# Report

## Marsden Park Warehouse – Air Quality Assessment

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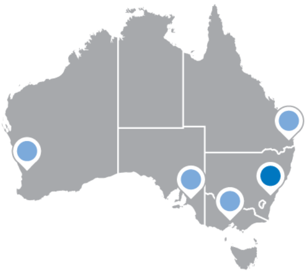


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# Executive summary

Pacific Environment was commissioned by LOGOS to undertake an air quality assessment for proposed industrial warehousing (the Project) on land off Hollinsworth Road, Marsden Park (the Site) within the Marsden Park industrial precinct.

Potential operational air quality impacts of the Project were assessed using a combination of qualitative and quantitative methods. Potential operational impacts were assessed using atmospheric dispersion modelling techniques in conjunction with pollutant emission estimates that have been based on Project-specific information.

- Emissions of $NO_x$ were found to result in a maximum 1 hour average incremental $NO_2$ impact of 53 µg/m³ at receptors R09 and R10 to the north of the Site. Assuming that all $NO_x$ exists in the form of $NO_2$, cumulative predictions were found to be approximately 50% of the EPA impact assessment criterion. Annual average $NO_2$ predictions were found to be minor relative to the criterion.

- $PM_{2.5}$ emissions were found to result in a maximum 24 hour average incremental impact of 1.2 µg/m³ at receptors R09 and R10 to the immediate north of the Site. When added to peak background levels these predictions were found to be within criterion. Noting that the existing background annual average $PM_{2.5}$ levels already exceed the EPA impact assessment criterion, localised annual average predictions of 0.7 µg/m³ are considered to present a minor risk of additional exceedances of the long-term EPA criterion.

Based on this analysis, the potential for the operational phase of the Project to adversely impact local air quality is considered minor.

A qualitative assessment of potential construction dust impacts was undertaken based on a conventional approach following the procedures set out in the UK Institute of Air Quality Management (IAQM) document *"Guidance on the assessment of dust from demolition and construction"* (IAQM, 2014). This assessment has identified relevant air quality risks and mitigation strategies.

It is recommended that a construction environmental management plan (CEMP) (that includes dust management) should be produced to cover the construction phase. This should contain details of the site-specific mitigation measures to be applied. Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW EPA Local Government Air Quality Toolkit.

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# 1 Introduction

Pacific Environment has been commissioned by LOGOS to undertake an air quality assessment for a proposed industrial warehousing (the Project) on land off Hollinsworth Road, Marsden Park (the Site) within the Marsden Park industrial precinct.

This assessment has considered air emissions associated with both construction and operation of the Project. The construction phase assessment is based on a conventional approach following the procedures set out in the UK Institute of Air Quality Management (IAQM) document *"Guidance on the assessment of dust from demolition and construction"* (IAQM, 2014). The operational assessment is based on a conventional approach following the procedures outlined in the NSW Environment Protection Authority (EPA) document titled *"Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW"* (NSW EPA, 2016), hereafter referred to as the 'Approved Methods'.

The Project is located at Marsden Park, approximately 40 km north-west of Sydney city, and approximately 7 km north-east of St Marys (see Figure 1.1).

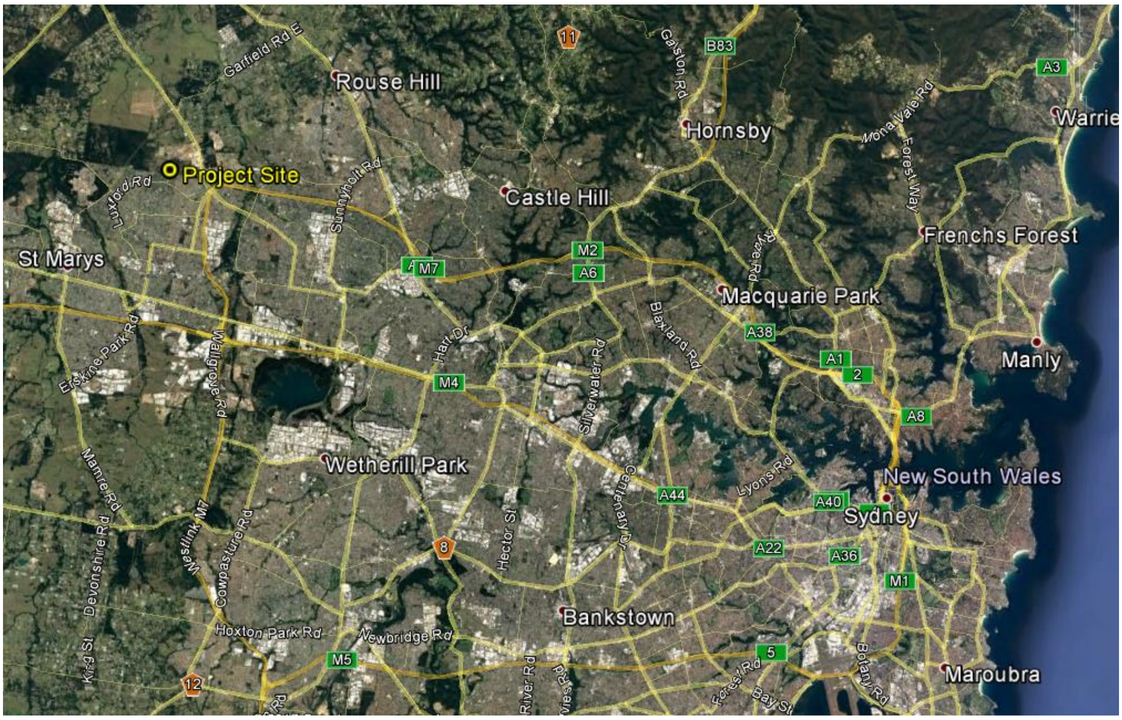



Figure 1.1: Aerial image showing the Project Site relative to Sydney.

The Project is to redevelop the existing greenfield land into an industrial estate. The Project will primarily comprise warehouses with loading dock facilities, hardstand areas, internal access roads, car parking spaces, office spaces, and landscaped garden areas. Site access will be via Hollinsworth Road along the north of the site. A westward extension of the current Hollinsworth Road is also proposed for site access to the western buildings. The project will include the construction and operation of seven warehouses.

Air emissions associated with the project primarily include construction dust, and combustion emissions associated with vehicle operations at the site. An assessment of these emissions along with appropriate mitigation strategies is detailed in this report.

# 2 Regulatory Framework

## 2.1 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARs) for the Project (State Significant Development - SSD 8606) require the following:

- an assessment of the air quality impacts (particularity dust) at private properties during construction and operation of the development, in accordance with the relevant Environment Protection Authority guidelines; and
- details of any mitigation, management and monitoring measures required to prevent and/or minimise emissions.

Assessment of potential air quality impacts associated with construction and operation have been provided in Section 5 and Section 6 (respectively). Detailed management measures for construction phase have been provided in Section 5.3, whilst management measure for operation have been provided in Section 7.

## 2.2 Impact Assessment Criteria

The Approved Methods (NSW EPA, 2016) specifies air quality assessment criteria relevant for assessing impacts from air pollution. These criteria are health-based (i.e. they are set at levels to protect against health effects) and for $PM_{10}$ and $PM_{2.5}$ are consistent with Amended National Environment Protection Measure for Ambient Air Quality (Ambient Air-NEPM) (NEPC, 1998). The Approved Methods were updated at the end of 2016 to make the annual average $PM_{10}$ criterion equivalent to the NEPM (25 µg/m$^3$), prior to this the criterion was 25 µg/m$^3$. The updated Approved Methods also introduced criteria for 24-hour average and annual average $PM_{2.5}$. Table 2-1 presents the air quality criteria for pollutants that are relevant to this study nitrogen dioxide ($NO_2$, $PM_{10}$ and $PM_{2.5}$). It is important to note that the criteria are applied to the cumulative impacts due to the Project and other sources.

Table 2.1. NSW EPA impact assessment criteria for particulate matter, carbon monoxide and nitrogen dioxide concentrations

| Pollutant | Standard | Averaging Period |
|---|---|---|
| $PM_{10}$ | 50 µg/m$^3$<br>25 µg/m$^3$ | 24-hour<br>Annual |
| $PM_{2.5}$ | 25 µg/m$^3$<br>8 µg/m$^3$ | 24-hour<br>Annual |
| $NO_2$ | 246 µg/m$^3$<br>62 µg/m$^3$ | 1 hour<br>Annual |

Notes: µg/m$^3$ – micrograms per cubic metre

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fall out relatively close to source. Dust deposition can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance or amenity impacts.

# 3 Existing Air Quality

To fully assess potential impacts against the relevant air quality criteria it is necessary to have information on existing air quality concentrations in the vicinity of the Project.

Air quality monitoring is undertaken at four locations within 14 km of the Project. The nearest EPA OEH monitoring station is at Vineyard, located approximately 7 km north east of the Project and monitors $NO_2$ and $PM_{10}$. The next closest monitoring station is at St Marys, located approximately 10 km south east of the Project and monitors $NO_2$, $PM_{10}$ and $PM_{2.5}$. The only monitoring station in the area that monitors all pollutants relevant for this assessment is Prospect, located approximately 11 km south-east of the Project. Richmond, located 14 km from the Project, is furthest away and monitors $NO_2$, $PM_{10}$ and $PM_{2.5}$.

A summary of the available air quality data is provided in the subsequent sections. Generally, air quality for the local area can be described as good, with the exception of isolated high pollution days or extreme events such as dust storms and bushfires.

## 3.1 Particulate Matter ($PM_{10}$)

A summary of the annual average $PM_{10}$ concentrations from 2012 to 2016 at the four closest OEH monitoring stations are presented in Table 3.1.

Table 3.1. Annual average $PM_{10}$ concentrations at Richmond, St Marys, Vineyard and Prospect (µg/m$^3$)

| Year | OEH Station | | | |
|---|---|---|---|---|
| | Richmond | St Marys | Vineyard | Prospect |
| 2012 | 15 | 14 | 14 | 17 |
| 2013 | 17 | 16 | 16 | 19 |
| 2014 | 15 | 17 | 16 | 18 |
| 2015 | 13 | 15 | 16 | 18 |
| 2016 | 16 | 16 | 17 | 19 |
| EPA Criterion | 25 | 25 | 25 | 25 |

## 3.2 Particulate Matter ($PM_{2.5}$)

A summary of the annual average $PM_{2.5}$ concentrations from 2012 to 2016 at Richmond, St Marys and Prospect are presented in Table 3.2.

Table 3.2. Annual average $PM_{2.5}$ concentrations at Richmond, St Marys and Prospect (µg/m$^3$)

| Year | OEH Station | | |
|---|---|---|---|
| | Richmond | St Marys* | Prospect** |
| 2012 | 5 | - | - |
| 2013 | 8 | - | - |
| 2014 | 7 | - | - |
| 2015 | 8 | - | 8 |
| 2016 | 8 | 8 | 9 |
| EPA Criterion | 8 | 8 | 8 |

*Notes: No $PM_{2.5}$ monitoring at St Marys until 2016. **No $PM_{2.5}$ monitoring at Prospect until December 2014.

## 3.3 Adopted Background Concentrations

Adopted background concentrations are summarised in Table 3.3.

Table 3.3 Summary of adopted background concentrations

| Pollutant | Source | Value | Concentration |
|---|---|---|---|
| $NO_2$ | St Marys | 1 hour maximum | 76 |
| | | Annual Average | 10 |
| $PM_{2.5}$ | Richmond | 24 hour maximum | 22.7* |
| | | Annual Average | 8.4 |

Note: *Excludes exceptional events such as bushfires and prescribed burning.

# 4 Dispersion meteorology

## 4.1 Review of available meteorological stations

Air quality impacts are influenced by meteorological conditions, primarily in the form of gradient wind flow regimes, and by local conditions generally driven by topographical features and interactions with coastal influences, such as the sea breeze. The local dispersion meteorology for the site, in relation to wind speed and direction, has been reviewed based on the data available at nearby meteorological stations.

The Bureau of Meteorology (BoM) collects climatic information at the Horsley Park Equestrian Centre Automatic Weather Station (AWS), located approximately 14 km south of the site. The NSW Office of Environment and Heritage (OEH) operate a meteorological station at St Marys, located approximately 10 km south west and at Prospect, located approximately 11 km south east of the Project.

The closest site and most representative location in terms of land use and surface roughness is the OEH monitoring site at St Marys. Annual and seasonal wind roses for 2013 at St Marys are shown in Figure 4.1. The dominant annual winds are from the south and south-southwest with a significant portion also from the north-northwest. This pattern is similar in all seasons with summer also showing a proportion of winds from the southeast. The percentage calms (defined as wind speeds less than 0.5 m/s) was 24.7% for 2013.

## 4.2 Representative year for modelling

As specified in the Approved Methods, five years of meteorological data are required to be reviewed so that a representative year of meteorological conditions can be selected. Appendix A provides an analysis of the five years of meteorological data from St Marys. Data from the Horsley Park Equestrian Centre was used to analyse rainfall trend as this parameter was not available from St Marys. The review identified 2013 as a representative year for dispersion modelling with no anomalous wind patterns compared to the other years examined and is therefore considered a representative year for dispersion modelling.

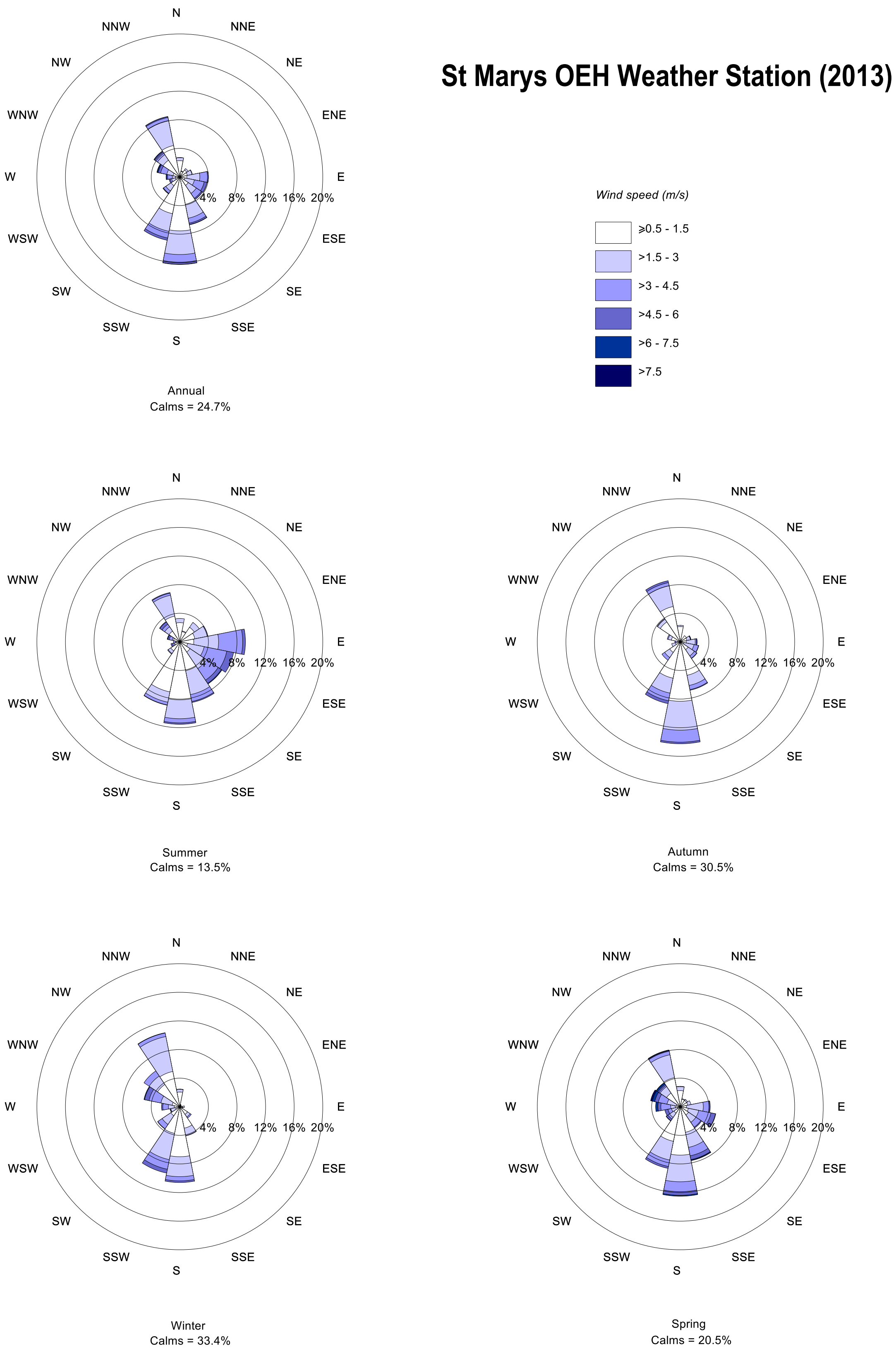



Figure 4.1: Annual and seasonal wind roses for St Marys (2013)

# 5 Construction Assessment

This section outlines the potential impacts of the construction of the warehouse. The main air quality and amenity issues at any construction site are:

- Annoyance due to dust deposition (soiling of surfaces)
- Visible dust plumes / visual amenity
- Elevated $PM_{10}$ concentrations due to dust-generating activities
- Exhaust emissions from diesel-powered construction equipment.

Exhaust emissions from on-site plant and site traffic are unlikely to have a significant impact on local air quality and in the majority of cases they will not need to be quantitatively assessed (IAQM, 2014).

Dust emissions can occur during the preparation of the land (e.g. demolition and earth moving) and during construction itself, and can vary substantially from day to day depending on the level of activity, the specific operations being undertaken, and the weather conditions. A significant portion of the emissions results from site plant and road vehicles moving over temporary roads and open ground. If mud is allowed to get onto local public roads, dust emissions can occur at some distance from the construction site (IAQM, 2014).

## 5.1 Assessment methodology

A full technical description of the assessment methodology and outcomes is provided in Appendix B. It is noted that there will be no demolition and therefore demolition works is not assessed. The activities considered are:

- Earthworks
- Construction
- Track out

The following provides an overview of the construction assessment.

The risk assessment process firstly identified if there were sensitive receptors that were at risk of dust impacts from construction activities from the Proposal.

The potential for dust emissions were then defined by allocating each construction stage a level of risk, as 'small', 'medium' or 'large' based on the detailed information about the construction activities, such as the number of heavy duty vehicles that would enter the site per day and the quantity of material to be handled during earthworks. The next step was to identify the sensitivity of the area based on the nature of sensitive receptors, such as 'human' or 'ecological' and then by the number and distance of these sensitive receptors to the proposed Proposal's construction activities.

## 5.2 Results

The results for the construction risk assessment are provided in Table 5.1. Overall earthworks and construction activities classed as 'medium risk' and track-out is considered 'low risk'.

Table 5.1. Summary of risk assessment for the Project

| Type of activity | Step 2A: Potential for dust emissions | Step 2B: Sensitivity of area | | | Step 2C: Risk of dust impacts | | |
|---|---|---|---|---|---|---|---|
| | | Dust soiling | Human health | Ecological | Dust soiling | Human health | Ecologica l |
| Demolition | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Earthworks | Medium | Medium | Low | n/a | Medium Risk | Low Risk | n/a |
| Construction | Medium | Medium | Low | n/a | Medium Risk | Low Risk | n/a |
| Track-out | Small | Medium | Low | n/a | Negligible | Negligible | n/a |

## 5.3 Mitigation

For those cases where the risk category is 'negligible', no mitigation measures beyond those required by legislation will be required. The results are shown in Table 5.2 to Table 5.6. Most of the recommended measures are routinely employed as 'good practice' on construction sites.

A construction environmental management plan (CEMP), that includes dust management, should be produced to cover the construction of the haul roads, amenity bund and evaporation ponds. This should contain details of the site-specific mitigation measures to be applied. Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW EPA Local Government Air Quality Toolkit[1]. Detailed guidance is also available from the UK (GLA, 2006) and the United States (Countess Environmental, 2006).

Table 5.2. Mitigation for all sites: Communications

| Item | Mitigation measure | Recommendation |
|---|---|---|
| 1 | Communication, notification and complaints handling requirements regarding air quality matters will be managed through the Community Communication Strategy (CCS). | Highly recommended |

[1] http://www.epa.nsw.gov.au/air/lgaqt.htm

Table 5.3. Mitigation for all sites: Dust management

| Item | Mitigation measure | Recommendation |
|---|---|---|
| 2 | A Construction Air Quality Management Plan will be developed and implemented to monitor and manage potential air quality impacts associated with the construction for the project. The Plan will be implemented for the duration of construction. | Highly recommended |
| Site management | | |
| 3 | Regular communication with sites in close proximity to ensure that measures are in place to manage cumulative dust impacts. | Highly recommended |
| Monitoring | | |
| 4 | Regular site inspections will be conducted to monitor for potential dust issues. The site inspection, and issues arising, will be recorded. | Highly recommended |
| Preparing and maintaining the site | | |
| 5 | Construction activities with the potential to generate dust will be modified or ceased during unfavourable weather conditions to reduce the potential for dust generation. | Highly recommended |
| 6 | Measures to reduce potential dust generation, such as the use of water carts, sprinklers, dust screens and surface treatments, will be implemented within project sites as required. | Highly recommended |
| 7 | Unsealed access roads within project sites will be maintained and managed to reduce dust generation. | Highly recommended |
| 8 | Where reasonable and feasible, appropriate control methods will be implemented to minimise dust emissions from the project site. | Highly recommended |
| 9 | Storage of materials that have the potential to result in dust generation will be minimised within project sites at all times. | Highly recommended |
| Operating vehicle/machinery and sustainable travel | | |
| 10 | All construction vehicles and plant will be inspected regularly and maintained to ensure that they comply with relevant emission standards. | Highly recommended |
| 11 | Engine idling will be minimised when plant are stationary, and plant will be switched off when not in use to reduce emissions. | Highly recommended |
| 12 | The use of mains electricity will be favoured over diesel or petrol-powered generators where practicable to reduce site emissions. | Highly recommended |
| 13 | Haul roads will be treated with water carts and monitored during earthworks operations, ceasing works if necessary during high winds where dust controls are not effective. | Highly recommended |
| 14 | A Sustainability Plan will be produced to manage the sustainable delivery of goods and materials. | Highly recommended |
| Construction | | |
| 15 | Suitable dust suppression and/or collection techniques will be used during cutting, grinding or sawing activities likely to generate dust in close proximity to sensitive receivers. | Highly recommended |
| 16 | The potential for dust generation will be considered during the handling of loose materials. Equipment will be selected and handling protocols developed to minimise the potential for dust generation. | Highly recommended |
| 17 | All vehicles loads will be covered to prevent escape of loose materials during transport. | Highly recommended |

Table 5.4. Mitigation specific to earthworks

| | Mitigation measure | Recommendation |
|---|---|---|
| 21 | Areas of soil exposed during construction will be minimised at all times to reduce the potential for dust generation. | Desirable |
| 22 | Exposed soils will be temporarily stabilised during weather conditions conducive to dust generation and prior to extended periods of inactivity to prevent dust generation. | Desirable |
| 23 | Exposed soils will be permanently stabilised as soon as practicable following disturbance to minimise the potential for ongoing dust generation. | Desirable |

Table 5.5. Mitigation specific to construction

| | Mitigation measure | Recommendation |
|---|---|---|
| 24 | Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. | Highly recommended |
| 25 | Ensure fine materials are stored and handled to minimise dust. | Desirable |

Table 5.6. Mitigation specific to track-out of loose material onto roads

| | Mitigation measure | Recommendation |
|---|---|---|
| 26 | Deposits of loose materials will be regularly removed from sealed surfaces within and adjacent to project sites to reduce dust generation. | If required |
| 27 | During establishment of project ancillary facilities, controls such as wheel washing systems and rumble grids will be installed at site exits to prevent deposition of loose material on sealed surfaces outside project sites to reduce potential dust generation. | If required |

## 5.4 Significance of risks

Once the risk of dust impacts has been determined in Step 2C and the appropriate dust mitigation measures identified in Step 3, the final step is to determine whether there are residual significant effects arising from the construction phase of a proposed development. For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be ‘not significant’ (IAQM, 2014).

However, even with a rigorous Dust Management Plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time. There is the risk that nearby buildings might experience some occasional dust soiling impacts. This does not mean that impacts are likely, or that if they did occur, that they would be frequent or persistent. Overall construction dust is unlikely to represent a serious ongoing problem. Any effects would be temporary and relatively short-lived, and would only arise during dry weather with the wind blowing towards a receptor, at a time when dust is being generated and mitigation measures are not being fully effective. The likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be ‘not significant’.

The sensitive receptors are located to the north and south of the nearest construction activities. In view of the prevailing winds originating from both the north and south (see Appendix A) consideration of construction activities during adverse conditions from these directions should be made to ensure dust impacts during construction are minimised.

# 6 Operational Assessment

The overall approach to the assessment follows the Approved Methods which specify how assessments based on the use of air dispersion models should be completed. They include guidelines for the preparation of meteorological data to be used in dispersion models and the relevant air quality criteria for assessing the significance of predicted concentrations from the Project.

## 6.1 Dispersion model

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the AERMET/AERMOD model. AERMOD was chosen as the most suitable model due to the source types, location of nearest receptors and nature of local topography. AERMOD is the US-EPA's recommended steady-state plume dispersion model for regulatory purposes. AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it incorporates more recent, and potentially more accurate, algorithms to represent both meteorological interactions and air quality dispersion.

A significant feature of AERMOD is the Pasquill-Gifford stability based dispersion is replaced with a turbulence-based approach that uses the Monin-Obukhov length scale to account for the effects of atmospheric turbulence based dispersion.

The AERMOD system includes AERMET, used for the preparation of meteorological input files and AERMAP, used for the preparation of terrain data. Terrain data were sourced from NASA's Shuttle Radar Topography Mission (SRTM) Data (3 arc-second (~90m) resolution) and processed within AERMAP to create the necessary input files.

AERMET requires surface and upper air meteorological data as inputs. Surface data were sourced from the Office of Environment and Heritage (OEH) meteorological station at St Mary's approximately 10 km southwest of the Project. Cloud cover data are required for AERMET and these were sourced from Bankstown Airport.

Appropriate values for three surface characteristics are required for AERMET as follows:

- Surface roughness, which is the height at which the mean horizontal wind speed approaches zero, based on a logarithmic profile.
- Albedo, which is an indicator of reflectivity of the surface.
- Bowen ratio, which is an indicator of surface moisture.

Values of surface roughness, albedo and Bowen ratio were determined based on a review of aerial photography.

## 6.2 Emissions to Air

### *Traffic Volumes*

Traffic volumes have been estimated for the Project have been undertaken by GTA Consultants (GTA, 2017) based on the Roads and Maritime Services (RMS) methodologies (RMS, 2002; RMS, 2013). These estimates are based on the area of the warehousing, and breakdowns of vehicle patronage for warehousing and distribution facilities.

GTA (2017) estimates that approximately 18% of vehicles movements will be heavy vehicles, reflecting an average of data provided in RMS (2013). This equates to a total of 4,978 movements per day, of which 896 have been assumed to be trucks, and 4,082 passenger vehicles. Heavy vehicles have been assumed to comprise 50% articulated trucks and 50% rigid trucks (fuelled on diesel). Passenger vehicle fleet has been assumed to comprise 87% petrol, and 13% diesel vehicles.

As per the GTA (2017) estimates, vehicle movements have been allocated in the dispersion model based on respective warehousing floor space. Whilst this floorplan reflects an earlier iteration of the Site design, given the marginal changes in footprints and layouts, the adopted values are considered representative for use in the modelling of air emissions from the Project. Table 7.1 provides a summary of these estimates.

Table 6.1: Estimate of daily vehicle volumes.

| Building | Modelled Warehouse Area | | Heavy Vehicles | Passenger Vehicles |
|---|---|---|---|---|
| | $m^2$ | % | | |
| B1A | 6,225 | 6% | 55 | 251 |
| B1B | 6,245 | 6% | 55 | 252 |
| B2A | 9,440 | 9% | 84 | 381 |
| B2B | 9,440 | 9% | 84 | 381 |
| B3 | 37,110 | 37% | 329 | 1,498 |
| B4 | 3,235 | 3% | 29 | 131 |
| B5 | 6,224 | 6% | 55 | 251 |
| B6 | 11,140 | 11% | 99 | 450 |
| B7 | 12,075 | 12% | 107 | 487 |
| **TOTAL** | **101,134** | **100%** | **896** | **4,082** |
| | | | **4,978** | |

## Emission Factors

This assessment of heavy duty vehicles (HDV) also requires an emission factor (g/km) for each vehicle type and pollutant. NSW-specific emission factors have been based on the Australian traffic emission data developed by PIARC (2012), rather than the default NPI values. The calculated mass emission factors for each pollutant investigated as part of this assessment are provided in Table 6.2.

Table 6.2: Estimate of daily vehicle volumes.

| Vehicle Type | Vehicle Speed | $NO_x$ | $PM_{2.5}$ |
|---|---|---|---|
| | km/h | Avg. g/vehicle-km | Avg. g/vehicle-km |
| Passenger | 5 | 0.53 | 0.020 |
| Heavy | | 6.47 | 0.24 |
| Passenger | 20 | 1.23 | 0.029 |
| Heavy | | 10.10 | 0.39 |

Emissions have been based on vehicle speeds of 20 km/h for public and access roads, and 5 km/h for loading docks and car parks. The 5 km/h speed applied for car parks and loading docks reflects an average speed, and hence incorporates an allowance for emissions associated with idling, starting and manoeuvring.

## *Vehicle Transit Emissions*

Vehicle transit emissions have been spatially allocated to road links in accordance with the site layout. Table 6.3 and 6.4 provide a summary of emission estimates for heavy vehicles and passenger vehicles (respectively).

Table 6.3: Estimated emissions from heavy vehicle movements

| Road Link | Modelled Movements | Length (m) | Distance Travelled (km) | Emissions (g/day) | |
|---|---|---|---|---|---|
| | | | | $NO_x$ | $PM_{2.5}$ |
| HR1 | 896 | 85 | 76 | 493 | 18 |
| HR2 | 607 | 143 | 87 | 561 | 21 |
| HR3 | 442 | 190 | 84 | 543 | 20 |
| HR4 | 139 | 207 | 29 | 186 | 7 |
| AR1 | 168 | 140 | 23 | 152 | 6 |
| AR2 | 303 | 145 | 44 | 284 | 10 |
| AR3 | 206 | 138 | 28 | 184 | 7 |
| BA12 | 139 | 182 | 25 | 163 | 6 |
| BA3 | 164 | 637 | 105 | 677 | 25 |
| BA4 | 29 | 43 | 1 | 8 | 0 |
| BA5 | 55 | 115 | 6 | 41 | 2 |
| BA6 | 99 | 258 | 25 | 165 | 6 |
| BA7 | 107 | 137 | 15 | 95 | 3 |
| **Total** | **-** | **-** | **549** | **3,552** | **131** |

Notes: HR – Hollinsworth Rd, AR – Access Road, BA – Building Access path to loading dock.

Table 6.4: Estimated emissions from passenger vehicle movements.

| Road Link | Modelled Movements | Length (m) | Distance Travelled (km) | Emissions (g/day) | |
|---|---|---|---|---|---|
| | | | | $NO_x$ | $PM_{2.5}$ |
| HR1 | 4,082 | 85 | 347 | 184 | 7 |
| HR2 | 2,763 | 143 | 395 | 210 | 8 |
| HR3 | 1,640 | 190 | 312 | 166 | 6 |
| HR4 | 1,265 | 207 | 262 | 139 | 5 |
| AR1 | 507 | 140 | 71 | 38 | 1 |
| AR2 | 500 | 145 | 73 | 39 | 1 |
| AR3 | 937 | 138 | 129 | 69 | 3 |
| CP1A | 63 | 55 | 3 | 4 | 0 |
| CP1B | 63 | 65 | 4 | 5 | 0 |
| CP2A | 191 | 170 | 32 | 40 | 1 |
| CP2B | 191 | 130 | 25 | 31 | 1 |
| CP3 | 1,498 | 150 | 225 | 277 | 6 |
| CP4 | 65 | 80 | 5 | 6 | 0 |
| CP5 | 126 | 10 | 1 | 2 | 0 |
| CP6 | 225 | 110 | 25 | 30 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| CP7 | 487 | 85 | 41 | 51 | 1 |
| **Total** | **-** | **-** | **1,950** | **1,036** | **40** |

Notes: HR – Hollinsworth Rd, AR – Access Road, CP – Car Park inc. access route.

## Loading Dock Operations

Detailed information on warehousing operations is not available at this stage of the Project. Emissions from loading dock operations have been assumed to include natural gas powered forklifts, as well as truck manoeuvring and idling. A truck manoeuvring distance of 50 m has been assumed for each heavy vehicle movement, and assigned to loading dock emissions.

Forklift emissions have been estimated using National Pollutant Inventory emission factors for warehousing operations (NPI, 2008), as detailed in Table 6.5.

Table 6.5: Estimate of forklift operating intensity

| Parameter | Value | Units |
|---|---|---|
| Capacity | 200 | kW |
| Load factor (average engine load during operation) | 0.2 | - |
| Fleet utilisation (average proportion of the fleet in operation) | 75% | - |
| Average power output | 30 | kWh/h per forklift |

Forklift numbers have been estimated based on a similar warehousing facility (Ramboll, 2016), and allocated based on warehouse floor space.

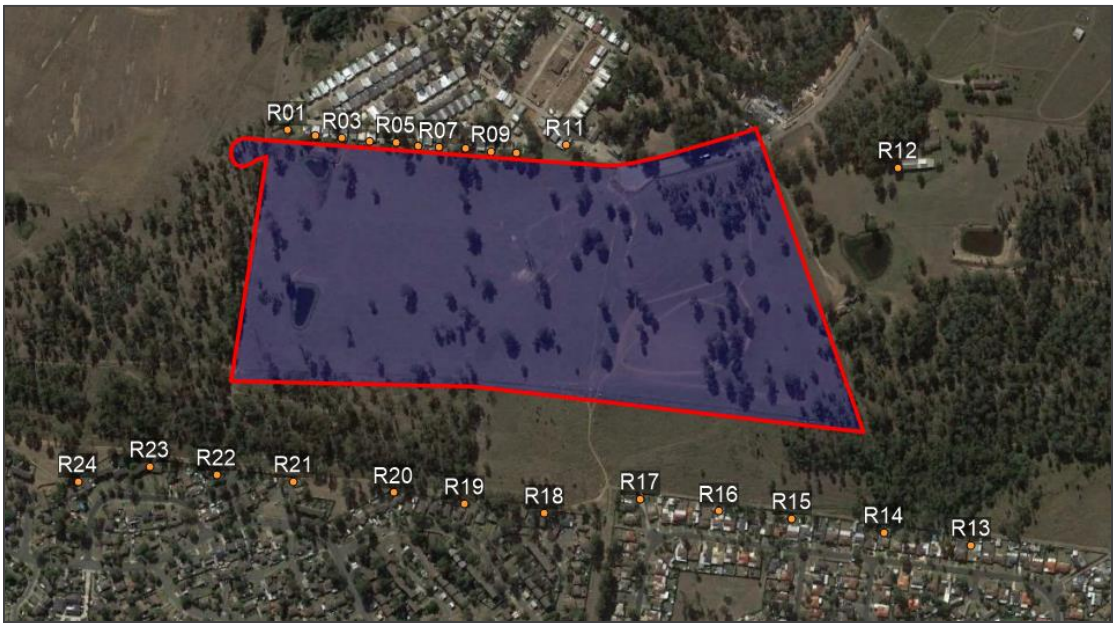
Table 6.6: Summary of forklift operation emission estimates

| Loading Dock | Number of forklifts | Operating Intensity (kwh/day) | Emissions (g/day) | |
|---|---|---|---|---|
| | | | $NO_x$ | $PM_{2.5}$ |
| LD1 | 2 | 1440 | 1,008 | 58 |
| LD2 | 2 | 1440 | 1,008 | 58 |
| LD3 | 4 | 2880 | 2,016 | 115 |
| LD4 | 1 | 720 | 504 | 29 |
| LD5 | 1 | 720 | 504 | 29 |
| LD6 | 1 | 720 | 504 | 29 |
| LD7 | 1 | 720 | 504 | 29 |

## 6.3 Sensitive Receptors

A total of 24 sensitive receptors have been designated to provide model outputs at specific locations. This include the following:

- 11 receptors (R01-R11) at the adjacent Ingenia Lifestyle Stoney Creek Retirement Community (to the north of the Site).
- Receptor R12 to the east of the Site.
- 12 residential receptors (R13-R24) at the suburbs of Hassall Grove and Bidwill (to the south of the Site).




(Base image sourced from Google Earth Pro)

Figure 6.1: Aerial image showing model receptor locations.

## 6.4 Source Configuration

Emissions have been spatially allocated in the model based on source length and weighted usage, as per estimated vehicle routes for each warehouse and car park – for heavy vehicles and passenger vehicles (respectively). Figure 6.2 provides a graphical representation of this layout.

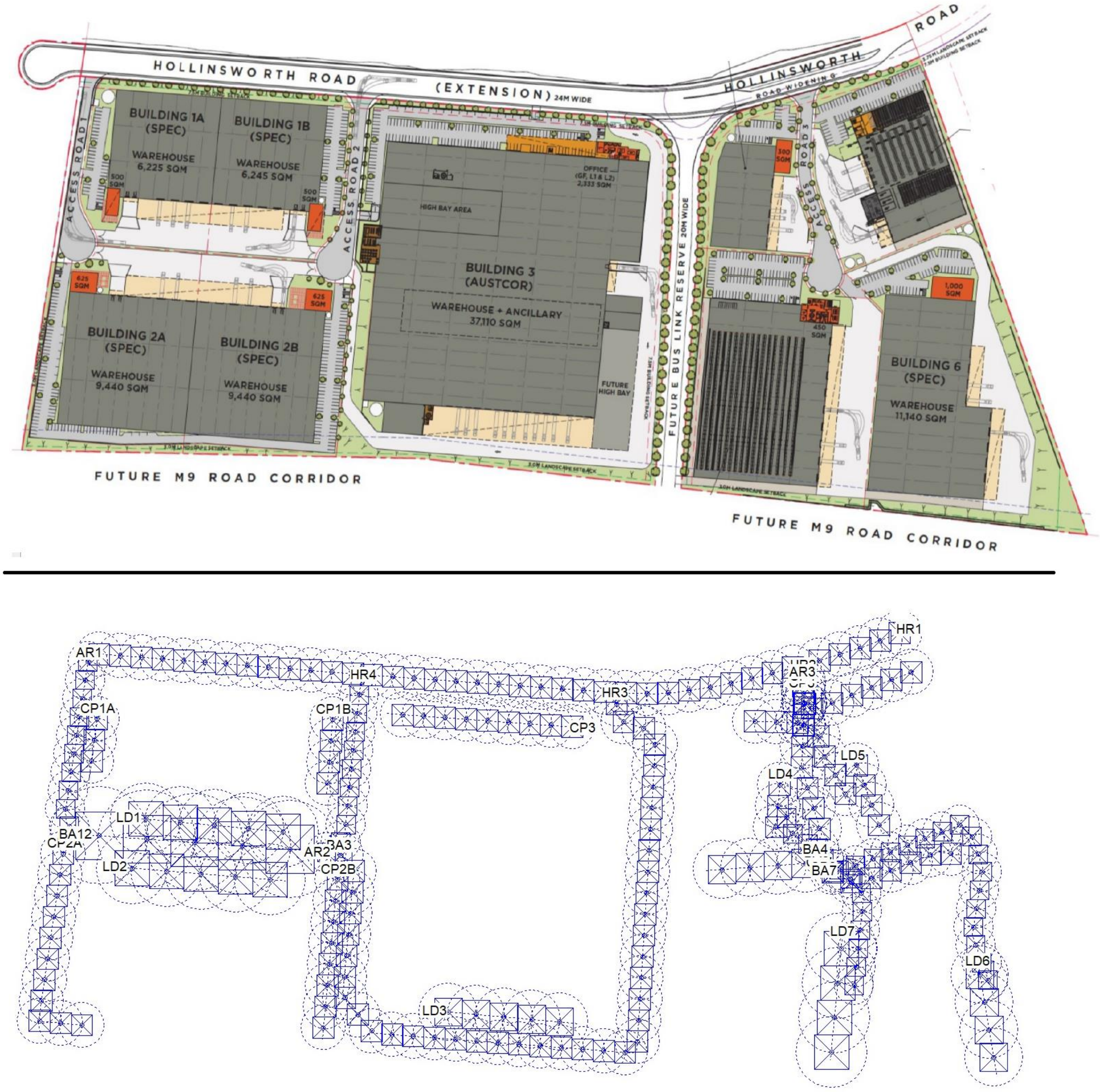



Figure 6.2: Site layout with corresponding emission source layout.

## 6.5 Results

This section provides a summary of the results of the dispersion modelling, with comparison of results against relevant impact assessment criteria. Results have been provided both in tabulated form, and as contour isopleths for the following:

- Maximum 1 hour average incremental $NO_2$ prediction (all $NO_x$ as $NO_2$)
- Annual average incremental $NO_2$ prediction (all $NO_x$ as $NO_2$)
- Maximum 24 hour average incremental $PM_{2.5}$ prediction
- Annual average incremental $PM_{2.5}$ prediction.

All results are presented in the mass-based units of micrograms per cubic metre (µg/m³) with geometric contour spacing (e.g. 1, 2, 5, 10, 20, 50, 100 µg/m³).

Contour isopleths of model predictions are provided in Figure 6.1 through Figure 6.4, whilst Table 6.1 provides a summary of model predictions at sensitive receptor locations, with assessment against EPA criteria.

As shown in Table 6.1, when peak 1 hour average $NO_2$ predictions (assuming all $NO_x$ exists in the form of $NO_2$) are added to peak background $NO_2$, cumulative predictions are within the assessment criterion at all sensitive receptor locations. In a similar manner, annual average $NO_2$ predictions were found to be within the annual average $NO_2$ assessment criterion at all sensitive receptor locations.

$PM_{2.5}$ emissions were found to result in a maximum 24 hour average incremental impact of 1.2 µg/m³ at receptors R09 and R10 to the immediate north of the Site. When added to peak background levels these predictions were found to be within criterion.

Existing background annual average $PM_{2.5}$ levels already exceed the EPA impact assessment criterion, localised peak annual average predictions of 0.7 µg/m³ are considered to present a minor risk of additional exceedances of EPA long-term criterion.

Table 6.7: Summary of dispersion model predictions at discrete receptor locations (µg/m³)

| Receptor | $NO_2$ | | | | $PM_{2.5}$ | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 hour maximum | | Annual | | 24 hour maximum | | Annual | |
| | Inc. | Cum. | Inc. | Cum. | Inc. | Cum. | Inc. | Cum. |
| R01 | 28 | 104 | 9 | 19 | 0.6 | 23.3 | 0.4 | 8.8 |
| R02 | 31 | 107 | 10 | 20 | 0.7 | 23.4 | 0.4 | 8.8 |
| R03 | 32 | 108 | 10 | 20 | 0.7 | 23.4 | 0.5 | 8.9 |
| R04 | 35 | 111 | 12 | 22 | 0.9 | 23.6 | 0.5 | 8.9 |
| R05 | 38 | 114 | 12 | 22 | 0.9 | 23.6 | 0.5 | 8.9 |
| R06 | 40 | 116 | 14 | 24 | 1.0 | 23.7 | 0.6 | 9.0 |
| R07 | 45 | 121 | 16 | 26 | 1.0 | 23.7 | 0.7 | 9.1 |
| R08 | 51 | 127 | 18 | 28 | 1.1 | 23.8 | 0.7 | 9.1 |
| R09 | 53 | 129 | 19 | 29 | 1.2 | 23.9 | 0.7 | 9.1 |
| R10 | 53 | 129 | 19 | 29 | 1.2 | 23.9 | 0.7 | 9.1 |
| R11 | 46 | 122 | 16 | 26 | 1.1 | 23.8 | 0.7 | 9.1 |
| R12 | 33 | 109 | 7 | 17 | 0.5 | 23.2 | 0.3 | 8.7 |
| R13 | 19 | 95 | 3 | 13 | 0.3 | 23.0 | 0.1 | 8.5 |
| R14 | 21 | 97 | 4 | 14 | 0.4 | 23.1 | 0.2 | 8.6 |
| R15 | 24 | 100 | 5 | 15 | 0.5 | 23.2 | 0.2 | 8.6 |
| R16 | 31 | 107 | 6 | 16 | 0.6 | 23.3 | 0.3 | 8.7 |
| R17 | 35 | 111 | 7 | 17 | 0.7 | 23.4 | 0.3 | 8.7 |
| R18 | 38 | 114 | 8 | 18 | 0.8 | 23.5 | 0.4 | 8.8 |
| R19 | 27 | 103 | 7 | 17 | 0.7 | 23.4 | 0.3 | 8.7 |
| R20 | 23 | 99 | 6 | 16 | 0.6 | 23.3 | 0.3 | 8.7 |
| R21 | 18 | 94 | 5 | 15 | 0.4 | 23.1 | 0.2 | 8.6 |
| R22 | 15 | 91 | 4 | 14 | 0.4 | 23.1 | 0.2 | 8.6 |
| R23 | 13 | 89 | 3 | 13 | 0.3 | 23.0 | 0.2 | 8.6 |
| R24 | 10 | 86 | 3 | 13 | 0.2 | 22.9 | 0.1 | 8.5 |
| ***Max*** | ***53*** | ***129*** | ***19*** | ***29*** | ***1.2*** | ***23.9*** | ***0.7*** | ***9.1*** |
| EPA Criterion | - | 246 | - | 62 | - | 25 | - | 8 |

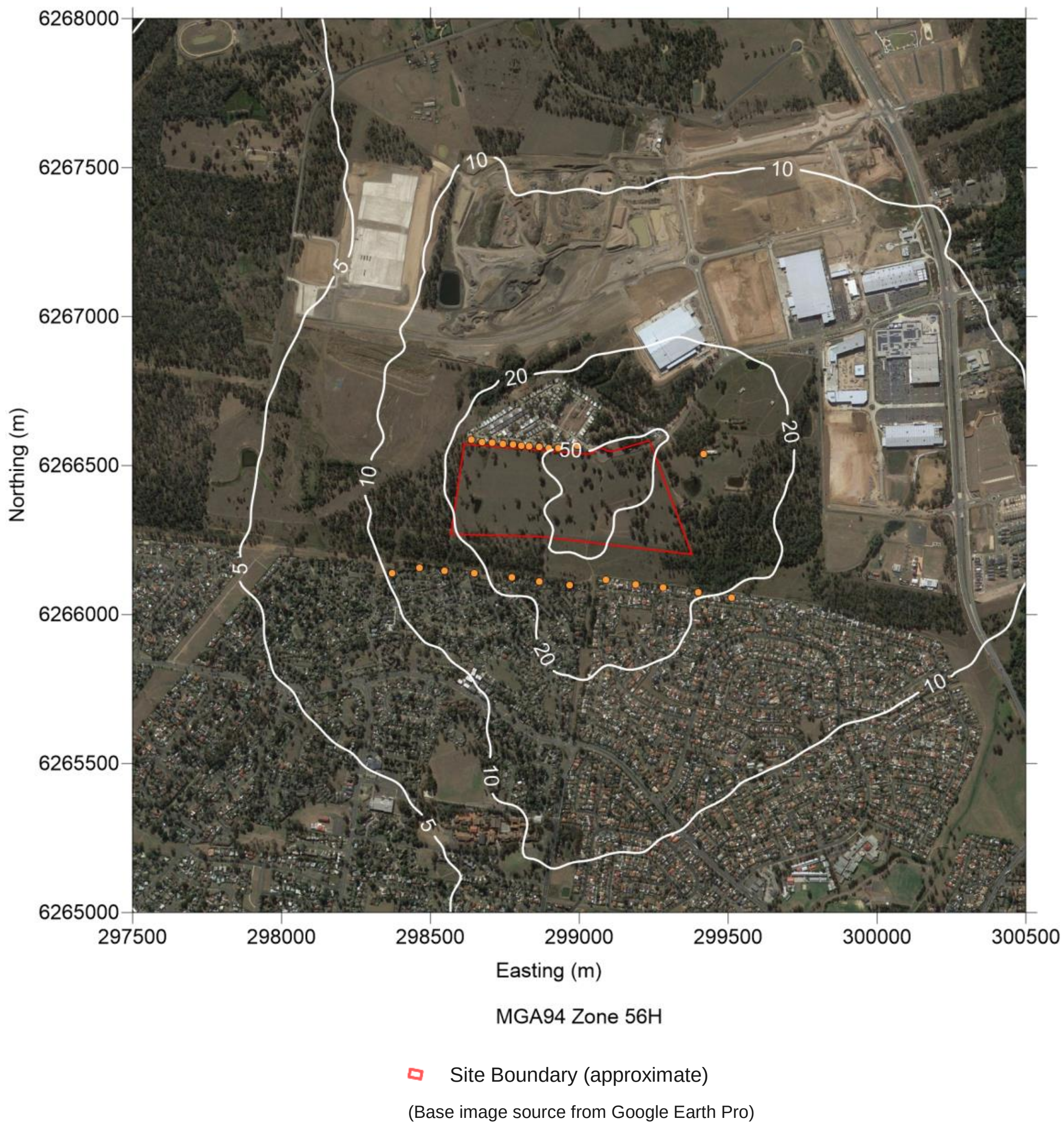



Figure 6.3: Maximum 1 hour average incremental $NO_2$ prediction (µg/m³) – all $NO_x$ as $NO_2$

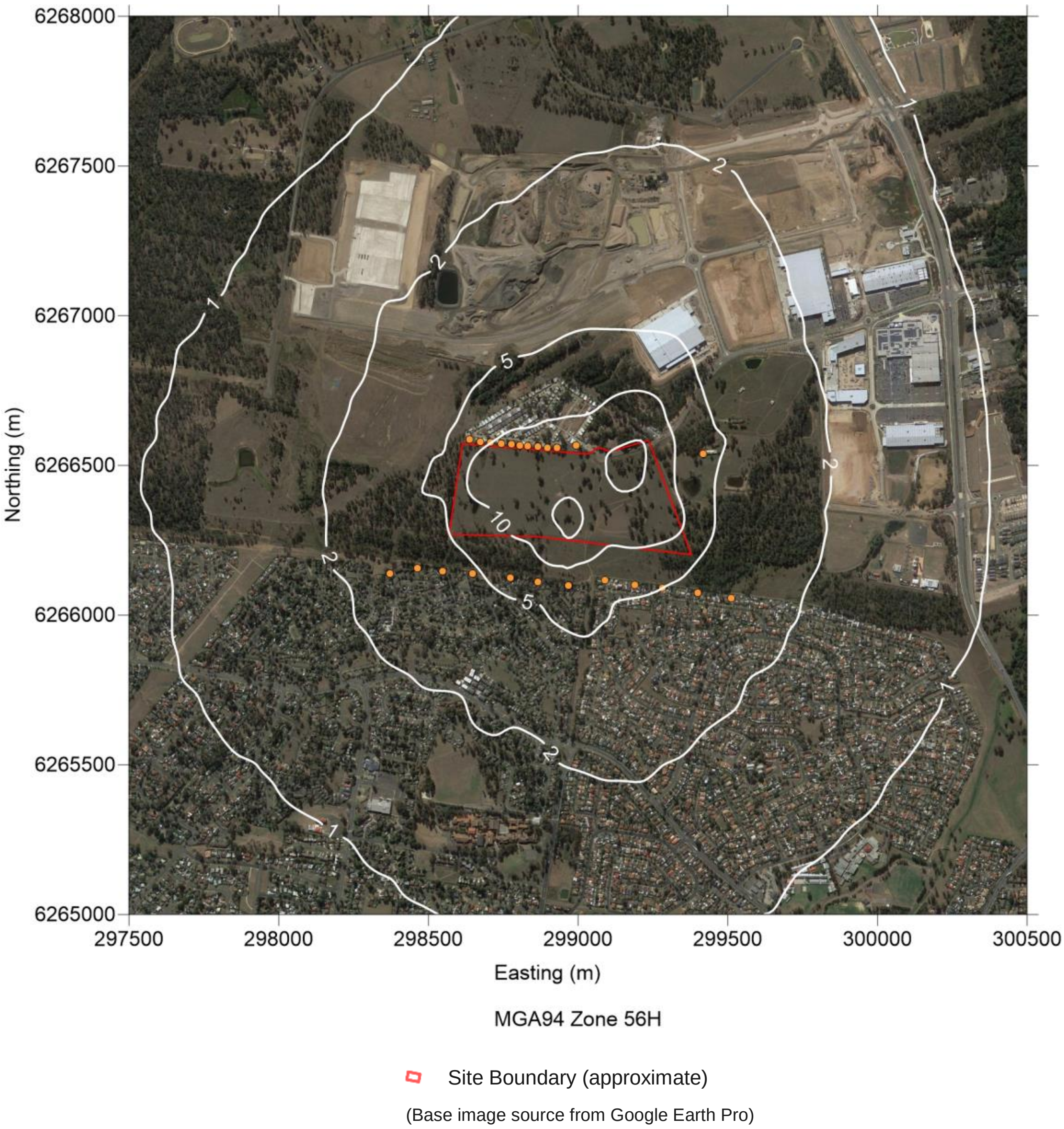



Figure 6.4: Annual average incremental $NO_2$ prediction (µg/m³) – all $NO_x$ as $NO_2$

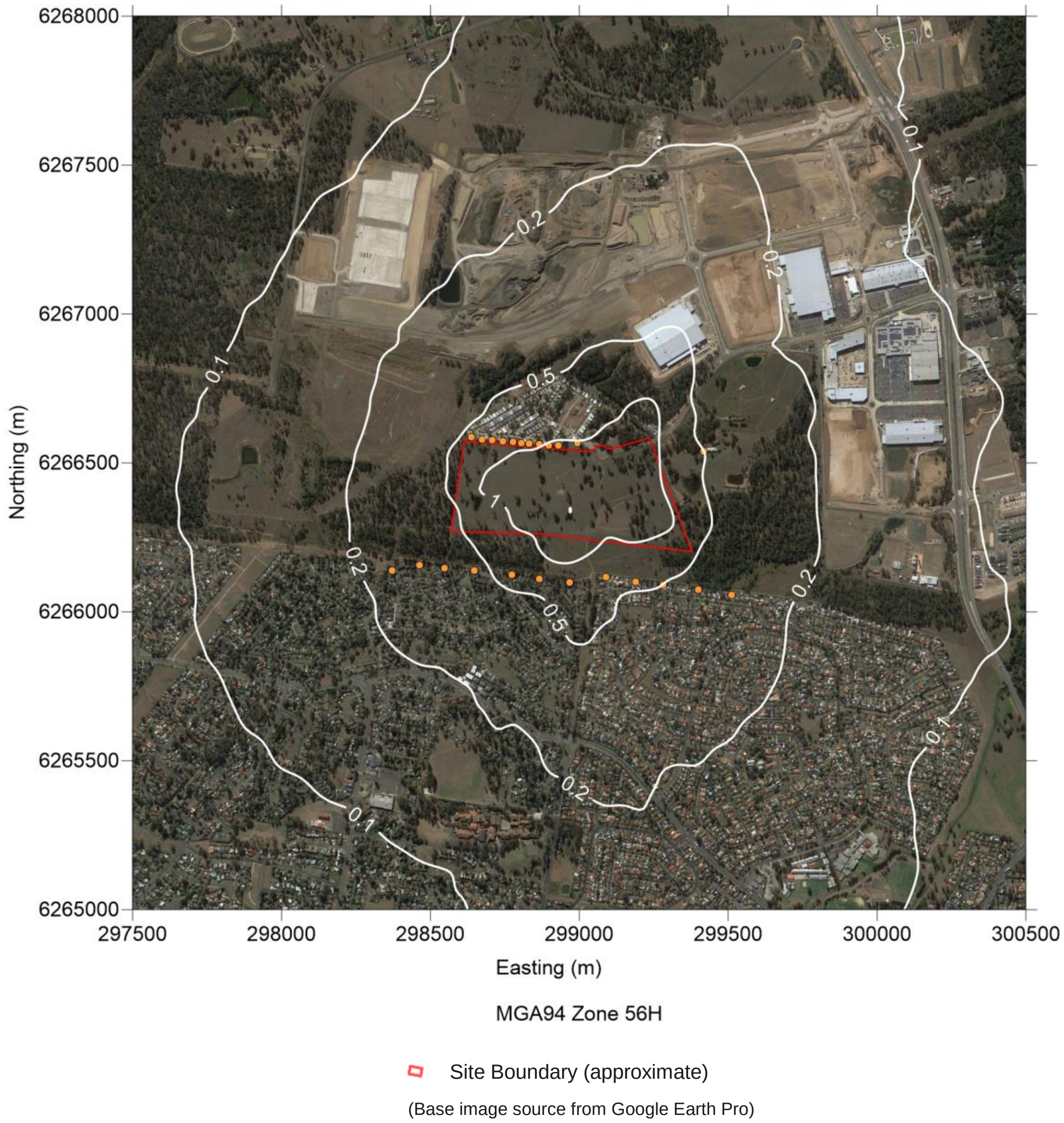



Figure 6.5: Maximum 24 hour average incremental $PM_{2.5}$ prediction (µg/m³)

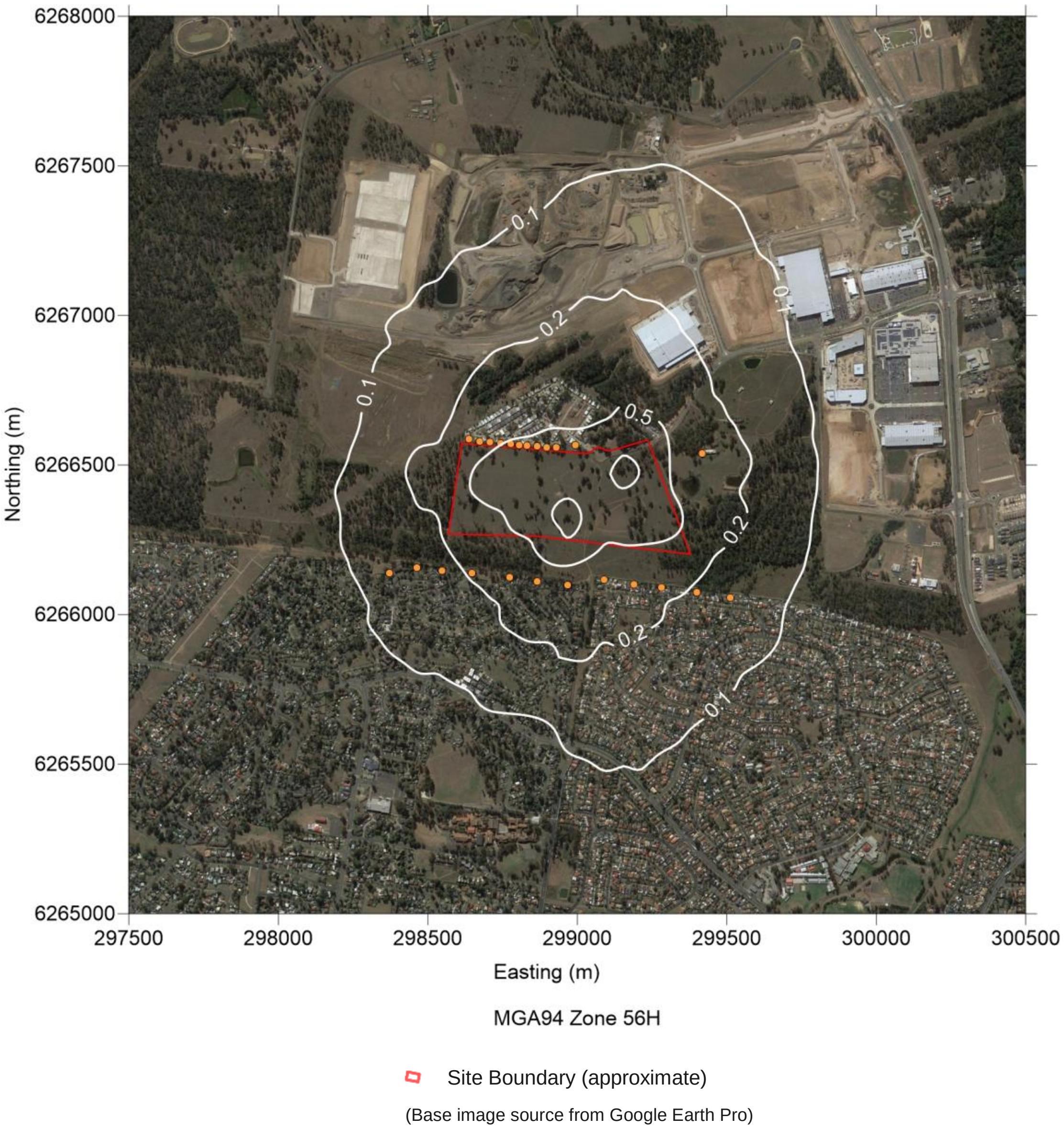



Figure 6.6: Annual average incremental $PM_{2.5}$ prediction (µg/m³)

# 7 Conclusions

Potential operational air quality impacts of the Project have been assessed using a combination of qualitative and quantitative methods. Potential operational impacts have been assessed using atmospheric dispersion modelling techniques in conjunction with pollutant emission estimates that have been based on Project-specific information.

- Emissions of $NO_x$ were found to result in a maximum 1 hour average incremental $NO_2$ impact of 53 µg/m³ at receptors R09 and R10 to the north of the Site. Assuming that all $NO_x$ exists in the form of $NO_2$, cumulative predictions were found to be approximately 50% of the EPA impact assessment criterion. Annual average $NO_2$ predictions were found to be minor relative to the criterion.
- $PM_{2.5}$ emissions were found to result in a maximum 24 hour average incremental impact of 1.2 µg/m³ at receptors R09 and R10 to the immediate north of the Site. When added to peak background levels these predictions were found to be within criterion. Noting that the existing background annual average $PM_{2.5}$ levels already exceed the EPA impact assessment criterion, localised annual average predictions of 0.7 µg/m³ are considered to present a minor risk of additional exceedances of EPA long-term criterion.

Based on this analysis, the potential for the operational phase of the Project to adversely impact local air quality is considered minor.

A qualitative assessment of potential construction dust impacts has been undertaken, based on a conventional approach following the procedures set out in the UK Institute of Air Quality Management (IAQM) document *"Guidance on the assessment of dust from demolition and construction"* (IAQM, 2014). This assessment has identified relevant air quality risks and mitigation strategies.

It is recommended that a construction environmental management plan (CEMP) (that includes dust management) should be produced to cover the construction phase. This should contain details of the site-specific mitigation measures to be applied (as outlined in Section 5). Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW EPA Local Government Air Quality Toolkit.

With regard to the management of potential air quality impacts from operation of the Project, it is recommended that the following mitigation measures be implemented:

- Ensuring that vehicles on the Site minimise time spent idling.
- Ensuring that access arrangement act to minimise vehicle queuing.
- Ensuring that vehicles are maintained to operate in a proper and efficient manner.

# 8 References

IAQM (2014) *Guidance on the assessment of dust from demolition and construction*, Institute of Air Quality Management, London http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

NEPC (1998) *National Environmental Protection Measure and Impact Statement for Ambient Air Quality*, National Environment Protection Council Service Corporation, Level 5, 81 Flinders Street, Adelaide SA 5000

NPI (2008) *National Pollutant Inventory Emission Estimation Technique Manual for Combustion Engines*, Version 3.0, Australian Government – Department of the Environment, Water, Heritage and the Arts, June 2008.

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Ramboll (2016) *Moorebank Precinct West Stage 2 Air Quality Impact Assessment*, Ramboll Environ Australia, 10 October 2016.

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RMS (2002) *Guide to Traffic Generating Development*, Roads and Maritime Services, 2002.

# Appendix A

## Five Year Analysis of Meteorological Data

As specified in the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* five years of data are required to be reviewed so that a representative year of meteorological conditions can be selected.

Annual and seasonal wind roses for St Marys OEH Weather Station have been prepared for 2009 through 2013 and are shown below. Rainfall data was unavailable from St Marys OEH Station, and so annual rainfall data from BOM site Horsley Park Equestrian Centre has been presented in Figure F8 to give further indication of meteorological conditions in the region for the given years. All five years of data collected at St Marys OEH Station show a similar pattern both annually and seasonally. There are some minor differences which are discussed below.

On an annual basis the prevailing wind directions originate from all directions of the compass, with fewer winds experienced from the northeast and north-northeast as well as from the southwest and west-southwest.

During summer the prevailing winds are dominated by flows originating from the southern and south-eastern quadrants.

Conversely, the months of winter are dominated by wind from the south, south-southwestern and north-northwestern quadrants. Almost no winds are experienced from the eastern, south-eastern and north-eastern directions in winter across all years of data examined.

The wind distribution patterns for autumn show a consistent trend to southern, south-southwesterly and south-southeasterly winds.

Spring conditions are less consistent, showing a mixed pattern with some prevalence for Southern, south-southeasterly and south-southwesterly winds as well as a north-northwesterly wind.

The percentage of calms is fairly consistent across all years and ranged between 20.4% for 2009 and 24.7% for 2013.

Further analysis was conducted for the five years of data. The long-term trend of monthly average temperature and monthly average wind speed is also shown below, though temperature data was unavailable for 2009.

A strong seasonal trend in monthly average temperatures is evidenced with the highest temperatures experienced during the summer months of December, January and February and the lowest temperatures during the winter months of June, July and August. 2011 and 2013 are shown to experience higher monthly average temperatures across most months. Generally speaking, the monthly average temperatures at St Marys OEH Weather Station do not vary significantly from year to year.

There is no strong relationship between the time of year and the monthly average wind speed. Generally speaking, the monthly average wind speeds are less during the months of April, May, June and July. 2009 measured clearly the highest winds speed across the five years investigated.

From this analysis, in addition to the consistent wind distribution patterns experienced discussed above it is considered that 2013 is a typical year and is therefore deemed a representative year for dispersion modelling.

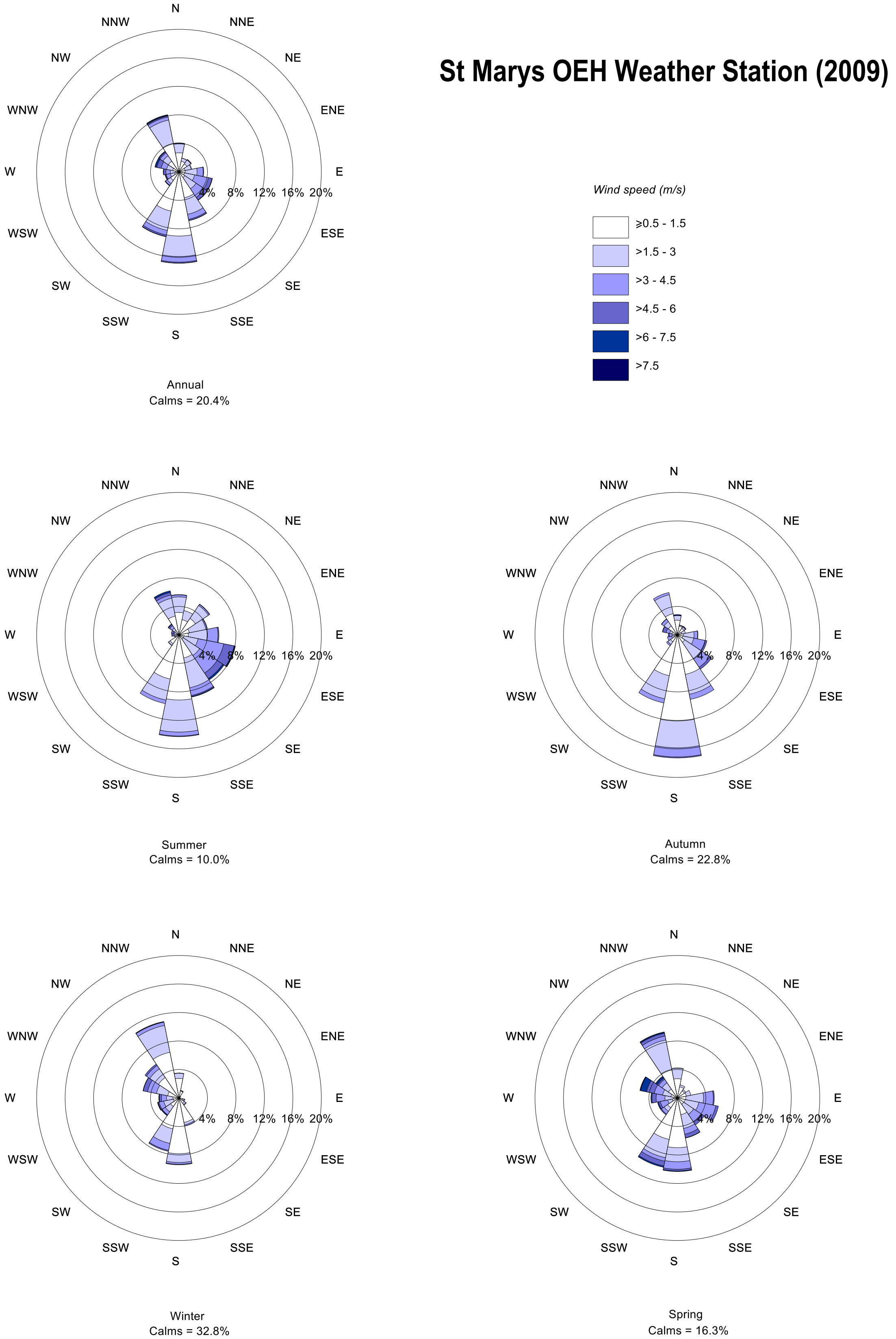


*Figure A-1: Annual and seasonal wind roses for St Marys OEH Station (2009)*

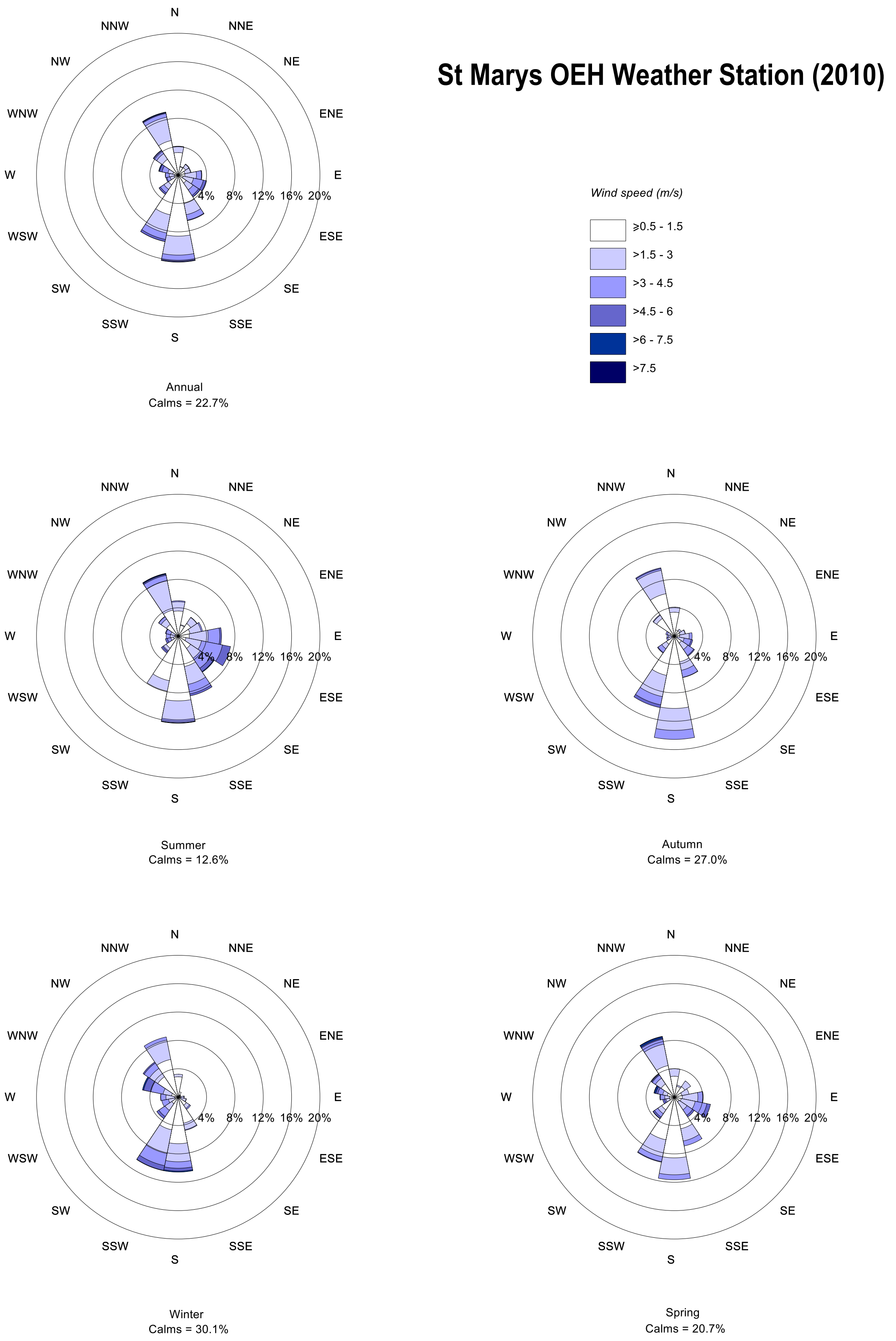


*Figure A-2: Annual and seasonal wind roses for St Marys OEH Station (2010)*

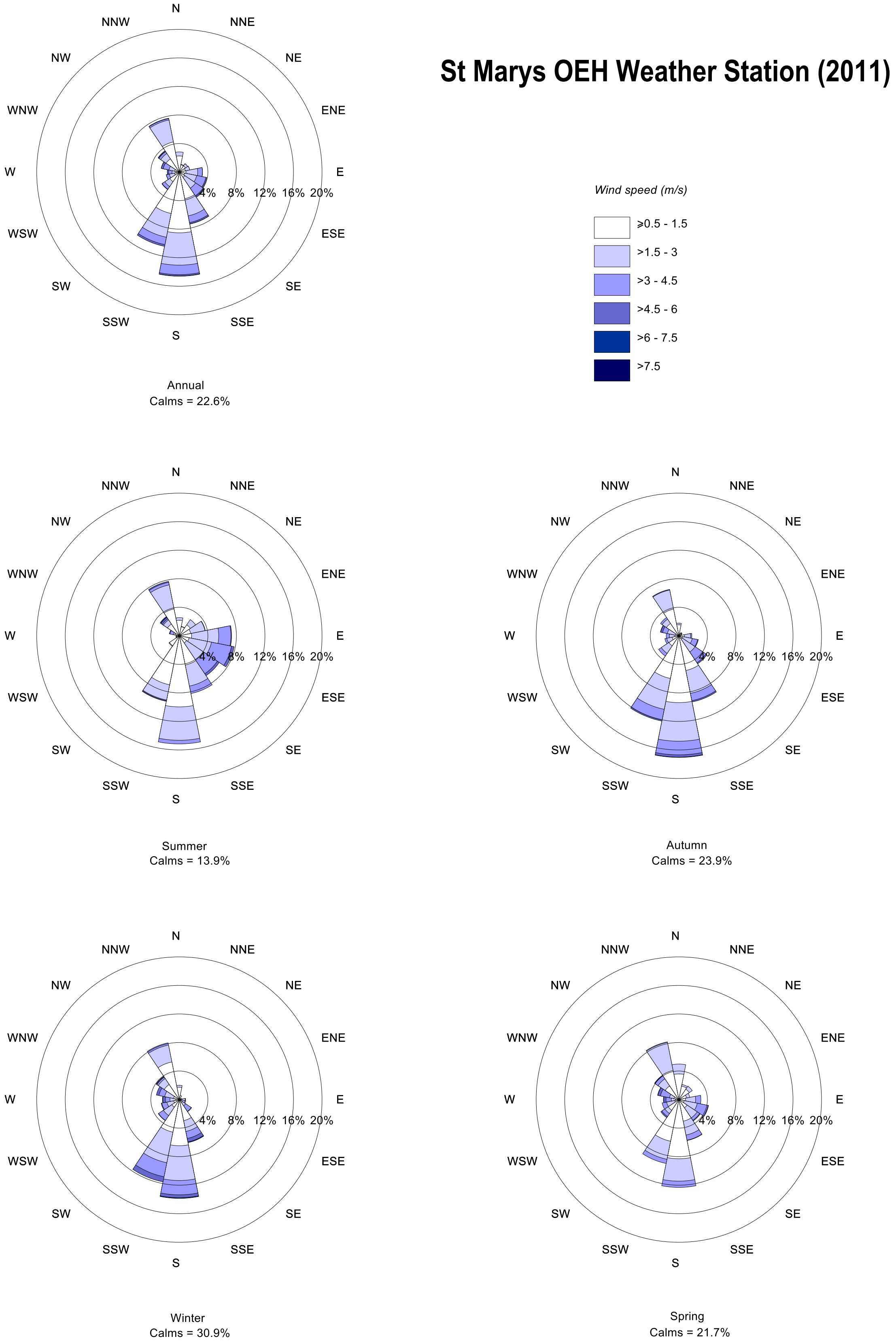


*Figure A-3: Annual and seasonal wind roses for St Marys OEH Station (2011)*

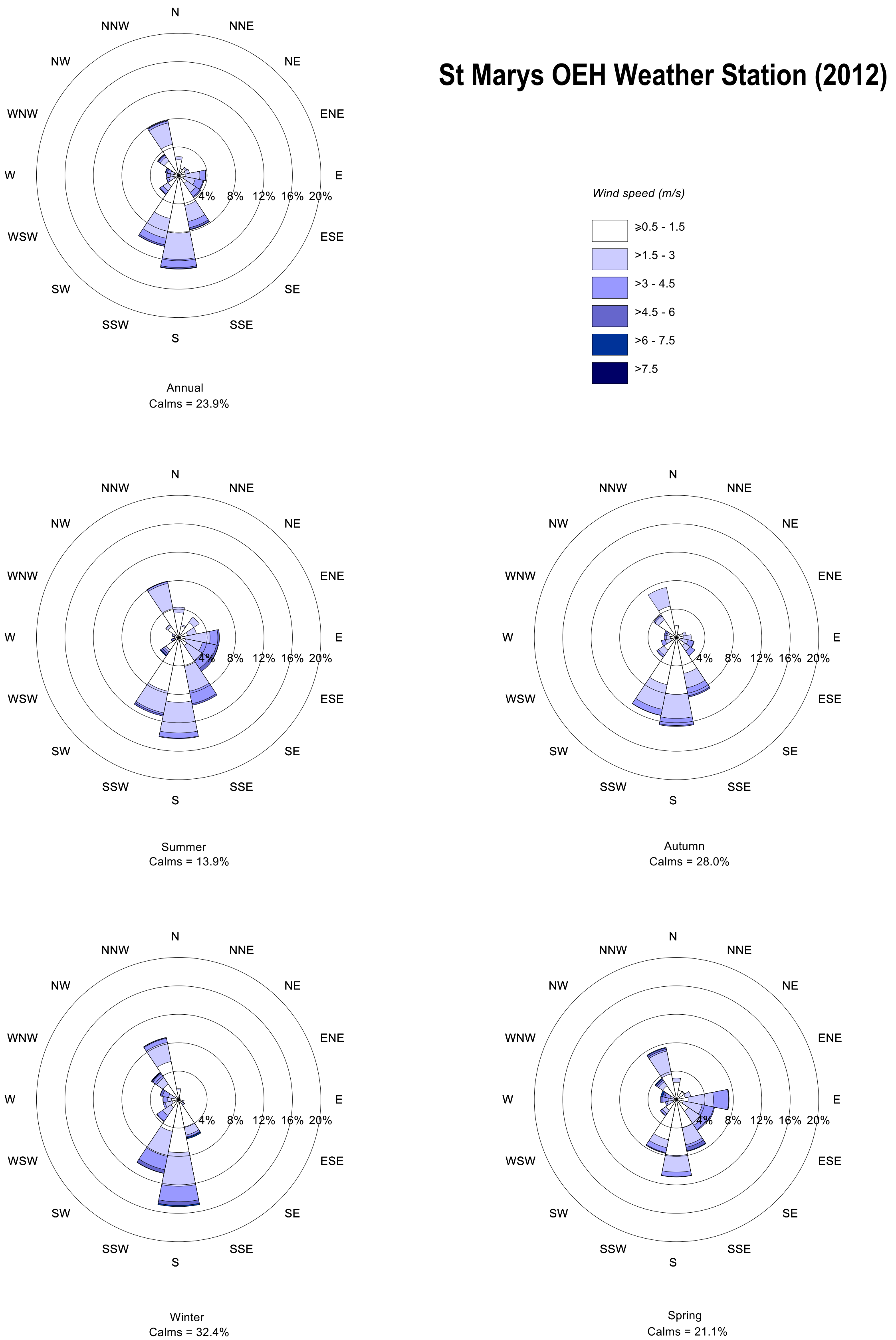


*Figure A-4: Annual and seasonal wind roses for St Marys OEH Station (2012)*

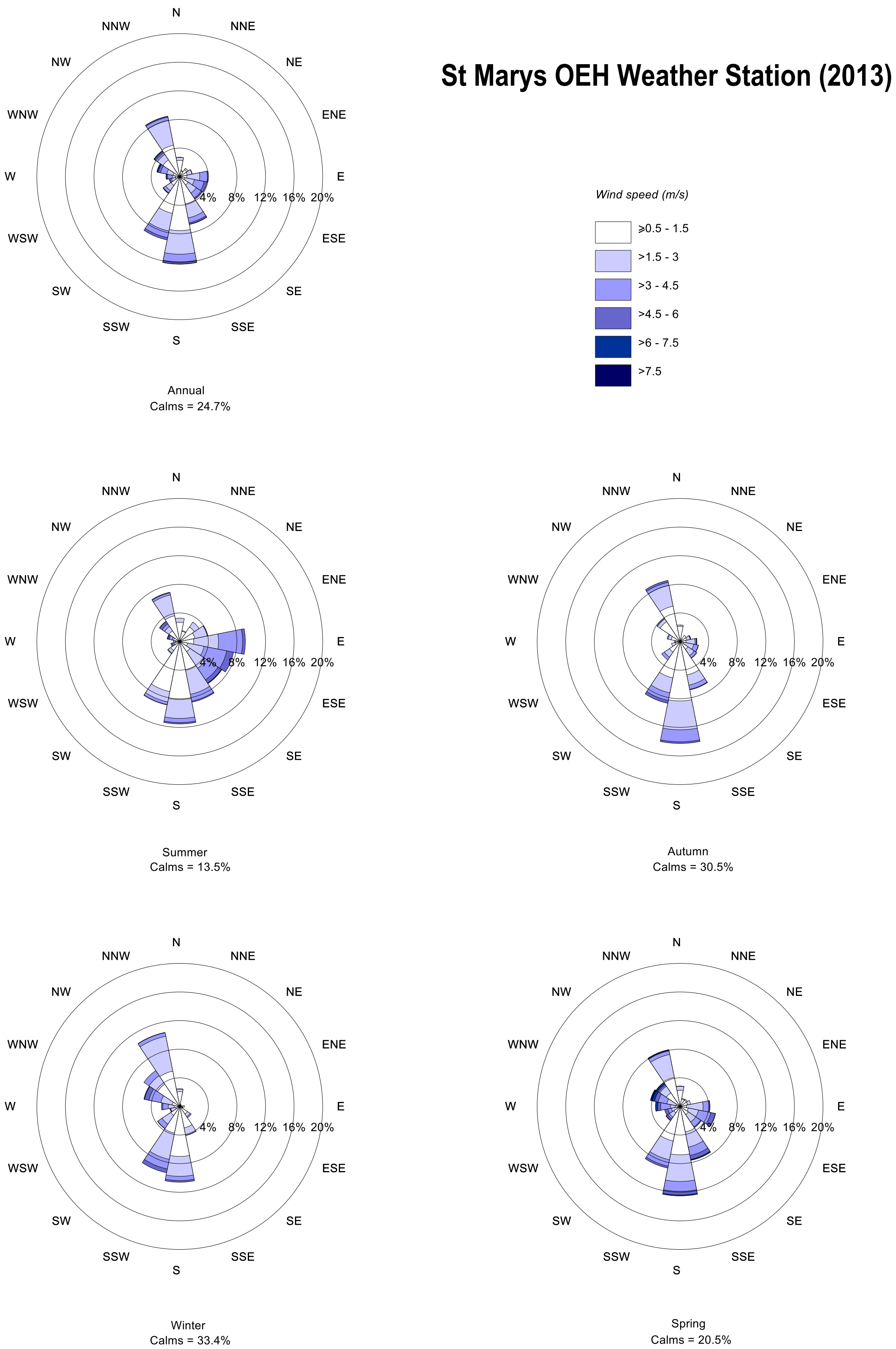


*Figure A-5: Annual and seasonal wind roses for St Marys OEH Station (2013)*

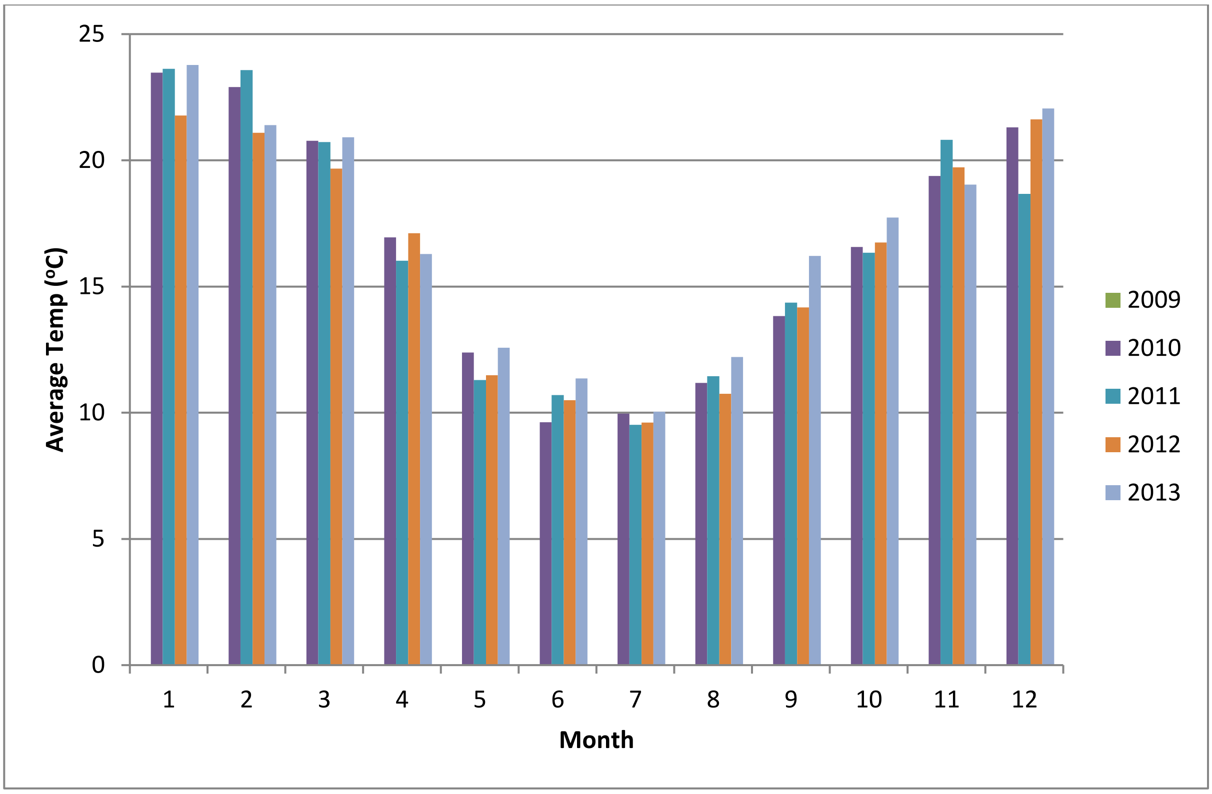


*Figure A-6: Monthly average temperature at St Marys OEH Station (2009 – 2013)*

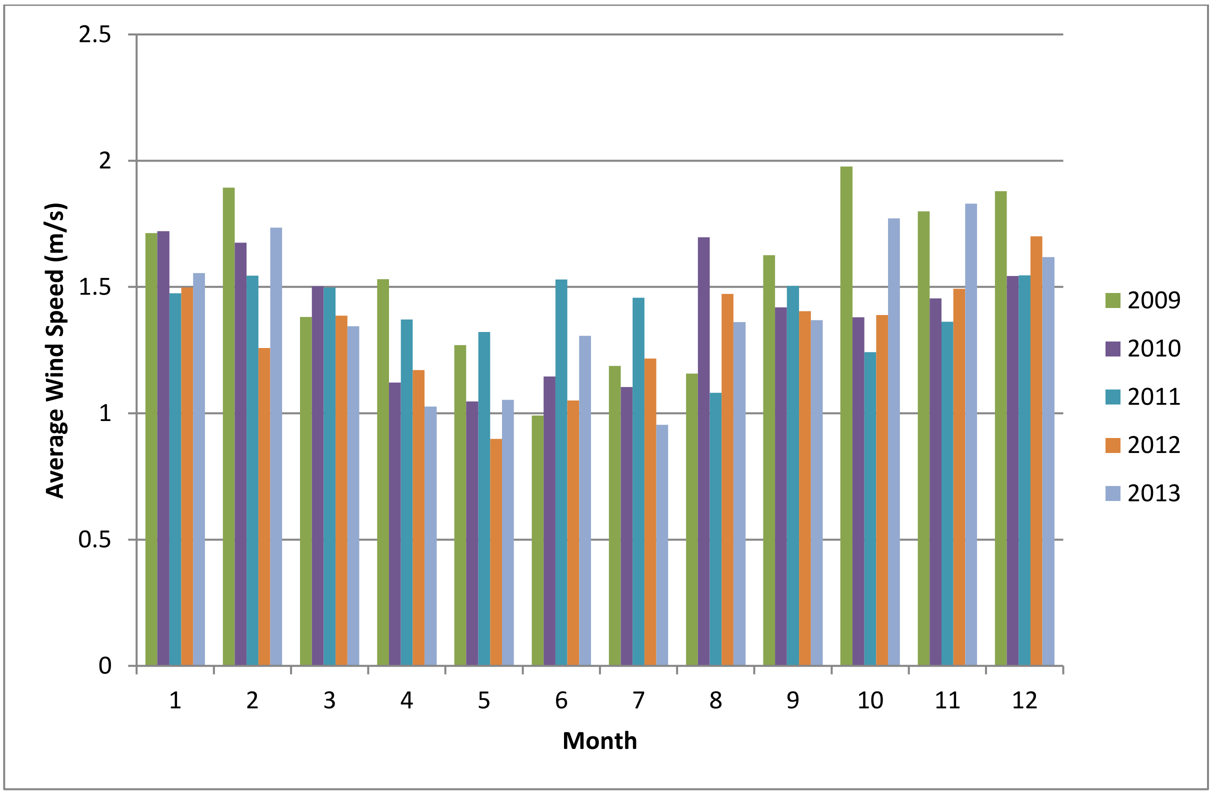


*Figure A-7: Monthly average wind speed at St Marys OEH Station (2009 – 2013)*

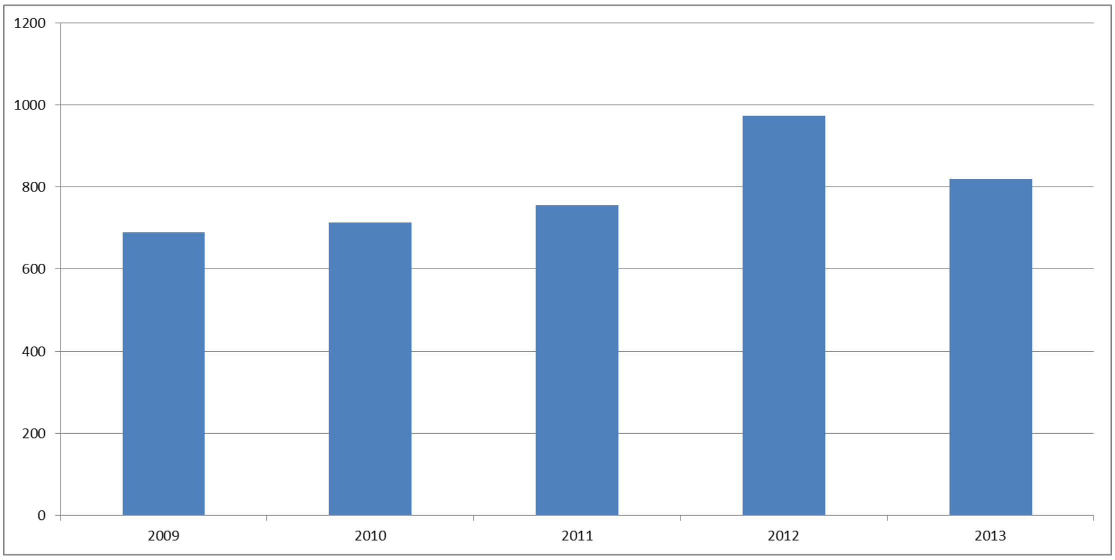


*Figure A-8: Annual rainfall at Horsley Park Equestrian Centre (2009 – 2013)*

# Appendix B

## Construction Dust Assessment Methodology

# B1.1 Overview

The risk of dust impacts from a demolition/construction site causing loss of amenity and/or health or ecological impacts is related to the following (IAQM, 2014):

- The nature of the activities being undertaken.
- The duration of the activities.
- The size of the site.
- The meteorological conditions (wind speed, direction and rainfall). Adverse impacts are more likely to occur downwind of the site and during drier periods.
- The proximity of receptors to the activities.
- The sensitivity of the receptors to dust.
- The adequacy of the mitigation measures applied to reduce or eliminate dust.

It is very difficult to quantify dust emissions from construction activities. Due to the variability of the weather it is impossible to predict what the weather conditions would be when specific construction activities are undertaken. Any effects of construction on airborne particle concentrations would also generally be temporary and relatively short-lived. Moreover, mitigation should be straightforward, as most of the necessary measures are routinely employed as ‘good practice’ on construction sites. It is therefore usual to provide a qualitative assessment of potential construction dust impacts. A largely qualitative approach has also been used here, and the impacts of construction have not been specifically modelled. The approach used for Proposal was based on that described by IAQM (2014). The aim is to identify risks and to recommend appropriate mitigation measures.

The IAQM guidance is designed primarily for use in the UK, although it may be applied elsewhere. Here, the guidance has been adapted for use in NSW, taking into account factors such as the assessment criteria for ambient $PM_{10}$ concentrations.

# B1.2 Assessment procedure

The IAQM assessment procedure for assessing risk is shown in Figure B1. Professional judgement is required in some steps, and where justification cannot be given a precautionary approach should be adopted.

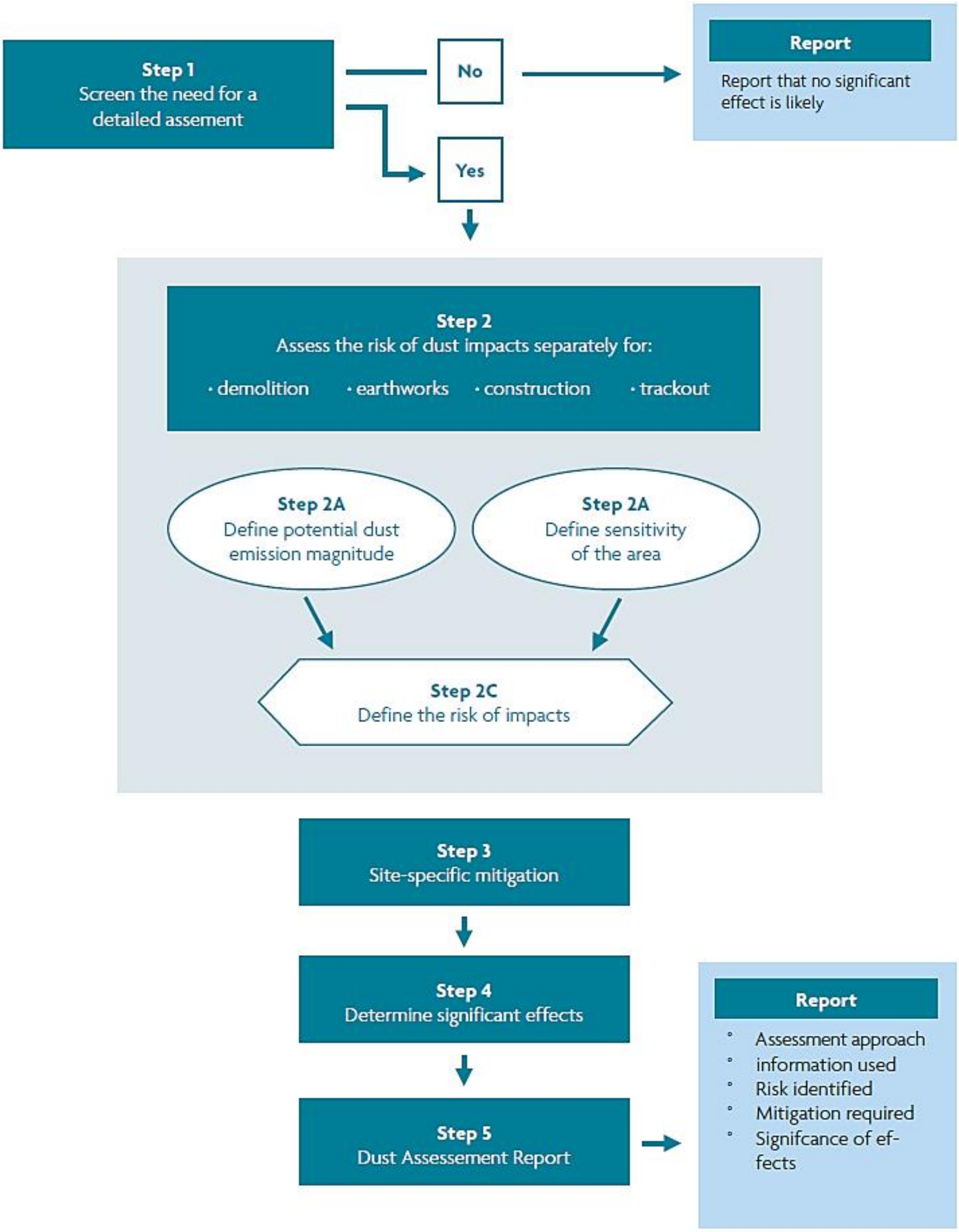


Figure B-1: Steps in an assessment of construction dust (IAQM, 2014)

Activities on construction sites can be divided into four types to reflect their different potential impacts, and the potential for dust emissions is assessed for each activity that is likely to take place. These activities are:

- *Demolition*. Demolition is any activity that involves the removal of existing structures. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time.

- *Earthworks*. This covers the processes of soil stripping, ground levelling, excavation and landscaping. Earthworks will primarily involve excavating material, haulage, tipping and stockpiling.

- *Construction*. Construction is any activity that involves the provision of new structures, modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, *etc*.
- *Track-out.* This involves the transport of dust and dirt by HDVs from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The assessment methodology considers three separate dust impacts:

- Annoyance due to dust soiling.
- The risk of health effects due to an increase in exposure to $PM_{10}$.
- Harm to ecological receptors

The assessment is used to define appropriate mitigation measures to ensure that there will be no significant effect.

The assessment steps, as they were applied to the mine, are summarised in the following Sections.

### *Step1: Screening*

Step 1 is a screening assessment. A construction dust assessment will normally be required where:

- There are human receptors within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).
- There are ecological receptors within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A 'human receptor', refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling, or exposure to $PM_{10}$ over a time period relevant to air quality standards and goals. In terms of annoyance effects, this will most commonly relate to dwellings, but may also refer to other premises such as buildings housing cultural heritage collections (e.g. museums and galleries), vehicle showrooms, food manufacturers, electronics manufacturers, amenity areas and horticultural operations (e.g. salad or soft-fruit production). An 'ecological receptor' refers to any sensitive habitat affected by dust soiling. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition, and the indirect impacts on fauna (e.g. on foraging habitats) (IAQM, 2014).

In this screening stage the individual areas of proposed construction works were examined. It can be seen from Figure B2 that there are sensitive receptors (project-related residences) within 350 metres of the boundaries of the project boundary.

Little information was available on the ecological sensitivity for the study area. In view of the current land use and proximity to urban areas it has been assumed that there are no ecologically sensitive receptors located within 50 m of the construction activities.

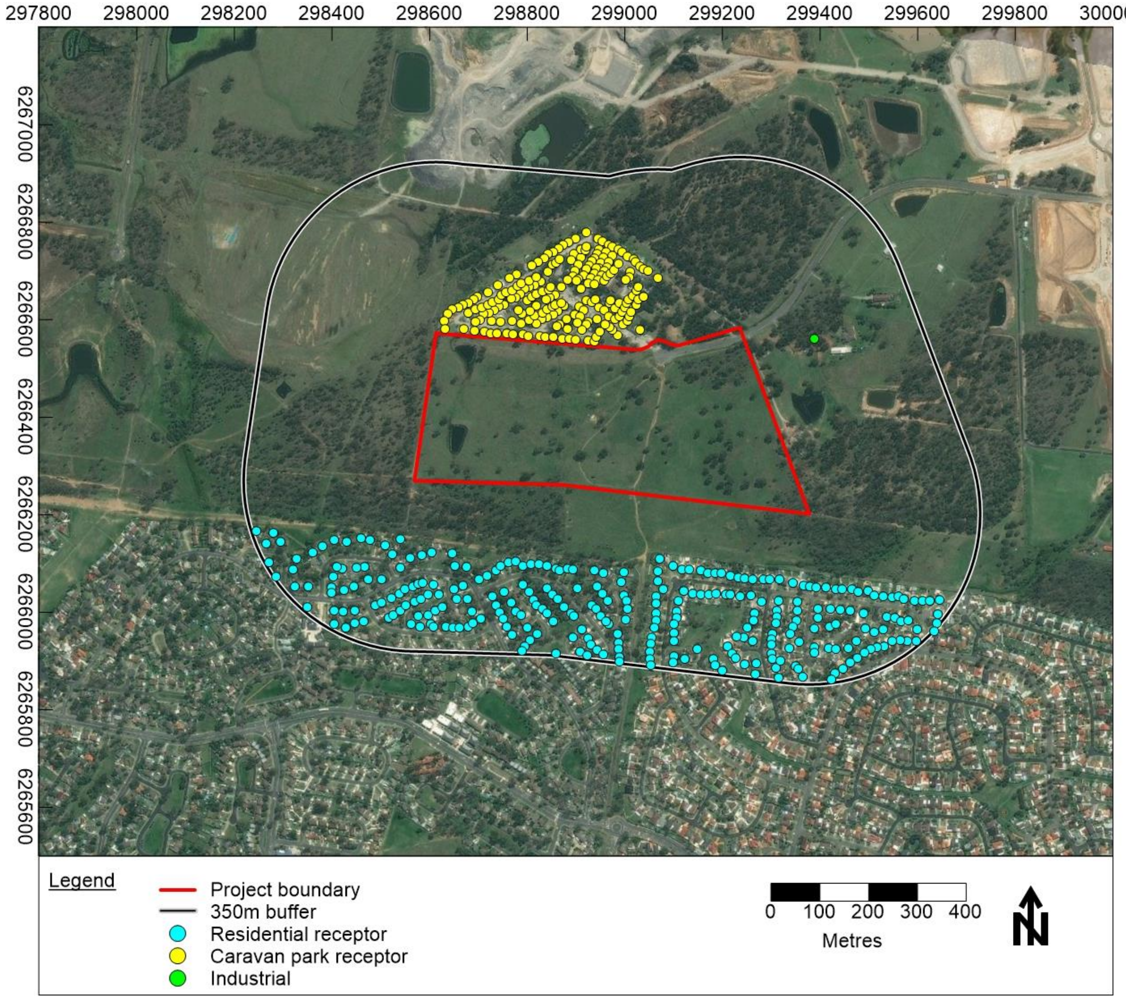


Figure B-2: Screening assessment – human receptors near the construction

The construction assessment therefore proceeded to Step 2 for soiling and human health impacts only, and ecological impacts were not assessed.

## *Step 2: Risk assessment*

In Step 2 the risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined separately for each scenario and each of the four activities (demolition, earthworks, construction, and track-out). Risk categories were assigned to the site based on two factors:

- The scale and nature of the works, which determines the magnitude of potential dust emissions. This is assessed in Step 2A.
- The sensitivity of the area, including the proximity of sensitive receptors (i.e. the potential for effects). This is assessed in Step 2B.

These factors are combined in Step 2C to give the risk of dust impacts. Risks are categorised as low, medium or high for each of the four separate potential activities. Where there is risk of an impact, then site-specific mitigation will be required in proportion to the level of risk.

### Step 2A: Potential for dust emissions

The criteria for assessing the potential scale of emissions based on the scale and nature of the works are shown in Table B1. Based on these criteria and construction assumptions provided, the appropriate categories for the Proposal are shown in Table B2.

Table B1: Site categories (scale of works) (from IAQM, 2014)

| Type of activity | Site category | | |
|---|---|---|---|
| | Large | Medium | Small |
| Demolition | Building volume >50,000 $m^3$, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level. | Building volume 20,000–50,000 $m^3$, potentially dusty construction material, demolition activities 10-20 m above ground level. | Building volume <20,000 $m^3$, construction material with low potential for dust release (e.g. metal cladding, timber), demolition activities <10 m above ground and during wetter months. |
| Earthworks | Site area >10,000 $m^2$, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth-moving vehicles active at any one time, formation of bunds>8 m in height, total material moved >100,000 tonnes. | Site area 2,500-10,000 $m^2$, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4-8 m in height, total material moved 20,000-100,000 tonnes. | Site area <2,500 $m^2$, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months. |
| Construction | Total building volume >100,000 $m^3$, piling, on site concrete batching; sandblasting | Building volume 25,000-100,000 $m^3$, potentially dusty construction material (e.g. concrete), piling, on site concrete batching. | Total building volume <25,000 $m^3$, construction material with low potential for dust release (e.g. metal cladding or timber). |
| Track-out | >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m. | 10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50–100 m. | <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m. |

Table B2: Site categories for the Proposal

| Type of activity | Activity assumptions | Category |
|---|---|---|
| Demolition | - No demolition is expected | n/a (a) |
| Earthworks | - Site area greater than 10,000 $m^2$, however total volume to be moved during earthworks is between 20,000-100,000 tonnes. | Medium |
| Construction | - Building volumes will be between ~166,000 $m^3$, however this is for total warehousing volume. A value of 20% is considered more reasonable.<br>- There will be potentially dusty construction material<br>- There will not be any piling or concrete batching | Medium |
| Track-out | - Total volume of material to be brought on site is 1,000$m^3$ for entire Project. Less than 10 HDV per day are anticipated.<br>- The surface material of the road will potentially be dusty e.g. during excavation activities. | Low |

Note (a): The site is currently greenfield therefore no demolition activities will take place as part of the Project.

## *Step 2B: Sensitivity of area*

The sensitivity of the area takes into account the specific sensitivities of local receptors, the proximity and number of the receptors, and the local background $PM_{10}$ concentration. Dust soiling and health impacts are treated separately.

## *Sensitivity of area to dust soiling effects on people and property*

The criteria for determining the sensitivity of an area to dust soiling effects are shown in Table B-3 Based on the IAQM guidance[2] the receptor sensitivity was assumed to be 'High':

Table B-3: Criteria for sensitivity of area to dust soiling effects (from IAQM, 2014)

| Receptor sensitivity | Number of receptors | Distance from source (m) | | | |
|---|---|---|---|---|---|
| | | <20 | <50 | <100 | <350 |
| High | >100 | High | High | Medium | Low |
| | 10-100 | High | Medium | Low | Low |
| | 1-10 | Medium | Low | Low | Low |
| Medium | >1 | Medium | Low | Low | Low |
| Low | >1 | Low | Low | Low | Low |

The number of nearby receptors was estimated from site plans (see Figure B-2). The exact counting of the number of 'human receptors' is not required by the IAQM guidance. Instead it is recommended that judgement is used to determine the approximate number of receptors within each distance band. For receptors which are not dwellings professional judgement should be used to determine the number of human receptors.

The numbers of receptors for each scenario and activity, and the resulting outcomes are shown in Table B-4.

[2] Professional judgement is used to identify where on the spectrum between high and low sensitivity a receptor lies. High sensitivity receptors can reasonably expect enjoyment of a high level of amenity. The appearance, aesthetics or value of their properties would be diminished by soiling, and the people or properties would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.

Table B-4: Results - sensitivity to dust soiling effects

| Activity | Receptor sensitivity | Number of receptors by distance from source | | | | Sensitivity of area |
|---|---|---|---|---|---|---|
| | | <20 m | 20-50 m | 50-100 m | 100-350 m | |
| Demolition | - | - | - | - | - | n/a |
| Earthworks | High | 10 | 15 | 34 | 787 | Medium |
| Construction | High | 10 | 15 | 34 | 787 | Medium |
| Track-out | High | 10 | 15 | N/A | N/A | Medium |

## *Sensitivity of area to human health impacts*

The criteria for determining the sensitivity of an area to human health impacts caused by construction dust are shown in Table B-5. Based on the IAQM guidance[3] the receptor sensitivity was assumed to be 'High'. The numbers of receptors for each scenario and activity, and the resulting outcomes are shown in

[3] The sensitivity of people to the health effects of $PM_{10}$ is based on exposure to elevated concentrations over a 24-hour period. High sensitivity receptors relate to locations where members of the public are exposed over a time period relevant to the air quality objective for $PM_{10}$ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.

Table B-6.

Table B-5: Criteria for sensitivity of area to health impacts

| Receptor sensitivity | Annual mean $PM_{10}$ conc. ($\mu g/m^3$) [(a)] | Number of receptors | Distance from source (m) | | | | |
|---|---|---|---|---|---|---|---|
| | | | <20 | <50 | <100 | <200 | <350 |
| High | >24 | >100 | High | High | High | Medium | Low |
| | | 10-100 | High | High | Medium | Low | Low |
| | | 1-10 | High | Medium | Low | Low | Low |
| | 21-24 | >100 | High | High | Medium | Low | Low |
| | | 10-100 | High | Medium | Low | Low | Low |
| | | 1-10 | High | Medium | Low | Low | Low |
| | 18-21 | >100 | High | Medium | Low | Low | Low |
| | | 10-100 | High | Medium | Low | Low | Low |
| | | 1-10 | Medium | Low | Low | Low | Low |
| | <18 | >100 | Medium | Low | Low | Low | Low |
| | | 10-100 | Low | Low | Low | Low | Low |
| | | 1-10 | Low | Low | Low | Low | Low |
| Medium | - | >10 | High | Medium | Low | Low | Low |
| | | 1-10 | Medium | Low | Low | Low | Low |
| Low | - | >1 | Low | Low | Low | Low | Low |

(a) Scaled for Sydney, according to the ratio of NSW and UK annual mean standards (30 $\mu g/m^3$ and 40 $\mu g/m^3$ respectively).

Table B-6: Results - sensitivity to health impacts

| Activity | Receptor sensitivity | Annual mean $PM_{10}$ conc. (µg/m$^3$) | Number of receptors by distance from source | | | | | Sensitivity of area |
|---|---|---|---|---|---|---|---|---|
| | | | <20 m | 20-50 m | 50-100 m | 100-200 m | 100-350 m | |
| Demolition | High | 18-21 | 10 | 15 | 34 | 228 | 559 | n/a |
| Earthworks | High | 18-21 | 10 | 15 | 34 | 228 | 559 | Low |
| Construction | High | 18-21 | 10 | 15 | 34 | 228 | 559 | Low |
| Track-out | High | 18-21 | 10 | 15 | n/a | n/a | n/a | Low |

## Risk of dust impacts

The dust emission potential determined in Step 2A is combined with the sensitivity of the area determined in Step 2B to give the risk of impacts with no mitigation applied. The criteria are shown in Table B-7.

Table B-7: Criteria for sensitivity of area to health impacts (from IAQM, 2014)

| Type of activity | Sensitivity of area | Dust emission potential | | |
|---|---|---|---|---|
| | | Large | Medium | Small |
| Demolition | High | High Risk | Medium Risk | Medium Risk |
| | Medium | High Risk | Medium Risk | Low Risk |
| | Low | Medium Risk | Low Risk | Negligible |
| Earthworks | High | High Risk | Medium Risk | Low Risk |
| | Medium | Medium Risk | Medium Risk | Low Risk |
| | Low | Low Risk | Low Risk | Negligible |
| Construction | High | High Risk | Medium Risk | Low Risk |
| | Medium | Medium Risk | Medium Risk | Low Risk |
| | Low | Low Risk | Low Risk | Negligible |
| Track-out | High | High Risk | Medium Risk | Low Risk |
| | Medium | Medium Risk | Low Risk | Negligible |
| | Low | Low Risk | Low Risk | Negligible |

## B1.3 Final results

The final results for the construction risk assessment are provided in Table B-8. Overall earthworks and construction activities classed as 'medium risk' and track-out was considered 'low risk'.

Table B-8: Summary of risk assessment for the Project

| Type of activity | Step 2A: Potential for dust emissions | Step 2B: Sensitivity of area | | | Step 2C: Risk of dust impacts | | |
|---|---|---|---|---|---|---|---|
| | | Dust soiling | Human health | Ecological | Dust soiling | Human health | Ecological |
| Demolition | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Earthworks | Medium | Medium | Low | n/a | Medium Risk | Low Risk | n/a |
| Construction | Medium | Medium | Low | n/a | Medium Risk | Low Risk | n/a |
| Track-out | Small | Medium | Low | n/a | Negligible | Negligible | n/a |