AIR QUALITY ASSESSMENT

161-179 PRINCES HIGHWAY, ARNCLIFFE

Arncliffe Eden Property Pty Ltd

30 June 2021

Job Number 21011226

Prepared by

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Air Quality Assessment
161-179 Princes Highway, Arncliffe

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Arncliffe Eden Property Pty Ltd. The report presents an assessment of potential air quality impacts associated with the proposed mixed-use development at Arncliffe, New South Wales (NSW) (hereafter referred to as the Project).

1.1 Project setting

This air quality assessment is submitted to the Department of Planning, Industry and Environment (DPIE) in support of a State Significant Development Application (SSDA-11429726) for the development of land identified at 26-42 Eden Street and 161-179 Princes Highway, Arncliffe (the site) for the purposes of a mixed-use precinct with open space, retail, and residential uses, comprising social and market housing as part of the NSW Land and Housing Corporation (LAHC)'s 'Communities Plus' program.

SSDA-11429726 seeks approval for the following development:

- Demolition of all existing buildings and structures on the site;
- Site preparation works, excavation and tree removal;
- The construction of a mixed-use development comprising:
    - 744 apartments across (4) buildings between 19-23 storeys in height as follows:
        - 186 market housing apartments in Building A;
        - 202 market housing apartments in Building B;
        - 180 social housing apartments in Building C; and
        - 176 market housing apartments in Building D;
    - *3*,113m^2 retail gross floor area;
    - 240m^2 for a future childcare centre;
    - 3,706m^2 of communal open space;
    - 813 spaces of lower ground and basement car parking; and
- 4,870m^2 of publicly accessible open space including a 4,000m^2 park, an 870m^2 public plaza (meeting space), and through site link connecting Eden Street and the Princes Highway.

In accordance with section 4.39 of the Environmental Planning & Assessment Act 1979 (EP&A Act), the Secretary's Environmental Assessment Requirements (SEARs) for SSDA-11429726 were issued on 18 December, 2020. This report has been prepared to respond to the following SEARs requirements:

23. Air Quality

The EIS must include an air quality assessment of onsite and offsite air quality impacts, including odours, in accordance with the relevant EPA guidelines. The assessment must detail construction and operational air quality impacts both onsite and on nearby sensitive receivers and outline the proposed management and mitigation measures that would be implemented.

The existing site is used for residential purposes, with 3 storey residential buildings. The site is surrounded predominantly by residential uses, with isolated light industrial uses along the Princes Highway. The majority of the built form surrounding the Project is 1 to 2 storeys, with isolated areas of redevelopment at 10 storeys, located along the Princes Highway. The Arncliffe train station is located approximately 100m northwest of the Project. The Arncliffe Ventilation Facility which includes ventilation outlets for the New M5 and F6 Extension tunnel projects is located approximately 570m to the east of the Project.

Figure 1-1 presents the Project location and the nearby roadways and rail corridor. **Figure 1-2** presents the wider context of the Project location, indicating the locations of the Arncliffe Ventilation Facility outlets.

Figure 1-3 to **Figure 1-5** present indicative Project layouts for the lower ground, upper ground and levels 13 to 15 respectively. The Upper Ground Plan includes indicative uses only which have not been specifically assessed in this assessment. The proposed child care centre would be subject a separate approval and assessment process once the layout is finalised.

Figure 1-1: Location of Project and nearby roadways

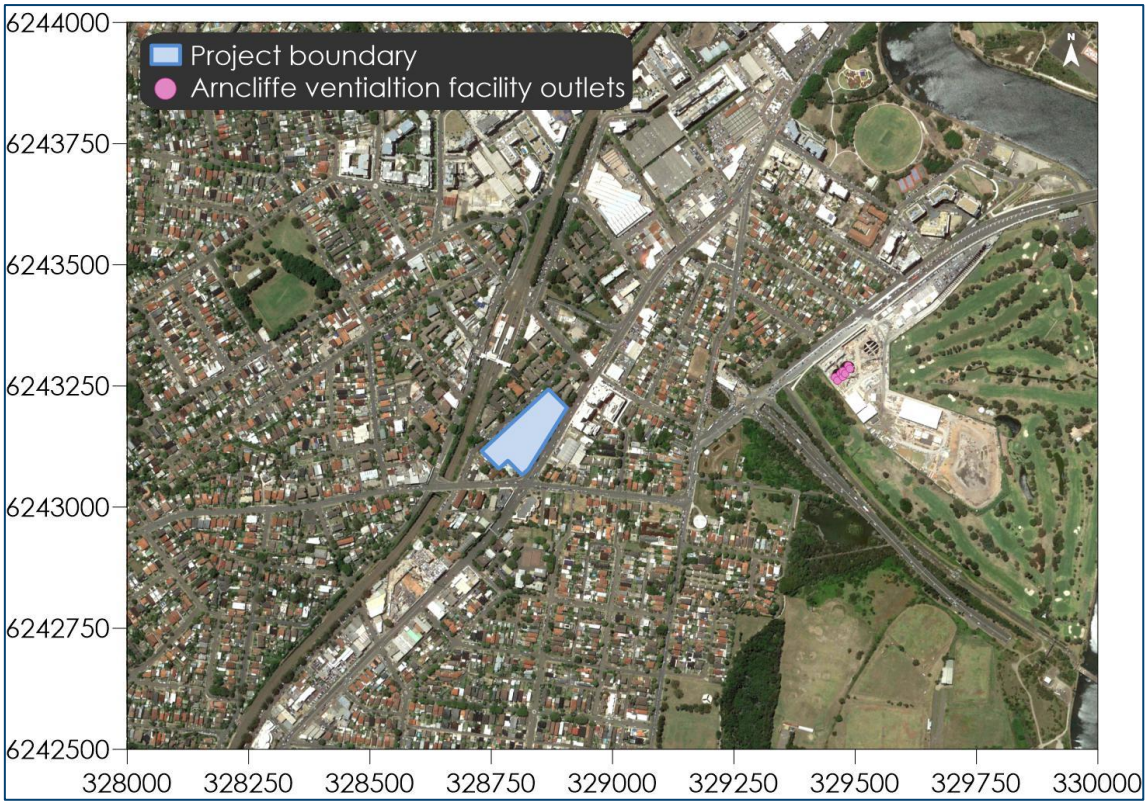

Figure 1-2: Location of Project and the Arncliffe Ventilation Facility

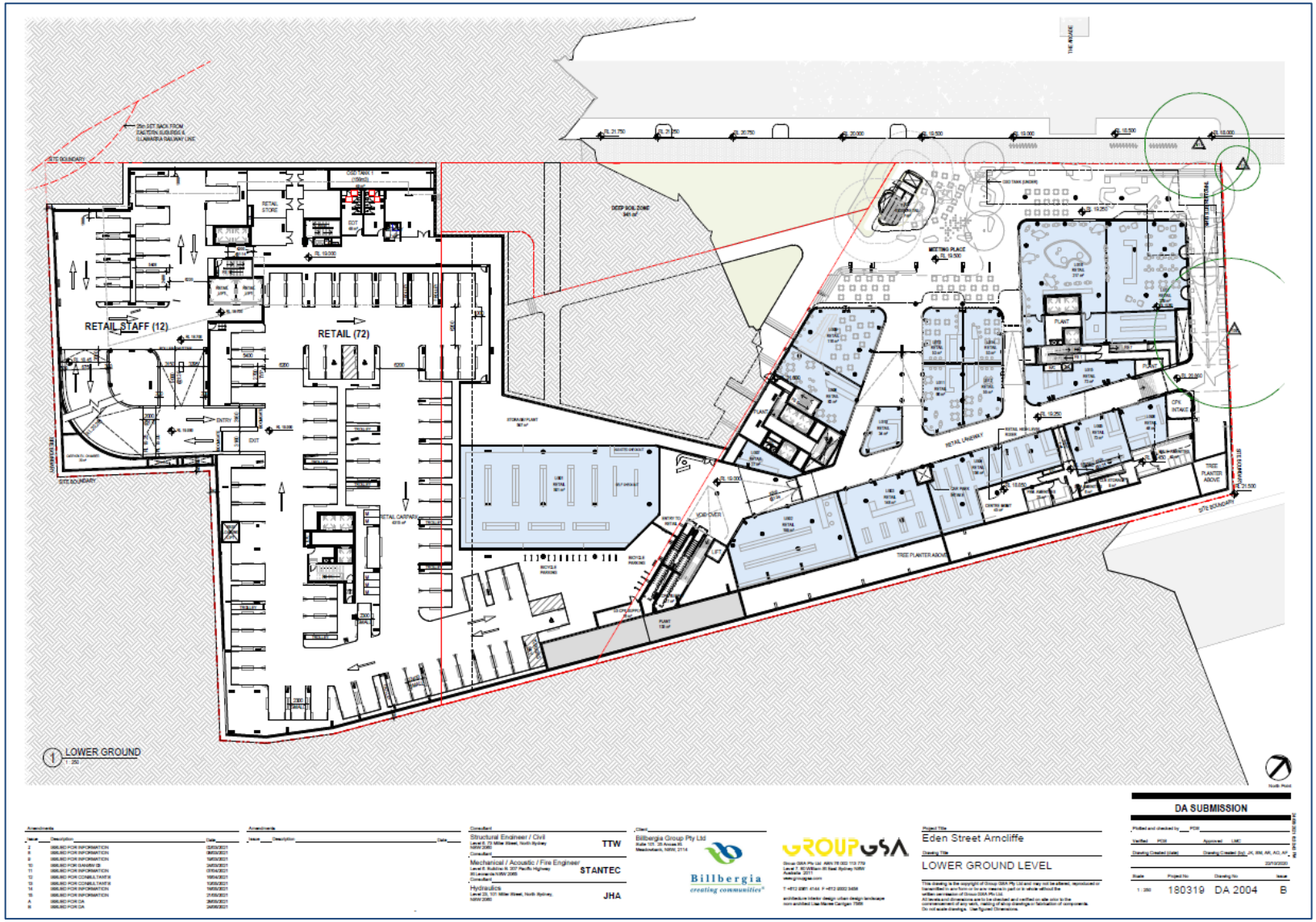

Figure 1-3: Indicative Project layout – Lower Ground Level

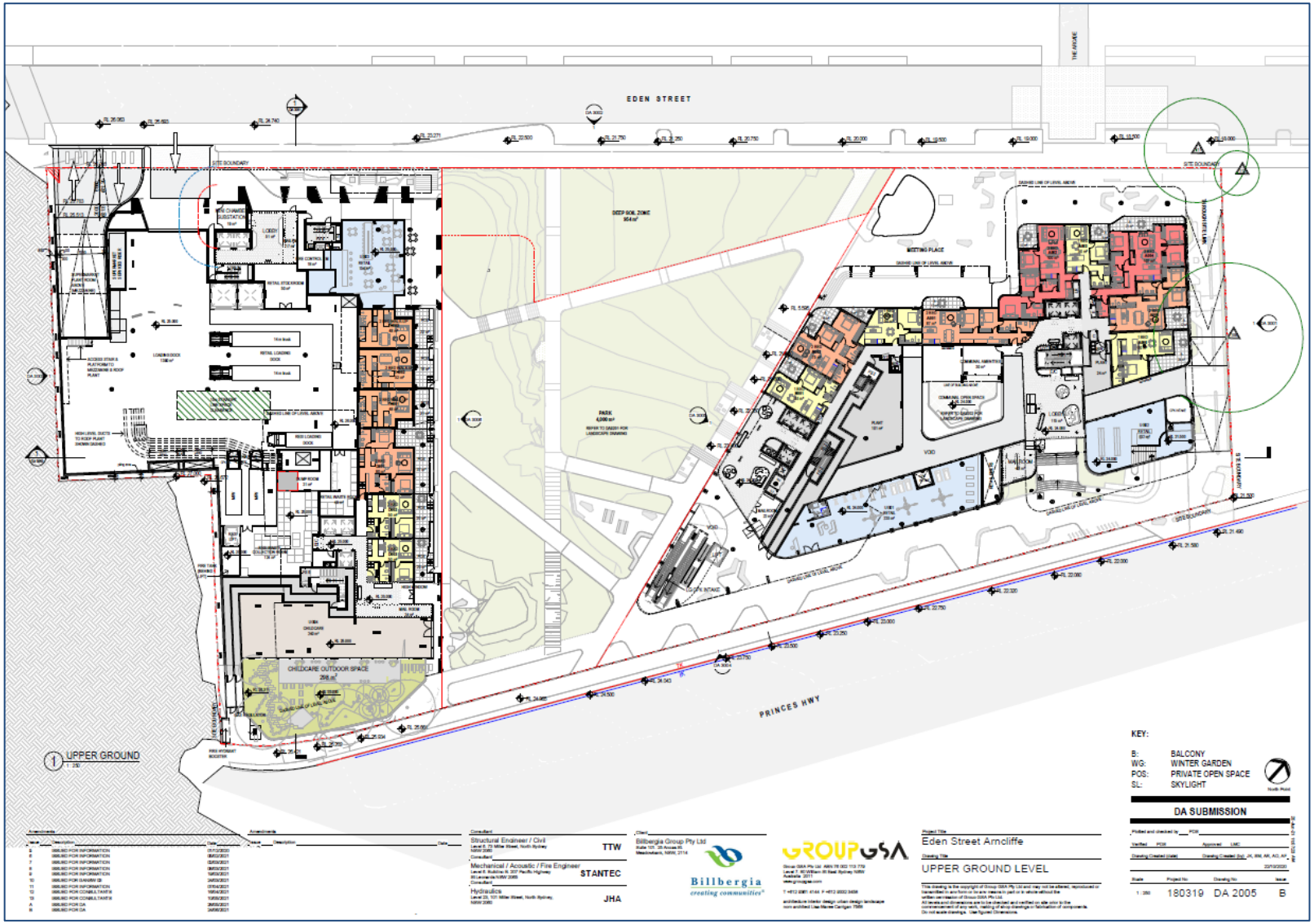

Figure 1-4: Indicative Project layout – Upper Ground Level

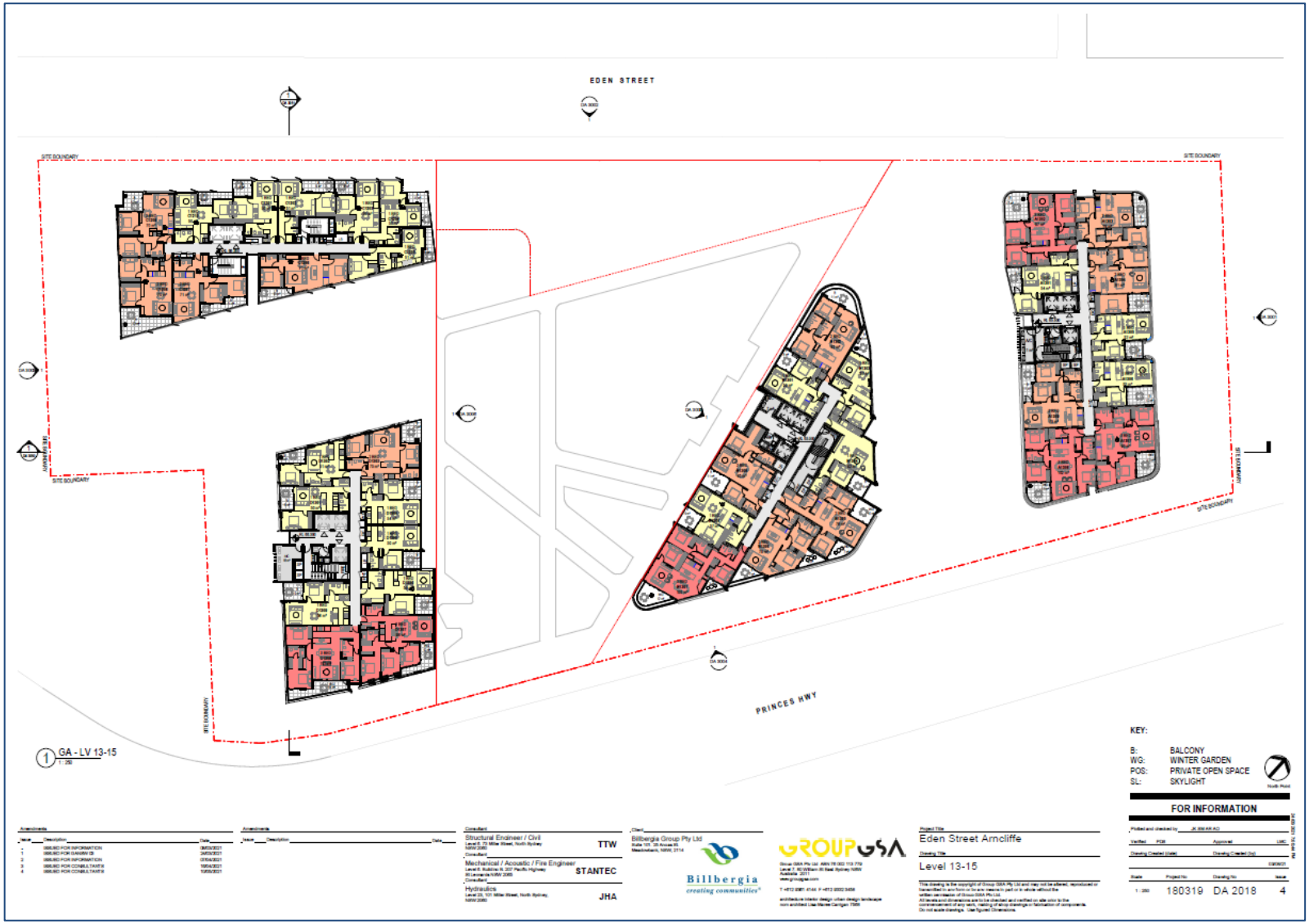

Figure 1-5: Indicative Project layout – Levels 13 to 15

2 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The criteria are set to protect the most sensitive persons in the community.

Table 2-1 summarises the key air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**). $PM_{2.5}$ and NO_2 are considered to be the critical pollutants with regard to potential impacts from traffic emissions.

Table 2-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging period	Criteria	Impact
$PM_{2.5}$	24 hour	25 µg/m^3	Cumulative
	Annual	8 µg/m^3	Cumulative
NO_2	1 hour	246 µg/m^3	Cumulative
	Annual	62 µg/m^3	Cumulative

In line with recent major road projects such as the Western Harbour Tunnel (**RMS, 2020**), where the background levels are above or near to the 8µg/m^3 annual $PM_{2.5}$ criterion, a change in annual average $PM_{2.5}$ of 1.7µg/m^3 has been considered an acceptable health risk based on the increase of risk in all-cause mortality for ages 30 and over.

Conservatively, for this assessment, an incremental annual average $PM_{2.5}$ criterion of 1.7µg/m^3 has been adopted to evaluate the total impact from potential future road traffic at the proposed development, rather than the change in levels that residences at the Project site (whether existing or proposed) would experience due to potential future increases in traffic volumes.

3 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

3.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station Sydney Airport AMO (Site No. 066037) were analysed to characterise the local climate in the proximity of the Project. The weather station at Sydney Airport AMO is located approximately 2.5km southeast of the Project.

Table 3-1 and **Figure 3-1** present a summary of data from the Sydney Airport AMO collected over an approximate 60 to 91-year period for the various meteorological parameters.

The data indicate that on average January is the hottest month with a mean maximum temperature of 26.7ºC and July is the coldest month with a mean minimum temperature of 7.3ºC.

Rainfall peaks during the first half of the year and declines the latter half of the year, with an annual average rainfall of 1079.1 mm over 95.7 days. The data show June is the wettest month with an average rainfall of 124.8 mm over 8.9 days and September is the driest month with an average rainfall of 59.7 mm over 6.8 days.

Humidity levels exhibit little variability over the day and season. Mean 9am humidity levels range from 61% in October to 74% in June. Mean 3pm humidity levels vary from 49% in August to 63% in February.

As expected, wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. The mean 9am wind speeds range from 12.6km/h in May to 16.3km/h in October. The mean 3pm wind speeds vary from 17.1km/h in May to 25.3km/h in November.

Table 3-1: Monthly climate statistics summary – Sydney Airport AMO

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (ºC)	26.7	26.5	25.4	23.0	20.2	17.7	17.2	18.4	20.7	22.7	24.2	25.9	22.4
Mean min. temp. (ºC)	19.0	19.1	17.6	14.3	11.0	8.8	7.3	8.2	10.6	13.4	15.6	17.6	13.5
Rainfall													
Rainfall (mm)	93.8	114.2	118.1	106.0	95.3	124.8	69.2	75.6	59.7	70.1	79.5	72.8	1079.1
No. of rain days (≥1mm)	8.1	8.6	9.5	8.4	8.3	8.9	6.6	6.7	6.8	7.8	8.3	7.7	95.7
9am conditions													
Mean temp. (ºC)	22.4	22.3	21.1	18.2	14.6	11.9	10.8	12.5	15.7	18.4	19.9	21.6	17.4
Mean R.H. (%)	70	73	73	71	73	74	71	65	62	61	64	66	69
Mean W.S. (km/h)	14.4	13.8	12.9	12.9	12.6	13.4	13.3	14.4	15.5	16.3	16.0	14.8	14.2
3pm conditions													
Mean temp. (ºC)	24.8	24.8	23.9	21.7	19.0	16.6	16.1	17.2	19.0	20.7	22.1	23.9	20.8
Mean R.H. (%)	60	63	61	59	58	57	52	49	51	54	56	58	57
Mean W.S. (km/h)	24.1	23.0	21.0	19.3	17.1	17.8	18.2	20.8	23.1	24.6	25.3	25.2	21.6

Source: **BoM, 2021**

°C = degrees Celsius mm = millimetres % = percent km/h = kilometres per hour

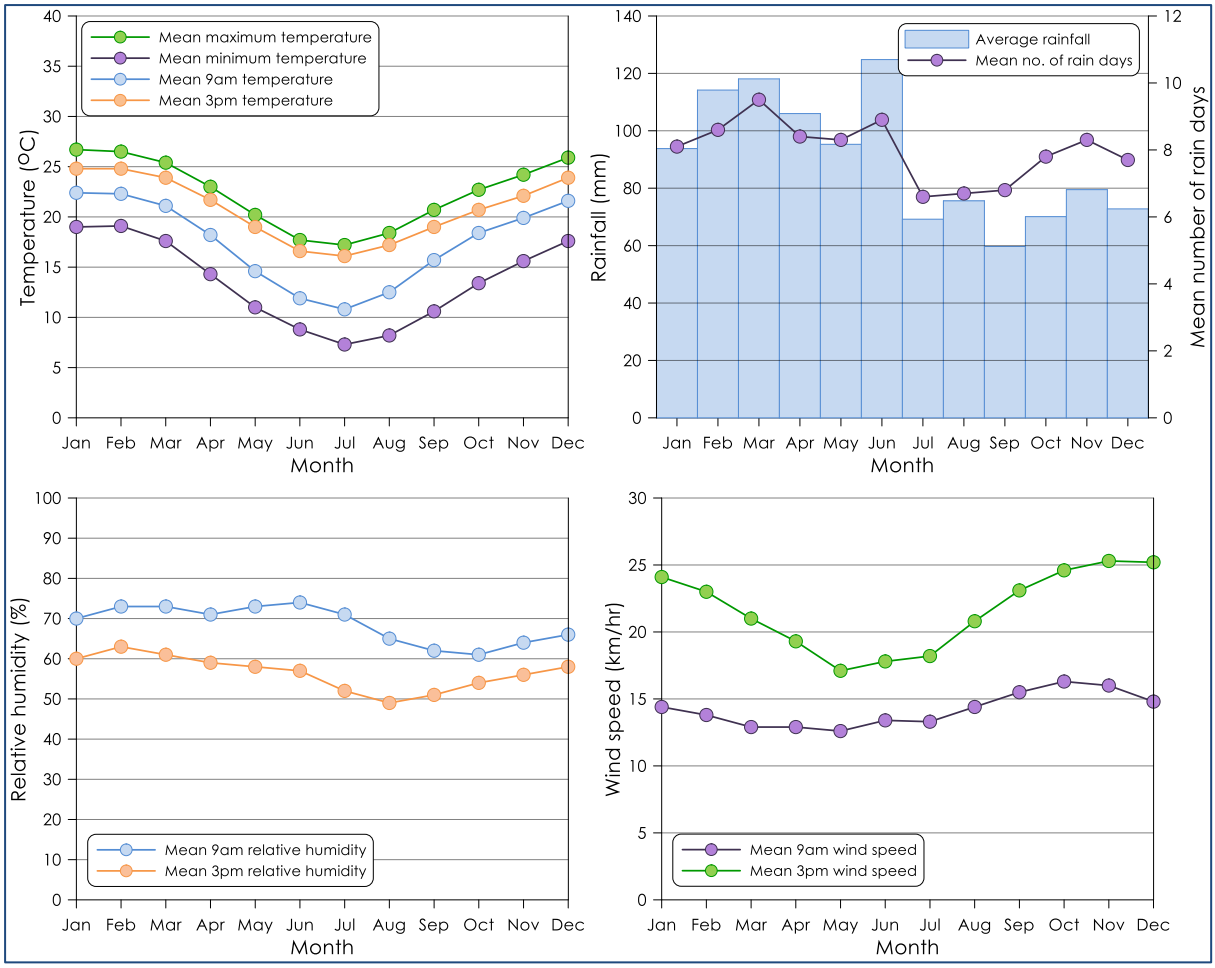

Figure 3-1: Monthly climate statistics summary – Sydney Airport AMO

3.2 Local meteorological conditions

Annual and seasonal windroses for the Sydney Airport AMO weather station during the 2015 calendar period are presented in **Figure 3-2**.

The 2015 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of long-term data trends in meteorological data recorded for the area as outlined in **Appendix A**.

Strong winds are generally experienced in the area due to its proximity to the coast. Winds from the northwest quadrant are typically weaker than winds from other directions. On an annual basis, the winds are varied with the highest portion originating from the northwest.

In summer, winds are typically from the northeast and southeast quadrants, with dominant winds from the northeast and south. The autumn distribution is similar to the annual distribution with a lower portion of northeast winds. During winter, winds are typically from the northwest quadrant, with winds from the northwest most frequent. Spring has similar distribution to the annual distribution.

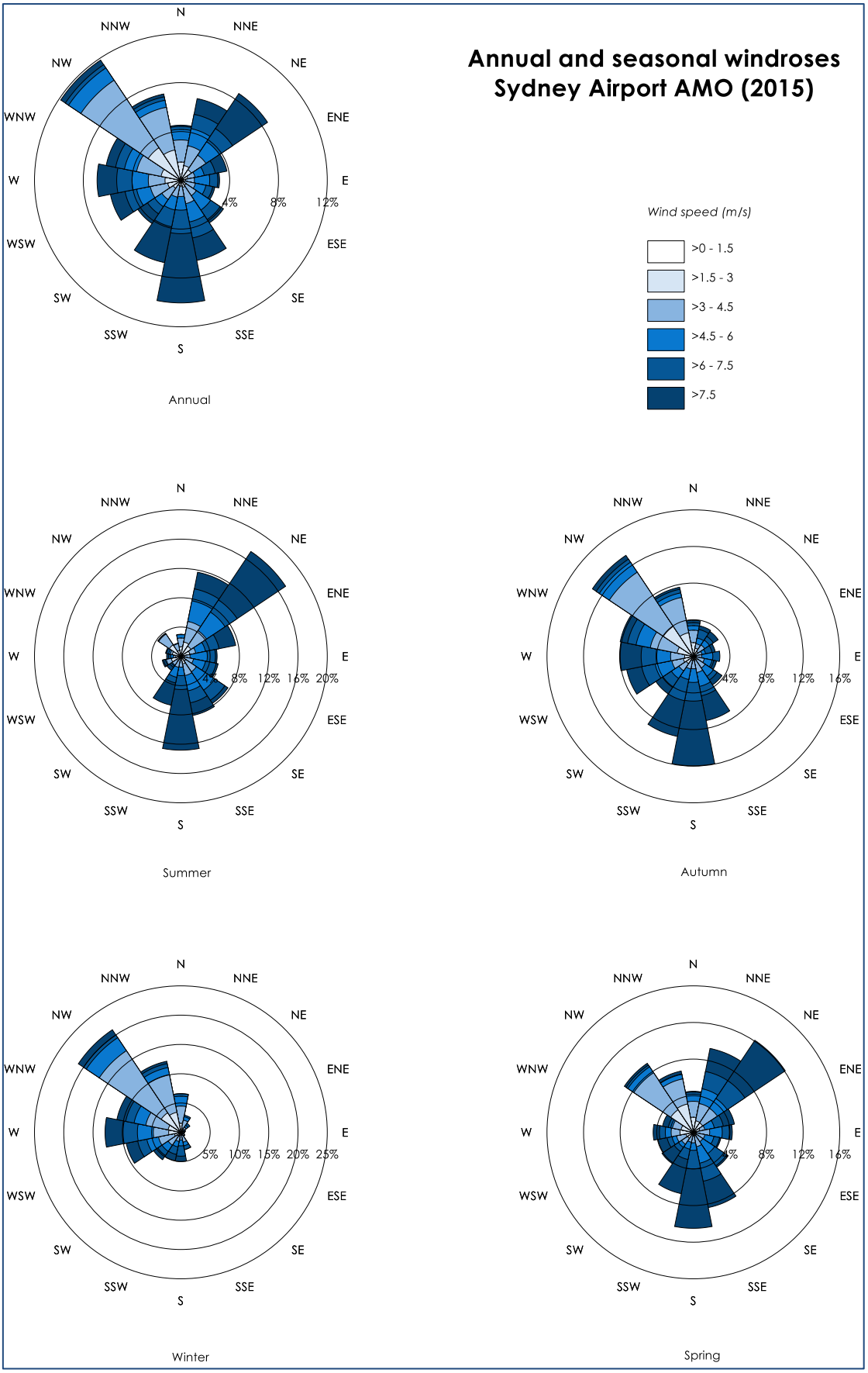

Figure 3-2 : Annual and seasonal windroses – Sydney Airport AMO

3.3 Local air quality monitoring

Data from the nearest air quality monitor operated by the NSW Department of Planning, Industry and Environment (DPIE) at Earlwood, located approximately 2.5km to the north-northwest from the Project, were used to quantify the existing background level for assessed pollutants at the Project site.

It is noted that there are siting issues at the Earlwood monitoring station due to trees within 20 metres (m) of the station however there does not appear to be any other DPIE monitoring stations in the vicinity of the Project without siting issues which recorded $PM_{2.5}$ in 2015.

3.3.1 $PM_{2.5}$ monitoring

A summary of the available $PM_{2.5}$ data for the Earlwood monitoring station is presented in **Table 3-2**. The data indicate that the annual average $PM_{2.5}$ levels are generally above or close to the relevant criterion of 8µg/m^3 for the period reviewed. The annual average $PM_{2.5}$ level in 2015 which corresponds to the modelling year was 8.5µg/m^3. As such, the incremental criterion as described in **Section 2**, has been adopted.

The maximum 24-hour average $PM_{2.5}$ concentrations were found to exceed the relevant criterion of 25µg/m^3 for all years in the review period.

Figure 3-3 presents the 24-hour average $PM_{2.5}$ data recorded at the Earlwood monitoring station for the review period. There was a significant increase in the frequency of elevated levels of the 24-hour average $PM_{2.5}$ criterion in 2019 and 2020, predominantly due to smoke associated with the 2019/2020 bushfires.

The 70th percentile of the measured levels of 10.0µg/m^3 for the 2015 period was adopted to represent the background level in line with the State Environment Protection Policy (Air Quality Management) guidance (**Victorian Government, 2001**).

Table 3-2: Summary of $PM_{2.5}$ levels from Earlwood (µg/m^3)

Year	Annual average	Maximum 24-hour average	Number days at or above 24-hour average criterion (25µg/m^3)	70th percentile 24-hour
2015	8.5	28.0	2	10.0
2016	8.1	33.3	5	9.4
2017	7.3	50.9	2	8.4
2018	7.8	28.5	1	9.2
2019	-	86.2	22	10.5
2020	8.0	85.1	9	8.3

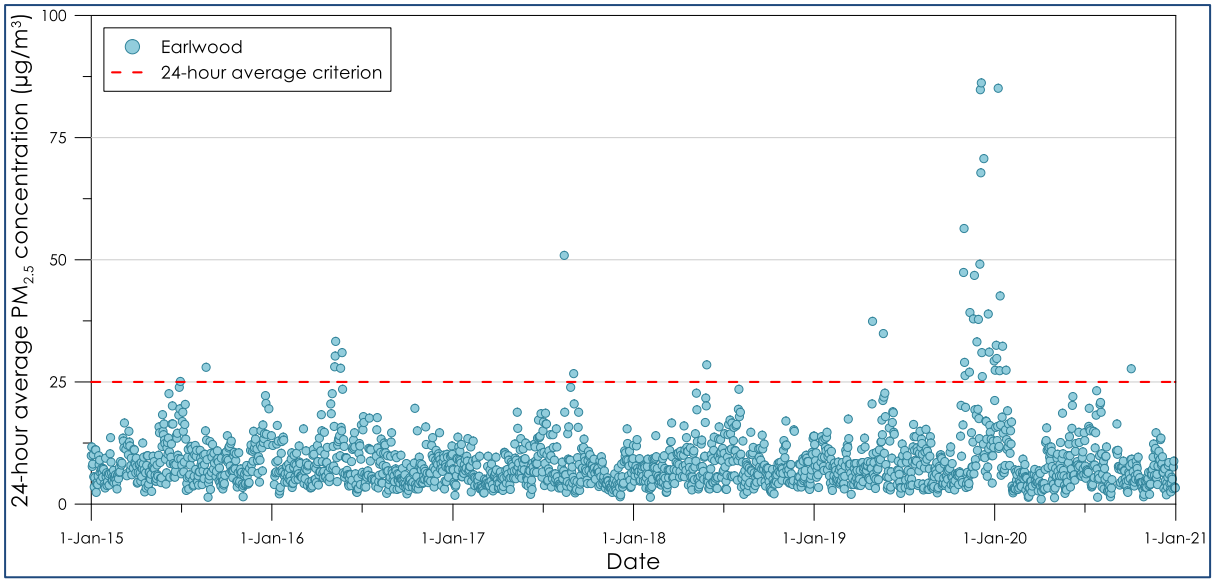

Figure 3-3: 24-hour average $PM_{2.5}$ concentrations at Earlwood

3.3.2 NO_2 monitoring

A summary of the available NO_2 data for the Earlwood monitoring station from 2015 to 2020 is presented in **Table 3-3**. The data indicate that the annual average and 1-hour average NO_2 levels are below the relevant criterion for the period reviewed.

Figure 3-4 presents the maximum daily 1-hour average NO_2 data recorded at the Earlwood monitoring station for the review period. The data show a seasonal trend of higher levels during the winter months and lower levels during the summer months.

Consistent with the meteorological data, the 2015 monitoring data were applied to represent background concentrations at the Project. The annual average of 16.4µg/m^3 and the maximum 1-hour average of 108.7µg/m^3 in 2015 at Earlwood have been adopted as the background NO_2 levels for this assessment.

Table 3-3: Summary of NO_2 levels from Earlwood (µg/m³)

Year	Annual average (criterion 62µg/m³)	Maximum 1-hour average (criterion 246µg/m³)
2015	16.4	108.7
2016	-	88.2
2017	22.6	137.4
2018	20.5	102.5
2019	20.5	125.1
2020	18.5	82.0

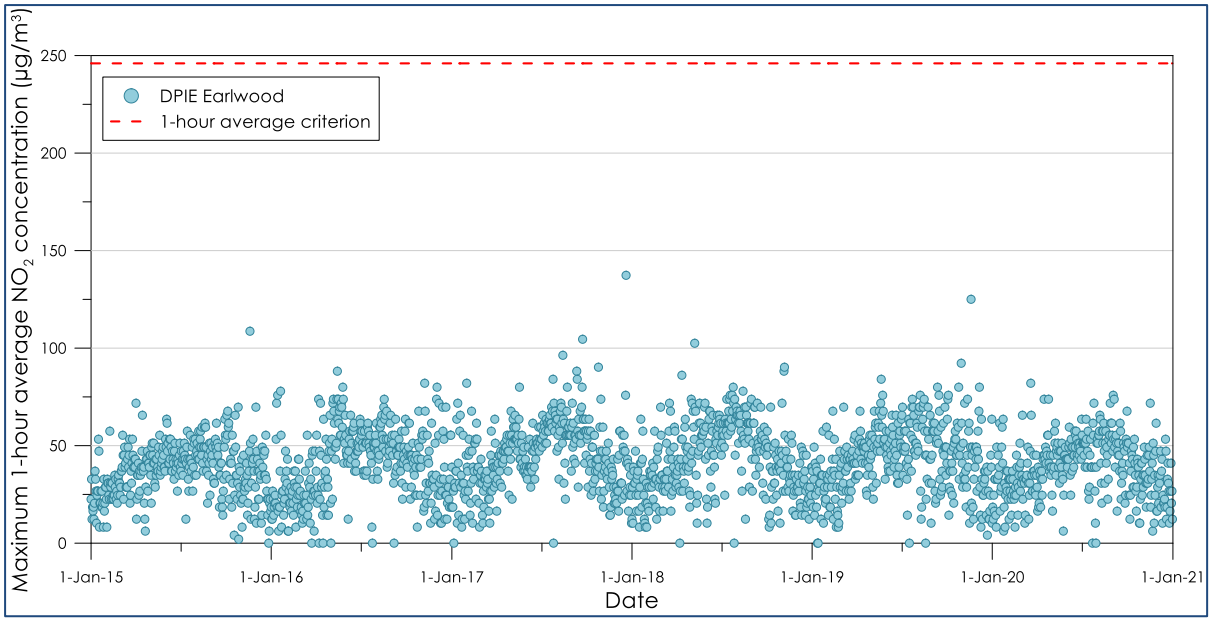

Figure 3-4: Maximum daily 1-hour average NO_2 concentrations at Earlwood

4 AIR EMISSION SOURCES

The focus of this report is to consider the potential for air quality impacts to occur from the construction of the Project on the surrounding environment and the potential for other sources of air pollution to adversely impact upon the Project. The main sources of potential air emissions in the local area which can adversely affect the Project site are identified to arise from road traffic, the rail line and the Arncliffe Ventilation Facility.

4.1 Project construction

The Project construction period is anticipated to occur over an approximate five-year period. In general, the earthworks phase of construction has the greatest potential for dust generation while significant dust impacts are not anticipated to occur from the later stages of construction. Potential dust emissions from the earthworks phase will be primarily generated due to windblown dust generated from exposed areas, material handling, vehicle movements.

The potential particulate impacts due to these activities are difficult to accurately quantify on any given day due to the short sporadic periods of dust generating activity which may occur over the construction time frame.

The total amount of dust generated from the construction process is unlikely to be significant given the nature of the activities. Given that the earthwork activities would occur for a limited period, no significant or prolonged effect at any off-site receiver is predicted to arise.

To ensure dust generation is controlled during the construction activities and the potential for off-site impacts is reduced, appropriate (operational and physical) mitigation measures will be implemented as necessary. Suggested dust mitigation measures to apply during construction are outlined in **Table 4-1**.

Table 4-1: Suggested construction dust mitigation measures

Source	Mitigation measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of visible dust cannot be maintained)
	Engines of on-site vehicles and plant to be switched off when not in use
	Vehicles and plant are to be fitted with pollution reduction devices where practicable
	Vehicles are to be maintained and serviced according to manufacturer's specifications
	Visual monitoring of construction activities is to be undertaken to identify dust generation
Exposed areas	The extent of exposed surfaces and stockpiles is to be kept to a minimum
	Exposed areas and stockpiles are either to be covered or are to be dampened with water as far as is practicable if dust emissions are visible
	Re-instate hardstand/concrete capping as soon as possible after completion of construction activities.
Material handling	Drop heights from loading and handling equipment are to be reduced as much as practical
Hauling material/ vehicle movements	Concrete hardstand on-site and entry / exit points on Anderson and Baker Street to be swept/cleaned regularly as required etc.
	Construction vehicle traffic is to be restricted to designated routes (same routes as operational heavy vehicles)
	Construction speed limits are to be enforced
	Vehicle loads are to be covered when travelling off-site

4.2 Roadways

The Project is located on the Princes Highway which is a classified state road and has an average daily traffic volume of approximately 40,000 vehicles/day along the road segment adjacent to the Project (**RMS, 2021**).

Emissions from vehicles can impact local air quality. The key pollutants with regard to vehicles are considered to be $PM_{2.5}$ and NO_2. In general, pollutant concentrations decrease exponentially with increasing distance from the road.

$PM_{2.5}$ and NO_2 emissions from traffic along the Princes Highway and other local roads have been modelled to determine the potential air quality impacts at the Project. **Section 5** outlines the dispersion modelling approach and **Section 6** presents the air dispersion modelling results.

4.3 Rail line

The Project is located in the vicinity of the Illawarra rail line with the Arncliffe train station approximately 100m northwest of the Project.

The rail line is used for passenger transport services and is also a rail freight route in NSW. Emissions from diesel trains can impact local air quality. The majority of trains passing by the Project would be electric passenger trains with infrequent diesel freight trains passing though (approximately 2.5 trains per hour).

It is expected that with the transient nature of the diesel freight trains generating only minor amounts of air emissions, the spatial displacement would allow for sufficient dilution as to not result in tangible impact at the Project site and has not been assessed further in this study.

4.4 Arncliffe Ventilation Facility

The Arncliffe Ventilation Facility which includes ventilation outlets for the New M5 and F6 Extension tunnel projects is located approximately 570m to the east of the Project. Ventilation outlets are used to manage air quality for road tunnel projects.

Air impacts in the vicinity of the Project from the Arncliffe Ventilation Facility and associated surface road network were modelled in the F6 Extension Air Quality Technical Report (**RMS, 2018a**). **Figure 4-1** to **Figure 4-4** present the contour plots for 1-hour average NO_2, annual average NO_2, 24-hour average $PM_{2.5}$ and annual average $PM_{2.5}$ for the 2036-DS scenario (the do something scenario i.e. with the F6 extension project in the 2036 year) respectively from the Air Quality Technical Report.

The figures indicate that 1-hour and annual NO_2 levels experienced at the site from the F6 extension project would be below the relevant criteria, however the maximum 24-hour and annual average $PM_{2.5}$ levels would exceed the criteria. As noted in **Section 3.3.1**, the background 24-hour average $PM_{2.5}$ levels in the vicinity of the Project exceed the 25µg/m^3 criterion on occasion and the annual $PM_{2.5}$ levels in the vicinity of the Project are generally above the cumulative 8µg/m^3 criterion.

Figure 4-5 presents the change in annual average $PM_{2.5}$ which is calculated as the 2036-DS scenario with the F6 extension project minus the 2036-DM scenario which is the future scenario without the F6 extension project. The data indicate that the F6 extension project is anticipated to lead to a reduction in the annual average $PM_{2.5}$ levels experienced in the vicinity of the Project.

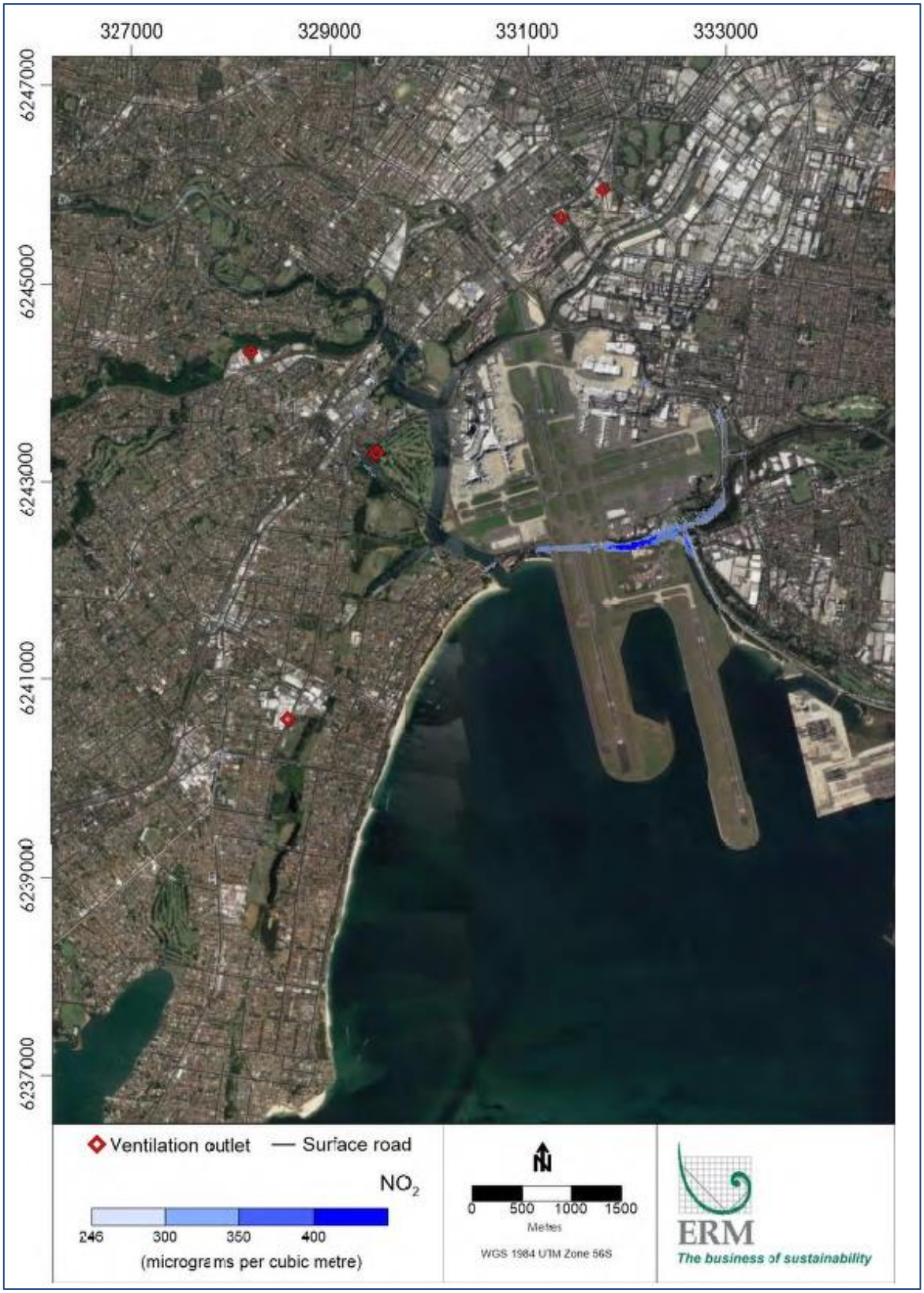

Figure 4-1 : F6 Extension Project maximum 1-hour average NO_2 contour plot for the 2036-DS scenario

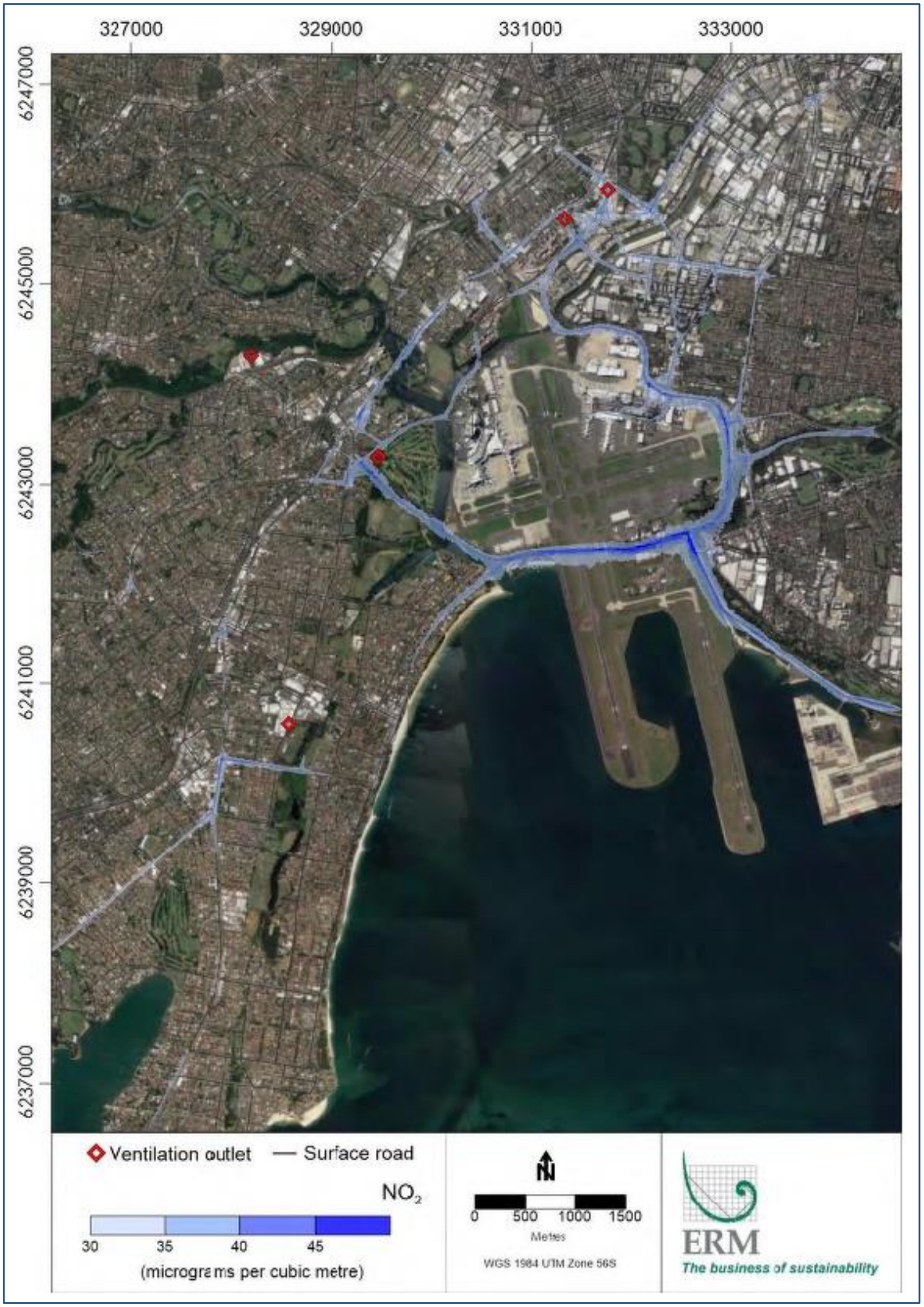

Figure 4-2 : F6 Extension Project annual average NO_2 contour plot for the 2036-DS scenario

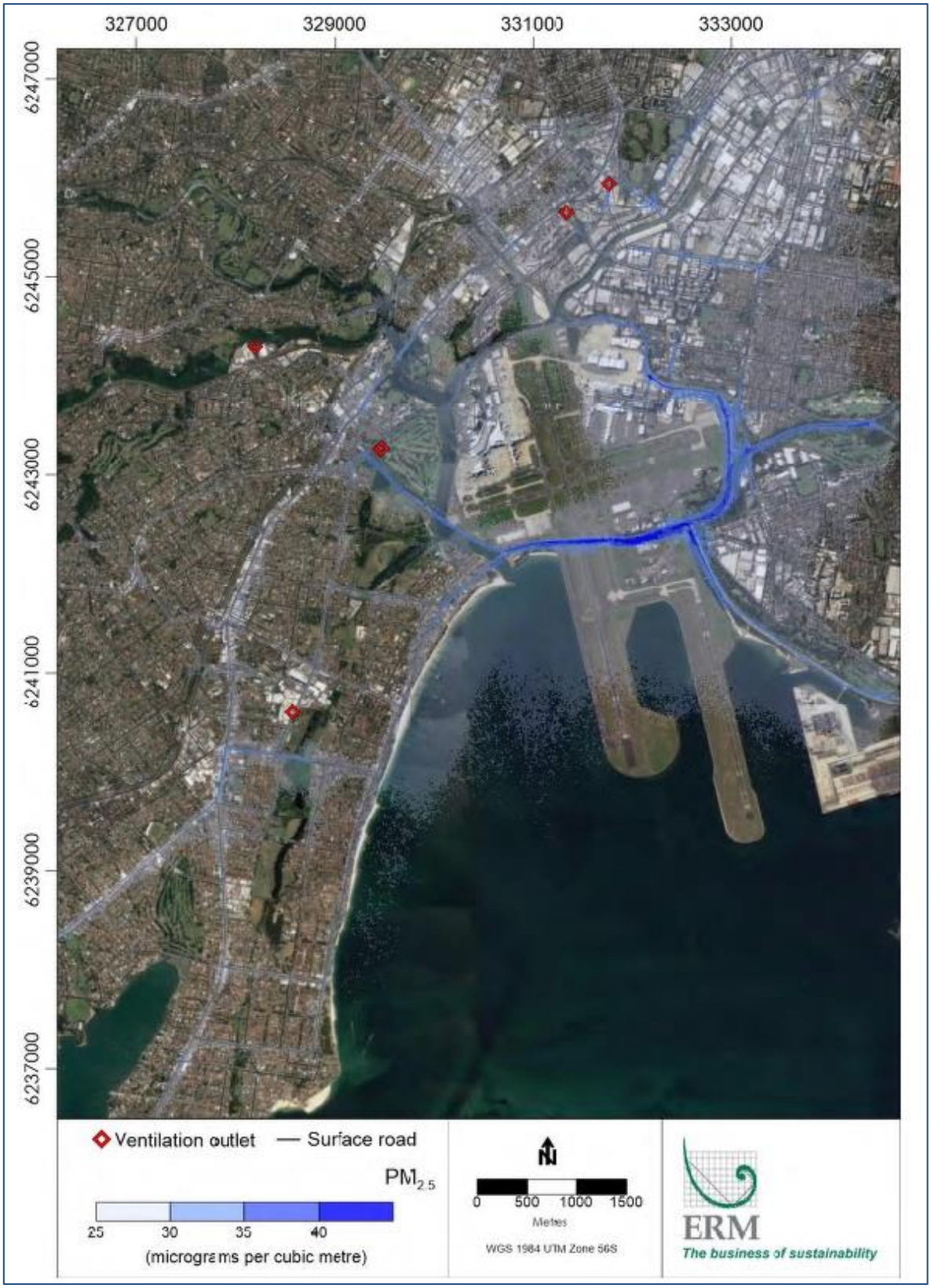

Figure 4-3 : F6 Extension Project maximum 24-hour average $PM_{2.5}$ contour plot for the 2036-DS scenario

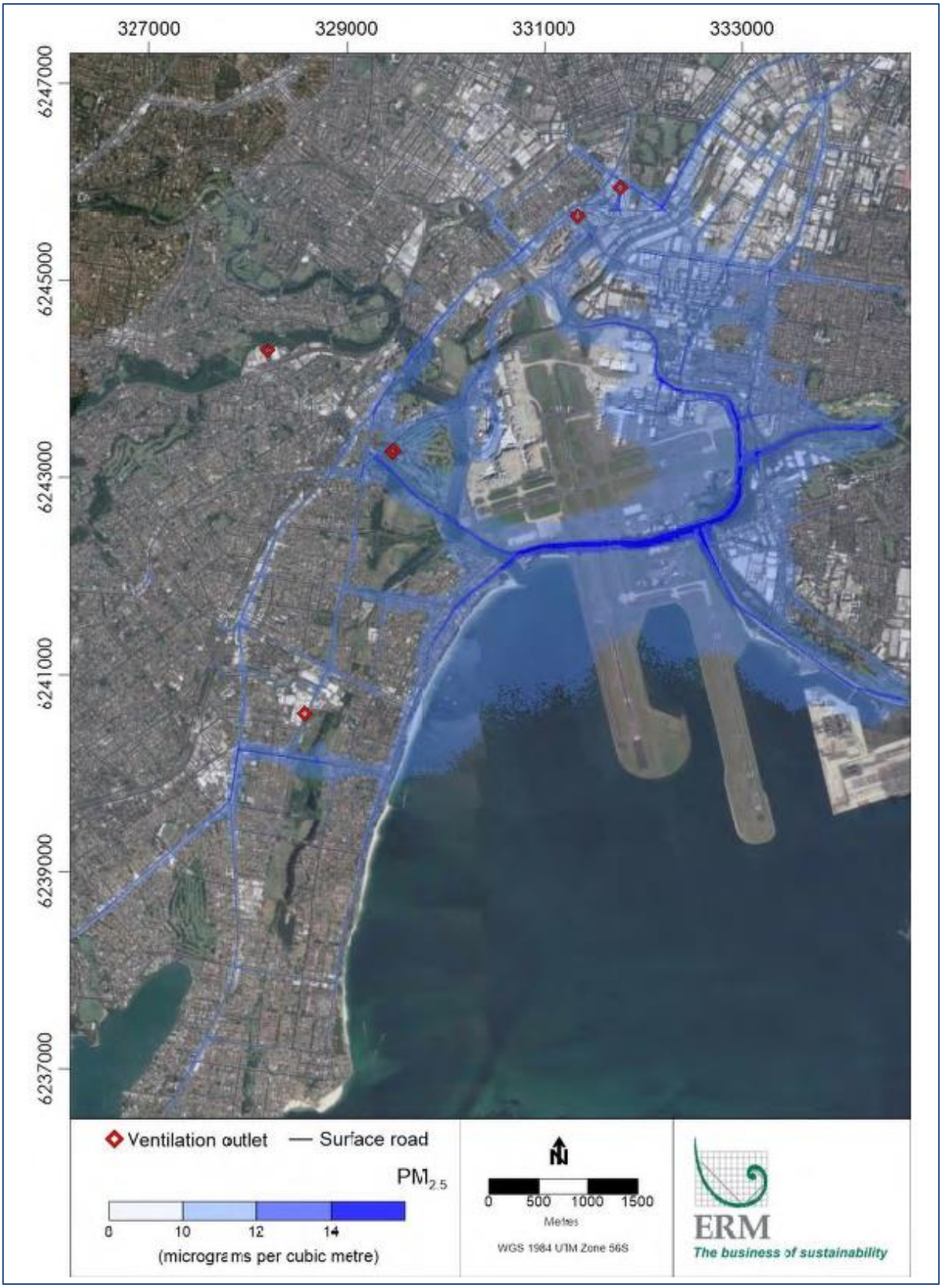

Figure 4-4 : F6 Extension Project annual average $PM_{2.5}$ contour plot for the 2036-DS scenario

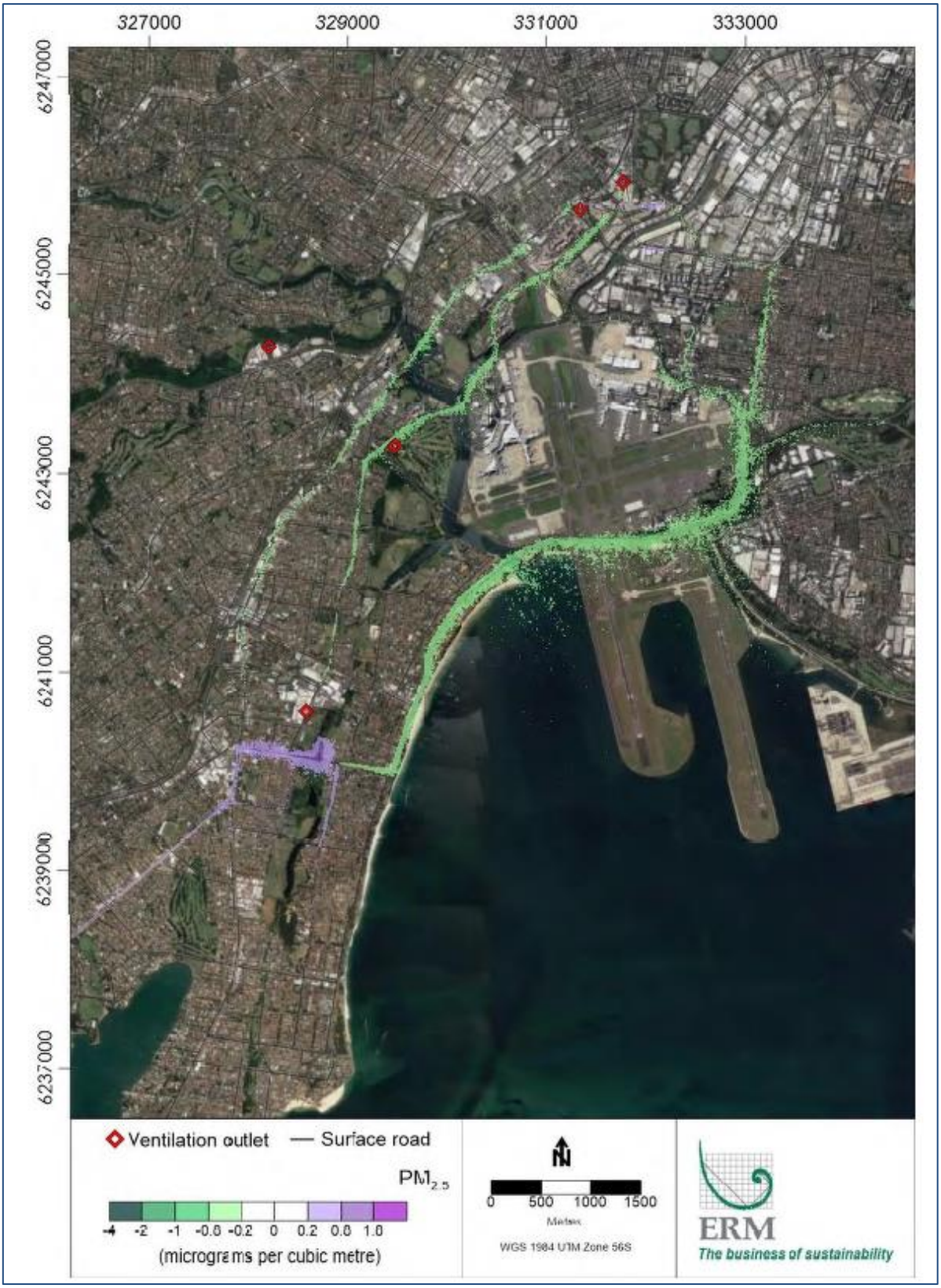

Figure 4-5 : F6 Extension Project change in annual average $PM_{2.5}$ (2036-DS minus 2036-DM)

5 DISPERSION MODELLING APPROACH

5.1 Modelling methodology

The CAL3QHCR roadway pollution dispersion model was used to estimate impacts from Princes Highway, Forest Road/Wickham Street and Eden Street on the Project. The model was set up with free flow links and queue links for idling emissions at intersections.

5.1.1 Meteorological modelling

Site specific meteorological data used in the model were obtained by running The Air Pollution Model (TAPM) with observations from Sydney Airport AMO for the 2015 calendar year.

Figure 5-1 presents the annual and seasonal windroses from the TAPM data. Overall, the TAPM modelling reflects the expected wind distribution patterns at the Project. While TAPM predicts lower wind speeds than those measured at the Sydney Airport AMO, the use of generally lower wind speeds is considered conservative as dispersion is poorer under lower wind speed conditions.

Figure 5-1: Annual and seasonal windroses from TAPM Extract

5.2 Emission estimation

Daily traffic volumes were obtained from the NSW Roads and Maritime Services (RMS) Traffic Volume Viewer (**RMS, 2021**).

Traffic Volume Viewer counter station 23011 along Princes Highway north of Burrows Street is considered to be the most spatially representative counter of traffic along Princes Highway in the vicinity of the Project, however it only has data available for the 2009 year. The available data from counter station 23011 was compared with other traffic counters along the Princes Highway and was found to be generally similar to counter station 23032 located along Princes Highway south of Taylor Avenue. Based on the available 2009 data, a factor of 1.2 was calculated to be the applicable factor to determine the likely daily traffic volumes at counter station 23011, based on the levels at counter station 23032.

Diurnal traffic profiles for the year 2019 were adopted for Princes Highway from counter station 23032. While data are available for the more recent 2020 year, this year has not been selected as there was a decrease in daily traffic volumes from 2019 to 2020 potentially due to the COVID19 coronavirus. In the 2019 year, an average daily traffic volume of 39,517 vehicles/day was recorded along Princes Highway. In the modelling, the daily traffic volumes along Princes Highway were multiplied by a factor of 1.2 and increased by a further 10% to account for a potential future increase in traffic including traffic generated by the development.

It is noted that north of the M5 exit, traffic volumes along the Princes Highway approximately double as indicated in the F6 Extension Traffic Report (**RMS, 2018b**) and by Traffic Volume Viewer station 23001. The M5 exit is located approximately 200m north of the Project and thus is considered to be too far from the Project to tangibly impact traffic pollutant levels.

The Traffic Volume Viewer counter station 23032 along Forest Road north of Bayview Street was used to represent potential vehicle movements along Forest Road/Wickham Street in the vicinity of the Project. Diurnal traffic profiles for the year 2018 were adopted for Forest Road/Wickham Street as this is the most recent complete dataset available for this counter station. In the 2018 year, an average daily traffic volume of 30,346 vehicles/day was recorded along Forest Road. In the modelling, the daily traffic volumes along Forest Road/Wickham Street were increased by 10% to account for a potential future increase in traffic including traffic generated by the development.

As there were no available traffic volume data for Eden Street, a daily volume of 4,000 vehicles per day has been nominally adopted to represent local traffic and additional traffic generated by the development. The hourly vehicle profiles (percentage of total daily vehicles per hour of day) for Eden Street have been adopted from the Traffic Volume Viewer station 23011 along Princes Highway.

Table B-1 to **Table B-3** in **Appendix B** provide the hourly vehicle profiles which were applied in the model.

Hourly NO_x and PM_{10} emission rates for free flowing traffic were obtained from the RMS Tool for Roadside Air Quality (TRAQ) for the 2021 fleet year. **Table 5-1** outlines the estimated emission rates. The traffic composition along Eden Street was assumed to be 6.7% heavy vehicles as per the TRAQ default settings for local/residential roads. The traffic composition along Princes Highway and Forest

Road/Wickham Street were assumed to be 7% and 8% heavy vehicles respectively per the F6 Extension Traffic Report (**RMS, 2018b**).

Table 5-1: Free flow emissions factors (g/vehicle/km)

Road	Grade	NOx	PM_{10}
Eden Street	-4 Northbound	0.11	0.05
	4 Southbound	0.68	0.06
Princes Highway	-4 Northbound	0.11	0.05
	4 Southbound	0.83	0.06
Forest Road/Wickham Street	-6 Eastbound	0.10	0.05
	-4 Eastbound	0.12	0.05
	4 Westbound	0.90	0.06
	6 Westbound	1.13	0.07

Emission factors from the **US EPA** (**2008**) were used to calculate the emission rates for idling queuing vehicles at intersections. Idling emission rates applied in this assessment are outlined in **Table 5-2**.

Table 5-2: Idling emissions rates (g/hr/vehicle)

Road	Percentage heavy vehicles	NOx	PM_{10}
Eden Street	6.7%	5.50	0.08
Princes Highway	7%	5.59	0.08
Forest Road/Wickham Street	8%	5.89	0.09

$PM_{2.5}$ was assumed to be 92% of PM_{10} per the US EPA emission factors (**US EPA**, **2008**). As a conservative measure, NO_2 was assumed to be 50% of NO_x, whereas a value between 10% and 20% would be more realistic.

5.3 Modelled receptors

Receptors have been modelled across the Project site at various receptor heights. Receptor heights corresponding to the Upper Ground Floor (0m) to Level 3 (approximately 9m) have been assessed in this study at 3m intervals.

Figure 5-2 presents the modelled receptor grid map covering the Project site.

Figure 5-2: Modelled receptor map

6 DISPERSION MODELLING RESULTS

The predicted incremental and cumulative pollutant impacts from traffic sources at the Project are presented in **Table 6-1**. The maximum incremental impacts presented represent the most impacted receptors within the Project boundary (refer to **Figure 5-2** for the Project receptor locations). The most impacted receptors for each height are close to the site boundary near to Princes Highway.

The results indicate the predicted 1-hour and annual average NO_2 and 24-hour average $PM_{2.5}$ cumulative impacts at the Project site do not exceed the relevant criteria.

The predicted maximum incremental annual average $PM_{2.5}$ impacts from road traffic at the Project are below the incremental criterion of 1.7µg/m^3.

The results indicate that the highest impacts from road traffic occur close to ground level and decrease with height.

Table 6-1: Predicted incremental and cumulative impacts at the Project

Project Level	Receptor Height modelled (m)	Pollutant	Averaging period	Maximum incremental impact (µg/m³)	Background (µg/m³)	Cumulative impact (µg/m³)	NSW EPA criterion (µg/m³)	Incremental criteria (µg/m³)
Upper ground	0	$PM_{2.5}$	24-hour	3.3	10.0	13.3	**25**	-
			Annual	1.6	-	-	-	**1.7**
		NO_2	1-hour	81.2	108.7	189.9	**246**	-
			Annual	6.3	16.4	22.7	**62**	-
Level 1	3	$PM_{2.5}$	24-hour	2.6	10.0	12.6	**25**	-
			Annual	1.1	-	-	-	**1.7**
		NO_2	1-hour	75.0	108.7	183.7	**246**	-
			Annual	5.4	16.4	21.8	**62**	-
Level 2	6	$PM_{2.5}$	24-hour	1.8	10.0	11.8	**25**	-
			Annual	0.8	-	-	-	**1.7**
		NO_2	1-hour	63.9	108.7	172.6	**246**	-
			Annual	4.6	16.4	21.0	**62**	-
Level 3 (first residential floor)	9	$PM_{2.5}$	24-hour	1.3	10.0	11.3	**25**	-
			Annual	0.6	-	-	-	**1.7**
		NO_2	1-hour	52.5	108.7	161.2	**246**	-
			Annual	3.6	16.4	20.0	**62**	-

Figure 6-1 presents a pollutant concentration isopleth showing the spatial distribution of the predicted incremental impacts associated with the roadways (alone) for annual average $PM_{2.5}$ at ground level.

The figure indicates that the incremental annual average $PM_{2.5}$ impact from road traffic would be approximately 1µg/m^3 at the nearest proposed building façade on the upper ground level, which is well below the adopted incremental criterion of 1.7µg/m^3.

Figure 6-1: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Upper ground level 0m

7 DISCUSSION

The levels of air pollutants experienced at the Project would be consistent with those experienced at the existing residences at the Project site and surrounding residential land uses. High density residential developments similar to the proposed Project already exist or have been approved in the vicinity of Princes Highway, such as the 10 storey residential buildings located along Princes Highway directly across the road from the Project.

The background data indicate that annual average $PM_{2.5}$ levels would generally already be above the 8µg/m^3 cumulative criterion at existing residences at and in the vicinity of the Project regardless of any impact from road traffic.

As such the incremental annual average $PM_{2.5}$ criterion of 1.7µg/m^3 applied to major road projects was adopted to assess the potential impacts from road traffic. This assessment conservatively assesses the total annual $PM_{2.5}$ impact from road traffic against this criterion, not simply the change in levels that residences at the Project site (whether existing or proposed) would experience due to potential future increases in traffic volumes.

8 SUMMARY AND CONCLUSIONS

This study has assessed the potential for air quality impacts associated with traffic emissions to impact upon the proposed mixed-use development at 161-179 Princes Highway and 26-42 Eden Street, Arncliffe.

Air dispersion modelling was used to predict the potential for air quality impacts at the Project site due to the effects of traffic emissions from all nearby roads. The modelling uses conservative assumptions and accounts for future growth in traffic volumes. The results show that all pollutant levels at the Project would be within the relevant impact assessment criteria.

Overall, the assessment demonstrates that the Project design is adequate to ensure no adverse impacts above criteria would arise once it is developed.

9 REFERENCES

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Appendix A

Selection of Meteorological Year

Selection of meteorological year

The selection of the period for modelling considered the representativeness of the chosen year against available long-term datasets.

A statistical analysis of five contiguous years of meteorological data from the Sydney Airport AMO is presented in **Table A-1**. The standard deviation of the five years was analysed against the long-term measured wind speed, temperature and relative humidity spanning a 60 to 71-year period recorded at the station.

The analysis indicates that 2016 is closest to the long-term average for wind speed, the closest year to the long-term average for temperature is 2015 and for relative humidity, 2015 is the closest.

This analysis suggests 2015 could be considered as the most representative of the long-term measured wind speed, temperature and relative humidity.

Further analysis of 2015 against the other years was performed to determine its suitability. **Figure A-1** shows the frequency distributions for wind speed, wind direction, temperature and relative humidity of 2015 compared with the mean of the 2011 to 2020 data set. The 2015 data aligned satisfactorily with mean data, therefore based on a review of all years, the 2015 data were selected for modelling.

Table B-1: Statistical analysis results of standard deviation from long-term meteorological data at Sydney Airport AWMO

Year	Wind speed	Temperature	Relative humidity
2015	0.86	0.78	3.14
2016	0.84	1.09	5.00
2017	0.98	1.00	4.74
2018	1.07	0.95	4.77
2019	0.85	1.09	4.14

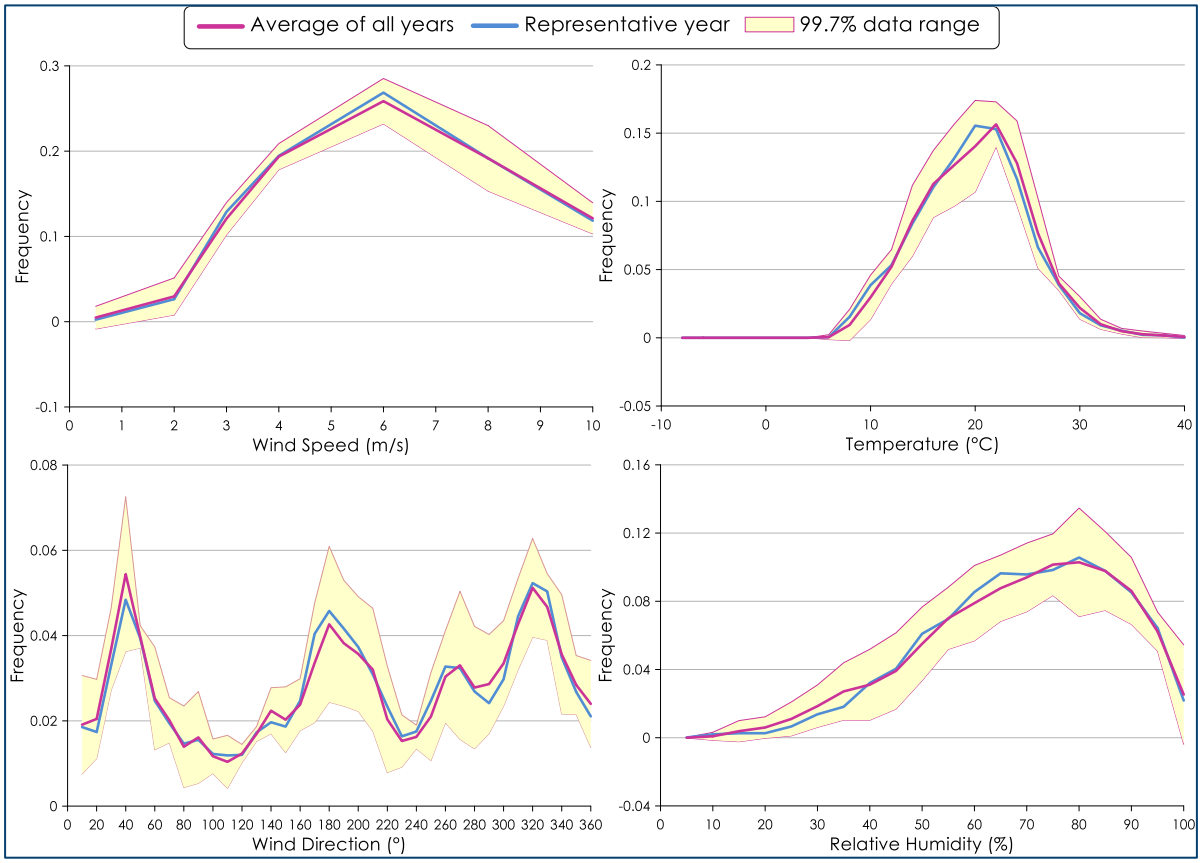

Figure A-1: Graphical analysis of meteorological conditions at Sydney Airport AMO

Appendix B

Diurnal Traffic Profiles

Table B-1: Diurnal traffic profiles – Prince Highway

Hour of day	Number of vehicles per hour	
	Northbound	Southbound
1	353	472
2	243	282
3	242	210
4	261	185
5	344	168
6	882	266
7	1,726	552
8	2,174	729
9	2,062	942
10	1,770	999
11	1,546	1,126
12	1,446	1,246
13	1,475	1,368
14	1,391	1,466
15	1,356	1,732
16	1,280	2,170
17	1,294	2,424
18	1,360	2,644
19	1,247	2,146
20	927	1,306
21	784	1,027
22	761	1,024
23	666	883
24	491	714

Table B-2: Diurnal traffic profiles – Eden Street

Hour of day	Number of vehicles per hour	
	Northbound	Southbound
1	27	36
2	19	22
3	19	16
4	20	14
5	26	13
6	68	20
7	132	42
8	167	56
9	158	72
10	136	77
11	119	86
12	111	96
13	113	105
14	107	112
15	104	133
16	98	166
17	99	186
18	104	203
19	96	165
20	71	100

Hour of day	Number of vehicles per hour	
	Northbound	Southbound
21	60	79
22	58	79
23	51	68
24	38	55

Table B-3: Diurnal traffic profiles – Forest Road

Hour of day	Number of vehicles per hour	
	Eastbound	Westbound
1	154	283
2	106	175
3	118	129
4	186	120
5	328	147
6	907	201
7	1,445	371
8	1,328	535
9	1,186	742
10	1,111	739
11	909	809
12	853	883
13	830	939
14	810	969
15	779	1,004
16	805	1,204
17	786	1,315
18	845	1,352
19	808	1,261
20	666	923
21	557	762
22	498	704
23	416	646
24	260	479