12 Air quality and greenhouse gases

The air quality and greenhouse gas assessment included a review of climatic data obtained from the airport site and an analysis of ambient air quality data collected at monitoring stations in the vicinity of the airport site. Air quality impacts associated with the construction of the proposed airport (particularly construction dust) were modelled as were emissions and air quality impacts associated with operation of the proposed airport. Other air quality parameters that were assessed included odour, regional air quality impacts (ozone) and greenhouse gas emissions.

Construction would result in dust emissions generated during both the bulk earthworks and the construction of aviation infrastructure. The results of the air dispersion modelling show that the predicted dust impacts during construction would be below the air quality assessment criteria at all sensitive residential receptors. Odour from the asphalt plant is also predicted to be below the relevant criteria at all sensitive residential receptors and would be largely contained within the airport site.

Operation of the proposed Stage 1 development would result in an increase in emissions of nitrogen dioxide (NO_2), particulate matter (quantified as PM_{10} and $PM_{2.5}$), carbon monoxide (CO), sulfur dioxide (SO_2) and air toxics. There would also be odour emissions from exhaust and from the onsite wastewater treatment plant. The highest offsite concentrations of the air quality metrics evaluated were generally predicted to occur at the receptors located to the north and north-east of the airport site.

Background traffic, associated with the broader urbanisation of Western Sydney, on surrounding road infrastructure was found to be a significant contributor to offsite ground level concentrations, particularly for those receptors located close to proposed roadways. The dispersion modelling found that there were almost no predicted exceedances of the air quality assessment criteria at any of the sensitive residential receptors investigated as part of the assessment of the Stage 1 development. Predicted $PM_{2.5}$ does exceed a future NEPM-AAQ objective for 2025 at a number of sensitive receptors, however this is primarily attributable to background concentrations. The modelling also predicted an exceedance of the 99.9th percentile one-hour maximum for formaldehyde shown at a receptor on the airport site. This exceedance is principally governed by the contribution from external roads as opposed to activities of the proposed airport. Predicted offsite odour concentrations were expected to be below detection limits for both aircraft exhaust emissions and odours from the onsite wastewater treatment plant.

Predicted ozone concentrations were found to exceed the relevant air quality criteria. However, the contribution of the Stage 1 development was found to be marginal in the context of predicted background regional ozone levels.

Scope 1 and Scope 2 greenhouse gas emissions from the Stage 1 development have been estimated to comprise about 0.13 Mt CO_2-e/annum, with the majority of emissions associated with the consumption of purchased electricity. These greenhouse gas emissions would represent approximately 0.11 per cent of Australia's projected 2030 transport-related greenhouse gas emission inventory. For this reason, it can be concluded that the greenhouse gas emissions from the proposed airport would not be material in terms of the national inventory. Although not typically included in greenhouse gas inventories due to potential for double counting, Scope 3 emissions from burning of fuel in aircraft were also quantified at around 2.5 Mt CO_2-e/annum.

Mitigation and management measures would be implemented to reduce potential air quality impacts during both construction and operation of the Stage 1 development. In particular, a dust management plan would be developed and implemented as part of an Air Quality Construction Environmental Management Plan to address potential impacts during construction. Air quality monitoring would also be undertaken at the airport site during operations as part of an Air Quality Operational Environmental Management Plan. Even though greenhouse gas emissions from the proposed airport would not be material in terms of the national inventory, a number of mitigation measures would also be implemented during operations to reduce these emissions.

12.1 Introduction

This chapter provides a review of the local and regional air quality impacts of the proposed airport. This chapter draws on a comprehensive local air quality and greenhouse gas assessment (included as Appendix F1 (Volume 4)) and a regional air quality assessment (included as Appendix F2 (Volume 4)).

The local air quality assessment considered primary emissions from the construction and operation of the proposed airport, such as nitrogen dioxide (NO_2), particulate matter (quantified as PM_{10} and $PM_{2.5}$), carbon monoxide (CO) and sulfur dioxide (SO_2). The regional assessment considered formation of ozone (O_3) through reactions involving primary emissions.

The potential impacts of the proposed Stage 1 development on local and regional air quality and the anticipated greenhouse gas emissions from the construction and operation of the Stage 1 development are considered and appropriate mitigation and management measures have been identified to reduce potential impacts.

The local air quality and greenhouse gas assessment and the regional air quality assessment have been prepared in consultation with the Australian Government Department of the Environment and Energy and have been carried out in accordance with the *Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport* (EIS guidelines).

12.2 Methodology

The air quality and greenhouse gas assessment draws on a local air quality and greenhouse gas assessment (see Appendix F1 (Volume 4)) and regional air quality assessment (see Appendix F2 (Volume 4)). Both assessments involved the development of an emissions inventory, a profile of existing air quality and meteorology, selection of representative sensitive receptors and dispersion modelling to understand how emissions from the proposed airport would disperse through the atmosphere. The results of the modelling were then compared against relevant air quality criteria for the protection of human health and the environment to identify exceedances. Measures were then identified where necessary to mitigate and manage emissions and exceedances.

The local and regional air quality assessments were undertaken in accordance with relevant regulatory guidelines, namely the EIS Guidelines, NSW Environment Protection Authority's Approved Methods for the Modelling and Assessment of Air Pollutants and the tiered procedure for ozone assessment. The assessments also utilised industry standard models including AERMOD, The Air Pollution Model (TAPM) and Comprehensive Air Quality Model with extensions (CAMx).

Both assessments were undertaken at a spatial scale appropriate to the emissions being assessed and the spatial extent over which impacts would be evident. Air emissions in the local air quality assessment were modelled up to around five kilometres from the airport site, while ozone was modelled for the NSW Greater Metropolitan Region equalling about 55,000 square kilometres.

Methodologies for the local air quality and greenhouse gas assessment and regional air quality assessment are summarised here and provided in Appendix F1 and Appendix F2 (Volume 4).

12.2.1 Local air quality

12.2.1.1 Emissions inventory

The construction and operation emissions inventories were derived using emissions factors that quantify each type of emission based on planned activities and equipment.

The construction emissions inventory was based primarily on the planned construction activities as outlined in Chapter 6 (Volume 1), including bulk earthworks and operation of machinery. It is expected that some construction activities could occur simultaneously. Therefore, the assessment of construction impacts adopted a worst case scenario to quantify emissions in which various construction activities are assumed to occur simultaneously.

The operation emissions inventory was based primarily on the indicative airport layout as outlined in Chapter 5 (Volume 1) and planned aircraft movements during the operation of the Stage 1 development. The main activities predicted to generate air emissions are listed in Table 12–1.

Emissions from road traffic were also quantified for construction and operation. Traffic projections were sourced from the traffic, transport and access assessment presented in Appendix J (Volume 4). It is noted that the projections also included predicted increases in background traffic associated with the broader urbanisation of Western Sydney predicted to occur over coming decades.

The majority of the adopted emissions factors are incorporated in the US Federal Aviation Administration Emissions Dispersion Modelling System utilised in the assessment, incorporating emissions factors from other sources such as the US Environmental Protection Authority and the International Civil Aviation Organization.

This approach is an industry standard that has been utilised in several similar assessments in Australia, including environmental assessments of Sydney Airport and Adelaide Airport.

Table 12–1 Summary of activities generating atmospheric emissions at the proposed airport

NPI source type		Description
Emissions directly from aircraft	Aircraft main engine	Main engines of aircraft ranging from start-up to shut-down.
	Auxiliary power unit	Auxiliary power unit located on-board aircraft providing electricity and pre-conditioned air while on the ground and bleed air for main engine start.
Aircraft handling emissions	Ground support equipment	Ground support equipment necessary to handle the aircraft during the turnaround at the stand, including ground power units, air climate units, aircraft tugs, conveyor belts, passenger stairs, fork lifts, tractors, cargo loaders, etc.
	Airside traffic	Service vehicle and machinery traffic, including sweepers, trucks (catering, fuel, sewage), cars, vans, buses etc. that circulate on service roads within the airport perimeter and typically within the restricted area.
	Aircraft refuelling	Evaporation through aircraft fuel tanks (vents) and from fuel trucks or pipeline systems during fuelling operations.
Stationary/ infrastructure sources	Power/heat generating plant	Facilities that produce energy for the airport infrastructure, namely boiler houses, heating/cooling plants, co-generators.

NPI source type		Description
	Emergency power generator	Diesel or other generators for emergency operations (e.g. for buildings or for runway lights).
	Aircraft maintenance	All activities and facilities for maintenance of aircraft, i.e. washing, cleaning, paint shop, engine test beds, etc.
	Airport maintenance	All activities and facilities for maintenance of airport facilities, including cleaning operations.
	Fuel	Fuel storage, distribution and handling.
	Construction and demolition activities	All construction and demolition activities involved in airport operation and development, including the resurfacing of roads and runways.
	Fire training	Activities for fire training with different fuels (e.g. kerosene, butane, propane, wood).
	Wastewater treatment	All activities and facilities for the collection, storage and treatment of wastewater onsite.
Landside traffic	Vehicle traffic	Cars, vans, trucks, buses, motorbikes etc. associated with the proposed airport on access roads, drop-off areas and parking lots. Emissions include tailpipe and evaporative releases.

12.2.1.2 Existing air quality and meteorology

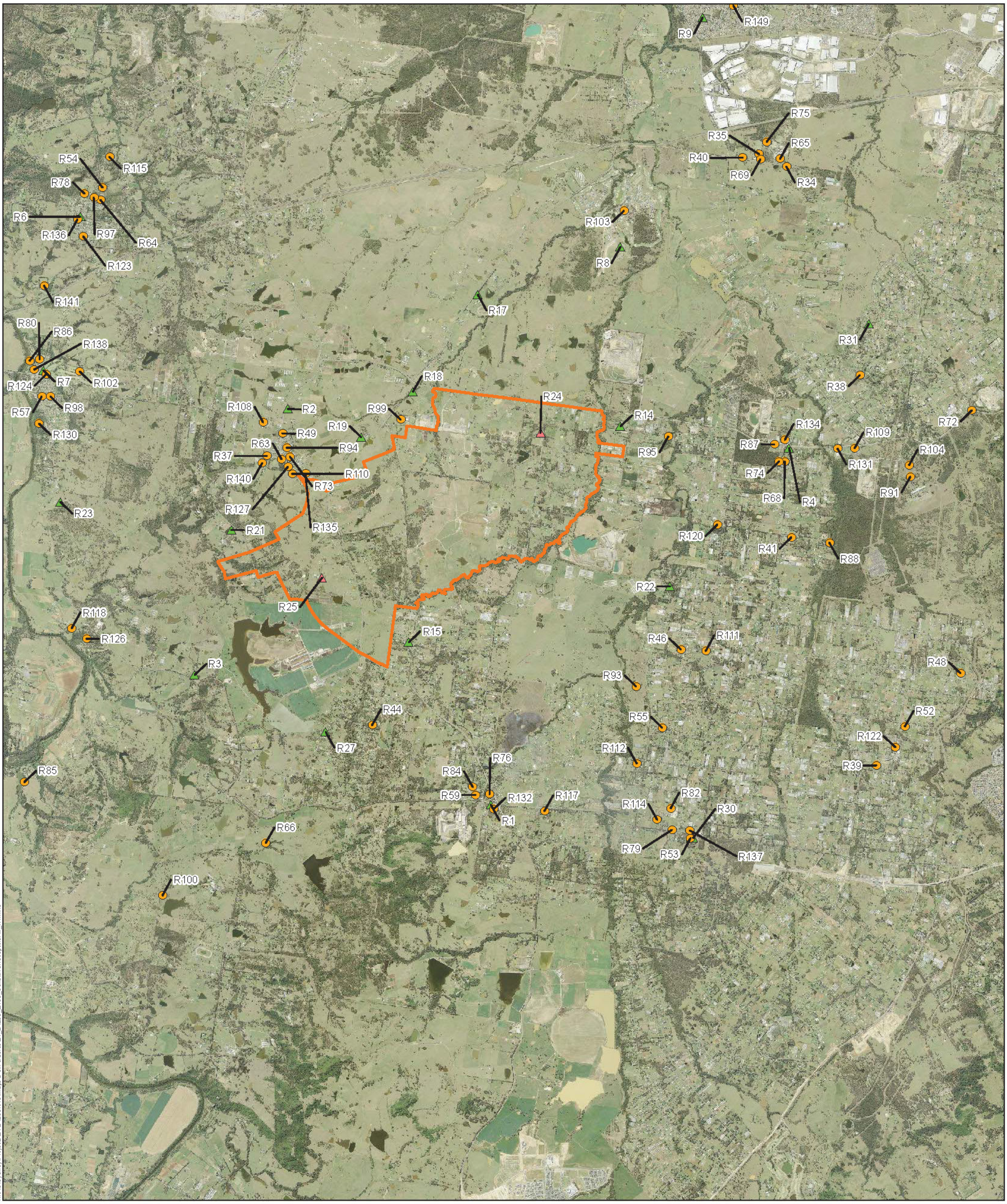
Existing air quality was characterised from air quality monitoring data collected over ten years (2005–2014) at monitoring stations operated by the NSW Office of Environment and Heritage. Monitoring stations included Bringelly, Macarthur/Campbelltown West, Liverpool and Richmond. Parameters recorded included nitrogen dioxide, particulate matter, sulfur dioxide and ozone.

Existing meteorology was characterised from climatic data collected over five years (2010–2014) at an automatic weather station situated at Badgerys Creek operated by the Bureau of Meteorology. Parameters recorded included temperature, rainfall, humidity, wind speed and wind direction at hourly intervals. The data were a key input into the dispersion model discussed in Section 12.2.1.2.

12.2.1.3 Sensitive receptors

Sensitive receptors are defined as places typically occupied by people that are susceptible to environmental impacts. Sensitive receptors were identified within about 5 kilometres of the airport site for the purpose of assessing the potential impacts of air emissions at these locations.

Given the density of sensitive receptors in the vicinity of the airport site, a representative selection comprising 152 of these sensitive receptors was made. The selection included a range of sensitive receptor types including residences, schools, churches and other community infrastructure. The selection also included sensitive receptors from suburbs surrounding the airport site at varying distances. Two receptors were also selected within the airport site for the purpose of assessing potential impacts of air emissions on airport workers and patrons during operation of the Stage 1 development. The locations of the identified sensitive receptors are shown in Figure 12–1.



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Airport site
- Community
- Residential
- Airport site

0 0.5 1 2

Kilometres

Figure 12-1 - Location of sensitive receptors in the vicinity of the airport site

12.2.1.4 Dispersion modelling

Dispersion modelling of construction and operation emissions was undertaken using the AERMOD Modelling System (US EPA 2004), incorporating the emissions inventory (see Section 12.2.1.1) and existing air quality and meteorology (see Section 12.2.1.2).

AERMOD simulated the dispersion of key pollutants quantified in the emissions inventory including nitrogen dioxide (NO_2), particulate matter (quantified as PM_{10} and $PM_{2.5}$), carbon monoxide (CO) and sulfur oxides (SO_x) within the modelling domain about five kilometres around the airport site.

The results of the AERMOD simulation were then reviewed to identify predicted concentrations of air emissions at identified sensitive receptors. The predicted concentrations were then compared to the relevant criteria set under the *Approved Methods for the Modelling and Assessment of Air Pollutants* and the *National Environment Protection (Ambient Air Quality) Measure*.

12.2.1.5 Odour

The local air quality assessment also considered the potential for odour to be generated. The approach taken was to apply a conversation factor of odour units to relevant emissions and then assess the potential for odour to occur at sensitive receptors.

A conversion factor was applied to emissions incorporating organic compounds including aircraft exhaust, auxiliary power units and ground support equipment (Winther et al. 2005). Concentrations of emissions at sensitive receptors were identified from dispersion modelling (see Section 12.2.1.4) and compared to the recognised odour performance criterion of two odour units.

The potential for odour to be generated by wastewater treatment at the airport site was assessed by conducting odour sampling at two similar facilities. The results of the sampling informed odour emissions rates that were incorporated into dispersion modelling.

12.2.2 Regional air quality

12.2.2.1 Emissions inventory

The operations emissions inventory developed for the local air quality assessment was adopted for the regional air quality assessment (see Section 12.2.1.1).

12.2.2.2 Existing air quality and meteorology

Existing air quality was characterised with reference to air quality monitoring data and emissions source data for 2008–2009. This time period was selected as it includes the greatest number of ozone exceedances recorded over the past decade.

The existing air quality data were then increased in proportion to emissions projections developed by the NSW Environment Protection Authority. This was necessary in order to predict existing air quality in 2030 against which the operation of the Stage 1 development would be assessed. The projections consider economic growth, including additional traffic, and other future developments such as improvements in emissions standards and regulation.

Existing regional meteorology was characterised from climatic data collected from all suitable weather stations operated by the Bureau of Meteorology or Office of Environment and Heritage. A complete list of the 28 weather stations utilised in the assessment is provided in Appendix F2 (Volume 4).

Existing regional meteorology was also simulated in the model TAPM to produce a more detailed characterisation for use in dispersion modelling. The model outputs were validated against the climatic data, which showed a good correlation.

12.2.2.3 Dispersion modelling

Ozone formation and dispersion was modelled using the model CAMx, incorporating the emissions inventory (see Section 12.2.1.1), air quality data and meteorology data (see Section 12.4.1).

CAMx simulated the formation of ozone through reactions involving primary emissions from the proposed airport including nitrogen oxides, volatile organic compounds and carbon monoxide.

The model then simulated the dispersion of this ozone throughout the modelling domain across the NSW Greater Metropolitan Region equalling about 55,000 square kilometres. The model simulates the dispersion of ozone across 25 defined vertical levels at up to 8,000 metres elevation.

A number of scenarios were modelled in CAMx, including:

- a 2008/2009 base case based on historic emissions data;
- a 2030 base case assuming the proposed airport is not developed; and
- a 2030 Stage 1 development case assuming the proposed airport is developed.

Under each scenario, a number of days were simulated. The days were selected from historic weather data proven to be conducive to peak ozone formation.

The 2008/2009 base case was modelled to assess model performance. The results of the base case model were validated against actual air quality data. The validation exercise indicated a good degree of correlation between predicted and actual ozone concentrations.

12.2.3 Greenhouse gases

The local air quality assessment also included the development of a greenhouse gas inventory for the construction and operation of the Stage 1 development.

The greenhouse gas assessment was guided by:

- the *Greenhouse Gas Protocol,* developed by the World Resources Institute and the World Business Council on Sustainable Development;
- the *National Greenhouse and Energy Reporting Act 2007* (Cth)*;*
- the National Greenhouse and Energy Reporting Regulations 2008 (Cth);
- the *National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2015* (Cth)*;* and
- the *Technical guidelines for the estimation of greenhouse gas emissions by facilities in Australia*, developed by the Australian Government Department of the Environment.

Greenhouse gas emissions are defined as Scope 1, Scope 2 or Scope 3. The distinction between these emissions categories is depicted in Figure 12–2.

Scope 1 emissions are those directly emitted by the reporting entity (in this case the airport developer or operator), and include exhaust from operational vehicles or carbon dioxide from the decay of cleared vegetation. Scope 2 emissions are those indirectly created by the reporting entity through the purchase of energy. Scope 3 emissions are facilitated by the reporting entity but controlled by other entities, and would include exhaust from aircraft controlled by airline companies utilising the proposed airport. Scope 3 emissions are not typically included in greenhouse gas inventories for accounting purposes given their liability to be double counted, particularly as they would likely also be reported as Scope 1 emissions by the entity with direct operational control.

In accordance with industry standard practice the inventory focussed on Scope 1 and Scope 2 emissions. Some consideration was also given to aircraft fuel burning, which is anticipated to be the major source of Scope 3 emissions for the proposed airport but would largely be under the direct operational control of airline companies utilising the proposed airport.

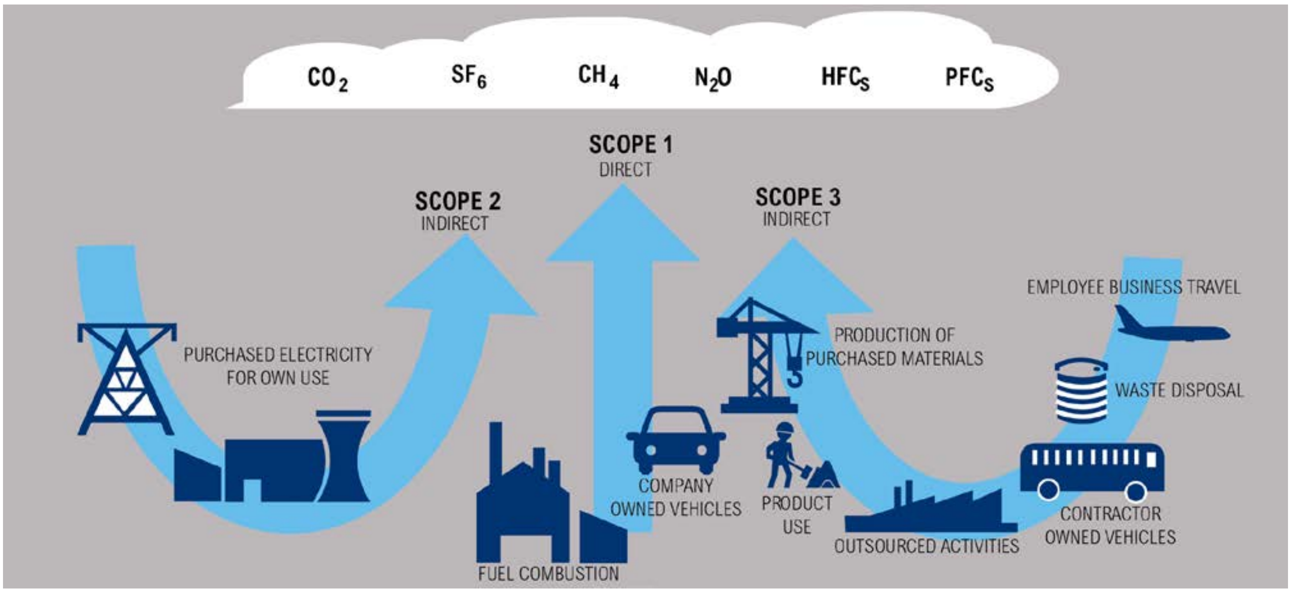


Figure 12–2 Overview of the three scopes and emissions sources across a reporting entity

Greenhouse gas emissions were quantified in the Emissions Dispersion Modelling System (see Section 12.2.1.4) and expressed terms of their equivalence in tonnes of carbon dioxide (t CO_2-e).

Greenhouse gas emissions are typically calculated from emissions factors as follows:

$$Emission_i = Activity\ data \times EF_i$$

In this equation, the estimated emissions of a greenhouse gas (i) is the product of the Activity data (for example, the amount of fuel combusted for energy generation) and the emissions factor appropriate to the activity and emission type (EF_i).

12.3 Air quality criteria

12.3.1 Gaseous pollutants and particulate matter performance criteria

Legislation, guidelines and standards governing air pollutant emissions and ambient air quality have been introduced at the Commonwealth and State government levels. Legislation, guidelines and other standards which have been considered for this assessment are summarised in Table 12–2.

Regulated air pollutants are divided into 'criteria' pollutants and 'air toxics'. Criteria pollutants tend to be ubiquitous and emitted in relatively large quantities, and their health effects have been studied in some detail. Air toxics are gaseous or particulate organic pollutants that are present in the air in low concentrations and have characteristics hazardous to human, plant or animal life. The main sources of pollutants investigated in the local air quality and greenhouse gas assessment are summarised in Appendix G (Volume 4).

Table 12–2 Emissions and air quality legislation

Legislating body	Legislation/measures	Summary
Ambient air quality		
Australian Government	*Airports Act 1996*	Promotes the sound development of civil aviation in Australia. It contains an obligation on airport lessee companies to develop a master plan every five years including a detailed environmental strategy which is required to address amongst other things continuous improvement in the environmental consequences of activities at the airport; progressive reduction in extant pollution at the airport and development and adoption of a comprehensive environmental management system for the proposed airport that maintains consistency with relevant Australian and international standards. The Airports Act also contains a number of offences related to pollution at airports. An Airport Plan is required to authorise the construction and operation of the Stage 1 development.
	Airports (Environment Protection) Regulations 1997 (AEPR)	Imposes a general duty to prevent or minimise environmental pollution once an airport lease is granted. Promotes improved environmental management practices at airports. Includes provisions setting out definitions, acceptable limits and objectives for air quality, as well as monitoring and reporting requirements.
	Air Navigation (Aircraft Engine Emissions) Regulations Chicago Convention Annex 16	The regulations make it an offence to fly certain aircraft if they do not meet relevant emissions standards including the standards set out in Annex 16 to the Chicago Convention.
	National Environment Protection (Ambient Air Quality) Measure (NEPM-AAQ)	Sets the national health-based air quality standards for six air pollutants (carbon monoxide, nitrogen dioxide, sulfur doxide, lead, ozone and PM_{10}) and includes advisory reporting standards for $PM_{2.5}$.
	National Environment Protection (Air Toxics) Measure (NEPM-AT)	Sets a nationally consistent approach to monitoring (by reference to 'investigation levels') for five air toxics: benzene, formaldehyde, toluene, xylenes and benzo(a)pyrene (as a marker for polycyclic aromatic hydrocarbons). These are not compliance standards but are for use in assessing the significance of the monitored levels of air toxics with respect to the protection of human health.

Legislating body	Legislation/measures	Summary
NSW Government	*Protection of the Environment Operations Act 1997* (POEO Act), and the Protection of the Environment Operations (General) Regulation 2009	The POEO Act provides a range of controls with regard to air quality including requirements to maintain plant and equipment in proper and efficient condition and to operate plant and equipment in a proper and efficient manner. This includes the means of processing, handling, moving, storage and disposal of materials.
Emissions of air quality criteria pollutants		
Australian Government	*National Environment Protection (National Pollutant Inventory) Measure*	The primary goals are to: (a) collect a broad base of information on emissions and transfers of substances and (b) disseminate information to all sectors of the community. This NEPM covers a variety of air pollutants.
NSW Government	*Protection of the Environment Operations Act* (2007) (POEO Act) and Protection of the Environment Operations (Clean Air) Regulation (2010) (Clean Air Regulation)	The object of the POEO Act is to achieve the protection, restoration and enhancement of the quality of the NSW environment having regard to the need to maintain ecologically sustainable development. The Clean Air Regulation prescribe standards for certain groups of plant and premises to regulate industry's air emissions and impose requirements on the control, storage and transport of volatile organic liquids.
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA Approved Methods)	This policy document lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. It is referred to in Part 5: Air impurities from emitted activities and plant of the Clean Air Regulation. It also prescribes the air pollutants and averaging periods that an airport's emissions are to be assessed against.
Emissions of greenhouse gases		
Australian Government	*National Greenhouse and Energy Reporting Act (2007)*	An airport lessee company (ALC) is required to register and report its operational greenhouse gas emissions attributable to the activities over which it has operational control. This is because it is expected that its emissions will exceed relevant thresholds. This may also apply to the construction contractor and other contractors or users of the airport (e.g. airlines).
Ozone-depleting substances		
Australian Government	*Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* and the Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995	This Act and these Regulations impose controls on the manufacture, import, export and management of substances that deplete ozone in the atmosphere including CFCs 11, 12, 113, 114 and halons 1211, 1301 and 2402.
NSW Government	*Ozone Protection Act 1989*	This Act regulates or prohibits the manufacture, sale, distribution, conveyance, storage, possession and use of ozone-depleting substances in NSW.

The air quality criteria adopted for use in the air quality assessment are principally those defined in thins EPA Approved Methods. The NSW EPA Approved Methods account for various pollutant criteria and averaging periods from multiple sources, including the NEPM-AAQ.

In some cases, the NSW EPA Approved Methods mirror the NEPM-AAQ. In other cases, where no similar criteria are stated in the Approved Methods, criteria outlined in the NEPM-AAQ have been adopted in the assessment. Examples of the latter are average annual PM_{10} and $PM_{2.5}$.

A summary of the adopted criteria and their source is provided in Table 12–3. In each case, where several performance criteria are available, the more stringent criterion has been used.

In 2016, the National Environment Protection Council approved a variation to the NEPM-AAQ for particulate matter to reflect the latest scientific understanding of health risk. The variation includes new or revised standard for $PM_{2.5}$ and PM_{10}. Whilst the NSW EPA Approved Methods have not yet been updated to reflect the changes, the new standards have been adopted in this assessment.

Table 12–3 Air quality criteria applicable to the airport

Pollutant	Criterion[a]	Averaging period	Source[b]
Carbon monoxide (CO)	87 ppm or 100 mg/m^3	15 minutes	NSW EPA
	25 ppm or 30 mg/m^3	1 hour	NSW EPA
	9 ppm or 10 mg/m^3	8 hours	NSW EPA, AEPR (b)
Nitrogen dioxide (NO_2)	16 pphm or 320 µg/m^3	1 hour	AEPR
	12 pphm or 246 µg/m^3	1 hour	NSW EPA
	3 pphm or 62 µg/m^3	1 year	NSW EPA
Total suspended particulate matter (TSP)	90 µg/m^3	1 year	NSW EPA, AEPR
Particulate matter < 10 µm (PM_{10})	50 µg/m^3	24 hours(c)	NSW EPA, NEPM-AAQ
	25 µg/m^3	1 year	NSW EPA, NEPM-AAQ
Particulate matter < 2.5 µm ($PM_{2.5}$)	25 µg/m^3	24 hours	NEPM-AAQ
	20 µg/m^3 (by 2025)	24 hours	NEPM-AAQ
	8 µg/m^3	1 year	NEPM-AAQ
	7 µg/m^3 (by 2025)	1 year	NEPM-AAQ
Deposited dust – Incremental	2 g/m^2/month	Annual	NERDDC
Deposited dust – Cumulative	4 g/m^2/month	Annual	NERDDC
Lead (Pb)	1.5 ppm	3 months	AEPR
	0.5 µg/m^3	1 year	NSW EPA
Photochemical oxidants (as ozone (O_3))	0.10 ppm or 210 µg/m^3	1 hour	NSW EPA(d), AEPR
	0.08 ppm or 170 µg/m^3	4 hours	NSW EPA(e), AEPR
Sulfur dioxide (SO_2)	25 pphm or 710 µg/m^3	10 minutes	NSW EPA(f), AEPR
	20 pphm or 570 µg/m^3	1 hour	NSW EPA, AEPR
	8 pphm or 228 µg/m^3	1 day	NSW EPA
	2 pphm or 60 µg/m^3	1 year	NSW EPA, AEPR
Benzene	0.009 ppm or 29 µg/m^3	99.9th one-hour max	NSW EPA
Toluene	0.09 ppm or 360 µg/m^3	99.9th one-hour max	NSW EPA
Xylene	0.004 ppm or 180 µg/m^3	99.9th one-hour max	NSW EPA
Formaldehyde	0.18 ppm or 20 µg/m^3	99.9th one-hour max	NSW EPA
Benzo[a]pyrene	0.4 µg/m^3	99.9th one-hour max	NSW EPA

(a) ppm = parts per million; pphm = parts per hundred million; µg/m^3 = micrograms per cubic metre; mg/m^3 = milligrams per cubic metre.

(b) NSW EPA = Approved Methods for the Modelling and Assessment of Air Pollutants in NSW; AEPR = Airports (Environment Protection) Regulations 1997.

(c) Up to 5 exceedances allowed per year in NEPM-AAQ.

(d) Given as 214 µg/m^3 in Approved Methods.

(e) Given as 171 µg/m^3 in Approved Methods.

(f) Given as 712 µg/m^3 in Approved Methods.

In recognition of the potential health issues that may arise from exposure to air toxics, 'investigation levels' have been set for five pollutants in ambient air under the NEPM-AT. These investigation levels are listed in Table 12–4.

Table 12–4 Advisory standard air toxic investigation levels applicable to the proposed airport

Pollutant	Criterion[a]		Averaging period	Source
Benzene	0.003	ppm	1 year[d]	Air Toxics NEPM, investigation levels
PAHs[b] (as B[a]P)[c]	0.3	ng/m^3	1 year[d]	Air Toxics NEPM, investigation levels
Formaldehyde	0.04	ppm	24 hours	Air Toxics NEPM, investigation levels
Toluene	1.0	ppm	24 hours	Air Toxics NEPM, investigation levels
	0.1	ppm	1 year[d]	Air Toxics NEPM, investigation levels
Xylenes	0.25	ppm	24 hours	Air Toxics NEPM, investigation levels
	0.20	ppm	1 year[d]	Air Toxics NEPM, investigation levels

(a) ng/m^3 – nanograms per cubic metre.

(b) PAH – polycyclic aromatic hydrocarbons.

(c) B[a]P – benzo[a]pyrene, the most widely studied PAH and used as an indicator compound.

(d) Mean 24-hour monitoring results.

12.3.1.1 Odour performance criteria

The NSW EPA Approved Methods also include ground-level concentration criteria for complex mixtures of odorous air pollutants, taking account of population density in a given area. Table 12–5 lists the odour criteria to be exceeded not more than one per cent of the time, across different population densities. The two odour unit criterion applies to the airport site as an urban area.

Table 12–5 Odour performance criteria for the assessment of odour

Population of affected community	Criterion for complex mixtures of odorous air pollutants (odour units) 99th percentile
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (2000) and/or schools and hospitals	2

12.3.1.2 Greenhouse gases

The National Greenhouse and Energy Reporting Scheme (NGER Scheme) comprise legislation, regulations and technical guidelines for the reporting of greenhouse gas emissions and energy consumption data. The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a mandatory obligation on corporations which exceed defined thresholds to report greenhouse gas emissions, energy consumption and other related information. Methods and criteria for calculating greenhouse gas emissions under the NGER Act are provided in the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*.

Corporate and facility reporting thresholds for greenhouse gas emissions and energy consumption per financial year are provided in Table 12–6. Emissions are measured in terms of tonnes of carbon dioxide equivalent (CO_2-e) which is a value representing the normalisation of different types of greenhouse gases to their equivalent global warming potential of carbon dioxide.

Table 12–6 NGER reporting thresholds

Corporate threshold		Facility threshold	
Greenhouse gas emissions (kt CO_2-e)	Energy usage (TJ)	Greenhouse gas emissions (kt CO_2-e)	Energy usage (TJ)
50	200	25	100

Source: DCCEE, 2007.

As the proposed airport (once operational) is anticipated to have combined Scope 1 and Scope 2 emissions greater than 25 kilotonnes carbon dioxide equivalent (kt CO_2-e) in a financial year, emissions are expected to be required to be reported under the NGER Scheme.

If a corporation has operational control over facilities whose greenhouse gas emissions or energy use in a given reporting year:

- individually exceed the relevant facilities threshold; or
- when combined with other facilities under the corporation's operational control, exceed the relevant corporate thresholds, that corporation must report its greenhouse gas emissions or energy use (as the case may be) for that year under the NGER Act.

This definition may encompass the Airport Lessee Company (ALC), a construction company, various other contractors and airlines. A preliminary assessment of greenhouse emissions and energy use for the Stage 1 development is presented in Section 12.7.

12.3.1.3 Regional air quality (ozone)

The NEPM-AAQ standards for ozone are summarised in Table 12–7 and expressed as parts per million by volume. The NEPM-AAQ standards are identical to the impact assessment criteria prescribed in the NSW EPA Approved Methods, with the impact assessment criteria in the NSW EPA Approved Methods expressed as parts per hundred million and in micrograms per cubic metre of air (see Table 12–8). The NEPM-AAQ standard, like the NSW EPA criteria, also allows for the goal to be exceeded for one day a year.

The ambient ozone monitoring data and ozone modelling results presented in this chapter use parts per billion as the preferred reporting unit. A concentration of 100 parts per billion for one-hour ozone is equivalent to the NEPM-AAQ standard of 0.10 parts per million and the NSW EPA Approved Methods criterion of 10 parts per hundred million, while a concentration of 80 parts per billion for four-hour ozone is equivalent to the NEPM-AAQ standard of 0.08 parts per million and the NSW EPA Approved Methods criterion of eight parts per hundred million.

Table 12–7 National standards for ozone (NEPM-AAQ)

Averaging period	Maximum concentration	Maximum allowable exceedances
1 hour	0.10 ppm	1 day a year
4 hours	0.08 ppm	1 day a year

Table 12–8 Impact Assessment criteria for ozone (NSW EPA)

Averaging period	Concentration	
	Parts per hundred million	µg/m³a
1 hour	10	214
4 hours	8	171

12.4 Existing environment

This section describes the meteorological conditions (wind speed and direction, temperature, rainfall and humidity) at the airport site. The existing, ambient air quality in the vicinity of the airport site is also described.

12.4.1 Meteorology

Air quality is influenced by meteorological conditions. Wind speed, wind direction, temperature and relative humidity all affect the potential dispersion and transport of emissions and are basic input requirements for dispersion modelling.

Climatic data was reviewed for five consecutive years (2010-14). Summary statistics are provided in Appendix F1 (Volume 4). These data were used to describe the local meteorology at Badgerys Creek.

12.4.1.1 Wind speed and direction

The average wind speed across the five-year period was 2.6 metres per second. The percentage of calm periods with winds less than 0.5 metres per second across the period was nine per cent.

An analysis of the climatic data suggests that there is no strong relationship between the time of year and the monthly average wind speed, although the monthly average wind speeds are generally less during autumn as shown on Figure 12–3.

There is also little variation in average wind speed between years. The highest annual average wind speed of 2.9 metres per second was recorded in 2010 and the lowest annual average wind speed of 2.4 metres per second was recorded in 2012.

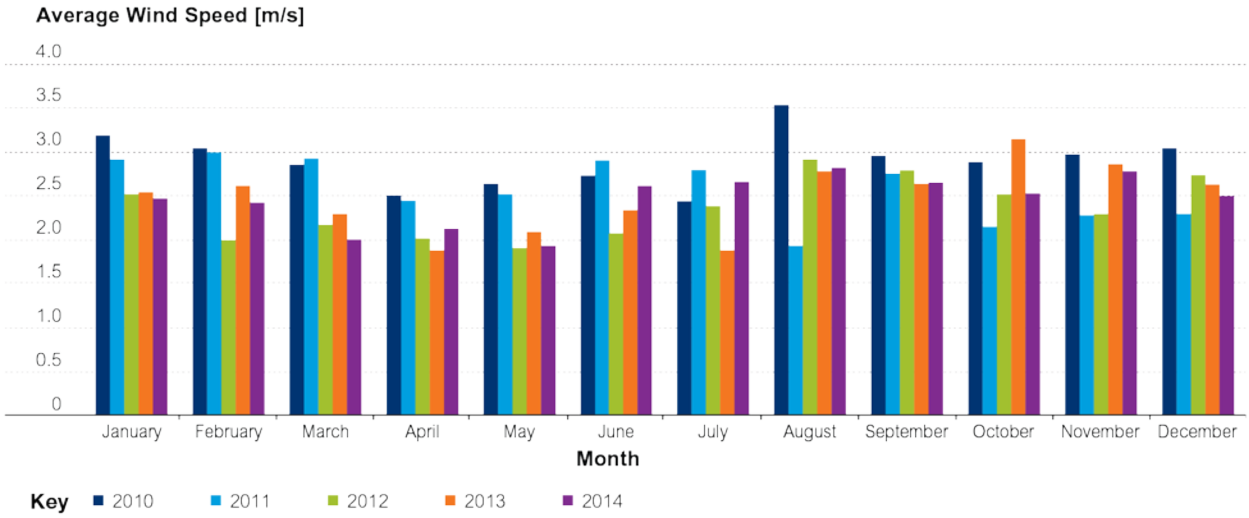


Figure 12–3 Monthly average wind speed at Badgerys Creek (2010-2014)

On an annual basis, the predominant winds at Badgerys Creek originate from the south-west, followed by the south-south-west and north. Very few winds originate from the north-west. The prevailing winds vary across the seasons with the characteristic south-westerly wind less prominent during summer where winds from the north-east become more frequent. During winter, the majority of winds originate from the south-west. There is a consistent seasonal pattern across all years. Annual and seasonal wind roses for 2010 to 2014 are presented in Appendix F1 (Volume 4).

12.4.1.2 Temperature, rainfall and humidity

Key temperature, rainfall and humidity statistics at Badgerys Creek are provided in Table 12–9.

There is a strong seasonal variation in temperature at Badgerys Creek. The annual average temperature between 2010 and 2014 was 17 degrees Celsius. On average, January was the hottest month, with an average monthly temperature of 23 degrees Celsius and maximum of 45 degrees Celsius. June and July were the coldest months for the five-year period, with average temperatures of 11 degrees Celsius and 10 degrees Celsius, respectively. The minimum temperatures for these months were -2 degrees Celsius and -1 degrees Celsius, respectively.

The rainfall data collected at Badgerys Creek indicate that February is the wettest month, with an average rainfall of 114 millimetres while July is the driest month, with an average rainfall of 30 millimetres. The average monthly rainfall for all years was 68 millimetres.

The annual average relative humidity reading at Badgerys Creek was 73 per cent. The month with the highest relative humidity on average was June, with an average of 79 per cent. The months with the lowest relative humidity were September and October.

Table 12–9 Temperature, rainfall and humidity statistics at Badgerys Creek

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean temperature (°C)	23	22	20	17	13	11	10	12	15	17	20	21	17
Minimum temperature (°C)	10	11	9	5	1	-2	-1	0	1	5	7	8	-2
Maximum temperature (°C)	45	41	35	30	27	21	24	28	33	36	41	40	45
Mean rainfall (mm)	76	114	106	62	37	80	30	42	35	47	101	85	68
Mean relative humidity (%)	71	76	76	77	76	79	76	69	67	67	73	71	73

12.4.1.3 Vertical profile

A vertical profile describes wind speed at various elevations through the atmosphere. Vertical profile measurements of the lower atmosphere are made daily at Sydney Airport. No other regular measurements of this kind are made within the Sydney region. The wind speed and wind direction measurements are made using a radiosonde, typically up to 7,000 metres above ground level. The vertical profile measurements of wind speed between 2010 and 2014 are shown in Figure 12–4. As shown, wind speeds peak around 3,000-4,000 feet in the order of 20-30 metres per second, with incidences of even higher wind speeds.

The measurements of wind speed indicate that in the lower few hundred metres of the atmosphere, the wind speeds are generally relatively low, up to eight metres per second. Layers of high wind speeds are observed between 800 metres and 1,000 metres and again between 3,500 metres and 4,500 metres. The highest observed wind speed was 116 metres per second.

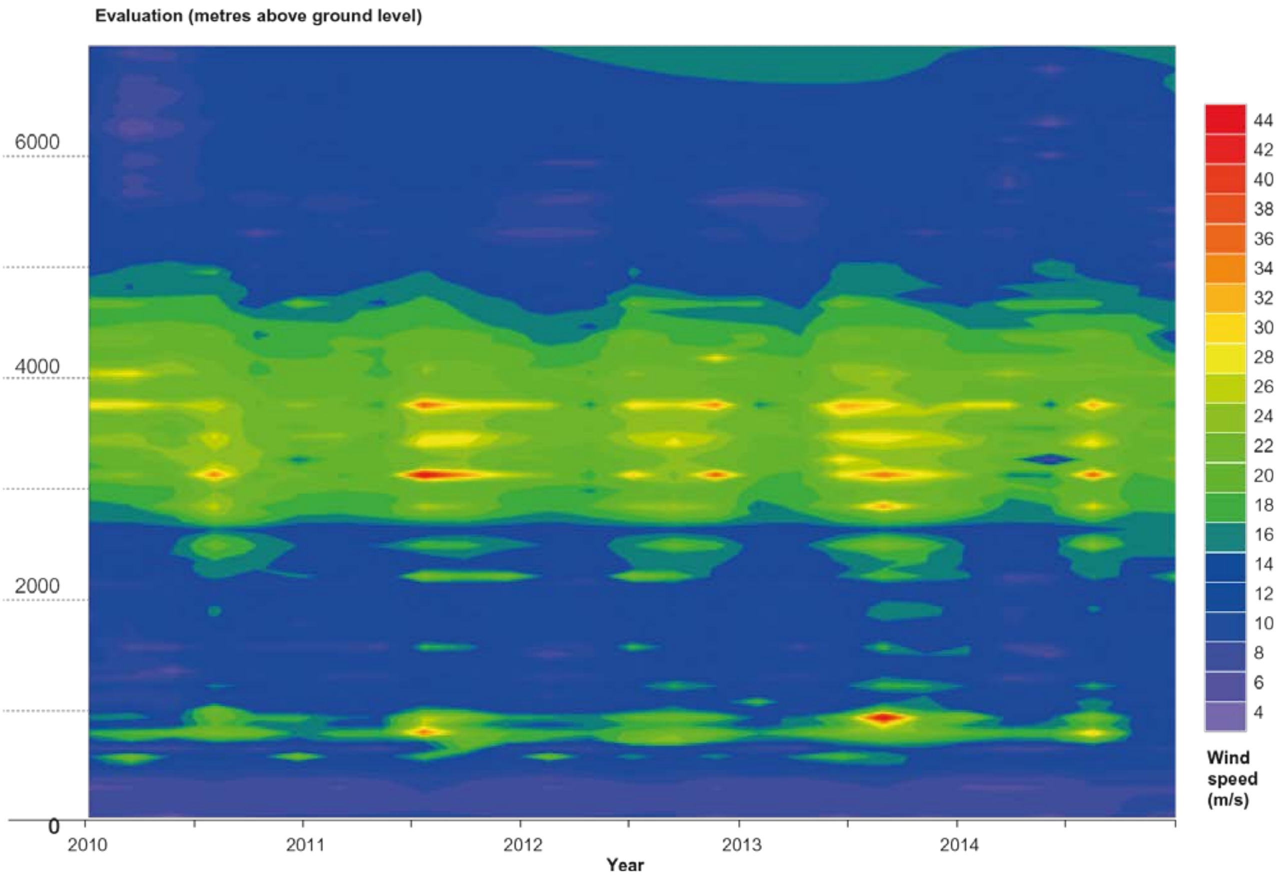


Figure 12–4 Vertical profile of wind speed at Sydney Airport (2010-14)

12.4.2 Local ambient air quality

To assess the potential impacts of the proposed airport against the relevant air quality assessment criteria described in Section 12.3, it is necessary to have information on background concentrations of pollutants so that the cumulative (ambient conditions plus project incremental emissions) impact may be evaluated.

Air quality monitoring data collected between 2005 and 2014 from the NSW OEH monitoring stations in Bringelly, Macarthur/Campbelltown West, Liverpool and Richmond were used to describe the existing air quality in Badgerys Creek. The data was compared with the criteria given in Table 12–3 and Table 12–4.

A summary of the available air quality data is provided below with further information provided in Appendix F1 (Volume 4). Generally, air quality for the local area is good, with the exception of isolated high pollution days or extreme events such as dust storms and bushfires. Uncontrolled combustion events such as bushfires will influence regional observations of PM_{10} and $PM_{2.5}$, and to a lesser extent, nitrogen oxides.

12.4.2.1 Nitrogen dioxide (NO_2)

The main oxides of nitrogen present in the atmosphere are nitric oxide, nitrogen dioxide and nitrous oxide. The major human activity which generates oxides of nitrogen is fuel combustion, mainly in motor vehicles. Oxides of nitrogen form in the air when fuel is burnt at high temperatures. This is mostly in the form of nitric oxide with usually less than 10 per cent in the form of nitrogen dioxide. Once emitted, nitric oxide combines with oxygen ('oxidises') to form nitrogen dioxide, especially in warm sunny conditions. These oxides of nitrogen may remain in the atmosphere for several days, during which chemical processes may generate nitric acid, and nitrates and nitrites as particles. These oxides of nitrogen play a major role in the chemical reactions that generate photochemical smog (OEH 2014a).

Data for nitrogen dioxide were obtained from the monitoring station at Bringelly. The data is presented in Table 12–10. There were no exceedances of the nitrogen dioxide one-hour average criteria of 246 micrograms per cubic metre (the one-hour maximum concentration ranged between 51 micrograms per cubic metre and 92 micrograms per cubic metre). There were also no exceedances of the annual average criteria of 62 micrograms per cubic metre (the annual average concentrations ranged between 9 micrograms per cubic metre and 13 micrograms per cubic metre).

There is a strong seasonal influence on nitrogen dioxide concentrations, peaking during the winter months. This trend is attributed to the more stable atmospheric conditions during winter that leads to reduced dispersion as well as the limited photochemical processes that react with nitrogen dioxide during the summer months.

Further analysis of the data shows that the greatest concentrations of nitrogen dioxide originate from the east and are associated with the key local nitrogen oxides sources, such as vehicle emissions from the M7 motorway which is located to the east of the Bringelly monitoring station.

Table 12–10 Maximum one-hour and annual average nitrogen dioxide concentrations at Bringelly

Year	One-hour maximum ($\mu g/m^3$)	Annual average ($\mu g/m^3$)	Exceedances of one-hour standard (days per year)
EPA criterion	246	62	n/a
2005	92	13	No exceedances
2006	82	13	No exceedances
2007	90	12	No exceedances
2008	68	10	No exceedances
2009	70	9	No exceedances
2010	76	12	No exceedances
2011	60	10	No exceedances
2012	78	11	No exceedances
2013	76	10	No exceedances
2014	51	10	No exceedances

12.4.2.2 Particulate matter

Particulate matter is solid or liquid particles that are suspended in air that may reduce visual amenity or adversely impact health. It is measured as PM_{10} (particles less than 10 micrometres in diameter) and $PM_{2.5}$ (particles less than 2.5 micrometres in diameter). Examples of particles in the air include dust, smoke, plant spores, bacteria and salt. Particulate matter may be a primary pollutant, such as smoke particles, or a secondary pollutant formed from the chemical reaction of gaseous pollutants. Human activities resulting in particulate matter in the air include mining; burning of fossil fuels; transportation; agricultural and hazard reduction burning; the use of incinerators; and the use of solid fuel for cooking and heating (OEH 2014a).

Data for PM_{10} was obtained from the monitoring station at Bringelly. The data are presented in Table 12–11. The maximum concentrations of 24-hour average PM_{10} have been fairly constant over the last 10 years, generally ranging between 40 micrograms per cubic metre and 97 micrograms per cubic metre (the exception is 2009, where elevated 24-hour average PM_{10} concentrations were measured on a number of occasions as a result of a series of dust storms). There have been several exceedances of the 24-hour average criterion of 50 micrograms per cubic metre. Aside from 2009, the annual average concentrations appear to be generally decreasing with no exceedances of the criterion of 25 micrograms per cubic metre (the annual average concentrations ranged between 25 micrograms per cubic metre and 15 micrograms per cubic metre).

Further analysis of the data suggests that the greatest concentrations originate from the north-west, and to a lesser extent, from the east, west and south-east. The dominant north-west source is likely to be a function of natural events such as bushfires and dust storms that tend to be associated with the hot dry prevailing winds originating from this direction. To the east and south-west are the densely populated precincts of Liverpool and Campbelltown which encompass a multitude of potential particulate matter sources.

Table 12–11 Maximum 24-hour and annual average PM_{10} concentrations at Bringelly

Year	24-hour maximum (µg/m³)	Annual average (µg/m³)	No. of exceedances of 24-hour standard
EPA criterion	50	25	n/a
2005	55	19	2
2006	72	20	3
2007	51	18	1
2008	63	16	1
2009	1,684	25	6
2010	41	15	No exceedances
2011	86	16	2
2012	40	16	No exceedances
2013	97	17	3
2014	43	17	No exceedances

Data for $PM_{2.5}$ were obtained from the monitoring stations at Liverpool and Richmond. The data are presented in Table 12–12. The data indicate that $PM_{2.5}$ concentrations are higher at Liverpool than Richmond, with combustion emissions from urbanisation anticipated to be a major source of the measured differences. There are a number of days across the monitoring period where the 24-hour average measurements are above the NEPM goal of 25 micrograms per cubic metre. As with the PM_{10} monitoring data, the dust storms from 2009 have also been captured in the data set, recording up to 268 micrograms per cubic metre at Liverpool.

Table 12–12 Maximum 24-hour and annual average $PM_{2.5}$ concentrations at Liverpool and Richmond

Year	24-hour max (µg/m³)		Annual average (µg/m³)		No. of exceedances of 24-hour standard	
	Liverpool	Richmond	Liverpool	Richmond	Liverpool	Richmond
NEPM standard	25 (20[a])		8 (7[a])		n/a	
2005	31	23	8	6	2	0
2006	48	78	9	6	3	1
2007	23	21[b]	7	6[b]	0	0
2008	32	18	6	7	1	0
2009	268	149	8	6	5	2
2010	22	21	6	4	0	0
2011	38	43	6	5	2	2
2012	25	117	9	5	0	2
2013	74	83	9	8	2	14
2014	24	25	9	7	0	0

[a] NEPM-AAQ aim by 2025.

[b] Less than 75% data retrieval for year.

12.4.2.3 Carbon monoxide (CO)

Carbon monoxide is an odourless, colourless gas produced by incomplete oxidation (burning). As well as wildfires, carbon monoxide is produced naturally by oxidation of the oceans and organic decomposition. In cities, the motor vehicle is by far the largest human source, although any combustion process may produce it (OEH 2014a).

Data for carbon monoxide were obtained from the monitoring station at Macarthur and Campbelltown West, though only a short data set is available from the monitoring station at Campbelltown West. The data are presented in Table 12–13.

The one-hour maximum concentrations of carbon monoxide show a reasonably stable trend through the years with a slight decrease after 2006. The eight-hour maximum concentrations also show a slight decrease that occurred after 2007. There have been no exceedances of one-hour or eight-hour carbon monoxide criteria at Macarthur.

Table 12–13 Minute, one-hour and eight-hour average carbon monoxide concentrations at Macarthur and Campbelltown West

Year	15-minute maximum (mg/m^3)		One-hour maximum (mg/m^3)		Eight-hour maximum (mg/m^3)	
	Macarthur	Campbelltown West	Macarthur	Campbelltown West	Macarthur	Campbelltown West
EPA criterion	100	100	30	30	10	10
2005	-	-	2.3 [a]	-	1.2 [a]	-
2006	-	-	2.5	-	2.3	-
2007	-	-	2.4	-	2.2	-
2008	-	-	1.5	-	1.1	-
2009	-	-	1.6	-	0.9	-
2010	-	-	2.0	-	1.1	-
2011	-	-	2.1	-	1.3	-
2012	-	-	1.1 [a]	1.1 [a]	0.8 [a]	0.8 [a]
2013	-	-	-	10.5	-	8.6
2014	-	2.1	-	1.5	-	1.2

[a] Less than 75 per cent data retrieval for year

12.4.2.4 Sulfur dioxide (SO_2)

Sulfur dioxide in the atmosphere arises from both natural and human activities. Natural processes which release sulfur compounds include decomposition and combustion of organic matter; spray from the sea; and volcanic eruptions. The main human activities producing sulfur dioxide are the smelting of mineral ores containing sulfur and the combustion of fossil fuels (OEH 2014a).

Data for sulfur dioxide were obtained from the monitoring stations at Bringelly and Campbelltown West, though only a short data set is available from the monitoring station at Campbelltown West. The data are presented in Table 12–14. There have been no exceedances of the criteria for any of the required averaging periods.

The data show one-hour maximum concentrations of sulfur dioxide fluctuating over the past 10 years. In 2007 and 2008, one-hour maximum concentrations of sulfur dioxide rose by 50 per cent from the 2006 level. Concentrations then decreased during 2010 and 2011 and subsequently rose in 2011.

The 24-hour concentrations follow a similar trend to the one-hour maximums with a significant drop in 2010 and subsequent increase in 2011. Annual average sulfur dioxide concentrations appear to have decreased from 2010 to 2011 but then increased again in 2012 and 2013.

Further analysis of the data suggests that the greatest concentrations of sulfur dioxide originate from the east, and are most likely associated with vehicle emissions and industry located in this direction. Fluctuations may be caused by variations in meteorology or the intensity of activity.

Table 12–14 Maximum 15-minute, one-hour, eight-hour and annual average sulfur dioxide concentrations at Bringelly and Campbelltown West

Year	10 minute maximum (µg/m³)	One-hour maximum (µg/m³)		24-hour maximum (µg/m³)		Annual average (µg/m³)	
	Campbelltown West	Bringelly	Campbelltown West	Bringelly	Campbelltown West	Bringelly	Campbelltown West
EPA criterion	712	570	570	228	228	60	60
2004	-	43	-	6.8	-	0.6	-
2005	-	26	-	7.5	-	0.7	-
2006	-	26	-	6.3	-	1.0	-
2007	-	49	-	8.2	-	1.2	-
2008	-	54	-	7.5	-	0.3	-
2009	-	34	-	9.2	-	-0.8	-
2010	-	23	-	5.7	-	0.7	-
2011	-	31	-	5.2	-	0.3	-
2012	-	43	23 (a)	5.1	5.7 (a)	0.5	1.4 (a)
2013	-	31	26	7.0	6.8	0.7	1.3
2014 (b)	80(c)	26	34	8.5	9.9	0.7	1.2

[a] Less than 75 per cent data retrieval for the year.

[b] Calibration issue with the instrument between January and May 2014. The data have been included for completeness.

[c] High resolution data were available for Campbelltown West only.

12.4.2.5 Air toxics

Air toxics include volatile organic compounds like benzene, dioxins, lead and other metals that are typically present in ambient air in low concentrations and are hazardous to human health or the environment. Major sources of these toxics include motor vehicle exhaust and some commercial and industrial processes. Knowledge of the health effects of air toxics is far from complete, but studies indicate that very small amounts of air toxics may present a risk to human health and the environment (OEH 2014a).

Continuous monitoring of air toxics is not measured as part of the OEH air quality monitoring network or under any other program at present. However, between 1996 and 2001, the NSW Environment Protection Authority (EPA) (then Department of Environment and Conservation (DEC)) conducted the Air Toxics Monitoring Project which investigated concentrations of the NEPM air toxics (benzene, toluene, xylene and polyaromatic hydrocarbons such as benzo[a]pyrene) for 24-hour periods at numerous locations across Sydney and NSW (DEC 2004a, DEC 2004b). In addition, the Ambient Air Quality Monitoring and Fuel Quality Testing Project collected 24-hour concentrations of formaldehyde at Rozelle and Turrella for a one year period from October 2008 to October 2009. The results of this monitoring have been published as part of the EPA's Current Air Quality in New South Wales technical paper (DECCW 2010).

The Air Toxics Monitoring Project found ambient concentrations of most tested substances were well below international ambient air quality goals at the time. The Ambient Air Quality Monitoring and Fuel Quality Testing Project also found low concentrations of all chemical pollutants, with many observations below the detection limit of the method.

12.4.2.6 Ozone

Near the ground, ozone is a colourless, gaseous secondary pollutant. It is formed by chemical reactions between reactive organic gases and oxides of nitrogen in the presence of sunlight – triggering a photochemical reaction. Ozone is one of the irritant secondary pollutants in photochemical smog and is often used as a measure of it (OEH 2014a).

Data for ozone in the vicinity of the airport site were obtained from the monitoring station at Bringelly. The data are presented in Table 12–15 and further analysis of regional ozone is presented in Section 12.4.5. There have been multiple exceedances of both the one-hour maximum criteria of 214 micrograms per cubic metre and the four-hour maximum criteria of 171 micrograms per cubic metre over the past 10 years. The one-hour maximum concentrations ranged between 188 micrograms per cubic metre and 268 micrograms per cubic metre and the four-hour maximum concentrations ranged between 149 micrograms per cubic metre and 235 micrograms per cubic metre.

Ozone concentrations vary based on the time of day and also time of year, with peak ozone concentrations occurring in the mid-afternoon and also during the summer months. The seasonal variability is associated with the availability of sunlight, with the increase in sunlight in the summer months driving the photochemical activity that generates ozone.

Table 12–15 Maximum one-hour and four-hour average ozone concentrations at Bringelly

Year	One-hour maximum (µg/m³)	Four-hour maximum (µg/m³)	Exceedances of one-hour standard (days per year)	Exceedances of four-hour standard (days per year)
EPA criterion (NEPM goal)	214	171	(1)	(1)
2005	261	235	8	5
2006	240	218	6	3
2007	255	219	10	5
2008	199	155	0	0
2009	257	232	7	3
2010	223	179	2	1
2011	268	226	5	2
2012	188	149	0	0
2013	231	207	3	1
2014	265	237	4	3

12.4.3 Odour

The airport site is mostly isolated from other industry activities that have the potential to be odorous. The exception is the poultry industry with a number of broiler and egg-laying farms in the vicinity, particularly to the east of the airport site. Multiple sources of odour are typically only treated cumulatively when similar in character and, as such, the consideration of background odour has not been included as part of this assessment.

12.4.4 Adopted local background concentrations

The background concentrations adopted for the local air quality assessment are presented in Table 12–16.

Table 12–16 Summary of assumed background concentrations

Pollutant	Averaging period	Year	Background	Location
Carbon monoxide (CO)	15 minutes	2014	2.1 mg/m³	Campbelltown West
	One-hour	2014	1.5 mg/m³	Campbelltown West
	Eight hours	2014	1.2 mg/m³	Campbelltown West
Nitrogen dioxide (NO_2)	One-hour	2014	Varied	Bringelly
	One year	2014	10 µg/m³	Bringelly
Particulate matter < 10 µm (PM_{10})	24 hours	2014	Varied	Bringelly
	One year	2014	17 µg/m³	Bringelly
Particulate matter < 2.5 µm ($PM_{2.5}$)	24 hours	2014	Varied	Bringelly[b]
	One year	2014	7 µg/m³	Bringelly[b]
Deposited dust	One year	n/a	2 g/m2/month	n/a
Sulfur dioxide (SO_2)	10 minutes	2014	80 µg/m³	Campbelltown West
	One-hour	2014	34 µg/m³	Campbelltown West
	24 hours	2014	9.9 µg/m³	Campbelltown West
	One year	2014	1.2 µg/m³	Campbelltown West
Benzene	One year	2008-09	1.0 µg/m³	Rozelle
Toluene[a]	24 hours	2008-09	15.3 µg/m³	Rozelle
	One year	2008-09	3.7 µg/m³	Rozelle
Xylenes[a]	24 hours	2008-09	16.6 µg/m³	Rozelle
	One year	2008-09	2.4 µg/m³	Rozelle
Formaldehyde	24 hours	2008-09	4.3 µg/m³	Rozelle
Benzo[a]pyrene	One year	2008-09	0.2 ng/m³	Blacktown

[a] 24-hour average value has been pro-rated based on the 1996-2001 data from Table 4–10 in Appendix F1 (Volume 4).

[b] Based on 2014 $PM_{2.5}$ / PM_{10} ratio of 0.31 at Liverpool and Richmond.

12.4.5 Regional air quality (ozone)

Regional air quality considers the formation of ozone through photochemical reactions from primary emissions of precursor gases including nitrogen oxides, volatile organic compounds and carbon monoxide.

Regional ozone is affected both by local formation and the transport of ozone and its precursor gases from upwind areas. As a secondary pollutant, ozone concentrations are generally more regionally homogeneous than concentrations of primary pollutants (USEPA 2013).

Meteorology and seasonality also play an important role in ozone formation. Peak ozone concentrations in Sydney tend to occur in the afternoon and during summer months due to the availability of sunlight and higher temperatures.

Elevated ground-level ozone concentrations are also associated with slow moving high pressure systems during the warmer seasons, often involving generally cloudless skies, light winds and the development of stable conditions near the surface that reduce the vertical mixing of the precursor gases. The combination of reduced mixing and light winds minimises the dispersal of pollutants, allowing their concentrations to build up (USEPA 2014).

There are a range of precursor gas emission sources which contribute to regional ozone generation. Sources include industrial, commercial, off-road mobile and on-road mobile emissions together with biogenic sources such as emissions of volatile organic compounds from areas of existing vegetation such as the Blue Mountains.

The relationship between ozone formation and emissions of precursor gases is not linear. For example, nitrogen oxides emissions can lead to both formation and destruction of ozone, depending on the local quantities of nitrogen oxides, volatile organic compounds and sunlight (USEPA 2014).

Ozone is currently measured at 15 Sydney monitoring sites, operated by the OEH. The maximum one-hour and four-hour average ozone concentrations for the most recent five years of monitoring data at these sites are presented in Table 12–17 and Table 12–18. The average across the five years is taken and the maximum five-year average is compared against the acceptance limits of 82 parts per billion (one-hour) and 65.2 parts per billion (four-hour). It is clear from the analysis that all areas of the Sydney region are currently classified as non-attainment.

The NSW EPA tiered procedure for ozone assessment requires classification of areas of Sydney as either attainment or non-attainment. An area is classified as attainment if ozone meets the acceptance limit, otherwise it is classified as non-attainment. As shown in Table 12–17 and Table 12–18 all areas within the Sydney region are classified as non-attainment.

Table 12–17 Classification of ozone nonattainment based on one-hour average ozone concentrations

Stations	Maximum ozone concentration (parts per billion)					Average
	2010	2011	2012	2013	2014	
Randwick	84	73	66	75	66	73
Rozelle	73	93	69	73	67	75
Lindfield	82	86	73	81	85	81
Chullora	83	114	80	105	79	92
Earlwood	85	99	82	101	69	87
Maximum five year average – Sydney central-east (non-attainment)						92
Richmond	89	116	85	95	90	95
St Marys	95	136	85	110	100	105
Vineyard	90	94	80	105	112	96
Prospect	104	126	80	111	103	105
Maximum five year average – Sydney north-west (non-attainment)						105
Liverpool	91	103	79	117	103	99
Bringelly	104	125	88	108	124	110
Bargo	110	126	91	95	105	105
Macarthur	119	131				
Oakdale	99	126	89	95	110	104
Campbelltown west				94	124	
Camden				110	123	
Maximum five year average – Sydney south-west (non-attainment)						110

Table 12–18 Classification of ozone nonattainment based on four-hour average ozone concentrations

Station	Maximum ozone concentration (parts per billion)					Average
	2010	2011	2012	2013	2014	
Randwick	77	69	63	67	61	67
Rozelle	67	80	54	63	60	65
Lindfield	79	84	71	74	75	77
Chullora	72	96	68	94	73	81
Earlwood	74	88	68	82	65	75
Maximum – Sydney central-east (non-attainment)						**81**
Richmond	82	88	70	76	73	78
St Marys	83	121	72	101	85	92
Vineyard	79	75	70	90	75	78
Prospect	97	114	73	104	97	97
Maximum – Sydney north-west (non-attainment)						**97**
Liverpool	81	95	71	110	87	89
Bringelly	89	118	72	102	113	99
Bargo	86	98	83	82	93	88
Macarthur	103	122				
Oakdale	88	98	81	81	88	87
Campbelltown west				82	111	
Camden				90	110	
Maximum – Sydney south-west (non-attainment)						**99**

Exceedances of the ambient ozone standards in Sydney are generally limited to the summer months (December to February). In some years, exceedances occur in the months of October, November and March, however outside the core summer periods, exceedances often coincide with bushfires events (for example November 2009 and October 2013).

A review of the most recent 10 years of monitoring data reveals exceedances of the one-hour and four-hour ozone standard in eight of the previous 10 years at Bringelly. Analysis of long term trends indicates that there is some evidence of decreasing monthly maximum ozone concentrations at Bringelly, near the airport site, as well as in other areas of Sydney.

12.5 Assessment of impacts during construction

12.5.1 Overview

Construction of the proposed Stage 1 development would result in dust emissions being generated during both the bulk earthworks and the construction of aviation infrastructure. Dust emissions during the bulk earthworks would result from:

- dozers;
- scrapers;
- the loading and unloading of material;
- hauling on paved and unpaved roads;
- wind erosion; and
- grading.

Dust emissions during the construction of aviation infrastructure would be generated by:

- the working crew (similar to the equipment used during bulk earthworks);
- the asphalt plant; and
- the concrete batching plant.

In addition to the above, there would also be diesel particulate matter emissions (comprising $PM_{2.5}$ only) from the onsite equipment as well as odour emissions from the asphalt plant.

This section describes the results of the air dispersion modelling for the construction of the Stage 1 development. The concentrations of PM_{10}, $PM_{2.5}$, dust deposition and odour were determined for 18 residential receptors and 75 community receptors in the vicinity of the airport site.

Only the residential receptors are discussed below as they were considered representative of the community receptors. The tabulated results for all receptors, including the community receptors, are provided in Appendix F1 (Volume 4).

Contour plots for each of the pollutants and relevant averaging periods are also provided in Appendix F1 (Volume 4).

12.5.2 Bulk earthworks

Table 12–19 presents a summary of the maximum 24-hour average and annual average particulate matter and dust deposition concentrations due to the onsite construction activities. Table 12–20 summarises the cumulative results including other sources/background predictions. The predicted dust impacts at the community receptors are provided in Appendix F1 (Volume 4).

The results show that the predicted dust impacts during the bulk earthworks would be at or below the air quality assessment criteria for each of the reported air quality parameters both incrementally as a result of the project and cumulatively when assessed with background concentrations and modelled inputs of other projects.

The contour plots show the spatial extent of particulate matter and the predicted concentrations across the local area (see Appendix F1 (Volume 4)). While the predicted concentrations remain low at all offsite residential receptors, the nature of the plume spread for the 24-hour and annual averaging periods is highest to the north-east and south-west of the airport site, consistent with the prevailing winds measured at Badgerys Creek (see Section 12.4.1).

Table 12–19 Predicted incremental particulate matter and dust deposition results during bulk earthworks

Receptor	Receptor description	PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)		Dust deposition (g/m^2/month)
		24 hour	Annual	24 hour	Annual	Annual
Assessment criteria		*50*	*25*	*25 (20[a])*	*8 (7[a])*	*2*
R1	Bringelly	1.0	0.1	0.4	<0.1	1 x10^{-5}
R2	Luddenham	2.1	0.3	0.5	0.1	7 x10^{-5}
R3	Greendale, Greendale Road	2.7	0.1	1.4	0.1	2 x10^{-5}
R4	Kemps Creek	1.3	0.1	0.8	<0.1	2 x10^{-5}
R6	Mulgoa	0.4	0.1	0.2	<0.1	1 x10^{-5}
R7	Wallacia	0.6	0.1	0.3	<0.1	1 x10^{-5}
R8	Twin Creeks, corner of Twin Creeks Drive and Humewood Place	2.0	0.3	0.7	0.1	5 x10^{-5}
R14	Badgerys Creek, Lawson Road	4.8	0.6	2.0	0.2	1 x10^{-4}
R15	Greendale, Mersey Road	3.3	0.4	1.2	0.1	5 x10^{-5}
R17	Luddenham Road	2.2	0.3	0.6	0.1	6 x10^{-5}
R18	Corner of Adams and Elizabeth Drive	6.5	1.0	1.8	0.2	2 x10^{-4}
R19	Corner of Adams and Anton Road	7.2	0.9	2.1	0.2	2 x10^{-4}
R21	Corner of Willowdene Avenue and Vicar Park Lane	2.9	0.5	0.7	0.1	1 x10^{-4}
R22	Rossmore, Victor Avenue	1.4	0.1	0.7	<0.1	2 x10^{-5}
R23	Wallacia, Greendale Road	0.8	0.1	0.3	<0.1	2 x10^{-5}
R27	Greendale, Dwyer Road	1.2	0.2	0.4	<0.1	3 x10^{-5}
R30	Rossmore residential	0.7	0.1	0.3	<0.1	7 x10^{-6}
R31	Mount Vernon residential	1.8	0.1	1.0	<0.1	2 x10^{-5}

Table 12–20 Predicted cumulative particulate matter and dust deposition results during bulk earthworks

Receptor	Receptor description	PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)		Dust deposition (g/m^2/month)
		24 hour	Annual	24 hour	Annual	Annual
Assessment criteria		*50*	*25*	*25 (20[a])*	*8 (7[a])*	*4*
R1	Bringelly	43.0	17.1	13.5	7.0	2.0
R2	Luddenham	42.7	17.3	13.3	7.1	2.0
R3	Greendale, Greendale Road	42.7	17.1	13.3	7.1	2.0
R4	Kemps Creek	42.6	17.1	13.3	7.0	2.0
R6	Mulgoa	42.6	17.1	13.3	7.0	2.0
R7	Wallacia	42.6	17.1	13.3	7.0	2.0
R8	Twin Creeks, corner of Twin Creeks Drive and Humewood Place	43.4	17.3	13.5	7.1	2.0
R14	Badgerys Creek, Lawson Road	43.0	17.6	13.4	7.2	2.0
R15	Greendale, Mersey Rd	44.6	17.4	14.0	7.1	2.0
R17	Luddenham Road	44.2	17.3	13.7	7.1	2.0
R18	Corner Adams and Elizabeth Drive	44.2	18.0	13.7	7.2	2.0
R19	Corner of Adams and Anton Road	43.9	17.9	13.6	7.2	2.0
R21	Corner of Willowdene Avenue and Vicar Park Lane	42.9	17.5	13.4	7.1	2.0
R22	Rossmore, Victor Avenue	42.7	17.1	13.3	7.0	2.0
R23	Wallacia, Greendale Road	42.6	17.1	13.3	7.0	2.0
R27	Greendale, Dwyer Road	43.0	17.2	13.4	7.0	2.0
R30	Rossmore residential	42.7	17.1	13.4	7.0	2.0
R31	Mt Vernon residential	42.6	17.1	13.3	7.0	2.0

[a]NEPM-AAQ aim by 2025

12.5.3 Construction of aviation infrastructure

Table 12–21 presents a summary of the maximum 24-hour average and annual average particulate matter and dust deposition concentrations at each of the 20 residential receptors, due to the construction of aviation infrastructure. Table 12–22 summarises the results cumulatively with other sources/background predictions. The predicted dust impacts at the community receptors are provided in Appendix F1 (Volume 4).

The results show that the predicted dust impacts during construction are forecast to be below the air quality assessment criteria for each of the reported air quality parameters. Dust impacts would be below the assessment criteria for both incremental impacts as a result of the project and cumulative impacts when assessed with the background concentrations and modelled inputs of other projects.

The contour plots show a similar trend to those described for the bulk earthworks, with maximum offsite concentrations predicted to the north-east and south-west of the airport site (see Appendix F1 (Volume 4)).

Table 12–21 Predicted incremental results during construction of aviation infrastructure

Receptor	Receptor description	PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)		Dust deposition (g/m²/month)
		24 hour	Annual	24 hour	Annual	Annual
Assessment criteria		*50*	*25*	*25 (20[a])*	*8 (7[a])*	*2*
R1	Bringelly	2.7	0.2	2.3	0.2	7 x10^{-6}
R2	Luddenham	2.7	0.4	2.4	0.3	4 x10^{-5}
R3	Greendale, Greendale Road	8.0	0.3	5.4	0.2	2 x10^{-5}
R4	Kemps Creek	11.0	0.2	2.8	0.2	1 x10^{-5}
R6	Mulgoa	1.3	0.1	0.7	0.1	7 x10^{-6}
R7	Wallacia	1.7	0.1	0.9	0.1	1 x10^{-5}
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	4.0	0.4	3.3	0.3	2 x10^{-5}
R14	Badgerys Creek, Lawson Road	25.4	1.2	6.6	0.7	5 x10^{-5}
R15	Greendale, Mersey Road	7.3	0.6	5.9	0.5	3 x10^{-5}
R17	Luddenham Road	5.3	0.4	2.4	0.3	3 x10^{-5}
R18	Corner of Adams and Elizabeth Drive	11.0	1.1	7.8	1.0	1 x10^{-4}
R19	Corner of Adams and Anton Road	8.7	1.1	7.0	1.1	1 x10^{-4}
R21	Corner of Willowdene Avenue and Vicar Park Lane	4.6	0.7	3.9	0.7	1 x10^{-4}
R22	Rossmore, Victor Avenue	6.6	0.3	2.2	0.2	1 x10^{-5}
R23	Wallacia, Greendale Road	2.1	0.2	1.2	0.2	1 x10^{-5}
R27	Greendale, Dwyer Road	2.6	0.2	2.9	0.2	2 x10^{-5}
R30	Rossmore residential	2.3	0.1	1.5	0.1	4 x10^{-6}
R31	Mt Vernon residential	5.9	0.2	2.9	0.2	1 x10^{-5}

Table 12–22 Predicted cumulative results during construction of aviation infrastructure

Receptor	Receptor description	PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)		Dust deposition (g/m^2/month)
		24 hour	Annual	24 hour	Annual	Annual
Assessment criteria		*50*	*25*	*25 (20[a])*	*8 (7[a])*	*4*
R1	Bringelly	45	17	14	7	2
R2	Luddenham	43	17	13	7	2
R3	Greendale, Greendale Road	43	17	13	7	2
R4	Kemps Creek	43	17	13	7	2
R6	Mulgoa	43	17	13	7	2
R7	Wallacia	43	17	13	7	2
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	47	17	14	7	2
R14	Badgerys Creek, Lawson Road,	50	18	14	8	2
R15	Greendale, Mersey Road	46	18	17	8	2
R17	Luddenham Road	44	17	15	7	2
R18	Corner of Adams and Elizabeth Drive	45	18	15	8	2
R19	Corner of Adams and Anton Road	44	18	15	8	2
R21	Corner of Willowdene Avenue and Vicar Park Lane	43	18	14	8	2
R22	Rossmore, Victor Avenue	43	17	13	7	2
R23	Wallacia, Greendale Road	43	17	13	7	2
R27	Greendale, Dwyer Road	43	17	14	7	2
R30	Rossmore residential	43	17	14	7	2
R31	Mt Vernon residential	43	17	13	7	2

[a]NEPM-AAQ aim by 2025.

12.5.4 Asphalt batching plant

The 99th percentile one-hour odour predictions for emissions from the asphalt batching plant are presented in Table 12–23. Odour from the asphalt plant would be below the relevant criteria at all sensitive residential receptors. The contour plot shows that the highest odour concentrations would be largely limited to within the airport site (see Appendix F1 (Volume 4)). The two odour unit contour (the adopted impact assessment criterion) spreads outside of the airport site a relatively short distance to the north. This area is currently unoccupied and, therefore, it is expected that there would be no adverse odour impacts to sensitive receptors from the asphalt batching plant.

Table 12–23 Predicted 99th percentile odour concentration from asphalt batching plant

Receptor	Receptor description	One-hour 99th percentile (odour units)
Assessment criteria		2
R1	Bringelly	<0.1
R2	Luddenham	<0.1
R3	Greendale, Greendale Road	<0.1
R4	Kemps Creek	0.1
R6	Mulgoa	<0.1
R7	Wallacia	<0.1
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	0.3
R14	Badgerys Creek, Lawson Road	1.7
R15	Greendale, Mersey Road	0.1
R17	Luddenham Road	0.4
R18	Corner of Adams and Elizabeth Drive	0.5
R19	Corner of Adams and Anton Road	0.1
R21	Corner of Willowdene Avenue and Vicar Park Lane	<0.1
R22	Rossmore, Victor Avenue	0.2
R23	Wallacia, Greendale Road	<0.1
R27	Greendale, Dwyer Road	<0.1
R30	Rossmore residential	<0.1
R31	Mt Vernon residential	0.2

12.6 Assessment of impacts during operation

This section describes the results of the emission calculations and air dispersion modelling for the operation of the proposed Stage 1 development.

12.6.1 Emissions

The emissions of criteria pollutants from the Stage 1 development are presented in Figure 12–5. Incremental emissions are generated by sources solely associated with the airport operations. These include emissions from aircraft, auxiliary power units, ground support equipment, parking facilities, terminal traffic, stationary sources and training fires. Cumulative emissions include the respective airport sources in addition to emissions from vehicles on external roadways, which is comprised of airport traffic and background traffic, as characterised within the surface transport and access technical report (see Chapter 15 and Appendix J (Volume 4)).

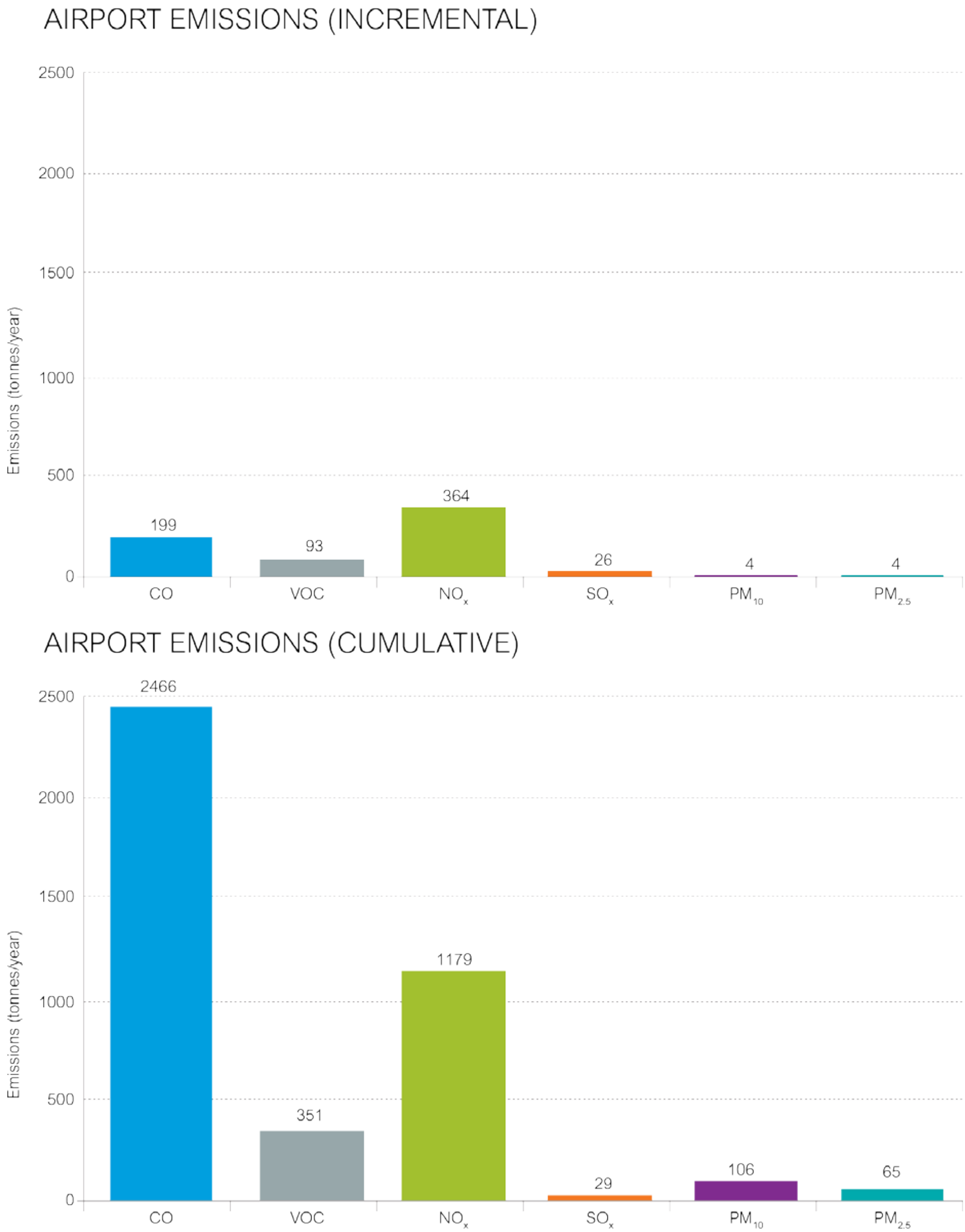


Figure 12–5 Estimated incremental and cumulative emissions for criteria pollutants

The emission inventory for the Stage 1 development is presented by source type in Table 12–24. The percentage contribution of each source to the full inventory for each pollutant is shown alongside the emission value.

Background traffic on the external road network is the largest overall source of emissions during the Stage 1 development. As such, the proposed airport represents a relatively small part of the full emissions inventory in the context of these background emissions.

The volume of emissions from background traffic can be attributed to the increased number of vehicles predicted to be using the road network at the time of operation of the Stage 1 development. Some of these vehicles would be accessing the airport, however the increase would largely be the result of significant urban development occurring in the region.

Review of the incremental emissions (that is, those emissions from the proposed airport in isolation) shows that aircraft engines are by far the most significant source for emissions at the airport site. The operation of auxiliary power units, ground support equipment, parking facilities and terminal traffic were also substantial sources of emissions.

Another significant component of incremental emissions are volatile organic compounds. Stationary sources and fuel tanks are the biggest contributor to these emissions. Evaporative losses from jet fuel at the onsite fuel farm are calculated to account for over 99 per cent of all fuel losses including diesel and petroleum reflecting the volatility of jet fuel.

Table 12–24 Airport emission inventory for criteria pollutants

Category	Emissions (tonnes per year)											
	CO		VOC		NO_x		SO_2		PM_{10}		$PM_{2.5}$	
Proposed airport	199	8%	93	26%	364	31%	26	88%	4	4%	4	7%
Aircraft engines	127	63%	27	29%	336	92%	23	91%	2	41%	2	42%
Ground support equipment	48.6	24%	2.0	2%	4.5	1%	0.5	2%	0.3	7%	0.3	7%
Auxiliary power units	4.7	2%	0.5	1%	17.3	5%	1.6	6%	1.1	24%	1.1	25%
Parking facilities	9.4	5%	1.0	1%	0.4	0%	0.0	0%	0.0	1%	0.0	0%
Terminal traffic	4.9	2%	0.5	0%	1.2	0%	0.0	0%	0.2	4%	0.1	2%
Stationary sources	2.4	1%	62.0	67%	4.4	1%	0.1	1%	0.3	7%	0.3	7%
Boilers	1.9	1%	0.1	0%	2.4	1%	0.0	0%	0.2	4%	0.2	4%
Engine tests	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Fuel tanks	0.0	0%	54.5	59%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Generators	0.4	0%	0.1	0%	2.0	1%	0.1	1%	0.1	3%	0.1	3%
Paint and Solvent	0.0	0%	7.2	8%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Training Fires	3.1	2%	0.1	0%	0.0	0%	0.0	0%	0.7	16%	0.7	16%
Airport traffic on road network	107	4%	12	3%	16	1%	0	0%	4	3%	2	3%
Background traffic on road network	2,159	88%	246	70%	800	68%	4	12%	98	92%	58	90%
Total	2,468	100%	351	100%	1,179	100%	29	100%	106	100%	65	100%

CO = Carbon monoxide, VOC = Volatile organic compounds, NO_x = Nitrogen oxides,
SO_2 = Sulfur dioxide, PM_{10} and $PM_{2.5}$ = Particulate matter

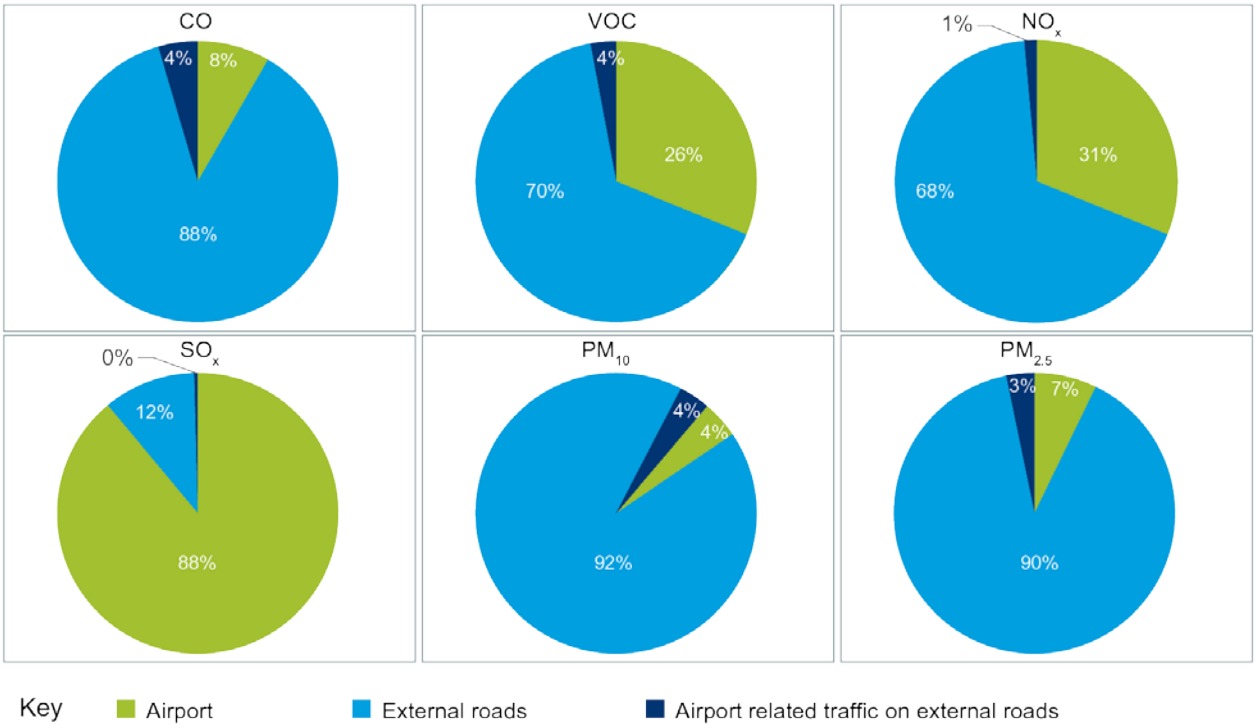


Figure 12–6 Estimated airport and external roads emissions as a percentage of total modelled for criteria pollutants

Forecast emissions from the proposed airport have also been considered in the context of the Sydney airshed. Projected emissions data for the Sydney airshed were prepared by the NSW EPA (2012) for the years 2016, 2021, 2026, 2031 and 2036. The projected emissions for 2031 have been compared with the incremental emissions from the proposed airport and are shown in Table 12–25. As the Sydney airshed forecast emissions are not available for 2030, it has been assumed that they would be substantially the same as 2031.

The comparison shows that incremental emissions from the Stage 1 development would represent a marginal share of total emissions in the Sydney airshed in 2030. In particular, the proposed airport would represent approximately 0.7 per cent of total anthropogenic emissions of nitrogen oxides within the Sydney airshed, with even smaller shares of sulfur dioxide and volatile organic compounds (0.2 per cent each), carbon monoxide (0.1 per cent) and particulate matter (less than 0.1 per cent).

Table 12–25 Forecast Sydney airshed emissions compared with forecast airport emissions

Pollutant	Forecast Sydney airshed emissions in 2031 (tonnes/year)	Forecast airport emissions in 2030 (tonnes/year)	Forecast airport emissions compared with Sydney airshed in 2030 (%)
CO	166,802	199	0.1%
VOC	98,369	93	0.1%
NOx	51,452	364	0.7%
SO_2	18,522	29	0.2%
PM_{10}	10,446	4	<0.1%
$PM_{2.5}$	12,834	4	<0.1%

Source: Forecast 2031 Sydney Airshed emissions (EPA 2012a).

Forecast airport emissions do not include contributions from external roadways.

CO = Carbon monoxide, VOC = Volatile organic compounds, NO_x = Nitrogen oxides, SO_2 = Sulfur dioxide, PM_{10} and $PM_{2.5}$ = Particulate matter

12.6.2 Dispersion modelling results

The concentrations of the criteria pollutants (carbon monoxide, nitrogen dioxide, sulfur dioxide, PM_{10}, $PM_{2.5}$ and volatile organic compounds) were determined for residential, onsite and community receptors in the local area. As the residential receptors are generally located in similar areas to the community receptors, only the residential and onsite receptors are discussed below. The results for all receptors, including the community receptors, are provided in Appendix F1 (Volume 4). Contour plots that show the spatial distribution of each pollutant are provided in Appendix F1 (Volume 4).

The incremental emissions comprise emissions from aircraft, auxiliary power units, ground support equipment, parking facilities, terminal traffic, stationary sources and training fires. Cumulative predictions include the airport sources as well as emissions from the external roadways and background contributions.

The dispersion modelling results are generally broken down into three categories.

- Airport – the incremental emissions from the operation of the proposed airport in isolation;
- External roads – emissions from traffic on roads surrounding the airport site, accounting for traffic due to the broader urbanisation of Western Sydney (including the proposed airport); and
- Cumulative – the total of emissions from the operation of the proposed airport, traffic on roads surrounding the airport site, and background concentrations recorded in the vicinity of the proposed airport (see Section 12.2.1.2) which would capture other major emissions sources in the region such as industrial developments.

12.6.2.1 Nitrogen dioxide (NO_2)

The dispersion modelling results for maximum one-hour and annual average nitrogen dioxide are presented in Table 12–26. The results of the dispersion modelling show predicted nitrogen dioxide concentrations to be below the air quality assessment criteria at all residential receptors when considering the airport both in isolation (incremental) and combined with the external roadways and background sources (cumulative).

The highest one-hour nitrogen dioxide concentrations are predicted to occur at sensitive receptors R3 and R25, where the cumulative concentration is predicted to reach about 70 per cent of the one-hour air quality criteria (320 µg/m^3). Sensitive receptor R25 is on the airport site and will not be residential.

The cumulative contributions from external roadways are shown to have negligible effects for some receptors and greater effects for others such as R22 at Rossmore.

Table 12–26 Predicted incremental and cumulative NO_2 concentrations

Receptor	Receptor description	Airport (µg/m^3)		Cumulative[a] (µg/m^3)	
		One-hour	Annual	One-hour	Annual
Assessment criteria		*320*	*62*	*320*	*62*
R1	Bringelly	84	11	145	19
R2	Luddenham	91	13	192	15
R3	Greendale, Greendale Road	194	12	213	13
R4	Kemps Creek	76	11	109	17
R6	Mulgoa	84	12	85	13
R7	Wallacia	90	11	92	13
R8	Twin Creeks, corner Twin Creeks Drive & Humewood Place	86	13	91	17
R14	Badgerys Creek, Lawson Road	147	13	153	18
R15	Greendale, Mersey Road	130	13	135	16
R17	Luddenham Road	96	13	103	17
R18	Corner Adams and Elizabeth Drive	107	17	108	21
R19	Corner Adams and Anton Road	111	19	112	23
R21	Corner Willowdene Avenue and Vicar Park Lane	171	13	177	15
R22	Rossmore, Victor Avenue	68	11	104	15
R23	Wallacia, Greendale Road	87	11	101	12
R24	Badgerys Creek 1 NE	166	18	169	26
R25	Badgerys Creek 2 SW	104	12	215	26
R27	Greendale, Dwyer Road	80	11	108	12
R30	Rossmore residential	66	11	126	18
R31	Mt Vernon residential	142	12	142	16

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.

12.6.2.2 Particulate matter (PM_{10})

The dispersion modelling results for maximum 24-hour average and annual average PM_{10} are presented in Table 12–27. The results of the dispersion modelling show predicted PM_{10} concentrations to be below the air quality assessment criteria (50 µg/m^3 over 24 hours and 25 µg/m^3 annually) at all assessed sensitive receptors.

As shown, the inclusion of traffic on external roadways increases the predicted concentrations at most assessed sensitive receptors. This is due to the relatively large proportion of the emissions inventory attributable to traffic as well as the broader spatial extent of these emissions sources.

Table 12–27 Predicted incremental and cumulative PM_{10} concentrations

Receptor	Receptor description	Airport (µg/m^3)		Airport + external roads (µg/m^3)		Cumulative[a] (µg/m^3)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
Assessment criteria		n/a	n/a	n/a	n/a	*50*	*25*
R1	Bringelly	0.5	<0.1	7.3	1.0	44	18
R2	Luddenham	0.5	<0.1	1.7	0.3	43	17
R3	Greendale, Greendale Road	1.0	<0.1	2.5	0.2	43	17
R4	Kemps Creek	0.6	<0.1	4.4	0.8	44	18
R6	Mulgoa	0.5	<0.1	1.5	0.2	43	17
R7	Wallacia	0.4	<0.1	1.4	0.2	43	17
R8	Twin Creeks, corner Twin Creeks Drive and Humewood Place	0.6	<0.1	2.6	0.5	44	18
R14	Badgerys Creek, Lawson Road	1.5	0.1	6.0	0.8	44	18
R15	Greendale, Mersey Road	1.1	0.1	2.1	0.5	44	17
R17	Luddenham Road	0.7	<0.1	2.9	0.5	43	18
R18	Corner Adams and Elizabeth Drive	0.7	0.1	3.2	0.7	44	18
R19	Corner Adams and Anton Road	2.0	0.2	3.1	0.7	44	18
R21	Corner Willowdene Avenue and Vicar Park Lane	0.9	<0.1	3.4	0.4	43	17
R22	Rossmore, Victor Avenue	0.9	<0.1	3.4	0.5	44	18
R23	Wallacia, Greendale Road	0.6	<0.1	2.0	0.2	43	17
R24	Badgerys Creek 1 NE	4.1	0.4	5.9	1.5	44	18
R25	Badgerys Creek 2 SW	0.6	<0.1	18.6	1.9	47	19
R27	Greendale, Dwyer Road	0.1	<0.1	1.7	0.2	43	17
R30	Rossmore residential	0.3	<0.1	6.0	1.1	44	18
R31	Mt Vernon residential	0.9	<0.1	4.0	0.5	43	18

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.
n/a – the criterion do not apply to this assessment scenario

12.6.2.3 Particulate matter ($PM_{2.5}$)

The dispersion modelling results for maximum 24-hour average and annual average $PM_{2.5}$ are presented in Table 12–28. The dispersion modelling shows predicted $PM_{2.5}$ concentrations to be below the current air quality assessment criteria (25 µg/m^3 over 24 hours and 8 µg/m^3 annually) at all assessed sensitive receptors.

Predicted $PM_{2.5}$ does exceed a future NEPM-AAQ objective for 2025 (7 µg/m^3 annually) at a number of sensitive receptors, however this is primarily attributable to background concentrations. As shown, the inclusion of traffic on external roadways increases the predicted concentrations at most assessed sensitive receptors. This is due to the relatively large proportion of the emissions inventory attributable to traffic as well as the broader spatial extent of these emissions sources.

Table 12–28 Predicted incremental and cumulative $PM_{2.5}$ concentrations

Receptor	Receptor description	Airport (µg/m^3)		Airport + external roads (µg/m^3)		Cumulative[a] (µg/m^3)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
Assessment criteria		*n/a*	*n/a*	*n/a*	*n/a*	*25 (20[b])*	*8 (7[b])*
R1	Bringelly	0.5	<0.1	4.3	0.6	14	8
R2	Luddenham	0.5	<0.1	1.1	0.2	14	7
R3	Greendale, Greendale Road	1.0	<0.1	1.9	0.1	13	7
R4	Kemps Creek	0.6	<0.1	2.6	0.5	14	7
R6	Mulgoa	0.5	<0.1	1.0	0.1	13	7
R7	Wallacia	0.4	<0.1	0.9	0.1	13	7
R8	Twin Creeks, corner Twin Creeks Drive and Humewood Place	0.6	<0.1	1.5	0.3	14	7
R14	Badgerys Creek, Lawson Road	1.4	0.1	4.1	0.5	14	7
R15	Greendale, Mersey Road	1.0	0.1	1.5	0.3	14	7
R17	Luddenham Road	0.7	<0.1	1.7	0.3	14	7
R18	Corner Adams and Elizabeth Drive	0.7	0.1	2.0	0.4	14	7
R19	Corner Adams and Anton Road	1.9	0.2	2.5	0.5	14	7
R21	Corner Willowdene Avenue and Vicar Park Lane	0.8	<0.1	2.1	0.2	14	7
R22	Rossmore, Victor Avenue	0.9	<0.1	2.0	0.3	14	7
R23	Wallacia, Greendale Road	0.6	<0.1	1.2	0.1	13	7
R24	Badgerys Creek 1 NE	3.9	0.3	4.3	0.9	14	8
R25	Badgerys Creek 2 SW	0.6	<0.1	11.1	1.1	18	8

R27	Greendale, Dwyer Road	0.1	<0.1	1.0	0.1	13	7
R30	Rossmore residential	0.3	<0.1	3.5	0.6	14	8
R31	Mt Vernon residential	0.9	<0.1	2.4	0.3	14	7

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.
[b] NEPM-AAQ aim by 2025.
n/a – the criterion do not apply to this assessment scenario

12.6.2.4 Carbon monoxide (CO)

The dispersion modelling results for maximum 15-minute, one-hour and eight-hour carbon monoxide are presented in Table 12-29. The results of the dispersion modelling show predicted carbon monoxide concentrations to be well below the air quality assessment criteria at all residential receptors for all averaging periods.

Table 12–29 Predicted incremental and cumulative CO concentrations

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		15-min	1-hour	8-hour	15-min	1-hour	8-hour	15-min	1-hour	8-hour
Assessment criteria		n/a	n/a	n/a	n/a	n/a	n/a	100	30	10
R1	Bringelly	0.6	0.4	0.1	3.8	2.9	0.4	5.9	4.4	1.6
R2	Luddenham	0.5	0.4	0.1	0.5	0.4	0.1	2.6	1.9	1.3
R3	Greendale, Greendale Road	0.9	0.7	0.1	1.4	1.0	0.2	3.5	2.5	1.4
R4	Kemps Creek	0.7	0.5	0.1	1.9	1.5	0.3	4.0	3.0	1.5
R6	Mulgoa	0.7	0.5	0.1	0.9	0.6	0.1	3.0	2.1	1.3
R7	Wallacia	0.3	0.2	0.0	0.9	0.7	0.1	3.0	2.2	1.3
R8	Twin Creeks, corner Twin Creeks Drive and Humewood Place	0.9	0.7	0.1	1.2	0.9	0.1	3.3	2.4	1.3
R14	Badgerys Creek, Lawson Road	1.8	1.4	0.2	2.2	1.7	0.3	4.3	3.2	1.5
R15	Greendale, Mersey Road	1.1	0.8	0.2	1.3	1.0	0.2	3.4	2.5	1.4
R17	Luddenham Road	0.5	0.4	0.1	1.0	0.7	0.1	3.1	2.2	1.3
R18	Corner Adams and Elizabeth Drive	0.7	0.5	0.1	1.6	1.2	0.3	3.7	2.7	1.5
R19	Corner Adams and Anton Road	2.3	1.7	0.3	2.4	1.8	0.3	4.5	3.3	1.5
R21	Corner Willowdene Avenue and Vicar Park Lane	1.1	0.8	0.2	1.7	1.3	0.2	3.8	2.8	1.4

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		15-min	1-hour	8-hour	15-min	1-hour	8-hour	15-min	1-hour	8-hour
R22	Rossmore, Victor Avenue	1.0	0.8	0.1	1.1	0.8	0.2	3.2	2.3	1.4
R23	Wallacia, Greendale Road	0.4	0.3	0.1	0.5	0.4	0.1	2.6	1.9	1.3
R24	Badgerys Creek 1 NE	3.1	2.3	0.5	4.6	3.4	0.6	6.7	4.9	1.8
R25	Badgerys Creek 2 SW	0.5	0.4	0.1	4.8	3.6	0.9	6.9	5.1	2.1
R27	Greendale, Dwyer Road	0.2	0.1	0.0	0.8	0.6	0.1	2.9	2.1	1.3
R30	Rossmore residential	0.4	0.3	0.1	3.1	2.3	0.3	5.2	3.8	1.5
R31	Mt Vernon residential	0.8	0.6	0.1	0.8	0.6	0.2	2.9	2.1	1.4

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.
n/a – the criterion do not apply to this assessment scenario

12.6.2.5 Sulfur dioxide (SO_2)

The dispersion modelling results for maximum 10-minute, one-hour, 24-hour and annual average sulfur dioxide, are presented in Table 12–30 (10-minute and one-hour averaging periods) and Table 12–31 (24-hour and annual averaging periods). The results of the dispersion modelling show predicted sulfur dioxide concentrations to be well below the air quality assessment criteria at all residential receptors for all averaging periods.

Table 12–30 Predicted incremental and cumulative maximum 10 minute and one-hour sulfur dioxide concentrations

Receptor	Receptor description	Airport (µg/m³)		Airport + external roadways (µg/m³)		Cumulative[a] (µg/m³)	
		10-min	1-hour	10-min	1-hour	10-min	1-hour
Assessment criteria		*n/a*	*n/a*	*n/a*	*n/a*	*700*	*570*
R1	Bringelly	28	19	29	19	109	53
R2	Luddenham	18	12	25	16	105	50
R3	Greendale, Greendale Road	63	42	83	55	163	89
R4	Kemps Creek	24	16	54	36	134	70
R6	Mulgoa	122	81	52	34	132	68
R7	Wallacia	66	44	32	21	112	55
R8	Twin Creeks, corner Twin Creeks Drive and Humewood Place	64	42	64	43	144	77

Receptor	Receptor description	Airport (µg/m³)		Airport + external roadways (µg/m³)		Cumulative[a] (µg/m³)	
		10-min	1-hour	10-min	1-hour	10-min	1-hour
R14	Badgerys Creek, Lawson Road	85	56	122	81	202	115
R15	Greendale, Mersey Road	49	32	66	44	146	78
R17	Luddenham Road	133	88	54	35	134	69
R18	Corner Adams and Elizabeth Drive	39	26	36	24	116	58
R19	Corner Adams and Anton Road	102	67	102	68	182	102
R21	Corner Willowdene Avenue and Vicar Park Lane	51	34	86	57	166	91
R22	Rossmore, Victor Avenue	25	16	49	32	129	66
R23	Wallacia, Greendale Road	83	55	43	29	123	63
R24	Badgerys Creek 1 NE	87	57	133	88	213	122
R25	Badgerys Creek 2 SW	84	56	40	27	120	61
R27	Greendale, Dwyer Road	16	11	16	11	96	45
R30	Rossmore residential	24	16	29	19	109	53
R31	Mt Vernon residential	90	59	90	59	170	93

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.
n/a – the criterion do not apply to this assessment scenario

Table 12–31 Predicted incremental and cumulative maximum 24-hour and annual average SO_2 concentrations

Receptor	Receptor description	Airport (µg/m³)		Airport + external roads (µg/m³)		Cumulative[a] (µg/m³)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
Assessment criteria		*n/a*	*n/a*	*n/a*	*n/a*	*228*	*60*
R1	Bringelly	1.8	0.1	2.0	0.1	11.9	1.3
R2	Luddenham	1.4	0.2	1.4	0.2	11.3	1.4
R3	Greendale, Greendale Road	4.6	0.2	4.6	0.2	14.5	1.4
R4	Kemps Creek	2.2	0.1	2.3	0.1	12.2	1.3
R6	Mulgoa	2.4	0.1	2.4	0.1	12.3	1.3
R7	Wallacia	1.5	0.1	1.5	0.1	11.4	1.3
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	2.2	0.2	2.2	0.2	12.1	1.4
R14	Badgerys Creek, Lawson Road	4.6	0.3	4.8	0.3	14.7	1.5
R15	Greendale, Mersey Road	3.9	0.3	3.9	0.3	13.8	1.5
R17	Luddenham Road	2.7	0.2	2.8	0.2	12.7	1.4

Receptor	Receptor description	Airport (µg/m³)		Airport + external roads (µg/m³)		Cumulative[a] (µg/m³)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
R18	Corner Adams and Elizabeth Drive	2.5	0.6	2.5	0.6	12.4	1.8
R19	Corner Adams and Anton Road	4.4	0.8	4.4	0.8	14.3	2.0
R21	Corner Willowdene Avenue and Vicar Park Lane	3.8	0.2	3.8	0.2	13.7	1.4
R22	Rossmore, Victor Avenue	2.4	0.1	2.5	0.1	12.4	1.3
R23	Wallacia, Greendale Road	2.8	0.1	2.9	0.1	12.8	1.3
R24	Badgerys Creek 1 NE	7.4	0.7	7.4	0.7	17.3	1.9
R25	Badgerys Creek 2 SW	2.2	0.1	2.3	0.2	12.2	1.4
R27	Greendale, Dwyer Road	0.6	0.1	0.7	0.1	10.6	1.3
R30	Rossmore residential	1.7	0.1	1.9	0.1	11.8	1.3
R31	Mt Vernon residential	4.2	0.1	4.3	0.2	14.2	1.4

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.
n/a – the criterion do not apply to this assessment scenario

12.6.2.6 Air toxics

The relevant dispersion modelling results for the four air toxics evaluated in this assessment (benzene, toluene, xylene and formaldehyde) are presented in Table 12–32 (99.9th percentile), Table 12–33 (24-hour averaging period) and Table 12–34 (annual averaging period). The results of the dispersion modelling show the predicted concentrations of air toxics to be well below the air quality assessment criteria for the 99.9th percentile. The exception was formaldehyde with an exceedance shown at onsite receptor R24 (see Table 12–32).

The 24-hour and annual average concentrations of benzene, toluene and xylenes were predicted to be orders of magnitude lower than the air quality assessment criteria. The concentration of formaldehyde was also less than 18 per cent of the criteria.

Table 12–32 Predicted incremental and cumulative 99.9th percentile one-hour average air toxic concentrations

Receptor	Receptor description	Airport (µg/m³)				Airport + external roads (µg/m³)			
		Benzene	Toluene	Xylene	Formaldehyde	Benzene	Toluene	Xylene	Formaldehyde
Assessment criteria		*29*	*360*	*180*	*20*	*29*	*360*	*180*	*20*
R1	Bringelly	0.1	<0.1	<0.1	0.7	1.5	0.6	0.4	11.1
R2	Luddenham	0.2	0.1	0.1	1.5	1.3	0.5	0.3	9.2
R3	Greendale, Greendale Road	0.2	0.1	<0.1	1.2	1.0	0.4	0.3	7.4
R4	Kemps Creek	0.1	<0.1	<0.1	0.9	1.3	0.5	0.4	9.8

Receptor	Receptor description	Airport (µg/m³)				Airport + external roads (µg/m³)			
		Benzene	Toluene	Xylene	Formaldehyde	Benzene	Toluene	Xylene	Formaldehyde
R6	Mulgoa	0.1	<0.1	<0.1	0.7	0.7	0.3	0.2	5.3
R7	Wallacia	0.1	<0.1	<0.1	0.7	0.6	0.2	0.2	4.2
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	0.1	<0.1	<0.1	0.8	0.9	0.3	0.2	6.3
R14	Badgerys Creek, Lawson Road	0.3	0.1	0.1	2.2	1.5	0.6	0.4	10.7
R15	Greendale, Mersey Road	0.3	0.1	0.1	1.8	1.4	0.5	0.4	10.5
R17	Luddenham Road	0.1	0.1	<0.1	1.0	0.9	0.3	0.2	6.6
R18	Corner Adams and Elizabeth Drive	0.2	0.1	<0.1	1.4	1.4	0.5	0.4	10.0
R19	Corner Adams and Anton Road	0.4	0.1	0.1	2.6	2.1	0.8	0.6	15.6
R21	Corner Willowdene Avenue and Vicar Park Lane	0.2	0.1	0.1	1.5	1.3	0.5	0.4	9.7
R22	Rossmore, Victor Avenue	0.2	0.1	<0.1	1.1	0.9	0.4	0.2	6.8
R23	Wallacia, Greendale Road	0.1	<0.1	<0.1	0.9	0.6	0.2	0.2	4.3
R24	Badgerys Creek 1 NE	0.6	0.2	0.2	4.2	3.2	1.2	0.8	23.2
R25	Badgerys Creek 2 SW	0.3	0.1	0.1	2.0	2.6	1.0	0.7	18.8
R27	Greendale, Dwyer Road	0.1	0.1	<0.1	1.0	1.1	0.4	0.3	7.9
R30	Rossmore residential	0.1	<0.1	<0.1	0.5	1.5	0.6	0.4	11.1
R31	Mt Vernon residential	0.2	0.1	0.1	1.4	1.1	0.4	0.3	8.3

Note Bold indicates exceedance of criterion

Table 12–33 Predicted incremental and cumulative 24-hour average air toxic concentrations

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		Toluene	Xylene	Formald-ehyde	Toluene	Xylene	Formald-ehyde	Toluene	Xylene	Formald-ehyde
Assessment criteria		*4,160*	*1,170*	*53*	*4,160*	*1,170*	*53*	*4,160*	*1,170*	*53*
R1	Bringelly	<0.1	<0.1	0.9	0.1	0.1	2.2	15.4	16.7	6.5
R2	Luddenham	0.1	0.1	1.6	0.1	0.1	1.5	15.4	16.7	5.8
R3	Greendale, Greendale Road	0.1	0.1	1.5	0.1	0.1	1.5	15.4	16.7	5.8
R4	Kemps Creek	0.1	<0.1	1.1	0.1	0.1	1.7	15.4	16.7	6.0
R6	Mulgoa	<0.1	<0.1	0.8	0.0	0.0	0.9	15.3	16.6	5.2
R7	Wallacia	<0.1	<0.1	0.8	0.0	0.0	0.9	15.3	16.6	5.2
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	<0.1	<0.1	0.8	0.1	0.0	1.1	15.4	16.6	5.4
R14	Badgerys Creek, Lawson Road	0.1	0.1	2.4	0.1	0.1	2.6	15.4	16.7	6.9
R15	Greendale, Mersey Road	0.1	0.1	2.0	0.1	0.1	1.7	15.4	16.7	6.0
R17	Luddenham Road	0.1	<0.1	1.1	0.1	0.0	1.1	15.4	16.6	5.4
R18	Corner Adams and Elizabeth Drive	0.1	0.1	1.5	0.1	0.0	1.3	15.4	16.6	5.6
R19	Corner Adams and Anton Road	0.1	0.1	2.7	0.2	0.1	3.0	15.5	16.7	7.3
R21	Corner Willowdene Avenue and Vicar Park Lane	0.1	0.1	1.7	0.1	0.1	1.4	15.4	16.7	5.7
R22	Rossmore, Victor Avenue	0.1	<0.1	1.2	0.1	0.0	1.3	15.4	16.6	5.6
R23	Wallacia, Greendale Road	0.1	<0.1	1.1	0.1	0.0	1.1	15.4	16.6	5.4
R24	Badgerys Creek 1 NE	0.2	0.2	4.6	0.3	0.2	4.9	15.6	16.8	9.2
R25	Badgerys Creek 2 SW	0.1	0.1	2.1	0.3	0.2	5.0	15.6	16.8	9.3
R27	Greendale,	0.1	<0.1	1.0	0.1	0.0	1.3	15.4	16.6	5.6

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		Toluene	Xylene	Formaldehyde	Toluene	Xylene	Formaldehyde	Toluene	Xylene	Formaldehyde
	Dwyer Road									
R30	Rossmore residential	<0.1	<0.1	0.5	0.1	0.1	1.9	15.4	16.7	6.2
R31	Mt Vernon residential	0.1	0.1	1.4	0.1	0.1	1.5	15.4	16.7	5.8

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.

Table 12–34 Predicted incremental and cumulative annual average air toxic concentrations

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		Benzene	Toluene	Xylene	Benzene	Toluene	Xylene	Benzene	Toluene	Xylene
Assessment criteria		*10*	*406*	*935*	*10*	*406*	*935*	*10*	*406*	*935*
R1	Bringelly	0.01	<0.01	<0.01	0.05	0.02	0.01	1.1	3.7	2.4
R2	Luddenham	0.02	0.01	0.01	0.03	0.01	0.01	1.0	3.7	2.4
R3	Greendale, Greendale Road	0.01	<0.01	<0.01	0.02	0.01	<0.01	1.0	3.7	2.4
R4	Kemps Creek	0.01	<0.01	<0.01	0.04	0.02	0.01	1.0	3.7	2.4
R6	Mulgoa	0.01	<0.01	<0.01	0.02	0.01	<0.01	1.0	3.7	2.4
R7	Wallacia	0.01	<0.01	<0.01	0.01	0.01	<0.01	1.0	3.7	2.4
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	0.01	0.01	<0.01	0.04	0.01	0.01	1.0	3.7	2.4
R14	Badgerys Creek, Lawson Road	0.02	0.01	<0.01	0.05	0.02	0.01	1.1	3.7	2.4
R15	Greendale, Mersey Road	0.01	0.01	<0.01	0.03	0.01	0.01	1.0	3.7	2.4
R17	Luddenham Road	0.01	0.01	<0.01	0.04	0.01	0.01	1.0	3.7	2.4
R18	Corner Adams and Elizabeth Drive	0.03	0.01	0.01	0.06	0.02	0.01	1.1	3.7	2.4
R19	Corner Adams and Anton Road	0.04	0.02	0.01	0.07	0.02	0.02	1.1	3.7	2.4
R21	Corner Willowdene Avenue and Vicar Park Lane	0.01	<0.01	<0.01	0.03	0.01	0.01	1.0	3.7	2.4

Receptor	Receptor description	Airport (µg/m³)			Airport + external roads (µg/m³)			Cumulative[a] (µg/m³)		
		Benzene	Toluene	Xylene	Benzene	Toluene	Xylene	Benzene	Toluene	Xylene
R22	Rossmore, Victor Avenue	0.01	<0.01	<0.01	0.03	0.01	0.01	1.0	3.7	2.4
R23	Wallacia, Greendale Road	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	1.0	3.7	2.4
R24	Badgerys Creek 1 NE	0.06	0.02	0.02	0.12	0.05	0.03	1.1	3.7	2.4
R25	Badgerys Creek 2 SW	0.02	0.01	<0.01	0.11	0.04	0.03	1.1	3.7	2.4
R27	Greendale, Dwyer Road	0.01	<0.01	<0.01	0.02	0.01	<0.01	1.0	3.7	2.4
R30	Rossmore residential	<0.01	<0.01	<0.01	0.06	0.02	0.01	1.1	3.7	2.4
R31	Mt Vernon residential	0.01	<0.01	<0.01	0.03	0.01	0.01	1.0	3.7	2.4

[a] The combined total of background air quality, emissions from external roadways and emissions from the proposed airport.

12.6.3 Odour

12.6.3.1 Aircraft exhaust

The modelling results for the 99th percentile one-hour odour emissions from aircraft exhaust are presented in Table 12–35. The modelling shows predicted odour concentrations to be below the threshold detection level of one odour unit at all but one of the residential receptors. At R24, the predicted odour concentration is one odour unit, indicating when a receptor is located in this area, they may detect odour from aircraft exhausts. This is, however, less than the NSW EPA odour performance criterion of two odour units.

The contour plots show that the highest odour concentrations would be largely limited to within the airport site (see Appendix F1 (Volume 4)).

Table 12–35 Predicted 99th percentile odour concentrations from aircraft exhaust

Receptor	Receptor description	One hour 99th percentile
Assessment criteria		*2*
R1	Bringelly	<1
R2	Luddenham	<1
R3	Greendale, Greendale Road	<1
R4	Kemps Creek	<1
R6	Mulgoa	<1
R7	Wallacia	<1

Receptor	Receptor description	One hour 99th percentile
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	<1
R14	Badgerys Creek, Lawson Road	<1
R15	Greendale, Mersey Road	<1
R17	Luddenham Road	<1
R18	Corner Adams and Elizabeth Drive	1
R19	Corner Adams and Anton Road	1
R21	Corner Willowdene Avenue and Vicar Park Lane	<1
R22	Rossmore, Victor Avenue	<1
R23	Wallacia, Greendale Road	<1
R24	Badgerys Creek 1 NE	1
R25	Badgerys Creek 2 SW	<1
R27	Greendale, Dwyer Road	<1
R30	Rossmore residential	<1
R31	Mt Vernon residential	<1

12.6.3.2 Wastewater treatment plant

The modelling results for the 99th percentile one-hour odour emissions from the onsite wastewater treatment plant are presented in Table 12–36. The modelling shows predicted odour concentrations to be below the relevant air quality criteria of two odours units as well as the threshold of detection at one odour unit at all assessed receptors.

Table 12–36 Predicted 99th percentile odour concentrations from wastewater treatment plant

Receptor	Receptor description	One hour 99th percentile
Assessment criteria		*2*
R1	Bringelly	<1
R2	Luddenham	<1
R3	Greendale, Greendale Road	<1
R4	Kemps Creek	<1
R6	Mulgoa	<1
R7	Wallacia	<1
R8	Twin Creeks, Corner Twin Creeks Drive and Humewood Place	<1
R14	Badgerys Creek, Lawson Road	<1
R15	Greendale, Mersey Road	<1
R17	Luddenham Road	<1

Receptor	Receptor description	One hour 99th percentile
R18	Corner Adams and Elizabeth Drive	<1
R19	Corner Adams and Anton Road	<1
R21	Corner Willowdene Avenue and Vicar Park Lane	<1
R22	Rossmore, Victor Avenue	<1
R23	Wallacia, Greendale Road	<1
R24	Badgerys Creek 1 NE	<1
R25	Badgerys Creek 2 SW	<1
R27	Greendale, Dwyer Road	<1
R30	Rossmore residential	<1
R31	Mt Vernon residential	<1

12.6.4 Emergency fuel jettisoning

Emergency fuel jettisoning refers to an emergency situation where an aircraft must jettison fuel in order to land safely – typically an emergency landing. Emergency fuel jettisoning is not a standard procedure and furthermore most domestic aircraft are incapable of doing it.

It is mandatory for fuel jettisoning events to be reported. In Australian airspace in 2014, there were 10 reported instances of civilian aircraft dumping fuel from 698,856 domestic air traffic movements and 31,345 international air traffic movements. This equates to approximately 0.001 per cent of all air traffic movements.

Notwithstanding the rarity of fuel jettisoning events, the potential impacts on local air quality would be further limited by the rules in place for fuel jettisoning to occur. These rules demand that pilots take reasonable precautions to ensure the safety of people and property and, where possible, conduct a controlled jettison at an altitude of above 6,000 feet.

Given the rarity of fuel jettisoning globally, the known low occurrence in Australian airspace, and the standards in place along with the high evaporation rates known to occur at high altitude, authorised fuel jettisoning associated with the operation of the proposed airport is unlikely to cause environmental or social impacts.

The operational conditions for emergency fuel jettisoning are discussed further in Chapter 7 (Volume 1).

12.6.5 Regional air quality

International studies have shown that emissions from airport operations are small when viewed in the context of regional emissions inventories (Ratliff et al. 2009). This is supported by data presented in the Air Emissions Inventory for the Greater Metropolitan Region in New South Wales (NSW EPA 2012) which shows that emissions from existing airport operations in Sydney are less than three per cent of total emissions for the Sydney region.

The daily maximum predicted one-hour ozone concentrations are presented in Table 12–37. Results are presented as peak concentrations for the 2030 future base case (no airport), the 2030 airport case (airport emissions plus the 2030 future base case) and the largest difference in daily maximums (the 2030 airport case minus the 2030 future base case). The largest difference represents the maximum change in daily maximum ozone concentration, as a result of the additional emissions from the Stage 1 development.

Table 12–37 Maximum daily predicted one-hour ozone concentration (parts per billion)

Date	2030 future base case peak value	2030 airport case peak value	2030 airport case – 2030 future base case largest difference
06/01/2009	149.1	149.1	0.4
07/01/2009	129.8	129.8	5.5
14/01/2009	106.6	106.6	1.3
29/01/2009	124.1	124.1	0.3
30/01/2009	107.4	107.4	0.6
31/01/2009	109.4	109.4	0.6
04/02/2009	103.8	103.8	1.2
05/02/2009	119.6	119.6	0.3
06/02/2009	112.5	112.5	0.8
07/02/2009	133.7	133.7	0.3
08/02/2009	148.6	148.6	0.6
20/02/2009	98.3	98.3	1.0

The results of the regional air quality analysis show that for each day of analysis, the peak predicted one-hour ozone concentrations were unchanged between the 2030 future base case and the 2030 airport case. This is because the predicted ozone concentrations from the proposed airport occur in different locations to where ozone peaks occur. Both the 2030 future base case and the 2030 airport case were above the NEPM-AAQ criterion of 100 parts per billion for all but one day of analysis.

To provide context, the predicted peak ozone concentrations presented in Table 12–37 can be compared with measured peak one-hour ozone concentrations at Bringelly. During 2014, there were two days when the maximum daily one-hour ozone concentration at Bringelly was above the NEPM-AAQ standard, with a peak concentration of 124 parts per billion measured in November 2014. It is noted that the modelled peak values are expected to be higher than observed peak values because monitoring networks never achieve full coverage of an airshed. In other words, modelling can predict higher peak ozone for areas not covered by monitoring networks.

The largest difference in daily maximum one-hour ozone concentrations, from the addition of airport emissions, was 5.5 parts per billion. However, the second highest was significantly lower at 1.3 parts per billion. This highlights that reliance on a single model result (for example, focussing on the largest ozone change) could accentuate the influence of uncertainties in the model's input data or model formulation. Therefore, the average of the 2^{nd} to 4^{th} highest ozone change (1.2 parts per billion) is used to describe ozone impacts. This approach is similar to the use of a 99^{th} percentile to describe maximum ozone impacts. When compared to the maximum allowable increment level of one part per billion, prescribed by the NSW EPA tiered procedure for ozone assessment, a marginal impact is predicted from the 2030 airport case.

The peak predicted four-hour ozone concentration were unchanged between the 2030 airport case and the 2030 future base case on eight days and increased on four days, by a maximum of 0.1 parts per billion as shown in Table 12–38.

Table 12–38 Maximum daily predicted four-hour ozone concentration (parts per billion)

Date	2030 future base case peak value	2030 airport case peak value	2030 airport case – 2030 future base case largest difference
06/01/2009	126.2	126.3	0.3
07/01/2009	115.3	115.4	2.4
14/01/2009	98.7	98.8	0.7
29/01/2009	95.9	95.9	0.5
30/01/2009	78.2	78.2	0.6
31/01/2009	99.9	99.9	0.5
04/02/2009	97.3	97.3	0.7
05/02/2009	108.7	108.7	0.4
06/02/2009	92.4	92.4	0.4
07/02/2009	121.0	121.0	0.7
08/02/2009	129.9	129.9	0.6
20/02/2009	83.9	84.0	1.3

The highest change in daily maximum four-hour ozone concentration, from the addition of airport emissions, was 2.4 parts per billion, while the second highest was 1.3 parts per billion. The average of the 2^{nd} to 4^{th} highest change in daily maximum four-hour ozone was 0.9 parts per billion, which is below the maximum allowable increment of one part per billion.

Increases in ozone are predicted to occur downwind of the airport site, usually to the south given prevailing winds. Spatial variation of ozone increases and decreases is presented in the spatial plots included in Appendix F2 (Volume 4).

A spatial analysis of ozone concentrations with and without the proposed airport shows some decreases in the vicinity of the proposed airport. Such decreases are attributable to ozone suppression by nitrogen oxides emissions.

The use of historical dates may appear counterintuitive for the modelling of future emissions. However, these dates represent the meteorological conditions that have historically led to peak ozone formation and therefore form a suitable basis for assessment of future scenarios.

12.7 Greenhouse gas assessment

This section presents the results of the greenhouse gas assessment which quantifies the greenhouse gas emissions in tonnes of carbon dioxide equivalent (CO_2-e) for construction and operation of the Stage 1 development.

Climate change generally refers to a rise in global temperatures attributable to greenhouse gas emissions from human activity. Climate change is also associated with other alterations in weather patterns including increased occurrence and intensity of severe weather events such as storms, floods, bushfires and droughts. The increase in global temperatures is also predicted to result in warming ocean temperatures and sea level rise. These effects have an impact on both humans and the environment.

According to the National Greenhouse Gas Inventory, Australia's civil aviation contributed a total of 17.7 million tonnes of CO_2-e in 2011, of which 60 per cent was attributed to international aircraft and the remainder to domestic aircraft. This contribution equals approximately 3.1 per cent of Australia's total emissions in that year (DIRD 2014).

12.7.1 Construction emission estimates

Greenhouse gas emissions generated during construction of the Stage 1 development are presented in Table 12–39. The two main sources of greenhouse gas emissions would be the operation of construction equipment and vegetation clearing. A conservative approach was applied when calculating the emissions. For example, it was assumed that the equipment used during construction of the aviation infrastructure would use as much fuel as the equipment used during the bulk earthworks. It was also assumed that construction equipment would be used for six working days a week. Public holidays and bad weather were also factored into the calculations. In addition, it was assumed that 50 per cent of the vegetation cleared was carbon and that 3.67 tonnes of CO_2-e is generated per tonne of carbon cleared (AGO 1999, 2000, 2002 and 2003).

Table 12–39 Summary of greenhouse gas emissions during construction

Scope	Source	Fuel type	Quantity	Emissions (t CO_2-e)
1	Equipment	Transport diesel oil	162 ML	286,111
1	Vegetation clearing	N/A	73.5 kt	134,873
				420,983

12.7.2 Operations emission estimates

Greenhouse gas emissions forecast to be generated during operation of the proposed Stage 1 development are presented in Table 12–40. As shown in Table 12–40, electricity consumption would account for the vast majority of greenhouse gas emissions (approximately 83 per cent). Electricity is a Scope 2 emission. Scope 1 emissions would account for the remaining 17 per cent of greenhouse gas emissions from the airport site. Greenhouse gas emissions from auxiliary power units would be the biggest contributor to Scope 1 emissions.

Table 12–40 Summary of estimated annual Scope 1 and 2 greenhouse gas emissions

Scope	Source	Fuel type	Annual quantity	Units	Annual emissions (t CO_2-e)
1	Ground support equipment	Transport diesel oil	0.85	ML	2,292
		Transport gasoline	2	ML	4,776
1	Auxiliary power unit	Stationary gasoline (jet fuel)	5	ML	10,975
1	Boilers	Stationary natural gas	1,489,809	m^3	3,005
1	Generators	Stationary diesel oil	0.04	ML	113
1	Fire training	Stationary Kerosene (jet fuel)	0.01	ML	14
1	Wastewater treatment plant	N/A	1,935	ML	1,204
1	Fugitive emissions	Transport gasoline (jet fuel)	985	ML	104
1	Fugitive emissions	Transport diesel oil	0.85	ML	0.1
1	Fugitive emissions	Transport gasoline	2	ML	0.2
2	Electricity	N/A	124,392,000	kWh	106,977
				TOTAL	129,462

Fuel Type reflects the categories in DoE (2014b)

Assumptions made within the greenhouse gas calculations are provided within Appendix F1 (Volume 4).

As an emissions factor was not available for jet fuel, emissions have been assumed to be the same as Avgas.

As mentioned in Section 12.2.2, it is not commonplace to report Scope 3 emissions due to the potential of double counting greenhouse gas emissions. Nevertheless, as they are considered significant for the proposed airport, the most probable primary contributor (combustion of aircraft fuel) has been quantified in Table 12–41. As shown, the combustion of aircraft fuel would generate about 2.5 Mt CO_2-e per annum. It must be noted that this assessment accounts for the greenhouse gas emissions being emitted during the entire flight of departing planes only. This method assumes the arriving planes' emissions are accounted for by the airport from which the planes departed. This method is common overseas and has been recommended by the Airport Cooperative Research Program (ACRP) (ACRP 2009).

Table 12–41 Summary of estimated annual Scope 3 greenhouse gas emissions

Scope	Source	Fuel type	Quantity	Emissions (t CO_2-e)
3	In flight aviation fuel	Transport gasoline (jet fuel)	986	2,524,504

Note: An emissions factor was not available for jet fuel, emissions have been assumed to be the same as Avgas.

Table 12–42 compares the Stage 1 development's estimated greenhouse gas emissions to NSW's total anthropogenic emissions in 2011–12. It shows that the annual Scope 1 and Scope 2 emissions from the Stage 1 development would be around 0.13 Mt CO_2-e, representing less than 0.1 per cent of NSW's total emissions for 2011–12.

Table 12–42 Comparison of greenhouse gas emissions

Location	Source coverage	Reference year	Emissions Mt CO_2-e
Stage 1 development	Scope 1 and 2	2030	0.13
NSW	Total	2011-12	154.7

Source: DoE (2014) and CER (2015).

Table 12–43 summarises Australia's current and forecast sectoral breakdown of greenhouse gas emissions for the 2013–14 financial year and 2029-30 financial year respectively.

As aviation is considered a part of 'transport' it can be concluded that the Stage 1 development would account for approximately 0.11 per cent of the total 'transport' greenhouse gas emissions throughout Australia around the time of operation.

Table 12–43 Australian sectoral breakdown of 2014–15 projection results to 2029–30

Sector	2013-14 Mt CO_2-e	2029-30 Mt CO_2-e
Electricity	180	224
Direct combustion	93	129
Transport	92	115
Fugitives	41	68
Industrial processes	32	39
Agriculture	82	92
Waste	13	16
Land use, land use change and forestry	14	41
Total	548	724

Source: DoE (2015)

12.8 Mitigation and management measures

Mitigation and management measures proposed to minimise the construction related impacts on local and regional air quality for the Stage 1 development are listed in Table 12–44. Measures, sub-plans and procedures to reduce greenhouse gas emissions during the operation of the proposed airport are also listed in Table 12–44. These measures would be incorporated in the Air Quality Construction Environmental Management Plan (CEMP) to be approved prior to commencement of Main Construction Works and the Operational Environmental Management Plan (OEMP), to be approved prior to commencement of operations, which are discussed further in Chapter 28 (Volume 2b).

These measures stated in Table 12–44 will build upon existing air quality management obligations, including monitoring, reporting and auditing requirements, for airports under the AEPR.

Table 12–44 Mitigation and management measures (air quality and greenhouse gases)

Issue	Mitigation/management measure	Timing
Dust management Plan	As part of the Air Quality CEMP, a dust management plan will be developed to mitigate the impacts of dust during construction. The plan will involve: • avoiding site runoff of water or mud to reduce the potential for track-out dust emissions; • only using cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays; • ensuring adequate water will be made available on the site for effective dust and particulate matter suppression and mitigation, using non-potable water where possible; • using enclosed chutes and conveyors and covered skips; • minimising drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment, and using fine water sprays on such equipment wherever appropriate; • making equipment readily available on-site to clean up spillages as soon as reasonably practicable after the event; • measures to reduce dust impacts from earthworks and other works as outlined elsewhere in this table; and • measures to reduce dust track out as outlined elsewhere in this table.	Pre-construction Construction
Dust impacts from bulk earthworks	Measures to address impacts from bulk earthworks will include: • minimise exposed areas as far as is practical; • re-vegetate earthworks and exposed areas or soil stockpiles to stabilise surfaces as soon as practicable; and • use of hessian, mulches or tackifiers to cover exposed areas as soon as possible after completion of earthworks where it is not possible to re-vegetate or cover with topsoil.	Construction
Dust impacts from other Main Construction Works	Measures to mitigate dust impacts associated with other Main Construction Works include: • avoiding scrabbling (roughening of concrete surfaces) where practicable; • storing sand and other aggregates in bunded areas and not allowing them to dry out unless required for particular processes. If they are required for particular purposes, appropriate additional control measures would need to be in place; • delivering bulk cement and other fine powder materials in enclosed tankers and storing them in silos with suitable emission control systems to prevent escape of material and overfilling during delivery; and • sealing and appropriately storing bags of any fine powder materials to prevent dust generation.	Construction

Issue	Mitigation/management measure	Timing
Dust track out	Mitigating the impacts associated with track out dust will involve: • using water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site. This may require the sweeper to be continuously in use; • avoiding dry sweeping of large areas; • sealing high use haul roads and regularly inspecting and making necessary repairs to the surface as soon as reasonably practicable; • recording all inspections of haul routes and any subsequent action in a site log book; • regularly cleaning and damping down hard surfaced haul routes with fixed or mobile sprinkler systems or mobile water bowsers; • implementing a wheel washing system (with rumble grids to dislodge accumulated dust and mud) prior to leaving the site; • providing an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and • locating site access points as far as practicable from sensitive receptors.	Construction
Vehicle and equipment emissions	A vehicle and equipment emissions plan will be developed and implemented as part of the Air Quality CEMP to mitigate the impacts associated with vehicle and equipment emissions. The plan will involve: • requiring vehicle operators to switch off engines when not in use; • avoiding the use of diesel or petrol powered generators and instead using mains electricity or battery powered equipment, where practicable; • considering appropriate vehicle speeds on sealed and unsealed roads; • developing and implementing a construction logistics plan to manage the sustainable delivery of goods and materials to the airport site; and • implementing measures to support and encourage sustainable travel for construction workers to and from the airport site, including public transport, shuttle busses, cycling, walking, and car-sharing (as also outlined in the Traffic and Access CEMP).	Construction
Dust monitoring	Additional monitoring requirements include that: • suitable locations for dust deposition, dust flux, or real-time PM_{10} continuous monitoring will be determined in consultation with the NSW Environment Protection Authority; • baseline monitoring will commence at least three months before Main Construction Works commence; • regular site inspections will be undertaken to monitor compliance with the dust management plan. Inspection results will be recorded and the inspection log made available to the Department of Infrastructure and Regional Development upon request; and • more frequent site inspections by the person accountable for air quality and dust issues will be conducted onsite when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	Pre-construction / Construction

Issue	Mitigation/management measure	Timing
Air quality OEMP	The Air Quality OEMP will include the following measures to reduce air emissions and the potential for ground level ozone formation: • using ground support equipment powered by electric, hydrogen, compressed natural gas or compressed air, including belt loaders, pushback tractors, bag tugs, and cargo loaders, where appropriate; • providing remote ground power facilities for remote aircraft parking positions, where practicable; • installing co-generation or tri-generation in-lieu of traditional gas fired boilers or solar hot water systems to replace gas fired boilers; • where possible, avoiding certain activities, such as training fires, and maintenance (spray painting) during the ozone seasons; • using underground fuel hydrant systems and/or vapour recovery systems for refuelling and fuel storage; and • promoting the use of public transport to the airport for workers, passengers and other airport users.	Operation
Greenhouse gases – Scope 1 and Scope 2 emissions	The following measures will be implemented to minimise Scope 1 and Scope 2 greenhouse gas emissions: • using ground support equipment powered by electric, hydrogen, compressed natural gas or compressed air, including belt loaders, pushback tractors, bag tugs, and cargo loaders, where appropriate; • training ground support equipment drivers in techniques to conserve fuel and implementing a no-idling policy; • considering in the detailed design process ways to minimise greenhouse gas emissions through the design of the runway, taxiways, gates and terminals to minimise aircraft and ground support equipment travel distances without limiting long term aeronautical capacity at the airport; • promoting aircraft management procedures that achieve reduced fuel use as far as practicable; • using fixed electrical ground power and preconditioned air supply to aircraft and avoiding the use of auxiliary power units by stationary aircraft where possible; • using high efficiency power, heating and cooling plants on the airport site; and • making use of renewable energy sources where practicable for the generation, use or purchase of electricity, heating and cooling.	Operation
Greenhouse gases – Scope 3 emissions	The following measures will be implemented to minimise Scope 3 greenhouse gas emissions: • promoting the use of public transport to the airport for workers, passengers and other airport users; • developing the waste and resource OEMP in accordance with Table 28-28 (Volume 2b), to implement waste saving initiatives such as composting and recycling; and • installing tenant energy sub-metering systems.	Operation
Air quality monitoring	The ALC is required to monitor air pollution under the AEPR. An air quality monitoring station will be installed at the airport site to monitor NO_X, NO, NO_2, CO, O_3, PM_{10}, $PM_{2.5}$ and VOCs and record ambient air quality data prior to operations commencing to establish baseline air quality conditions.	Pre-operation / Operation

12.9 Conclusion

Construction of the proposed Stage 1 development would generate dust emissions during both the bulk earthworks and the construction of aviation infrastructure. The asphalt batching plant would also generate some odour during construction. The results of the air dispersion modelling show that the dust impacts during construction are expected to be below the air quality assessment criteria at all sensitive residential receptors. Odour from the asphalt plant would also be below the relevant criteria at all sensitive residential receptors and largely contained within the airport site. Some odour may be detected outside of the airport boundary to the north, however, this area is currently unoccupied and, as such, it is not expected to impact on sensitive receptors.

Operation of the proposed Stage 1 development would result in an increase in emissions of nitrogen dioxide, particulate matter, carbon monoxide, sulfur dioxide and air toxics. There would also be odour emissions from exhaust and from the onsite wastewater treatment plant. The highest offsite concentrations of the air quality metrics evaluated were generally predicted to occur at the receptors located to the north and north-east of the proposed airport. This is anticipated to be a function of the prevalence of south-westerly winds and the proximity of these receptors to activities at the proposed airport.

Background traffic, associated with the broader urban development of Western Sydney, on surrounding road infrastructure was found to be a significant contributor to predicted offsite ground level concentrations, particularly for those receptors located close to proposed roadways.

The dispersion modelling found that there were almost no predicted exceedances of the air quality assessment criteria at any of the sensitive residential receptors investigated as part of the assessment of the Stage 1 development. Predicted $PM_{2.5}$ would exceed a future NEPM-AAQ objective for 2025 at a number of sensitive receptors, however this is primarily attributable to background concentrations. The modelling also predicted an exceedance of the 99.9th percentile one-hour maximum for formaldehyde shown at one receptor on the airport site. Predicted offsite odour concentrations were below odour detection limits for both aircraft exhaust emissions and odours from the onsite wastewater treatment plant.

The maximum predicted one-hour ozone concentration remained unchanged following the implementation of the airport and four-hour ozone concentrations increased by a maximum of 0.1 parts per billion. Both predicted base case and the Stage 1 development were generally above the NEPM criteria. The average change in daily maximum four-hour ozone was 0.9 parts per billion, which is below the maximum allowable increment of one part per billion.

Scope 1 and Scope 2 greenhouse gas emissions from the Stage 1 development have been estimated to comprise 0.13 Mt CO_2-e/annum, with the majority of emissions associated with purchased electricity. The Scope 1 and Scope 2 greenhouse gas emissions estimated for the proposed Stage 1 development represent approximately 0.11 per cent of Australia’s projected transport-related greenhouse gas emission inventory in the 2029-2030 financial year. While not typically included in greenhouse gas inventories due to potential for double counting, Scope 3 emissions from burning of fuel in aircraft using the proposed airport were also quantified at around 2.5 Mt CO_2-e/annum.

Mitigation and management measures would be implemented to reduce potential air quality impacts during both construction and operation of the proposed Stage 1 development. In particular, a dust management plan would be developed and implemented to address potential impacts from dust generated during construction. Air quality monitoring would also be undertaken at the airport site during operations. These measures will build upon existing air quality management obligations, including monitoring, reporting and auditing requirements, for airports under the AEPR.