The prevailing winds at Wyong monitoring site typically change from

[2] Wind roses show the wind direction and speed at a location. The length of each bar around the circle in these wind roses shows the percentage of time the wind blows from a specific direction. The colours along the bars indicate wind speeds. Wind speed in shown in metres per second (m/s).

onshore easterly winds during warmer months to offshore westerly winds during cooler months, as summarised in Table 5.

Table 5 Predominant winds in four seasons at Wyong

Season	Predominant wind
Spring	Easterly
Summer	East (north-east, east and south-east), with a strong southerly
Autumn	South-west and north-west
Winter	West, north-west and south-west

The study by Hyde et al. (1997) illustrates the Central Coast Region is affected by pollution from both local and remote sources: the transport of ozone and other pollutants from the Sydney and Newcastle regions into the Central Coast.

A north-easterly component in the sea breeze or gradient wind can result in emissions from the Newcastle area being advected down to the Central Coast area towards the Sydney airshed (Hyde et al. 1997).

Plumes from Eraring Power Station that are carried offshore during the morning can be carried back onshore within the afternoon sea breezes in spring and summer. Under south-westerly winds in autumn and winter, these plumes can also be carried north towards the Newcastle region.

3.5 Emission sources

The 2013 Calendar Year Air Emissions Inventory for the Greater Metropolitan Region (NSW EPA, 2019) identified sources contributing to pollutant emissions in the Central Coast Region.

Table 6 presents the top three emission activities contributed to PM2.5, PM10, SO_2, NOx and CO emissions in 2013 for the Central Coast Region (NSW EPA 2019). For PM2.5, 42.8% of emissions arise from residential wood heating, followed by non-metallic mineral mining and quarrying (12.9%) and prescribed burning and bushfires (8.2%). For PM10, non-metallic mineral mining and quarrying and residential wood heating contribute 29.5% and 24.8% respectively to the total PM10 emissions in the region.

The main source of SO_2 emissions within the region is electricity generation at the power stations (Vales Point and Eraring power stations), that contribute 99.9% of the SO_2 emissions. Electricity generation is also the biggest contributor to NOx emissions (79.7%), while petrol vehicle and diesel vehicle exhaust only play minor roles (7% and 5% respectively) in contributions to the NOx emissions in this region. The CO emissions arise mainly from petrol vehicle exhaust (32.6%), residential lawn mowing and garden equipment (16.7%) and residential wood heating (16.3%).

Table 6 Top three emission activities contributing to PM2.5, PM10, SO_2, NOx and CO emissions in 2013 in the Central Coast Region

Substance	Top three emission activities in the region		
PM2.5	Domestic–commercial	Commercial	Natural
	Residential wood heating 42.8%	Non-metallic mineral mining and quarrying 12.9%	Prescribed burning and bushfires 8.2%
PM10	Commercial	Domestic–commercial	Industrial
	Non-metallic mineral mining and quarrying 29.5%	Residential wood heating 24.8%	Agriculture 7.0%
SO_2	Industrial	Natural	Industrial
	Electricity generation 99.7%	Prescribed burning and bushfires 0.1%	Ceramic product manufacturing 0.1%
NOx	Industrial	Off-Road	On-Road
	Electricity generation 79.7%	Diesel vehicle exhaust 7.2%	Petrol vehicle exhaust 5.2%
CO	On-Road	Domestic–commercial	Domestic–commercial
	Petrol vehicle exhaust 32.6%	Residential lawn mowing & garden equipment 16.7%	Residential wood heating 16.3%

3.6 Historical air quality monitoring in the Central Coast

The Wyong air quality monitoring station in the Central Coast region was established in 2012, as shown in Table 2. A comprehensive list of metadata for the air quality monitoring stations, including location, commissioning and decommissioning dates, is available on the Department's website: Air quality monitoring network.

Long-term trend analysis of pollutants is available at numerous sources, so is not replicated here. Sources include:

- annual NEPM compliance reports, which give a comprehensive summary of air quality trends and statistical data for this region against the NEPM air quality standards and goals: Air quality annual reports
- NSW State of the Environment Reports (Air Quality), which are published on three-year cycles

  NSW annual air quality statements, which summarise air quality across the network by calendar year.

Summary

Since 2012, air quality has been ‘very good’ or ‘good’ for 90% of days in the Central Coast.

The levels of CO, SO_2 and NO_2 have been below the relevant standards during this period and no exceedances have been recorded. Ozone levels have generally remained below the national standard, with only three exceedance days since 2012. Particle levels (PM10 and PM2.5) have generally remained below the national standards, however, there has been an increase in PM10 in 2018 and 2019. In 2019, due to the ‘black summer’ bushfires, the Central Coast recorded its highest number of exceedance days for ozone and particles (PM10 and PM2.5) since 2012.

3.7 Community engagement

Monitoring must serve community needs. The NSW Government listens and learns from communities, pursuing the best outcomes and creating opportunities that benefit all. Monitoring must always be done for the sake of people’s wellbeing and the prosperity of NSW. The NSW EPA leads engagement activities to identify and respond to community needs. It produces a range of draft policies, agreements and reports that call for community involvement, engagement and consultation. For example, in 2017, the NSW Government invited air quality stakeholders to complete an online survey to help inform the development of a clean air policy for New South Wales. Survey respondents called for more monitoring stations in locations such as Lake Macquarie. Consequently, a new station has been established at Morisset.

NSW Government Air Program scientists participate in community engagement activities and panels administered by the NSW EPA. There are several continuous feedback channels for the public to discuss air quality monitoring and reporting. These include:

- website feedback forms
- Environment Line online, or email info@environment.nsw.gov.au, or phone 131 555
- correspondence arising from email newsletters and reports.

Feedback and queries from these channels have resulted in a number of actions for improving air quality monitoring and reporting. For example:

- Community feedback during the NSW 2019–20 bushfire period demonstrated a need to improve our public information services. The NSW Government is working with other jurisdictions, through the National Air Technical Advisory Group (NATAG), to ensure a nationally consistent approach to air quality data reporting and to deliver health information that is easier to understand. The NSW Government implemented the Environmental Health Standing Committee (enHealth) recommendation for hourly PM2.5 reporting and related health messaging on its website in November 2020.
- The Enhance Website and Data Delivery (EWADD) project, commissioned in 2019, is implementing a system for managing, reporting and delivering air quality data to meet changing business needs and customer expectations. A new website will deliver enhanced public-facing air quality data and information services and replace the data management and reporting system that has operated since 2008.

3.8 Overall analysis

Conclusions from analysis of other factors and recommendations for air quality monitoring

Based on analysis of factors, two stations are required in the region. The monitoring plan will be updated annually, with a major review in 2025.

In mid-2020, the NSW Government committed to commissioning an air quality monitoring station in Morisset. This was both to supplement industrial air quality monitoring in the region undertaken under licence agreements, and to provide live air quality readings to the community. The station was commissioned in November 2020.

The significant bushfire crisis of 2019–20 across Australia, and the consistently high levels of air pollution measured across NSW, highlighted the dual purposes of an active air quality monitoring network: monitoring air quality impacts across long time periods, and providing information to help members of the public manage impacts on their health in real time. To perform this second task adequately, monitors (whether fully NEPM-compliant or not) need to be located in areas where they can provide accurate information to the widest cohort of the community as possible.

The NSW Government is considering providing monitoring in locations which have a large population base and which are not significantly close to existing monitoring stations, or where unique terrain or emission sources mean the expected air quality cannot be inferred from other monitoring stations. Deployment of new monitoring must also be considered against available resources, geographic equity across the entire State, and frequency of pollution events expected.

Staged updates to the air quality website will be undertaken during the 2021–25 period. We are working with the Australian Government and other jurisdictions to ensure a nationally consistent approach to reporting air quality and associated health advice. A new, dedicated air quality website is under development, with its official launch expected in 2022.

Within the Central Coast Region, the number of monitoring stations across the entire region is sufficient. However, during the ‘black summer’ bushfire crisis, public feedback suggested the current monitoring location at Wyong, while useful for informing general air quality exposure over longer periods of time for the Central Coast, may not be appropriately located to inform the larger population base located in the southern areas near Gosford under bushfire conditions. This was particularly the case if the major particle emissions source was in the raised bushland area to the west, either as a result of bushfires or planned burns. Consideration may need to be given to how this area might be monitored under those scenarios, what form that monitoring would take (permanent or incident), and whether lower-capital-cost particle monitors might be sufficient to achieve this aim.

4. Further information

Review of air quality data from Lake Macquarie and Wyong

The NSW EPA commissioned a consultancy to review annual air quality data from the Lake Macquarie and Wyong regions for 2014 and 2015 (Todoroski Air Sciences 2015 & 2016).

Air quality data from the NSW Government-operated Wallsend and Wyong monitoring stations and several industry monitoring stations were included in the review, with data for PM10, PM2.5, SO_2 and NO_2 evaluated. The review found the monitoring stations recorded

very good air quality in 2014 and good air quality in 2015. No exceedances of national air quality standards were recorded at any of the monitoring stations in 2014.

In 2015, PM10 concentrations were observed to exceed the 24-hour PM10 standard on one day at the Wallsend and Wyong monitoring stations. This event was likely caused by a dust storm, which led to elevated levels of PM10 across New South Wales (Todoroski Air Sciences 2015). In 2015, PM2.5 concentrations exceeding the 24-hour standard at one day at one of the industry-owned monitoring stations (Wyee). This exceedance was likely due to a local source (such as a household wood heater) emitting fine particles in the vicinity of the monitoring station (Todoroski Air Sciences 2016).

5. References

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