OAKDALE WEST ESTATE

Construction Air Quality Management Plan
SSD 7348

Prepared for:

Goodman Property Services (Aust) Pty Ltd
Level 17
60 Castlereagh Street
Sydney NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Goodman Property Services (Aust) Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Goodman Property Services (Aust) Pty Ltd (Goodman) to prepare a Construction Air Quality Management Plan (CAQMP) for the construction of Oakdale West Industrial Estate (Oakdale West) located in western Sydney area of Erskine Park, New South Wales (NSW).

The CAQMP is required under Condition D92 of Development Consent for State Significant Development 7348 (SSD 7348), granted in 2019 by the Department of Planning, Industry and Environment (DPIE) for the Oakdale West 'Concept Proposal' and 'Stage 1 Development'.

Whilst development consent has been granted for Oakdale West 'Concept Proposal' and 'Stage 1 Development', this CAQMP is specifically for the construction of Oakdale West only. The construction of Western North South Link Road (WNSLR) is covered in a separate CAQMP.

1.1 Development Overview

Oakdale West is a regional warehouse and distribution hub, is located at Kemps Creek within the Penrith Local Government Area (LGA) and forms part of the broader Oakdale Industrial Precinct located within the Western Sydney Employment Area (WSEA) (see **Figure 1**).

Goodman obtained Development Consent SSD 7348 on 13 September 2019 from the DPIE for the Oakdale West 'Concept Proposal' and 'Stage 1 Development'. The Concept Proposal essentially comprises a 'Master Plan' to guide the staged development of Oakdale West and core development controls that will form the basis for design and assessment of future development applications for the site. It includes:

- Establishing primary site access, road layouts (including internal road network and connections to the external road network), developable and non-developable lands, biodiversity offsets, indicative development stages and development controls for the future development of the site;
- Stage 1 Development of the Estate including:
  - Estate Works, including site preparation, bulk earthworks and retaining walls, catchment level stormwater infrastructure, trunk services connections and utility infrastructure, roads and access infrastructure associated with Stage 1 and subdivision in Stage 1 development works;
  - Precinct Development, including construction, fit out and use of warehouse buildings within Precinct 1, detailed earthworks, on lot stormwater, services and utility infrastructure and construction of industrial/warehouse buildings;
  - Construction of a new regional road known as the WNSLR connecting to Lenore Drive to provide the primary access to the site; and
  - Western boundary landscaping.

This CAQMP has been prepared to cover the earthworks and civil construction to be undertaken by Burton Civil Engineering Contractors (Burton) across Oakdale West (see **Figure 2**). A separate CAQMP has been prepared to cover the construction of the WNSLR which will be undertaken by Robson Civil Projects (Robson). AT&L Associates (AT&L) will act as the Project Manager and Contract Superintendent overseeing both the construction of the Oakdale West and WNSLR.

Note: Where Goodman is nominated as having responsibility as the Applicant, this may be delegated to their specialist consultants.

For the purposes of this document, the development is described in *Environmental Impact Statement, Oakdale West Estate - State Significant Development Application* (EIS) prepared by Urbis (2017), including all specialist assessments and other appendices.

Figure 1 Regional Locality

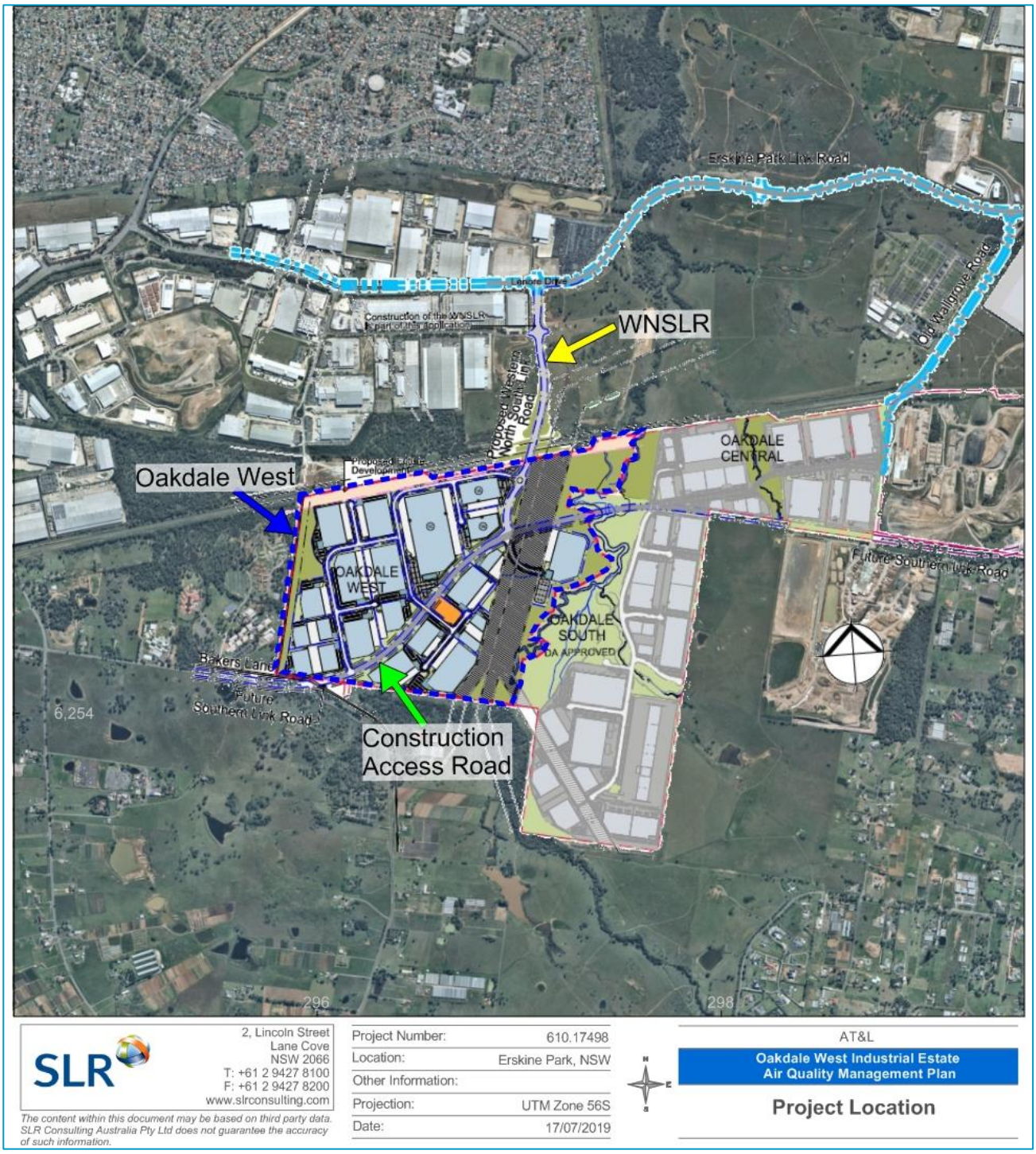
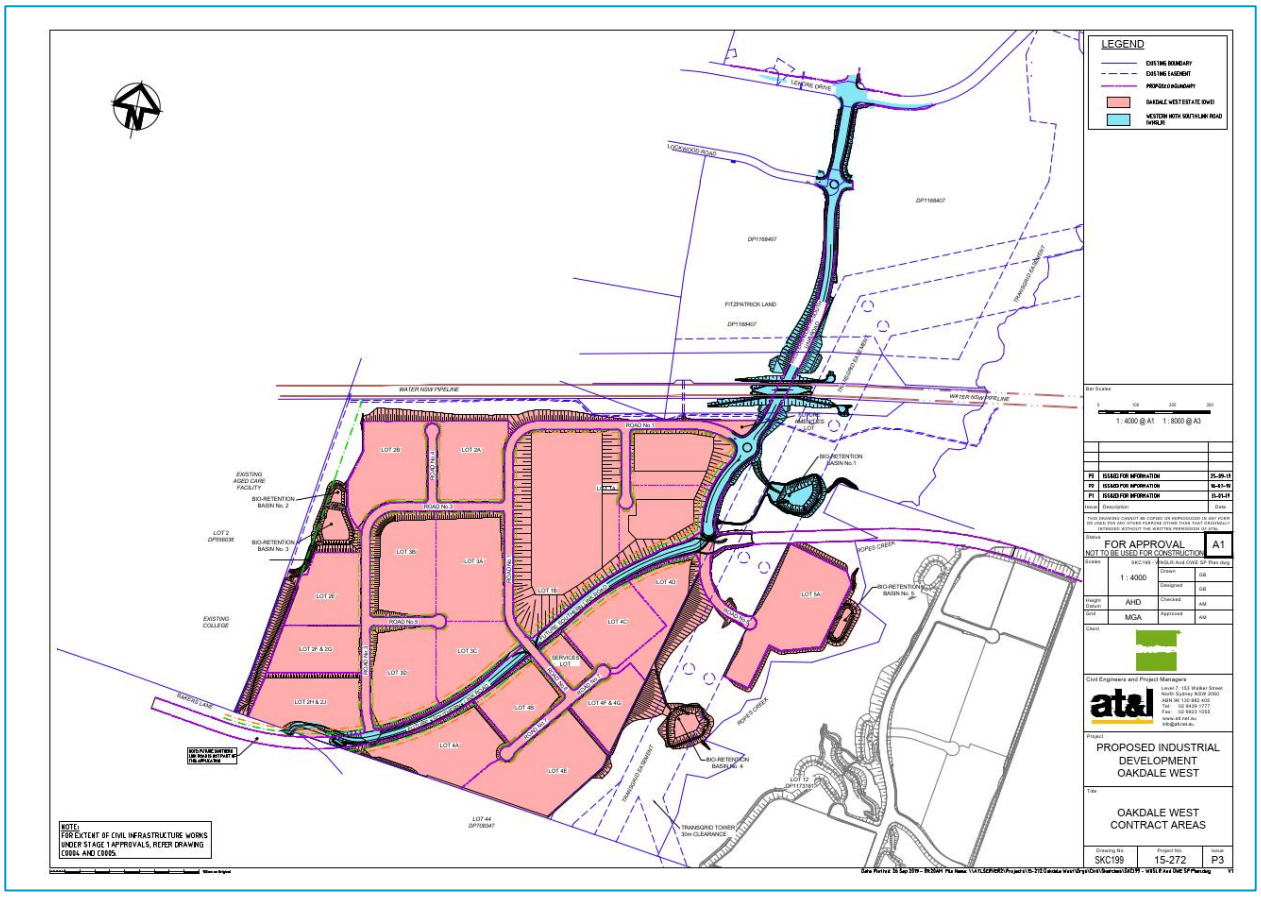


Figure 2 Oakdale West Layout



1.2 Objectives of the CAQMP

The objectives of the CAQMP are as follows:

- Maintain acceptable levels of amenity for surrounding residents;
- Ensure compliance with relevant ambient air quality criteria for particulate matter at surrounding receptor locations;
- Maintain an effective response mechanism to deal with issues and complaints relating to dust emissions from the construction works;
- Outline roles and responsibilities in relation to the management of dust emissions during construction; and
- Promote environmental awareness among employees and subcontractors.

2 Statutory Requirements

2.1 Development Consent

The Development Consent (SSD 7348) requirements stipulated for the construction of Oakdale West and where they have been addressed in this CAQMP are shown in **Table 1**.

Table 1 Assessment against Development Consent Conditions

Conditions	Response/Section Reference
Condition D98 of SSD 7348	
The Applicant must take all reasonable steps to minimise dust generated during all works authorised by this consent	**Section 8**
Condition D99 of SSD 7348	
During construction of Stage 1, the Applicant must ensure that: (a) exposed surfaces and stockpiles are suppressed by regular watering and or other dust suppression methods; (b) all trucks entering or leaving the Site with loads have their loads covered; (c) trucks associated with Stage 1 do not track dirt onto the public road network; (d) public roads used by these trucks are kept clean; and (e) land stabilisation works are carried out progressively on site to minimise exposed surfaces.	**Section 8**
Condition D100 of SSD 7348	
(a) be prepared by a suitably qualified and experienced person(s)	2-page CV of the author is attached in **Appendix B**
(b) detail and rank all emissions from all construction activities, including particulate emissions	**Section 4**
(c) describe a program that is capable of evaluating the performance of the construction and determining compliance with key performance indicators	**Section 10**
(d) identify the control measures that will be implemented for each emission source	**Section 8**
(e) nominate the following for each of the proposed controls: - key performance indicator - monitoring method - location, frequency and duration of monitoring - record keeping - complaints register - response procedures - compliance monitoring	**Section 8 &** **Section 10**
Condition D118 of SSD 7348	

Conditions	Response/Section Reference
(a) details of: (i) the relevant statutory requirements (including any relevant approval, licence or lease conditions); (ii) any relevant limits or performance measures and criteria; and (iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, Stage 1 or any management measures;	**Section 5.2**
(b) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 8**
(c) a program to monitor and report on the: (i) impacts and environmental performance of Stage 1; and (ii) effectiveness of the management measures set out pursuant to paragraph (b) above;	**Section 10**
(d) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 11**
(e) a program to investigate and implement ways to improve the environmental performance of Stage 1 over time;	**Section 13**
(f) a protocol for managing and reporting any: (i) incident and any non-compliance (specifically including any exceedance of the impact assessment criteria and performance criteria); (ii) complaint; (iii) failure to comply with statutory requirements; and	**Section 9 &** **Section 10** See overarching CEMP
(g) a protocol for periodic review of the plan.	**Section 13**

3 Project Overview

3.1 Location

Oakdale West is legally described as Lot 11 DP 1178389 at the far south-western extent of the WSEA.

The site is bound to the north by the Water NSW Pipeline and to the east by the Ropes Creek riparian corridor. Land along the eastern boundary of the site is also affected by a transmission easement associated with the Transgrid infrastructure. To the east of the site is Goodman's Oakdale South estate. Emmaus Catholic College and Emmaus Retirement Village is located to the west of the site. Other boundaries interface with adjoining rural lands used for a mix of rural-residential, agricultural.

3.2 Surrounding Land Uses

The area surrounding Oakdale West includes land uses such as industrial warehouses and factories, several of which have been identified as having the potential to be considered sources of air emissions. The nearest residential receptors to Oakdale West boundary is located approximately 50 m south on Aldington Road, Erskine Park.

3.3 Construction Staging and Activities

Stage 1 development of the Oakdale West Concept Proposal includes the site preparation and infrastructure works required to facilitate further development of the estate in line with the Concept Proposal, along with the development of Precinct 1 for warehousing and distribution.

The remainder of the Oakdale West is expected to be developed over four further stages with Stage 2 being the development of Precinct 2, Stage 3 being Precinct 3, Stage 4 being Precinct 4 and Stage 5 being Precinct 5.

Construction is scheduled to commence prior to the WNSLR. This is estimated to occur during October 2019 and will take approximately 120 weeks.

The works that will be constructed by Burtons include:

- Bulk earthworks across the entire site (with the exception to the WNSLR works area which covers the Construction Access Road and Basin 1);
- Construction of the retaining and noise walls across the site;
- Construction of the western visual mound;
- Construction of lead in services infrastructure, including potable water, sewer, telecommunications and electrical;
- Construction of Roads 1, 2, 6 and part of Road 7;
- Construction of Basins 2, 3, 4, and 5; and
- Landscaping across the site.

No on-lot warehouse construction will be undertaken by Burtons. Burtons work will not be staged, however the Western visual mound , which includes the installation of a new snake proof barrier fence along the Western Boundary, will be programmed to occur as part of the works activities to be undertaken first.

The earthworks require the importation of approximately 500,000 – 600,000m^3 of material. Due to the limitations to the import of general fill via the Bakers Lane site entry, the importation process cannot commence until the WNSLR is completed and available for use.

3.4 Construction Hours

Construction hours for the Oakdale West will be in accordance with Condition D70 and D71 of Development Consent SSD 7348, which are reproduced below:

> ***D70**. The Applicant must comply with the hours detailed in Table 5, unless otherwise agreed in writing by the Planning Secretary.*
>
> ***Table 5**: Hours of Work*

Activity	Day	Time
Construction	Monday – Friday Saturday	7 am to 6 pm 8 am to 1 pm
Operation	Monday – Sunday (including public holidays)	24 hours

> ***D71**. Works outside of the hours identified in Condition D62 may be undertaken in the following circumstances:*
>
> *a) works that are inaudible at the nearest sensitive receivers;*
>
> *b) works agreed to in writing by the Planning Secretary;*
>
> *c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or*
>
> *d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.*

3.5 Construction Site Access

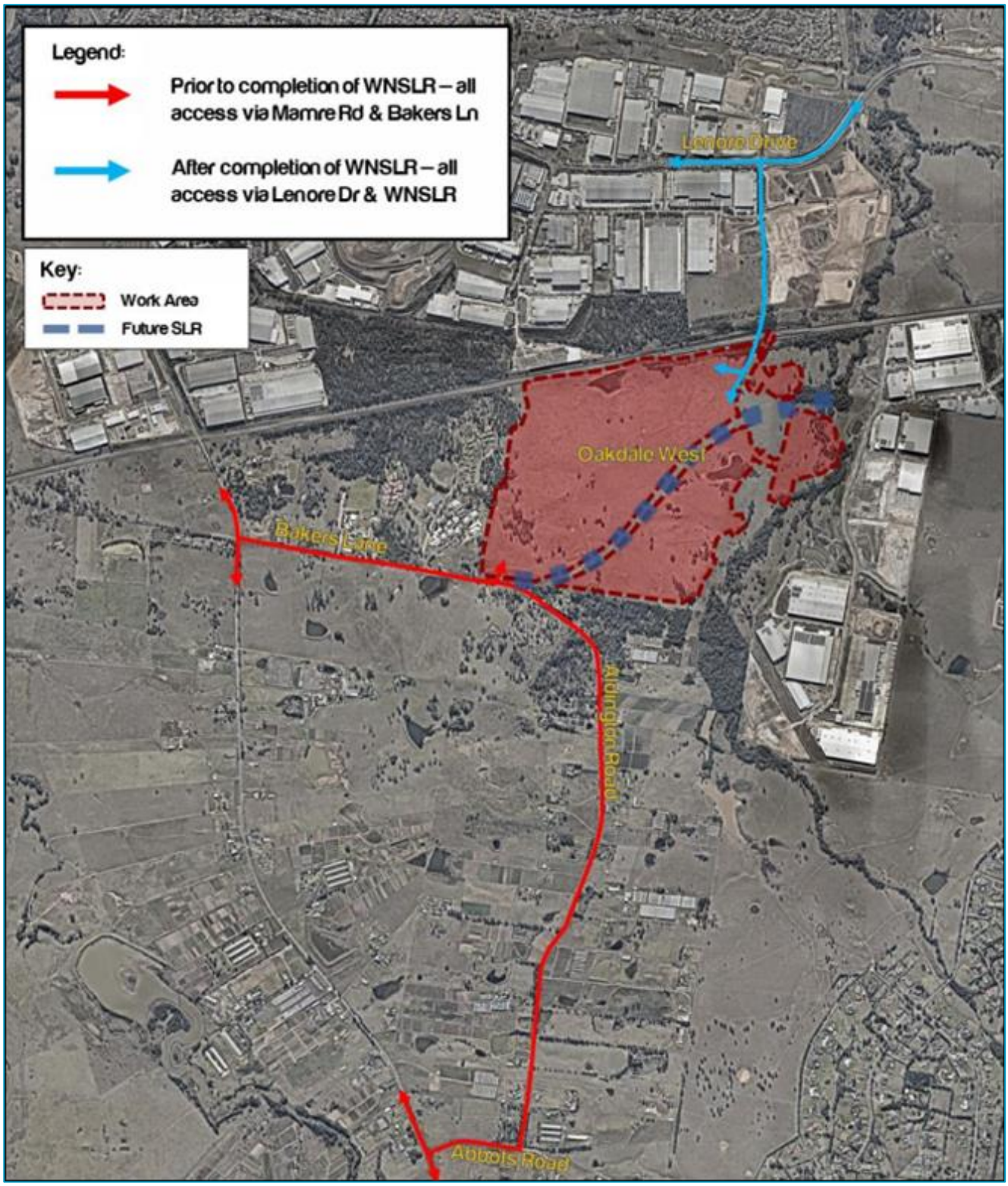
Access to Oakdale West will be separate from the construction access associated with the WNSLR works which will be constructed along the future Southern Link Road (SLR) alignment. The Oakdale West construction access will be located to the west of the SLR access off Bakers Lane.

Any construction traffic crossing the Robson Civil (contractor constructing the WNSLR) temporary Construction Access Road will do so via designated crossing points which will be determined in consultation between Burton and Robson. In accordance with the Construction Traffic Management Plan (CTMP) (Ason 2019), **Table 2** and **Figure 3** detail the site access arrangements for the construction of Oakdale west.

Table 2 Site Access

Work Zones	Access Arrangement
Prior to the completion of the WNSLR	All vehicles will access via Baker Lane
Post completion of the WNSLR	All vehicles will access via the WNSLR.

Figure 3 Site Access



3.6 Construction Contact Details

Table 3 lists the key contacts during the construction of Oakdale West.

Table 3 Construction Contact List

Role	Name	Company	Contact Details
Project Principal	Kym Dracopoulos	Goodman	0411 511 431 kym.dracopoulos@goodman.com
Project Manager	Alasdair Cameron	Goodman	0402 458226 Alasdair .cameron@goodman.com
Principal's Superintendent	Mark Ward	AT&L	0408 699 026 mark.w@atl.net.au
Contract Superintendent	AT&L	AT&L	02 9437 1777 info@atl.net.au
Project Manager	Alex Lohrisch	AT&L	0415 398 014 alexl@atl.net.au
Contractor's Project Manager	David Claxton Dermot Walsh	Burton	0418 286 093 david.claxton@burtoncontractors.com.au 0457 406609 Dermot.walsh@burtoncontractors.com.au
Environmental Coordinator	Luke Slechta	Burton	0429 771 070 luke.slechta@burtoncontractors.com.au
Work Health and Safety (WHS) Coordinator	Andre Van Gelder	Burton	0412 173 573 Andre.VanGelder@burtoncontractors.com.au
Environmental Representative	Carl Vincent	ERSED	0424 203 046 carl.vincent@ersed.com.au
Communications and Community Liaison Representative	Dan Thompson	SLR	0428 060 995 dthompson@slrconsulting.com

4 Potential Sources of Air Emissions

During the construction works, fugitive dust emissions are considered to be the primary emission type, which could give rise to nuisance and/or health impacts for the surrounding sensitive areas. The key potential sources of dust associated with construction of the OWE have been identified as:

- Dust emissions from earthworks activities (eg excavation and loading of soils to trucks);
- Wind-generated dust from disturbed surfaces and stockpiles;
- Wheel-generated dust and particulate matter emissions in diesel exhaust emissions from on-site plant and equipment and construction traffic movements; and
- Particulate matter associated with exhaust emissions from increased/congested traffic emissions due to road closures or diversions.

In addition to the construction activities being carried out at any point in time, a number of other environmental factors may also affect the generation and dispersion of dust emissions, including:

- Wind direction - determines whether dust and suspended particles are transported in the direction of the sensitive receptors;
- Wind speed - governs the potential suspension and drift resistance of particles;
- Surface type - more erodible surface material types have an increased soil or dust erosion potential;
- Surface material moisture - increased surface material moisture reduces soil or dust erosion potential;
- Other external factors such as current works being undertaken by others outside of the defined Project boundaries and current climatic (dry) weather conditions;
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

The Environmental Impact Statement (EIS) for the construction and operation of OWE was prepared by URBIS in November 2017 (URBIS 2017). Appendix U (Air Quality Impact Assessment) of the EIS states that the main emissions to air during the construction phase will be emissions of particulate matter (as TSP, PM_{10} and $PM_{2.5}$) and nuisance dust from the movement of vehicles and construction equipment, excavation and rehabilitation, demolition, clearing and grading, truck loading and unloading and wind erosion.

The construction activities are broadly divided into four categories, ie demolition, earthworks, construction (building) and trackout. Potential air quality impacts associated with the construction of the OWE and the relative risk ratings are addressed in **Section 7**.

5 Relevant Pollutants and Air Quality Criteria

5.1 Pollutants of Concern

As identified in **Section 4**, potential air pollutants of interest for the construction of Oakdale West are considered to be both:

- Suspended particulate matter; and
- Deposited dust.

The following sections outline the potential health and amenity issues associated with the above pollutants, while **Section 5.2** outlines relevant air quality assessment criteria.

5.1.1 Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The health effects of particulate matter are strongly influenced by the size of the airborne particles. Smaller particles can penetrate further into the respiratory tract, with the smallest particles having a greater impact on human health as they penetrate to the gas exchange areas of the lungs. Larger particles primarily cause nuisance associated with coarse particles settling on surfaces.

The term "total particulate matter" (TSP) refers to a category of airborne particles, typically less than 30 microns (µm) in diameter. Particulate matter with an aerodynamic diameter of 10 microns or less is referred to as PM_{10}. The PM_{10} size fraction is sufficiently small to penetrate the large airways of the lungs, while $PM_{2.5}$ (2.5 microns or less) particulates are generally small enough to be drawn in and deposited into the deepest portions of the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children. In an urban setting, the emission of $PM_{2.5}$ is primarily associated with vehicles exhausts resulting from the incomplete combustion of diesel.

For the purposes of this CAQMP, suspended particulate matter refers to PM_{10} only.

5.1.2 Deposited Dust

Section 5.1.1 is concerned in large part with the health impacts of particulate matter. Nuisance impacts need also to be considered, mainly in relation to deposited dust. Dust can cause nuisance by settling on surfaces and possessions, affecting visibility and contaminating tank water supplies. High rates of dust deposition can also adversely affect vegetation by blanketing leaf surfaces.

5.2 Ambient Air Quality Criteria

There are no air quality criteria outlined within the Development Consent SSD 7348, therefore the NSW EPA criteria have been adopted in **Table 4** and **Table 5**.

5.2.1 Suspended Particulate Matter

State air quality guidelines specified by the NSW Environmental Protection Agency (EPA) for the pollutants identified in **Section 5.1** are published in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2017a) (hereafter 'Approved Methods'). The ground level air quality impact assessment criteria listed in Section 7 of the Approved Methods have been established by NSW EPA to achieve appropriate environmental outcomes and to minimise associated risks to human health as published in the Approved Methods. They have been derived from a range of sources and are the defining ambient air quality criteria for NSW, and are considered to be appropriate for use in this assessment.

A summary of the relevant impact assessment criteria for particulate matter is provided in **Table 4**.

Table 4 NSW EPA Criterion for Particulate Matter

Pollutant	Averaging Period	Concentration
PM_{10}	24 Hours	50 µg/m^3
	Annual	25 µg/m^3

Source: EPA 2017a

5.2.2 Deposited Dust

The relevant criterion for nuisance dust deposition is provided in **Table 5**. The rate of dust deposition is measured by means of a collection gauge, which catches the dust settling over a fixed surface area and over a period of about 30 days.

Table 5 NSW EPA Criterion of Nuisance Dust Deposition

Pollutant	Averaging Period	Assessment Criteria (g/m^2/month)
Deposited dust	Annual	2 (maximum increase in deposited dust level) 4 (maximum total deposited dust level)

5.3 Local Government Air Quality Toolkit

The NSW EPA has developed the Local Government Air Quality Toolkit (EPA 2018), in response to requests from local Council officers for information and guidance on the common air quality issues they manage. Guidance is available under Part 3 of the Local Government Air Quality Toolkit for Construction Sites.

This document lists the common sources of emissions and mitigation and management measures to control airborne dust levels from construction sites and has been consulted in the development of this CAQMP.

6 Existing Environment

6.1 Local Meteorology

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Horsley Park Automatic Weather Station (AWS) (Station ID 67119), located approximately 5.5 kilometres (km) southeast of the Oakdale West. The long term and short term seasonal wind roses and long term rainfall patterns observed at the Horsley Park AWS indicate that:

- Winds that would blow fugitive dust emissions from the demolition/construction works towards the nearest sensitive receptors located to the west and south of the proposed construction activities occur rarely during autumn and winter, and are more likely to occur during summer and spring.
- The long term wind and rainfall patterns suggest that the construction at the Development Site have the greatest potential to impact on surrounding sensitive receptors during the months of May (autumn), and July (winter) to October (spring).

Full analysis of the wind roses and rainfall can be found in **Appendix A**.

6.2 Background Air Quality

The NSW OEH maintains a network of Air Quality Monitoring Stations (AQMSs) across NSW. The nearest such station is located at St Marys, approximately 4.5 km northwest of Oakdale West. The St Marys AQMS was commissioned in 1992 and is located on a residential property off Mamre Road, St Marys. It is situated in the centre of the Hawkesbury Basin and is at an elevation of 29 m.

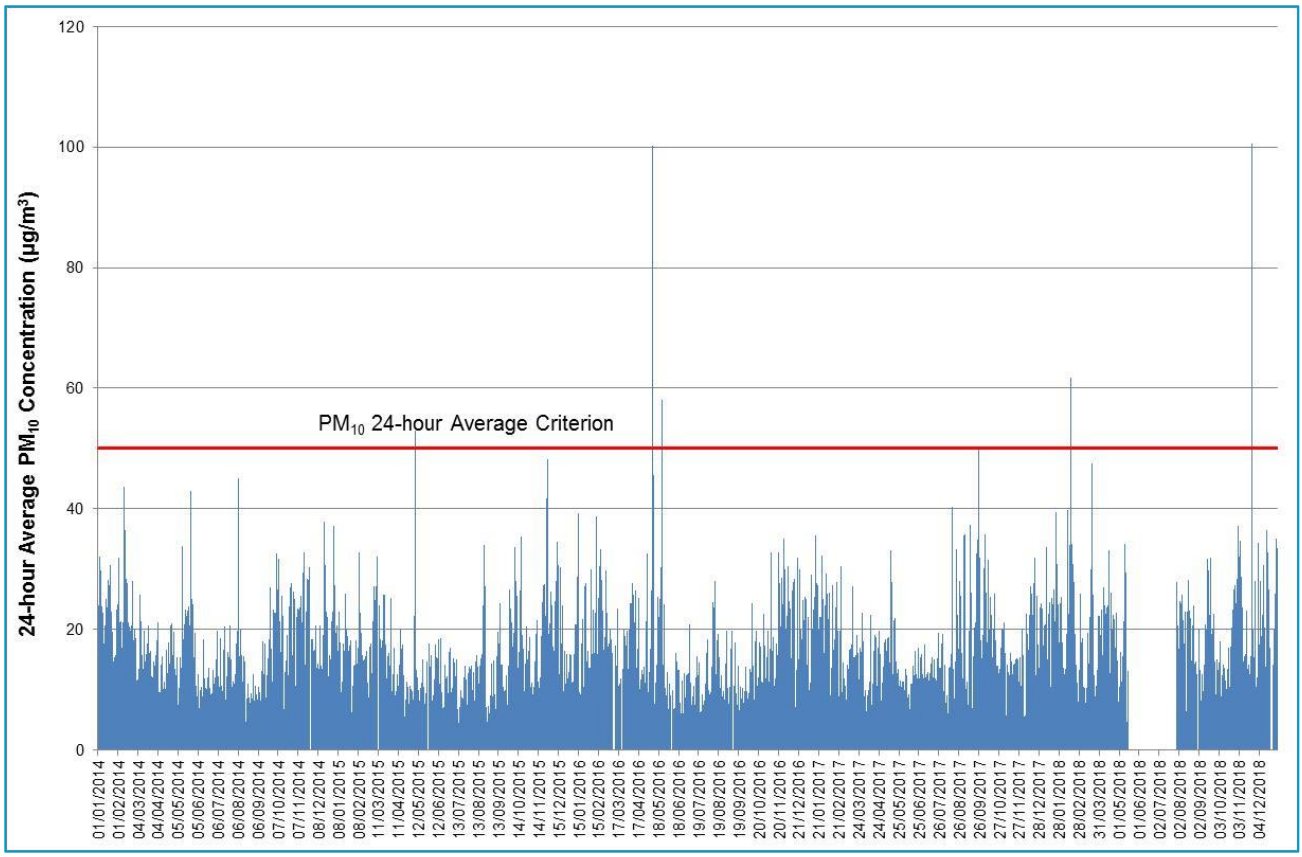
There were no exceedances of the 24 hour average criterion in 2014 and 2017, one exceedance in 2015 and three exceedances in 2016 and two exceedances in 2018. A summary of the PM_{10} concentrations for the last five years (2014-2018) is tabulated in **Table 6** and presented graphically in **Figure 4**.

Table 6 Summary of PM_{10} Monitoring Data at St Marys AQMS (2014 – 2018)

Averaging Period	Maximum 24-hour Average	Annual
	µg/m^3	µg/m^3
2014	45.0	16.7
2015	53.0[a]	15.0
2016	100.2[b]	16.1
2017	49.8	16.2
2018	100.5c	19.4
Criterion	50	25

[a] Recorded on 6 May 2015
[b] Recorded on 8 May 2016
[c] Recorded on 22 November 2018

Figure 4 Measured 24-Hour Average PM_{10} Concentrations at St Marys AQMS (2014 – 2018)



A review of the exceedances recorded during 2015 (OEH 2017a), 2016 (OEH 2018a), 2017 (OEH 2018b) and 2018 (OEH 2019) indicates that they were associated with natural events such as bushfires or dust storms, or hazard reduction burns.

It has been noted the NSW EPA in their publication – NSW Annual Air Quality Statement 2018 (OEH 2019) state that air quality is generally good in New South Wales based on information from the 43 station NSW Air Quality Monitoring Network. For 2018, the air quality was generally 'good', and air quality standards were met for 98% of the days in Sydney. During this time, exceedances of the national air quality standards for particle pollution have usually been associated with regional dust storms and vegetation fires.

PM_{10} concentrations vary across years with higher levels and more exceedances occurring in bushfire and dust storm affected years. Dry El Niño years (2002–2007) have been associated with a greater frequency of bushfires and dust storms and therefore higher particle pollution levels. Lower particle pollution levels have occurred during wetter La Niña years (2010–2012).

7 Assessment of Dust Emissions During Construction

The key potential health and amenity issues associated with construction of the OWE are, respectively:

- Elevated suspended particulate concentrations (PM_{10}); and
- Nuisance due to dust deposition (soiling of surfaces) and visible dust plumes that may potentially be observed to be leaving the site.

7.1 Construction Impact Assessment Methodology

Quantitatively assessing impacts of fugitive dust emissions from construction projects using predictive modelling is seldom considered appropriate, primarily due to the uncertainty in the details of the construction activities, including equipment type, number, location and scheduling, which are unlikely to be available at the time of the assessment. Furthermore, they are also likely to change as construction progresses. In comparison, the equipment and operations of a mine or quarry are determined during the planning stages and more likely to remain consistent for long periods (several months or years).

Instead, it is considered appropriate to conduct a qualitative assessment. Potential impacts of dust emissions associated with proposed demolition and construction activities at the Development Site has been performed based on the methodology outlined in the Institute of Air Quality Management (UK) (IAQM) document, "*Assessment of dust from demolition and construction*" (Holman et al 2014). This guidance document provides a structured approach for classifying construction sites according to the risk of air quality impacts, to identify relevant mitigation measures appropriate to the risk (see **Appendix C** for full methodology).

The IAQM approach has been used widely in Australia for the assessment of air quality impacts from construction projects and the identification of appropriate mitigation measures, which has been accepted by regulators across all states and territories for a variety of construction projects.

The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
  - the scale and nature of the works, which determines the potential dust emission magnitude; and
  - the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

7.2 Risk Assessment

Table 7 presents the preliminary risk of air quality impacts from uncontrolled construction activities determined using the risk matrix provided in (**Table C4** in **Appendix C**), based on the identified receptor sensitivity and sensitivity of the area.

Table 7 Preliminary Risk of Air Quality Impacts from Construction Activities (Uncontrolled)

Impact	Sensitivity of Area	Dust Emission Magnitude				Preliminary Risk			
		Demolition	Earthworks	Construction	Trackout	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Small	Large	Large	Medium	Negligible	Low Risk	Low Risk	Low Risk
Human Health	Low					Negligible	Low Risk	Low Risk	Low Risk

The results indicate that there is a low risk of adverse dust soiling and a low risk of human health impacts occurring at the off-site sensitive receptor locations if no mitigation measures were to be applied to control emissions during the works.

Based on the dust emission magnitudes and the preliminary risk from these activities, the activities are ranked as (highest risk to lowest risk):

1. Earthworks
2. Construction
3. Track out
4. Demolition

For almost all construction activity, the IAQM Methods notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is generally possible.

8 Mitigation Measures

The potential for dust emissions during construction works at Oakdale West and the potential impact (as discussed in **Section 4**) on surrounding sensitive receptors are anticipated to be largely controllable through a range of mitigation measures, including good site management, good housekeeping measures, appropriate vehicle maintenance and applying appropriate dust mitigation measures where required. The dust mitigation measures to be implemented during the construction of Oakdale West are detailed in **Table 8**. The dust mitigation measures specific to the key emission activities (i.e. earthworks, construction, track out and demolition) are also provided in **Table 8.**

Note: **Table 8** is replicated as Table 13 in the CEMP.

Table 8 Dust Mitigation Measures

Environmental Management Control	Person Responsible	Timing / Frequency	Reference / Notes
Communications			
The Community Communications Strategy will be implemented.	Communications and Community Liaison Representative	Prior to commencing construction and ongoing	Best practice
The name and contact details of person(s) accountable for air quality and dust issues will be displayed on the site boundary. This may be the Contractor's Project Manager.	Burton		
The head or regional office contact information will be displayed on site signage.			
Site Management			
All dust and air quality incidents will be undertaken as per Section 3.5 of the CEMP.	Burton	Ongoing	CEMP Section 3.5
All dust and air quality complaints will be undertaken as per Section 3.6 of the CEMP.			CEMP Section 3.6
Where excessive dust events occur (i.e. prolonged visual dust in a particular area), additional watering of dust producing activities will be undertaken or activities temporarily halted until such times that the dust source is under control.		During excessive dust events	Best practice
Horsley Park Bureau of Meteorology station weather forecast will be reviewed daily (i.e. wind, rain) to inform site dust management procedures for the day.		Daily	
Preparing and Maintaining the Site			
All reasonable steps to minimise dust generated will be undertaken during construction.	Burton	Ongoing	SSD 7348 Condition D90
Exposed surfaces and stockpile will be suppressed by regular watering or use of approved dust suppressants.			SSD 7348 Condition D91a
Land stabilisation works will be carried out in such a way on site to minimise exposed surfaces.			SSD 7348 Condition D91e

Environmental Management Control	Person Responsible	Timing / Frequency	Reference / Notes
Construction of Oakdale West will not cause or permit the emission of any offensive odour, as defined in the POEO Act.	Burton	Ongoing	SSD 7348 Condition D94
Dust generating activities in areas close to receptors will be closely monitored and additional mitigation applied as required to best manage potential dust emissions			Best practice
Stockpiles that will be in place for more than 20 days and are not actively used as well as any stockpiles that are susceptible to wind or water erosion will be suitably protected from erosion within 10 days of the establishment of each stockpile. Temporary stabilisation of disturbed surfaces will be undertaken within two weeks of the stockpile being established.			
Site fencing and barriers will be kept clean using wet methods.			
Operating Vehicle/Machinery and Sustainable Travel			
Trucks associated with Stage 1 will not track dirt off site and onto Bakers Lane	Burton	Ongoing	SSD 7348 Condition D91c
Project access roads used by delivery trucks will be kept clean.			SSD 7348 Condition D91d
All on-road vehicles will comply with relevant vehicle emission standards (prescribed by the NSW RMS), where applicable, and will be maintained in good condition, in accordance with manufacturer's specifications and POEO Act.			Best practice
Delivery trucks will switch off engines whilst undertaking a delivery on-site, if idling time is likely to exceed 5 minutes.			
Vehicle speed limit restrictions are implemented on site, including: • General - 20km/h • High risk area - 10km/h • Haul routes – 50 km/h			
Truck queuing and unnecessary trips will be minimised through logistical planning and by the identification and use of specific park up/hold areas away from the Project and Bakers Lane			
Operations			
Only cutting, grinding or sawing equipment fitted with suitable dust suppression systems, such as water sprays will be used.	Burton	Ongoing	Best practice
Adequate water supply will be available on the site for effective dust/particulate matter suppression/ mitigation using a combination of potable and non-potable water sources.			

Environmental Management Control	Person Responsible	Timing / Frequency	Reference / Notes
Water carts will be used on all denuded or exposed surfaces and unsealed roads to minimise dust emissions.	Burton	Ongoing	Best practice
Equipment, inclusive of, but not limited to Environmental spill kits will be readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.			
Works will be assessed during strong winds or in weather conditions where high levels of airborne particulates may potentially impact the sensitive receivers. Continual monitoring of wind speed and direction will be undertaken to guide this decision and ensure that adequate mitigation measures are undertaken		Continuously and during high winds	
Waste Management			
All trucks entering or leaving the Site will have their loads covered.	Burton	Ongoing	SSD 7348 Condition D91b
No waste materials, timbers or any other combustible materials will be burnt on site.			Best practice
Earthworks			
Scopes of work will be planned in such a way to assist in minimising the duration that surfaces are left denuded	Burton	Ongoing	Best practice
Rehabilitation of disturbed surfaces will be undertaken within 20 days of final construction levels.		Within 20 days of final construction levels	
If unanticipated strong odours or significant visual dust emissions are noted or observed on site, an investigation will be undertaken by the Burton Project Manager to identify the scope of work or source of the emission prior to undertaking and applying any additional mitigation measures.		Ongoing	
Construction			
Sand and other aggregates will not be allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	Burton	Ongoing	Best practice
Trackout			
Water-assisted road sweeper(s) will be used on an as required basis on Bakers Lane should any material be tracked out of the site.	Burton	Ongoing	Best practice
Record all regular inspections and maintenance undertaken of site haul routes and project related access roads (Bakers Lane) in a site log book.			
A wheel washing system and/or cattle grid system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site) will be implemented.			
Demolition			

Environmental Management Control	Person Responsible	Timing / Frequency	Reference / Notes
Ensure effective water suppression of dust is used during demolition operations.	Burton	Ongoing	Best practice
Bag and remove any biological debris or damp down such material before demolition.			

As required by condition D100 (e), **Table 9** summarises the parameters identified to assess the effectiveness of the control measures shown in **Table 8**.

Table 9 Summary of the Parameters to Assess the Effectiveness of Control Measures

Parameter	Visible Dust	Dust Deposition	Complaints	PM_{10}
Key performance indicator	No visible dust leaving the site boundary	<4 g/m^2/month	No complaints related to nuisance dust	<50 $\mu g/m^3$ as a 24-hour average
Monitoring method	Visual inspection/observations	Dust deposition gauges	-	See note
Location, frequency and duration of monitoring	Daily onsite inspection	Section 10	-	See note
Record keeping	Section 9	Section 11	Section 9	See note
Response procedures	Section 11	Section 11	Section 9	See note
Compliance monitoring	-	Section 10	-	See note

Note: Real-time suspended particulate monitors are installed at the site to assist with dust management (see **Section 9**). The monitoring system used however, does not meet the requirements of a compliance instrument. Should compliance-level monitoring be required as per **Table 10**, then this table will be updated to reflect the expanded monitoring programme.

9 Complaints Handling and Response Procedure

All complaints will be handled in accordance with the sections below and the OWE *Community Communication Strategy* (CCS) (SLR 2019).

9.1.1 Performance Objective

To ensure that all environmental complaints in relation to the air emissions from construction of the OWE are promptly and effectively received, handled and addressed.

9.1.2 Responsibility

The Communications and Community Liaison Representative is responsible for ensuring that the appropriate management response and handling procedures are instigated and carried through in the event of an environmental complaint. The induction and toolbox talks outlined in the CEMP will be used to ensure all site employees are aware of and understand their obligations for complaints response.

All employees who take receipt of a complaint, either verbal or written, are to immediately notify the Contractor's Project Manager, who will then contact the Communications and Community Liaison Representative.

9.1.3 Complaints Handling Procedure

Upon becoming aware of a complaint, the protocol outlined below will be followed.

1. Record and Acknowledge

Any employee who take receipt of a complaint, either verbal or written, is to immediately notify the Contractor's Project Manager who will then contact the Communications and Community Liaison Representative. The Contractor's Project Manager will be available 24 hours a day, seven days a week and have the authority to stop or direct works.

In the normal course of events, the first contact for complaints will usually be made in person or by telephone.

The complainant's name, address and contact details, along with the nature of the complaint, must be requested. If the complainant refuses to supply the requested information, a note will be made on the form and complainant advised of this.

2. Assess and Prioritise

The Communications and Community Liaison Representative will prioritise all complaints by considering the seriousness of the complaint including risk to health and safety and will attempt to provide an immediate response via phone or email. This will be undertaken in accordance with the CCS (SLR 2019).

3. Investigate

A field investigation will be initiated in an attempt to confirm details relevant to the complaint and the cause of the problem. Any air quality monitoring information and/or site records at and around the time of the complaint will be reviewed for any abnormality or incident that may have resulted in the complaint.

If the complaint is due to an incident, the notification requirements and handling procedures outlined in CEMP will be followed.

4. Action or Rectify

Once the cause of the complaint has been established, every possible effort will be made to undertake appropriate action to rectify the cause of the complaint and mitigate any further impact. The Communications and Community Liaison Representative will assess whether the complaint is founded or unfounded and delegate the remediation of the issue to the Contractor's Project Manager for action, as required.

As outlined in **Section 11**, if a complaint regarding air quality impacts is concluded to be substantiated, the need for any changes to the air quality mitigation measures identified for the Project in **Section 8** and/or the air quality monitoring programme outlined in **Section 10** is to be reviewed and, the AQMP updated as appropriate.

5. Respond to Complainant

The Communications and Community Liaison Representative and the Contract Superintendent will oversee the rectification of the issue. The Communications and Community Liaison representative will then respond to the complainant once the issue has been resolved. The complainant will be provided with a follow up verbal response on what action is proposed within two hours during night-time works (between the hours of 6:00 pm and 10:00 pm) and 24 hours at other times. Where a complaint cannot be resolved by the initial or follow-up verbal response, a written response will be provided to the complainant within ten days.

6. Record

It is imperative that an investigation of the situation is carried out and proposed improvements documented in order to minimise the potential for similar complaints in the future. On this basis, every complaint received is to be recorded in the Complaint Enquiry Form. A copy of the completed form will be maintained for at least five years. The complaint will also be recorded in the Complaints Register.

7. Preventative Action

Once the complaint has been suitably handled, proposed improvements will be investigated and implemented to minimise the potential of re-occurrence. The Complaint Enquiry Form will not be closed out until the preventative actions are completed and recorded on the form.

9.1.4 Complaints Register

A Complaints Register will be maintained during construction and will contain the following:

- A copy of the environmental complaint handling procedure;

- A separate reference sheet containing the contact details;
- Blank hard copies of the Complaint Enquiry Form; and
- Copies of all completed Complaint Enquiry Forms, which are to be maintained for at least five years after the event to which they relate.

10 Air Quality Monitoring Program

As discussed in **Section 7**, the risk of construction dust emissions causing nuisance impacts at off-site sensitive receptor locations is concluded to be low. It is also noted that any impacts will be temporary and managed through the implementation of appropriate mitigation measures (see **Section 8**).

It is noted that there is no stipulated requirement for air quality monitoring for Oakdale West within SSD 7348. Considering the low risk of the construction dust emissions causing nuisance at off-site sensitive receptor locations, dust monitoring at the nearest sensitive receptors is not considered to be warranted[1]. However, due to the possibility of concurrent construction of the OWE and the WNSLR, dust deposition monitoring at the nearest sensitive receptors, in conjunction with routine daily onsite visual inspections is deemed to be appropriate for this Project.

In addition, Goodman have installed three continuous particulate (TSP & PM_{10}) monitors along the western and southern OWE boundary. It is noted that while the samplers are installed in accordance with Australian Standard AS/NZS 3580.9.9, they are laser photometer instruments (aerosol samplers) and do not comply with the requirements of the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (DEC, 2006). They are therefore to be used as a daily management tool to warn of increasing ambient dust levels and the need to implement additional dust mitigation measures as required, but cannot be used as a compliance instrument to demonstrate compliance with the ambient air quality criteria.

The following monitoring will therefore be implemented for the Project:

- Dust deposition rates will be monitored using static dust gauges be conducted for the duration of this Project and started at six (6) locations around the WNSLR and OWE boundaries, plus one dust gauge as a background dust monitor.
- Dust deposition monitoring is to commence at least one month before commencement of construction work on site, to provide 'before construction' dust deposition levels.
- Real-time TSP and PM_{10} sampling at three (3) locations along the OWE site boundary.

The background dust monitor will be located upwind and further away from the construction works, closer to the nearby sensitive receptors towards the northwest. As there is a possibility of concurrent construction of the OWE, dust gauges within the OWE area are not proposed due to the inherent risk of equipment safety (e.g. heavy machinery knocking down the dust gauge).

[1] Note that dust monitoring/recording at any of the sensitive receptors may be an appropriate action in response to a potential complaint.

Indicative locations of the dust deposition gauges are shown in **Figure 5**. The exact locations of the gauges will depend on a number of factors, such as site accessibility, safety risk to equipment, distance from the construction works etc, and will need to be finalised by the dust monitoring contractor.

A summary of the proposed air quality monitoring program is shown in **Table 10**.

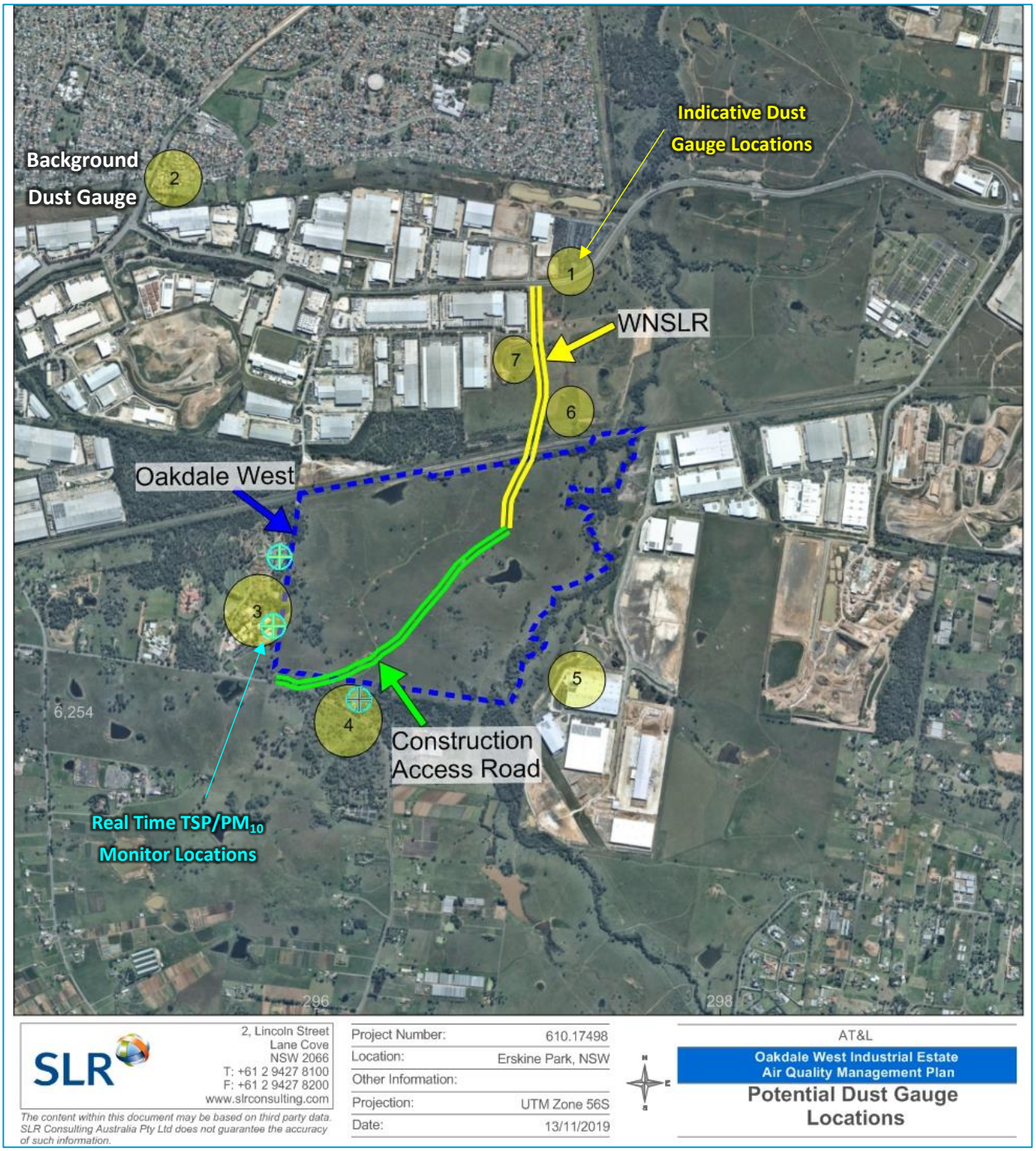
Table 10 Air Quality Monitoring Program

Description	Parameter	Methodology	Duration	Location	Frequency
Nuisance dust monitoring	Deposited dust in g/m^2/month	AS/NZS 3580.1.1:2016 - *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment*	During site preparation, earthworks, construction	Indicative locations shown in **Figure 5**	Monthly
Suspended Particulate Monitoring	TSP and PM_{10} concentrations in $\mu g/m^3$	Real-time monitoring using a light-scattering laser photometer (aerosol monitor). The monitors are to be calibrated every 6 months by co-locating a Low Volume Air Sampler (LVAS) at each monitoring location to derive a site-specific correction factor. LVAS calibration monitoring will be performed in accordance with: AS/NZS 3580.9.9 *Methods for Sampling and Analysis of Ambient Air – Determination of suspended particulate matter – PM_{10} low volume sampler – Gravimetric Method*	During site preparation, earthworks, construction	Current locations shown in **Figure 5**	Continuous with 6-monthly calibration

The background dust monitor will be located upwind and further away from the construction works, closer to the nearby sensitive receptors towards the northwest. As there is a possibility of concurrent construction of the OWE and WNSLR, dust gauges within the OWE area are not proposed due to the inherent risk of equipment safety (eg heavy machinery knocking down the dust gauge).

During the earthworks phase Burton shall undertake monitoring at locations 1-5. Following the handover of the WNSLR, Burton shall continue monitoring in locations 6 and 7 during the fill importation works.

Figure 5 Dust Monitoring Locations for the OWE Construction Project



In addition to the dust deposition monitoring, the contractor will:

- Perform daily on-site site observations and inspections, to visually assess dust levels at individual scopes of work. The inspection results are to be recorded in a daily log book, with the log to be available to the DPE when requested. The daily environmental inspections will include, but not be limited to:
  - Visual inspection of any airborne dust being generated on-site or being observed to be potentially blowing off-site;
  - Ensure the road leaving the site is free of soil, and that there is no observable soil tracking onto the road network;
  - Inspection of the erosion and sediment control systems for silt build-up; and
  - Inspection of stockpiles and waste storage areas to ensure no significant wind erosion is observable.
- Review Horsley Park Bureau of Meteorology (BoM) station daily weather forecast each working day (ie wind, rain etc) to assess and apply the appropriate site dust management procedures.
- Carry out weekly site inspections to monitor compliance with this CAQMP, record inspection results, and make an inspection log available to the DPE when requested; and
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

A summary of the requirements of the site dust inspection programme is provided in **Table 11**.

Table 11 Air Quality Management – Visual Inspections

Description	Parameter	Methodology	Duration	Location	Frequency
Daily visual inspections	On-site dust generation, vehicle exhaust emissions and compliance with mitigation measures	Visual inspection of dust-generating activities to: - identify if any dust clouds can be seen leaving site etc; - check for smoky exhausts on vehicles and equipment operating on site; and - confirm compliance with air quality mitigation measures specified in this CAQMP. - where excessive dust events occur (i.e. prolonged visual dust in a particular area), investigate/identify the scope(s) of work responsible for dust generation and apply additional mitigation measures until such times as the dust is not observed to be leaving the site - record inspection results and make an inspection log available to the DPE when asked.	During site preparation, earthworks, construction	On-site within boundaries of the Oakdale West Estate	Daily

11 Contingency Management Plan

The air quality contingency management plan for the OWE Project is shown in **Table 12**.

Table 12 Air Quality Contingency Management Plan for the OWE

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Visible dust leaving the site	Trigger	Daily inspections show that there is no visible dust leaving the site.	Daily inspections show that there is visible dust leaving the site.	Daily inspections show that there is visible dust leaving the site multiple times during a day OR from multiple locations within the site.
	Response	Continue monitoring program as normal.	Review and investigate construction activities and respective control measures. Where appropriate, implement additional remedial measures, such as: • *Deployment of additional water sprays, water trucks etc*	Undertake an investigation of the dust generating activities, and if necessary, temporarily halt the dust generating activities

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Dust deposition reading of >4g/m^2/month	Trigger	Dust deposition rates are less than 4 g/m^2/month at all the dust gauges.	Dust deposition rate greater than 4 g/m^2/month is recorded by any of the dust gauges	Dust deposition rates greater than 4 g/m^2/month are recorded by two or more dust gauges for two months in a row.
	Response	Continue monitoring program as normal.	• Analyse data to try to identify the source(s) of dust. • Review operations to reduce dust emissions from the identified key source(s). Implement any additional mitigation measures as required, such as additional watering.	• Review and investigate construction activities and respective control measures for the monitoring period. • If it is concluded that construction activities were directly responsible for the exceedance (ie the exceedance event was not caused due to high regional dust levels or local non-project dust source), submit an incident report to government agencies. **Note**: Real time suspended particulate monitoring is also to be undertaken, to assist in managing dust from onsite activities (see **Section 10**).
Complaints received regarding nuisance dust	Trigger	There are no complaints received during the construction	An air-quality related complaint is received from a nearby resident	Further complaints are received from the same complainant after the additional mitigation measures have been implemented
	Response	Continue monitoring program as normal.	• Report the complaint to the regulator, in line with complaints handling procedure (See **Section 9**). • Review and investigate construction activities and increase dust suppression measures (additional watering, covering stockpiles etc), where appropriate.	• Review real-time monitoring data at the existing continuous monitors to investigate the likelihood of onsite activities contributing (see **Appendix D**).

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Real-time suspended particulate matter monitoring (TSP and PM_{10})	Trigger	Running 24-hour average PM_{10} concentrations < 40 µg/m^3	Running 24-hour average PM_{10} concentrations >40 µg/m^3 but <50 µg/m^3	Running 24-hour average PM_{10} concentrations >50 µg/m^3
	Response	Continue monitoring program as normal.	Review and investigate construction activities and respective control measures. Where appropriate, implement additional remedial measures, such as: • Deployment of additional water sprays, water trucks etc • Relocation or modification of dust-generating sources • Record findings of investigations and actions taken to reduce dust levels • Continue to closely monitor dust levels to ensure they are decreasing If elevated dust levels are due to regional dust event (fire, dust storm etc) – still take action to minimise dust from the site to minimise cumulative impacts, but also record details of the cause of the elevated background levels.	• Review and investigate construction activities and respective control measures for the monitoring period, in an air pollution incident report (see **Appendix D**). • If it is concluded that construction activities were directly responsible for the exceedance (ie the exceedance event was not caused due to high regional dust levels or local non-project dust source), submit an incident report to government agencies.

12 Roles and Responsibilities

Overall roles and responsibilities relating to the project are outlined in Section 3.2 of the overarching CEMP.

The key responsibilities specifically for dust management are as follows:

12.1 Contractor's Project Manager

- Ensuring appropriate resources/plant/personnel are available for the implementation of this CAQMP;
- Assessing data from inspections and providing project-wide advice to ensure consistent approach and outcomes are achieved;
- Providing necessary training for project personnel to cover air quality management;
- Reviewing and update of this CAQMP;
- Ensuring that the Environmental Coordinator monitors the PM_{10} data being supplied by the onsite Senitex system, and any other dust monitoring systems identified as being required;
- Assessing and engaging (as required) additional mitigation controls to best manage the risks of elevated dust levels before commencing works each day and ensuring that the appropriate controls are implemented and effective;
- Reviewing weather forecasts daily and current observations of meteorological conditions (as recorded at Horsley Park AWS);
- Throughout the day, visually assessing the dust levels and the effectiveness of any dust controls that have been implemented, which may include engaging additional resources to reduce or mitigate the risk of dust leaving the site;
- Ceasing particular scopes of works as required in the event of excessive dust generation due to extreme weather conditions or inadequately controlled construction activities (eg high winds, surface dirt accumulation, etc.); and
- In the event that an air quality complaint is received, the procedure in Section 3.6 of the CEMP will be implemented (see **Section 9**).

12.2 Environmental Coordinator

- Undertaking dust monitoring program; and
- Review that control measures are working in accordance with the CAQMP.

12.3 All Workers on Site

- Observing any dust emission control instructions and procedures that apply to their work;
- Taking action to prevent or minimise dust emission incidents; and
- Identifying and reporting dust emission incidents.

13 Review and Improvement of the CAQMP

The review of the CAQMP will be undertaken at least quarterly and will include participation by Goodman. The review will comprise, as a minimum, the following:

- Identification of areas of opportunity for ongoing improved environmental performance;
- Analysis of the causes of any recorded non-compliances, including those identified in environment inspections and audits;
- Verification of the effectiveness of corrective and preventative actions; and
- Highlighting any changes in procedures resulting from process improvement.

This CAQMP will also be reviewed and, if necessary, revised in the following circumstances:

- Where there is any change to the scope of the construction activities and/or disturbance footprint;
- Where it is identified that the environmental performance is not meeting the objectives of the CAQMP;
- In the event of a substantiated complaint being received regarding air quality impacts; and/or
- At the request of a relevant regulatory authority.

14 References

- DEC 2006, Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, Department of Environment and Conservation NSW, December 2006.
- EPA 2017, Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Environment Protection Authority NSW, January 2017.
- EPA 2018, Local Government Air Quality Toolkit, Module 3 – Guidelines for Managing Air Pollution, Part 3 – Guidance Notes for Construction Sites, available online at https://www.epa.nsw.gov.au/your-environment/air/air-nsw-overview/local-government-air-quality-toolkit, accessed on 17 July 2018.
- OEH 2017a, NSW Annual Compliance Report 2015, National Environment Protection (Ambient Air Quality) Measure, published by Office of Environment and Heritage, OEH 2017/0211, May 2017.
- OEH 2017b, NSW Air Quality Statement 2016 – Towards Cleaner Air, published by Office of Environment and Heritage, OEH 2017/0013, January 2017.
- OEH 2018, NSW Air Quality Statement 2017 – Clearing the Air, published by Office of Environment and Heritage, OEH 2018/0044, January 2018.
- OEH 2019, NSW Annual Air Quality Statement 2018, published by Office of Environment and Heritage, OEH 2019/0031, January 2019.
- SLR Consulting (2019b) Community Communications Strategy
- URBIS 2017, Environmental Impact Statement Oakdale West Estate, State Significant Development Application, prepare for: Goodman Limited, SA6642, 1 November 2017.
- USEPA 2006, AP42 Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources, 13.2.5 – Industrial Wind Erosion, November 2006.

APPENDIX A

WIND ROSES AND RAINFALL DATA ANALYSIS

Wind Conditions

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of 'plume' stretching. Wind direction, and the variability in wind direction, determines the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Horsley Park Automatic Weather Station (AWS) (Station ID 67119), located approximately 5.5 kilometres (km) southeast of the Oakdale West. Considering the relatively flat terrain between Oakdale West and Horsley Park AWS, it is considered reasonable to assume that the wind conditions recorded at the Horsley Park AWS are representative of the wind conditions experienced at the Oakdale West.

Annual wind roses for the years 2014 to 2018 compiled from data recorded by the Horsley Park AWS are presented in **Figure A1**, with seasonal wind roses for 2018 presented in **Figure A2**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The 'Beaufort Wind Scale' (consistent with terminology used by the BoM) presented in **Table A1** was used to describe the wind speeds experienced at Oakdale West.

Table A1 Beaufort Wind Scale

Beaufort Scale #	Description	m/s	Description on land
0	Calm	0-0.5	Smoke rises vertically
1	Light air	0.5-1.5	Smoke drift indicates wind direction
2-3	Light/gentle breeze	1.5-5.3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
4	Moderate winds	5.3-8.0	Raises dust and loose paper, small branches are moved
5	Fresh winds	8.0-10.8	Small trees in leaf begin to sway, crested wavelets form on inland waters
6	Strong winds	>10.8	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

Source: http://www.bom.gov.au/lam/glossary/beaufort.shtml

The annual wind roses for the years 2014 to 2018 (**Figure A1**) indicate that predominant wind directions in the area are consistently from the southwest quadrant. Very low frequencies of winds from the north-eastern quadrant were recorded across all years. The annual frequency of calm wind conditions was recorded to be approximately 12%-14.5% for all the years between 2014 and 2018.

A review of the annual wind roses (**Figure A1**) indicates that:

- Winds that would blow fugitive dust emissions from the demolition/construction works towards the nearest sensitive receptors located to the north and northwest of the proposed construction activities occur approximately 15-20% of the time.

The seasonal wind roses for the year 2018 (**Figure A2**) indicate that:

- In summer, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 9.8 m/s). The majority of winds originated from eastern and south eastern quadrants, with very few winds from western directions. Calm wind conditions were recorded approximately 13% of the time during summer.
- In autumn, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 8.9 m/s). The majority of winds originated from southwest quadrant, with very few winds from north eastern directions. Calm wind conditions were observed to occur approximately 16% of the time during autumn.
- In winter, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 8.6 m/s). The majority of winds originated from southwest quadrant, with very few winds from northeast and east directions. Calm wind conditions were observed to occur approximately 16% of the time during winter.
- In spring, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 9.8 m/s). The frequency of winds are mostly even in each directions, with relatively low frequency of winds originating from northwest quadrant. Calm wind conditions were observed to occur approximately 14% of the time during spring.

Wind erosion of dust from exposed surfaces (ie, during the construction phase of the development) is usually initiated when wind speeds exceed the threshold friction velocity for a given surface or material, however a general rule of thumb is that wind erosion can be expected to occur above 5 m/s (USEPA 2006). The frequency of wind speeds for the period of 2014-2018 is presented in **Figure A3**. The plot showed that the frequency of wind speeds exceeding 5 m/s for the period 2014-2018 at Horsley Park AWS was approximately 6%.

Figure A1 Annual Wind Roses for Horsley Park (2014 to 2018)

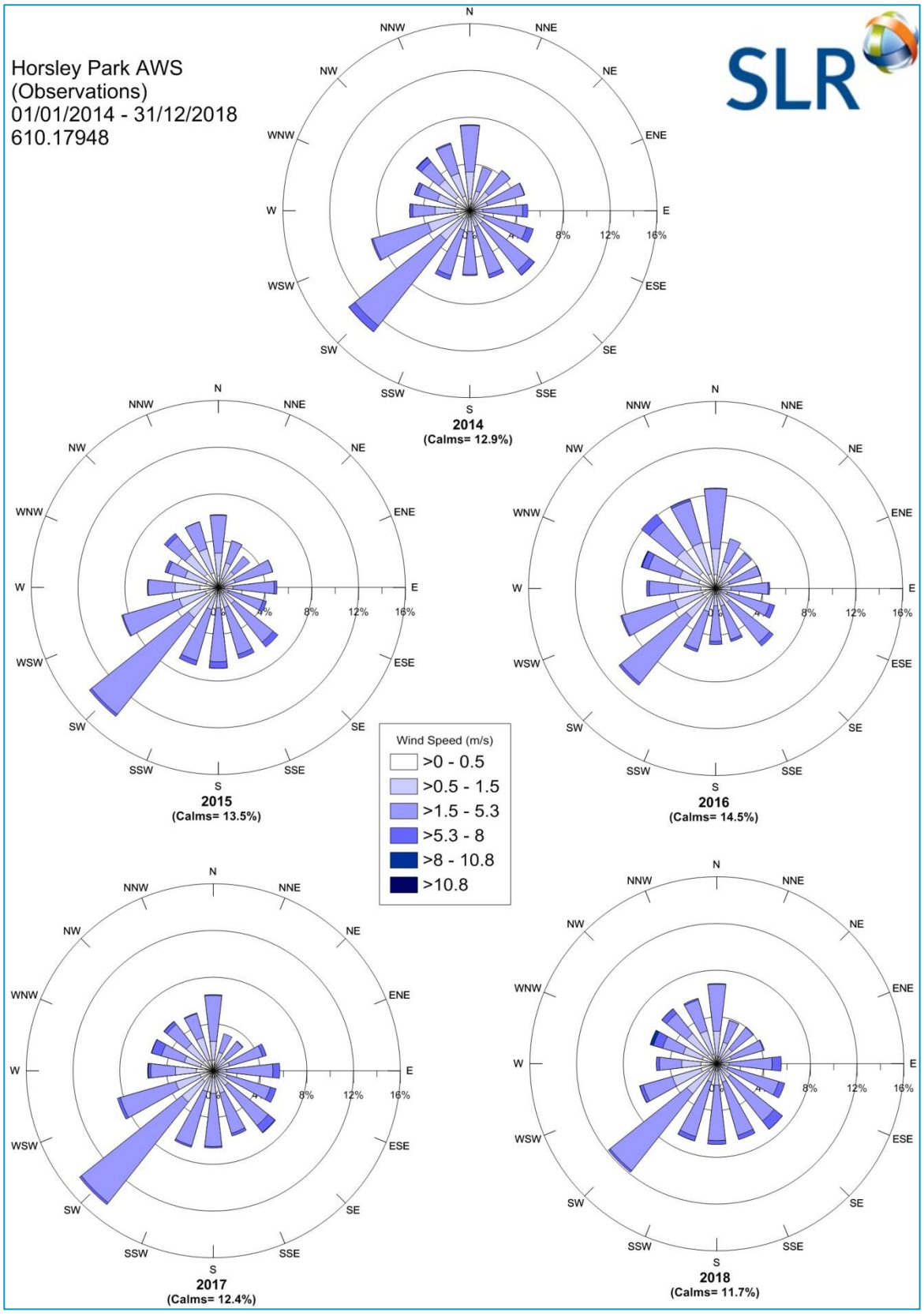


Figure A2 Annual and Seasonal Wind Roses for Horsley Park (2018)

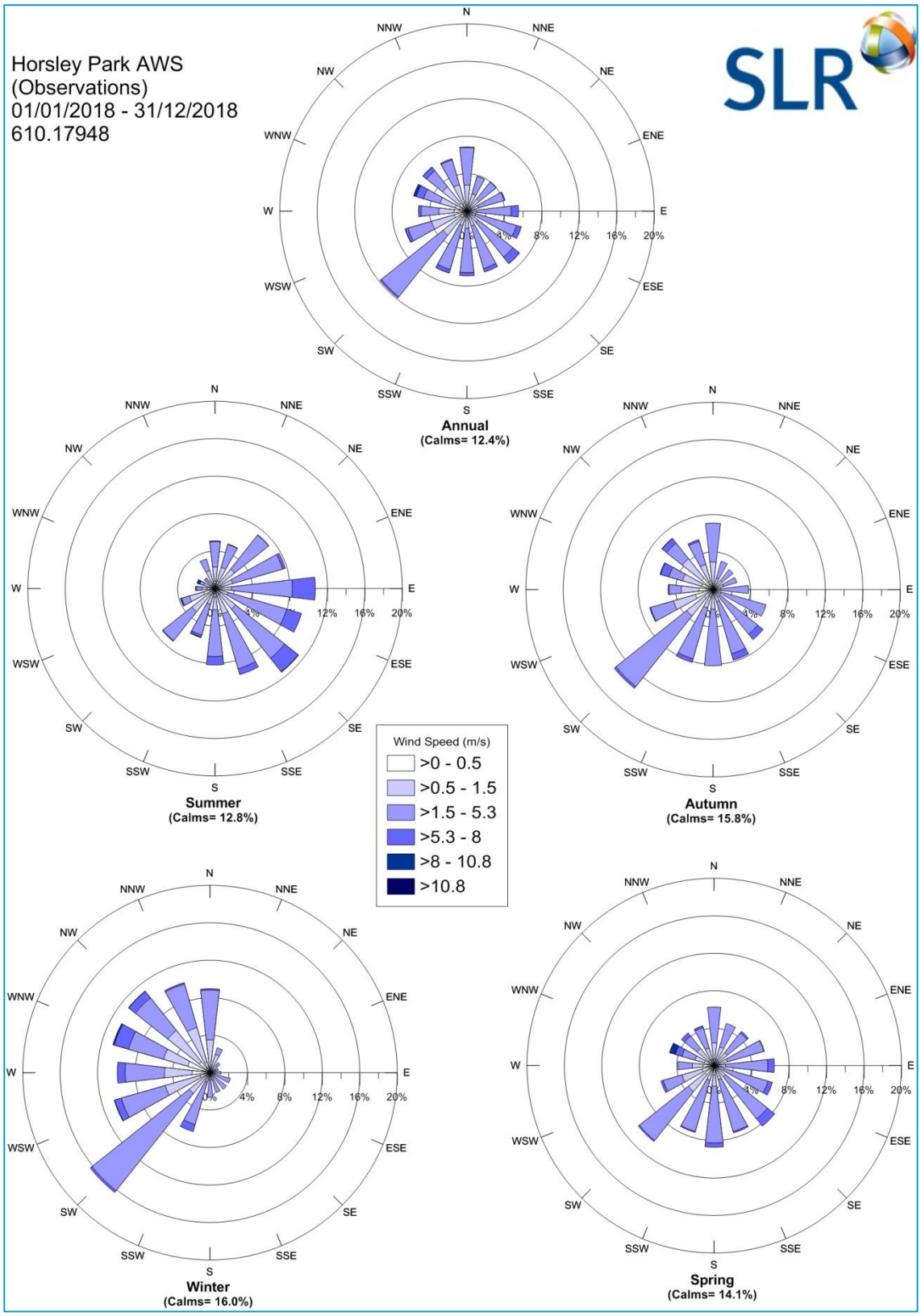
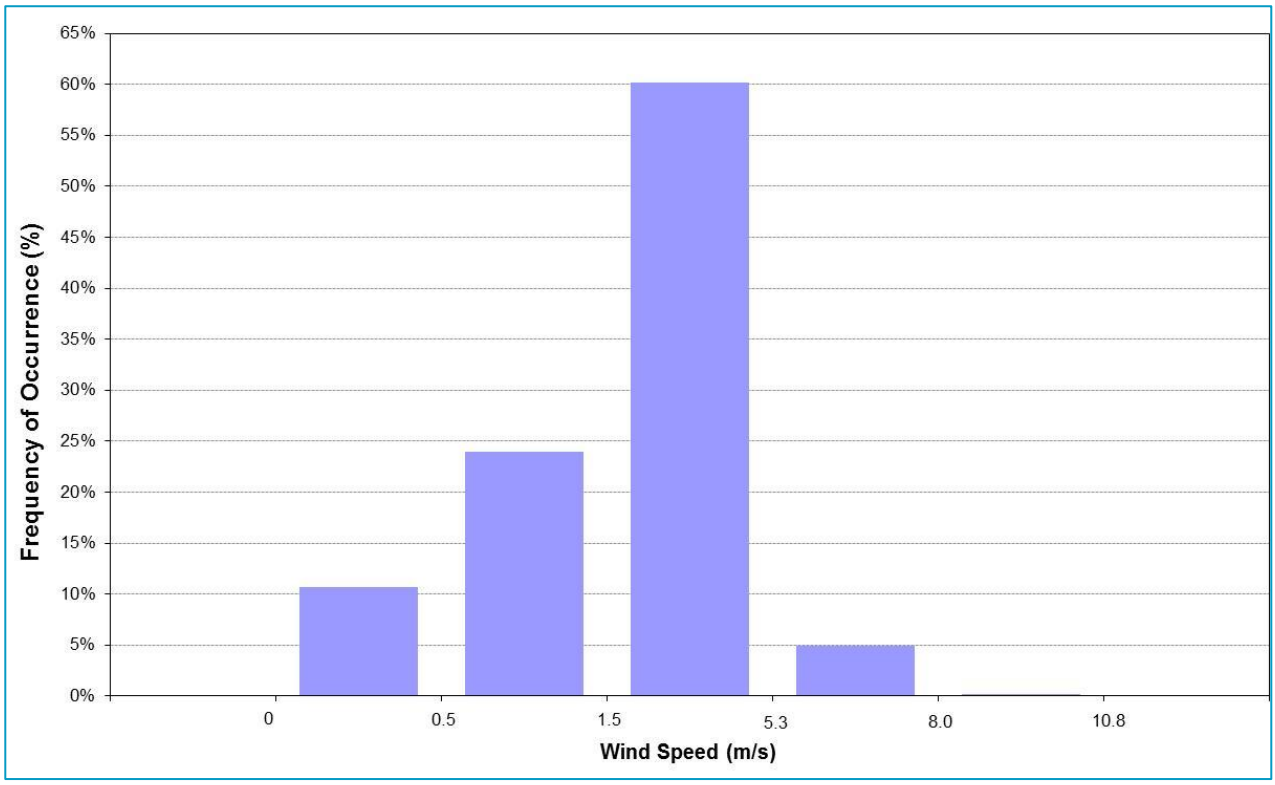


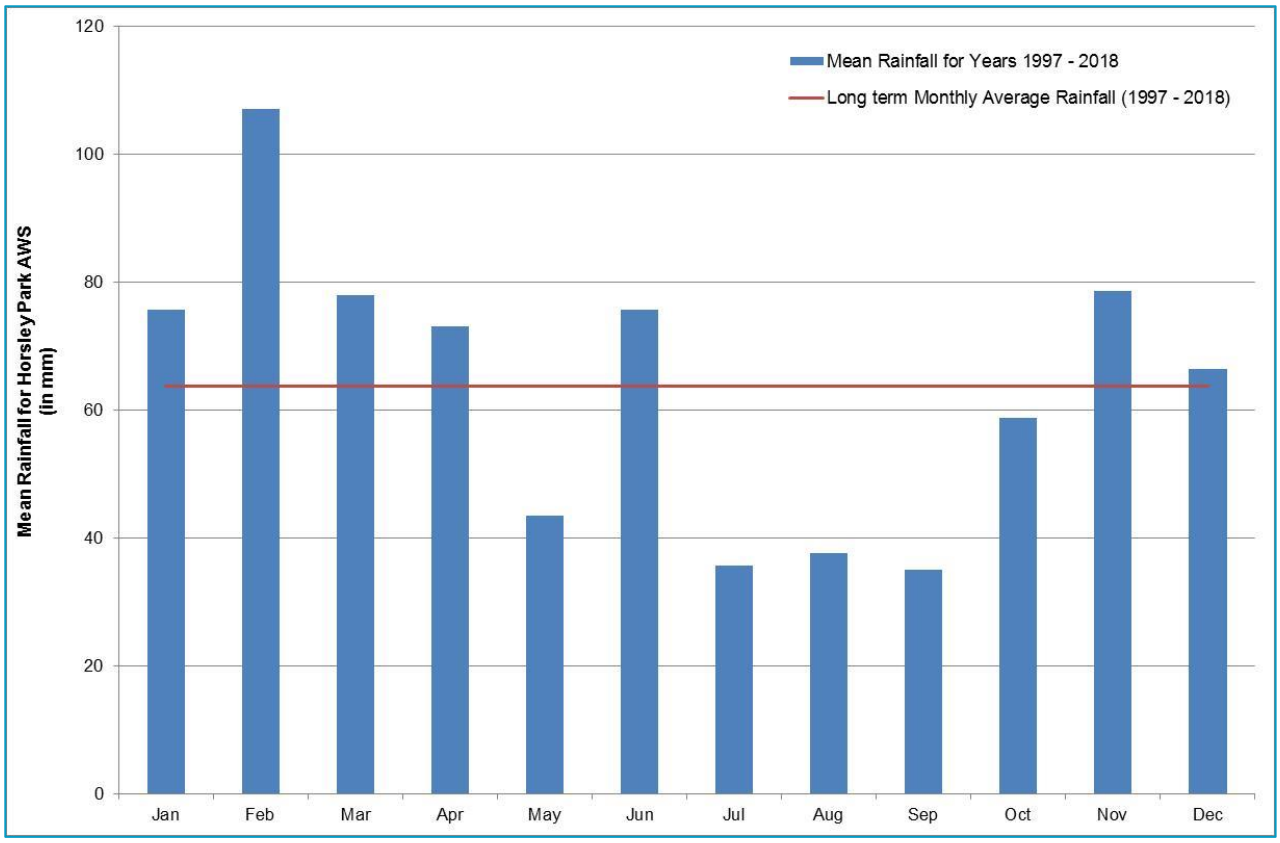
Figure A3 Wind Speed Frequency Chart for Horsley Park AWS – 2014-2018



Rainfall

Dry periods (no rainfall) have the greatest potential for fugitive dust emissions during construction. The long term monthly rainfall averages recorded at Horsley Park AWS rain gauge are shown in **Figure A4**. It is noted that generally rainfall is relatively low in mid-winter to mid spring periods. This rainfall pattern suggests that dust emissions from the demolition/construction activities at Oakdale West have the greatest potential to impact on receptors for the period of late autumn to early spring.

Figure A4 Long term Mean Rainfall for Horsley Park AWS – 1997 to 2018



APPENDIX B

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APPENDIX C

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the site, more than 50 m from the route used by construction vehicles on public roads and more than 500 m from the site entrance. This step is noted as having deliberately been chosen to be conservative, and will require assessments for most projects.

As noted in **Section 3.1**, the nearest sensitive receptor is located approximately 100 m from the nearest OWE boundary.

The screening criteria for detailed assessment are:

- a 'human receptor' within:
  - 350 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).
- an 'ecological receptor' within:
  - 50 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

Sensitive receptors (residences) are located within 350 m of the OWE boundary, therefore further assessment is required.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with suggested definitions for each category. The definitions given in the IAQM guidance for earthworks, construction activities and track-out, which are most relevant to this Development, are as follows:

Demolition *(Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time)*:

- ***Large***: Total 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;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and

- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.
- ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (eg silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.
- ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (eg sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

Construction *(Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc)*:

- ***Large***: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.
- ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (eg concrete), piling, on site concrete batching.
- ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (eg metal cladding or timber).

Track-out *(The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network)*:

- ***Large***: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
- ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
- ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

Note: Demolition of existing structures will be performed as part of this Development.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Based on the above, dust emission magnitudes have been categorised as presented in **Table C1**.

Table C1 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Demolition	Small	**IAQM Definition:** Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground,

Activity	Dust Emission Magnitude	Basis
		demolition during wetter months. **Relevance to this Project:** Demolition activities will predominantly be limited to removal of structures associated with the one old house within the site boundary.
Earthworks	Large	**IAQM Definition:** Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t. **Relevance to this Project:** The footprint of the site is approximately 154 ha and the Development site involves construction of twenty two new buildings (total volume of approximately 4.6 Mm^3).
Construction	Large	**IAQM Definition:** Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting. **Relevance to this Project:** The footprint of the site is approximately 154 ha and the Development site involves construction of twenty two new buildings (total volume of approximately 4.6 Mm^3).
Trackout	Medium	**IAQM Definition:** Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length. **Relevance to this Project:** *The traffic volume during construction is estimated to be 20 vehicle movements per hour.*

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table C1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table C2 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property 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.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where 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).	Locations where the people exposed are workers, and exposure is 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).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM10.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;

- any conclusions drawn from local topography;
- the duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Based on the criteria listed in **Table C2**, the sensitivity of the identified receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as they include residential areas where people may be reasonably expected to be present continuously as part of the normal pattern of land use.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table C3**. The sensitivity of the area should be derived for each of activity relevant to the project (ie construction and earthworks).

Table C3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor Sensitivity	Number of receptors	Distance from the 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

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table C4**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (ie an annual average of 19.4 $\mu g/m^3$ for PM_{10}) the IAQM method has been modified slightly.

This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table C4 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM_{10} conc.	Number of receptors [a,b]	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes:

(a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

As noted in **Section 3.2** , the nearest sensitive receptor is located within 350 m from the nearest OWE boundary. Based on the classifications shown in **Table C3** and **Table C4**, the sensitivity of the area to dust soiling and to health effects may both be classified as '*low*'. This categorisation has been made considering the individual receptor sensitivities derived above, the annual mean background PM_{10} concentration of 19.4 µg/m^3 recorded at St Marys AQMS (see **Section 6.2**) and the anticipated number of sensitive receptors present in the vicinity of the OWE.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table C5** (earthworks and construction), **Table C6** (track-out) and **Table C7** (demolition) to determine the risk category with no mitigation applied.

Table C5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table C6 Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Table C7 Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

APPENDIX D

AIR QUALITY NOTIFICATION FORM

WESTERN NORTH SOUTH LINK ROAD	
Air Quality Notification Form ➢ This form to be completed within 24hrs of an exceedance of PM10 dust >50 µg/m^3 (24hr average) on site (CAQMP Sect 5.2.1 Table 4 – 24hr average) ➢ This form to be completed by the Contractor PM, PE or Environmental Representative ➢ Please attach site observation photographs as required	
Contract	
Prepared by (Print Name)	
Position (Project PM, Engineer etc)	
Time/Day/Date of notification	
What were the PM_{10} levels recorded at the start of the shift?	
Condition Red Notification Summary Provide PM_{10} level data for the three Sentinex units located on site Ref: CAQMP Sect 11 Table 12.	South µg/m^3(24hr) North µg/m^3(24hr) West µg/m^3(24hr)
Was there scope of work specific dust generation observed during the reporting period? (If yes, please provide site specific area)	

WESTERN NORTH SOUTH LINK ROAD	
Was the measured dust level influenced by dust from external sources? (yes/no/possible)	
Dust generating construction related activities at the time of the notification (1) Provide a brief description of works being undertaken at the time of the dust being observed	
Background levels for PM10 recorded for the reporting period (St Mary's dust gauges) (2)	St Mary's AQMS µg/m^3(24hr)
Wind direction and speed relating to the reporting period (show variable wind directions and speed throughout the notification period. Attach wind charts if applicable) (3)	
Were additional dust mitigation resources implemented during the reporting period? (if yes, provide a brief description)	
Sign/Date	
OWE Contract Superintendent to Complete	
Notified ER Time/Day/Date	
Follow up required (yes/no)	
Is this notification issued as a result of an external complaint? If so, provide reference to CCCS report	
Sign/Date	

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