Parramatta Light Rail

Transport for New South Wales

Air Quality Working Paper

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Project Manager:	Caitlin Bennett
Author:	Luke Spencer
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Jacobs Australia Pty Limited

Level 7, 177 Pacific Highway
North Sydney NSW 2060 Australia
PO Box 632 North Sydney
NSW 2059 Australia
T +61 2 9928 2100
F +61 2 9928 2500
www.jacobs.com

Contents

Executive Summary

Introduction and purpose of this report

This document provides an assessment of potential air quality impacts associated with the construction and operational phases of the Parramatta Light Rail project. Noting the absence of specific guidance relating to air quality in the project-specific Secretary's Environmental Assessment Requirements (SEARs) (SSI 8285, released 18 April 2017), the assessment was completed against the *Critical State Significant Infrastructure Standard Secretary's Environmental Assessment Requirements* relating to air quality.

In meeting these requirements, the objectives of this assessment were to:

- Identify potential air quality impacts associated with the construction and operational phases of the project
- Develop suitable mitigation measures to prevent the generation of dust during construction and to manage potential impacts during operation, as required.

Impacts were assessed with reference to the following guidelines:

- *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*, (NSW Environment Protection Authority, 2016)
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*, (NSW Department of Environment and Conservation [DEC], 2007)
- *Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW*, (DEC, 2005).

Assessment overview and key findings

To determine potential impacts during the construction and operational phases of the project, a risk-based assessment was completed with reference to guidance presented in *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines.* The assessment identified several stages during construction which presented a medium residual, post-mitigated risk of impacts to air quality at surrounding receivers, with the generation of nuisance dust being the primary issue. The risk of air quality impacts during operations was evaluated to be low. Cumulative impacts from nearby projects occurring at the same time as the project were also considered.

Mitigation and management measures were developed for each phase of construction, and relevant activities associated with operations. With the implementation of these recommended measures, air quality is not expected to be a key environmental issue for the project.

Conclusion and next steps

The assessment identified that standard mitigation and management measures would be required to limit and effectively manage air quality impacts, particularly during the construction phase of the project. It was recommended that these measures are reviewed and updated as required once more detailed information regarding the method for construction of the project has been developed.

GLOSSARY AND ACRONYMS

Term	Definition
AAQMFQTP	Ambient Air Quality Monitoring and Fuel Quality Testing Project (NSW Environment Protection Agency)
AQI	Air quality index
AQIA	Air quality impact assessment
AQMG	*Air Quality Management Guideline 9TP-SD-107/2.0,* (Transport for NSW, 2015)
ATMP	Air Toxics Monitoring Program (NSW Environment Protection Agency)
AWS	Automatic weather station
BoM	Commonwealth Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CO	Carbon monoxide
CO_2	Carbon dioxide
DEC	Former NSW Department of Environment and Conservation
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
LRV	Light rail vehicle
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NSW	New South Wales
O_3	Ozone
OEH	NSW Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
PM_{10}	Particulate matter with an equivalent aerodynamic diameter less than 10 microns
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter less than 2.5 microns
POEO Act	NSW *Protection of the Environment Operations Act 1997*
SEARs	Secretary's environmental assessment requirements
SO_2	Sulfur dioxide
TSP	Total suspended particulates
VOCs	Volatile organic compounds

1. Introduction

1.1 Project background

Transport for New South Wales (Transport for NSW) is developing the Parramatta Light Rail to deliver a light rail network from Westmead to Carlingford via Parramatta CBD, and Camellia. This work builds on the actions identified in the *NSW Long Term Transport Master Plan* (Transport for NSW, 2012c), Sydney's *Light Rail Future – Expanding public transport, revitalising our city* (NSW Government, 2012) and *Unlocking Western Sydney's Potential with Light Rail: Western Sydney Light Rail Feasibility Study* (Parramatta City Council, 2013).

In December 2015, following extensive investigations into potential transport options, the NSW Government, announced a preferred Parramatta Light Rail network. The preferred network will link areas that are being transformed by government and private investment, including Westmead, Parramatta North, Camellia, Telopea and Rydalmere. Parramatta Light Rail will also serve major attractions in the Parramatta CBD including the new Western Sydney Stadium and the Museum of Applied Arts and Science.

On 17 February 2017, the NSW Government announced the preferred route for the first stage of Parramatta Light Rail (the project), which would link the following areas in the region:

- Westmead
- North Parramatta
- Parramatta Central Business District (CBD)
- Rosehill
- Camellia
- Rydalmere
- Dundas
- Telopea
- Carlingford

The Parramatta Light Rail network would be delivered in stages to ensure the infrastructure needed to support the current growth of Greater Parramatta is in place and light rail is operating as soon as possible. Planning work continues for Stage 2 of the network with consideration of other strategic transport projects (such as Sydney Metro West). This work is expected to be completed by the end of 2017.

1.2 Project description

The proposed action would include the provision and operation of the following key features:

- A light rail network of around 12 kilometres in length (including approximately seven kilometres within the existing road corridor separated from general traffic and approximately five kilometres utilising the existing Carlingford Line heavy rail and Sandown line for use as dedicated light rail corridors and replacing current heavy rail services).
- A total of 16 stops (subject to further design development). The stops would form a combination of side and island platforms depending on the final design of the proposed action and existing constraints at each stop location. Platforms would be approximately 45 metres long.
- Interchanges with existing rail and/or bus facilities at Westmead, Parramatta CBD, and Carlingford.
- Creation of two light rail priority zones (no general vehicle access) along Church Street (generally between Lennox Bridge and Macquarie Street) and Macquarie Street (generally between Horwood Place and Smith Street) within the Parramatta CBD.

- Light rail vehicle (LRV) driver amenities at light rail termini at Westmead and Carlingford and at the stabling and maintenance facility at Camellia.
- An integrated maintenance and stabling facility located in Rosehill. The maintenance facility would consist of a number of elements including:

- Stabling area for storage of LRVs.
- A stabling and maintenance building including a workshop containing servicing tracks to undertake LRV inspections and administration facilities for managing the administration, operation and maintenance of the PLR Systems.
- An automatic train wash plant and sanding plant for replenishing LRV sand boxes and for testing sanding equipment.

- Provision of a number of new bridge structures along the alignment including over James Ruse Drive, Clay Cliff Creek, Parramatta River (near the Cumberland Hospital) and Vineyard Creek, Rydalmere.
- Modification (including potential duplication at some locations) of Lennox Bridge (Church Street) and five existing bridge structures along the Carlingford Line (Parramatta River, Vineyard Creek, Kissing Point Road, Adderton Road and Pennant Hills Road) to accommodate the light rail alignment and active transport links.
- Alterations to the existing road network to accommodate the proposed action, including line marking, additional traffic lanes and turning lanes, new traffic signals, and changes to traffic flows (e.g. creation of left-in, left-out arrangements etc.).
- Ancillary infrastructure including up to eight electricity substations and overhead lines and poles to allow for LRV operations.
- Active transport corridors (shared paths) and additional urban design features along sections of the alignment and at stop locations.
- Replacement of existing rail infrastructure along the former Sandown Line corridor, between the junction at Camellia Station and the stabling and maintenance facility, and removal of the remaining rail infrastructure, east of the stabling and maintenance facility.
- Removal of existing rail infrastructure at the Parramatta Road level crossing and closure of the existing Carlingford Line north of Parramatta Road.

The project corridor is shown on Figure 1-1.

During construction, the project would be supported by several temporary ancillary facilities. Address and usage details for each compound site are listed below in Table 1-1.

Table 1-1 Details of temporary construction compounds sites

Temporary construction compound	Address	Primary use(s) during construction
Westmead Precinct		
Westmead Station Compound	Corner of Railway Parade and Hawkesbury Road, Westmead	Laydown/general construction activities to support construction proposed between Westmead Railway Station and the Cumberland Hospital Precinct both during and outside standard hours.
Hawkesbury Road	Corner of Hainsworth Street and Hawkesbury Road, Westmead	Laydown/general construction activities during standard hours to support construction proposed between Westmead Railway Station and the Cumberland Hospital Precinct.
Cumberland Hospital	Within the Cumberland Hospital Precinct between the Willow and Jarrah cottage buildings	Laydown/general construction activities to support construction within the Westmead Precinct and for the construction of the Parramatta North bridge both during

Temporary construction compound	Address	Primary use(s) during construction
		and outside standard hours.
Parramatta North Precinct		
Parramatta North Compound	Within the Cumberland Hospital Precinct	Parramatta North bridge works support as well as laydown and general construction activities both during and outside standard hours.
Factory Street Compound	Corner of Factory Street and Church Street, North Parramatta	Laydown/general construction activities to support activities within the North Parramatta Precinct both during and outside standard hours.
Fennell Street Compound	Corner of Fennell Street and Church Street, Parramatta	Laydown/general construction activities to support construction within the North Parramatta Precinct both during and outside standard hours.
Parramatta CBD Precinct		
O'Connell Street Compound	Vacant lot accessible from O'Connell Street on the western side of the Parramatta River directly adjacent to the foreshore	Laydown/general construction activities to support off-alignment road works both during and outside standard hours.
Barrack Lane Compound	Off Barrack Lane, Parramatta	Equipment storage and staff facilities.
Rosehill and Camellia Precinct		
Alfred Street Compound	129-133 Alfred Street, Parramatta	Laydown/general construction to support construction activities within Parramatta CBD as well as the bridge crossing over Clay Cliff Creek and James Ruse Drive. The facility would be in-use both during and outside standard hours.
Tramway Avenue	32 Tramway Avenue and the vacant lot adjacent to Clay Cliff Creek	Laydown/general construction to support activities within Parramatta CBD as well as the bridge crossing over Clay Cliff Creek and James Ruse Drive. The facility would be in-use both during and outside standard hours.
James Ruse Drive Compound	Corner of James Ruse Drive and Grand Avenue	Laydown/general construction activities both during and outside standard hours.
Parramatta River Bridge South Compound	South of the Parramatta River adjacent to the T6 Carlingford Line	Support works associated with modifications to the Parramatta River bridge activities both during and outside standard hours.
Carlingford Precinct		
Parramatta River Bridge North Compound	North of the Parramatta River adjacent to the T6 Carlingford Line	Support works associated with modifications to the Parramatta River bridge activities both during and outside standard hours.
Vineyard Creek Compound	Off Railway Street, Vineyard	Support modifications to the rail bridge over Vineyard Creek and more generally for works within the Carlingford precinct during standard hours of construction.
Rydalmere Station West Compound	Within an existing Sydney Trains maintenance compound off Victoria Road adjacent to the T6 Carlingford Line near Rydalmere	Support modifications to the rail bridge over Vineyard Creek and more generally for works within the Carlingford precinct during standard hours of construction.
Rydalmere Station East Compound	Within the existing Rydalmere Station commuter car park located off Victoria Road.	Support modifications to the rail bridge over Vineyard Creek and more generally for works within the Carlingford precinct during standard hours of construction.
Dundas Station Compound	Within an existing Sydney Trains maintenance	Support construction activities within the Carlingford

Temporary construction compound	Address	Primary use(s) during construction
	compound and Dundas Railway Station commuter carpark	Precinct during standard hours of construction.
Kissing Point Road Compound	At Vineyard Creek Reserve off Kissing Point Road, Dundas	Support the duplication of the Kissing Point Road bridge and general construction works within the Carlingford precinct both during and outside standard hours of construction.
Telopea Station Compound	Within the at-grade commuter carpark located adjacent to Telopea Station	General construction activities to support construction works within the Carlingford precinct during standard hours of construction.
Adderton Road Compound	Within Sydney Trains Compound off Adderton Road, Telopea	General construction activities to support construction works within the Carlingford precinct during standard hours of construction.
Carlingford Station Compound	Carlingford Station, Carlingford	Laydown/general construction activities to support construction works within the Carlingford precinct during standard hours of construction.

Figure 1-1: Key features of the project

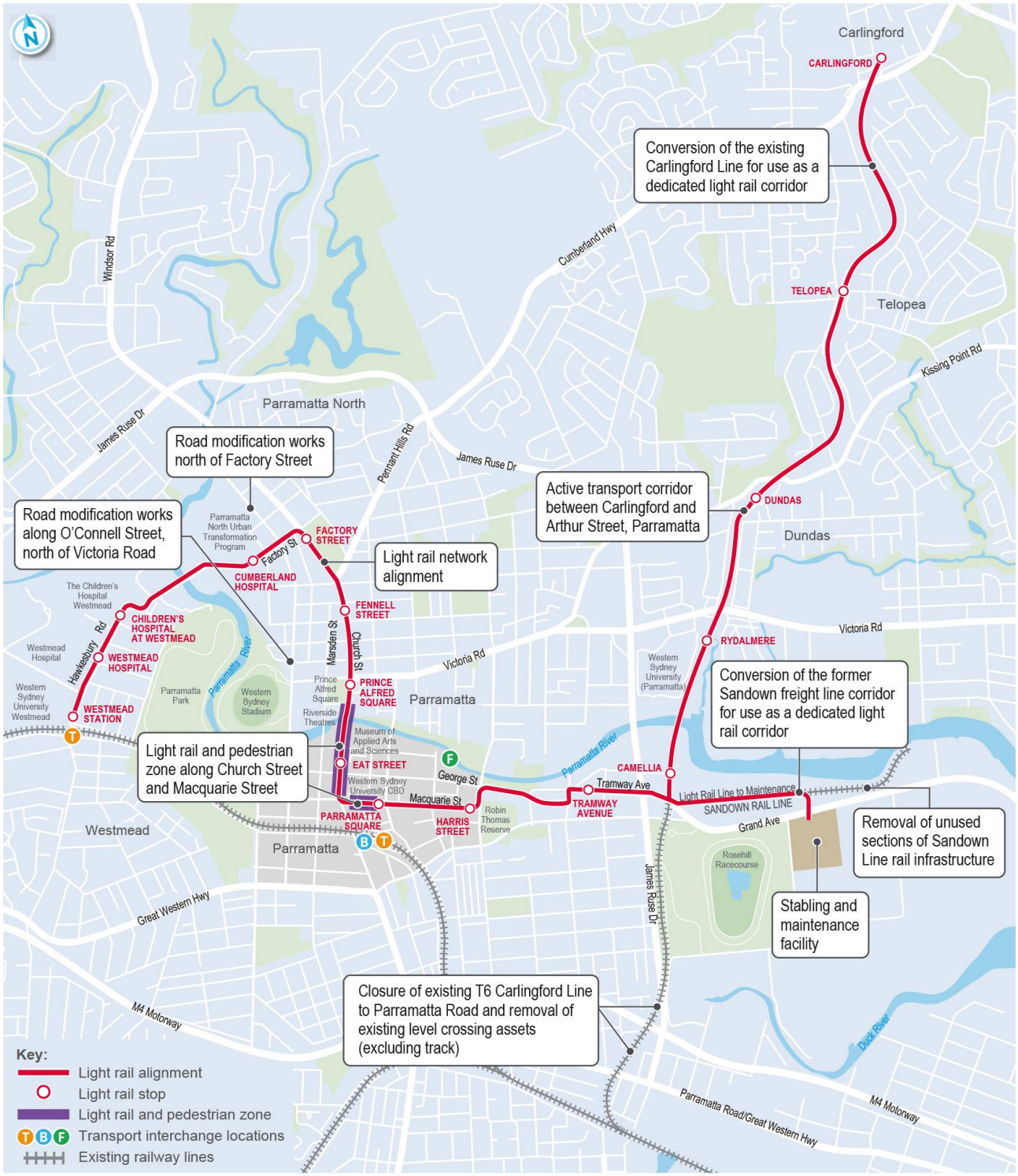

Figure 1.1 **Key features of the project**

1.3 Purpose and scope of this report

The project is subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act).

This air quality impact assessment (AQIA) is one of a number of technical papers that forms part of the Environmental Impact Statement (EIS). The purpose of this technical paper is to identify and assess the air quality impacts of the project during both construction and operation. In doing so it responds directly to the relevant Secretary's Environmental Assessment Requirements (SEARs) outlined in Section 1.4.

It is noted that air quality was not identified in the State Significant Infrastructure Application Report (SSIAR) as one of the key environmental issues associated with the project.

This technical paper considers the potential air quality impacts associated with all phases; namely construction and post-construction operational phases of the project. These impacts were evaluated at a local and regional level, including the potential for cumulative impacts associated with other nearby developments. In achieving this objective, the key aims for this paper were to:

- Identify potential air quality impacts associated with the construction and operational phases of the project
- Describe all features of the existing natural and human environment which may be affected by potential air quality impacts generated by the action
- Assess potential impacts to air quality at surrounding local and regional receivers during the construction and operational phases of the Project
- Develop suitable mitigation measures to prevent the generation of dust during construction and to manage potential impacts during operation, as determined to be required
- Evaluate the significance of residual air quality risks after the application of the recommended mitigation and management measures.

1.4 Secretary's environmental assessment requirements

The SEARs issued for the project (SSI 8285, released 18 April 2017) do not contain any specific requirements for assessment for air quality. In lieu of this, the assessment has been prepared to address the specific requirements for air quality assessment as outlined in the *Critical State Significant Infrastructure Standard Secretary's Environmental Assessment Requirements (SEARs)*, (NSW Department of Planning and Environment, 2015). These requirements have been reproduced below in Table 1-2, including a link to where these requirements are specifically addressed within this paper.

Table 1-2 Standard SEARs environmental assessment requirements for air quality

Requirement	Where addressed in this paper
The Proponent must undertake an air quality impact assessment (AQIA) for construction and operation of the project in accordance with the current guidelines.	This document
The Proponent must ensure the AQIA also includes the following: demonstrated ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation (2010)*; and	Sections 4 to 6
The Proponent must ensure the AQIA also includes a cumulative local and regional air quality impact assessment	

The project-specific SEARs describe how each of the 'key' environmental issues identified for the project is to be assessed. Though air quality was not identified to be a 'key issue' for the project, the same method has been applied in the completion of this assessment. Table 1-3 summarises where each of these requirements have been addressed in this study.

Table 1-3 SSI 8285 SEARs Condition 2 requirements for assessment of key issues and where these are addressed in this report

Requirement	Where addressed in this paper
2 (a) – Describe the biophysical and socio-economic environment, as far as it is relevant to that issue;	Section 4
2 (b) – Describe the legislative and policy context, as far as relevant to the issue;	Section 3
2 (c) – Identify, describe and quantify (if possible) the impacts associated with the issue including the likelihood and consequence (including worst-case scenario) of the impact (comprehensive risk assessment), and the cumulative impacts;	Sections 5 and 6
2 (d) – Demonstrate how potential impacts have been avoided (through design, or construction or operation methodologies)	Sections 5 and 7
2 (e) – Detail how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures (against performance criteria where relevant); and	Section 5
2 (f) – Detail how any residual impacts will be managed or offset, and the approach and effectiveness of these measures	Sections 5 and 7

1.5 Structure of this report

The structure and content of this report is as follows:

- Chapter 1 (this chapter) – Project background and description
- Chapter 2 – A description of the methodology used for the assessment and an outline of the air quality objectives
- Chapter 3 – Description of the legislative and policy context, and relevant criteria applicable to the project
- Chapter 4 – An overview of the existing environment
- Chapter 5 – An assessment of potential impacts during the construction and operational phases of the project including residual risks after the application of recommended mitigation measures
- Chapter 6 – Recommended measures to mitigate and manage potential air quality impacts during the project.
- Chapter 7 – Details of any residual impacts expected following mitigation
- Chapter 8 – Conclusion.

2. Assessment approach

This section of the report describes the methods applied in this study to assess potential air quality impacts during construction and operational phases of the project.

2.1 Definition of the study area

Consistent with other studies completed as part of the assessment of potential environmental impacts associated with the project, the study area used for this assessment considers local areas close to the project, as well as locations further away but which may be subject to cumulative impacts.

2.2 Identification of primary air quality risks

2.2.1 Construction

During construction, the primary risk to local air quality is the generation of dust. That is, particulate matter in the form of total suspended particulates (TSP), particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM_{10}) and particulate matter with an equivalent aerodynamic diameter less than 2.5 microns ($PM_{2.5}$). Airborne particulate matter has the potential to cause adverse respiratory or nuisance impacts if not properly managed.

Activities involving the excavation and handling of bulk materials, as well as those which result in the development of temporarily exposed surfaces have the greatest potential to generate dust. Table 2-1 details the volume of material expected to be excavated and fill required during the project.

Table 2-1 Volume of excavated material expected and fill required for the project

Precinct	Approximate volume of material to be excavated (m^3)	Approximate volume of material required for fill (m^3)	Earthwork balance (m^3)
Westmead Precinct	34,000	19,000	15,000
Parramatta North Precinct	33,000	19,000	14,000
Parramatta CBD Precinct	38,000	22,000	16,000
Rosehill and Camellia Precinct	28,000	16,000	12,000
Carlingford Precinct	23,000	50,000	-27,000
Camellia maintenance depot and stabling facility	20,000	90,000	-70,000
Total	**176,000**	**216,000**	**-40,000**
Best base (i.e. minimum) volume of fill required to be imported m^3			**40,000**
Worst case (i.e. maximum) volume of fill required to be imported m^3			**216,000**

The volumes shown above have been used to in combination with relevant emission factors to estimate the potential fugitive emissions to air. The emission estimation methods included the *National Pollutant Inventory Emission Estimation Technique Manual for Mining version 3.1* (NPI, 2012), (Department of Sustainability, Environment, Water, Population and Communities, 2012) and the *AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources,* (United States Environmental Protection Authority). The following quantities of fugitive emissions to air were estimated without controls from excavation and materials handling-related activities, as well as wind erosion:

- Excavation activities: 719kg, 340kg and 36kg of TSP, PM_{10} and $PM_{2.5}$ respectively over the course of the project resulting from the excavation of materials using guidance from Section 1.1.2 of NPI, 2012.
- Materials handling: 8493kg, 3290kg and 425kg of TSP, PM_{10} and $PM_{2.5}$ respectively over the course of the project resulting from the loading of cut materials to trucks, truck unloading of excavated cut, loading of

excavated cut to stockpiles, loading of materials from stockpiles to trucks and truck unloading of fill materials. This estimate is based on the approaches outlined in Sections 1.1.2 and 1.1.6 of NPI, 2012.

- Wind erosion: Entrainment from exposed surfaces at a rate of around 0.4, 0.2 and 0.02-0.03 kg/ha/h of TSP, PM_{10} and $PM_{2.5}$ from exposed surfaces based on the default values presented in Sections 1.1.17 and 1.1.18 of NPI, 2012.

Further emissions to air are also likely to be generated during the ballast screening, crushing and recycling activities planned within the Sandown line. It is presently estimated that a minimum of 5000 tonnes of ballast material would be screened, then crushed for use as recycled ballast as found to be suitable. Assuming a production rate of 750 tonnes per day and based on the minimum quantity of 5000 tonnes to be processed; 1488kg, 435kg and 74kg of TSP, PM_{10} and $PM_{2.5}$ was estimated to be emitted to air from the activity. These estimates consider dust arising from the loading of waste ballast materials to the screening and crushing process, processing of the material through a mobile screens and primary crushing unit, stockpiling of the process outputs, loading of the stockpiled products to trucks, haulage from site, and wind erosion resulting from the product stockpiles. Emissions from these sources were based on guidance presented in Sections 1 and Table 3 of NPI, 2012, with no control measures in place.

These values provide a conservative indication of the extent of dust generation which would be required to be effectively managed during the project without the application of effective work practices and control measures. The actual extent of dust materials emitted to air during construction is expected to be less and would be dependent on the nature of excavated and imported cut and fill materials; plant and equipment used; the effective use of control measures; and meteorological conditions present during the completion of the works.

Other potential air quality issues during construction would be localised and are expected to include exhaust fumes associated with combustion of fossil fuels, and the potential for odours associated with some excavated materials.

2.2.2 Operations

Although there would be an increase in electricity consumption associated with the project and a resulting increase in emissions at the location where the electricity was generated (if sourced from non-renewable energies), the air quality around the project may improve as a result of the change in transport mode shift from private vehicles to public transport.

Several potential additional local sources of emissions to air would be likely during operations including:

- Particulate matter from braking and the wearing of steel as a result of friction between the wheels and track
- Exhaust emissions during track maintenance activities
- Particulate matter entrainment during traction sanding maintenance activities.

Key pollutants associated with these types of emissions would include:

- Particulate matter, comprising TSP, PM_{10} and $PM_{2.5}$
- Carbon dioxide (CO_2)
- Carbon monoxide (CO)
- Sulphur dioxide (SO_2)
- Volatile organic compounds (VOCs)
- Oxides of nitrogen (NO_x).

2.3 Risk-based assessment method

To identify and appropriately manage the generation of dust emissions during construction and operations, a risk-based qualitative assessment method was applied. Details of this method are described below and the assessment of pre and post-mitigated risks to air quality are presented in **Section 5**.

2.3.1 Identification of local receivers, prevailing meteorological and ambient air quality conditions

Publically available imagery was reviewed to determine the location of nearby receivers in relation to the project study area.

To characterise prevailing weather conditions, long-term climate data including temperature, rainfall, wind speed and direction data were reviewed from the nearest monitoring stations operated by the Bureau of Meteorology (BoM) at Parramatta North (station number 066124) and Sydney Olympic Park (station no. 066212).

Background air quality conditions around the project were estimated from data collected at the nearest New South Wales (NSW) Office of Environment and Heritage (OEH) ambient air quality monitoring stations located at Chullora and Prospect.

2.3.2 Determination of initial risk ratings for each phase of construction

Potential air quality impacts were qualitatively assessed for each phase of construction and potential operational emission scenario. The likelihood (probability) and consequence (severity) of activities resulting in air quality impacts were evaluated to develop initial risk ratings. This was completed using metrics developed based on guidance from *AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines* shown below.

Table 2-2 Environmental risk evaluation matrix (AS/NZS ISO 31000: 2009)

Consequences	Likelihood				
	Very unlikely	Unlikely	Possible	Likely	Almost certain
Catastrophic	15	19	22	24	25
Major	10	14	18	21	23
Moderate	6	9	13	17	20
Minor	3	5	8	12	16
Insignificant	1	2	4	7	11

Table 2-3 Method for determining likelihood (probability), (AS/NZS ISO 31000: 2009)

Likelihood	Definition	Probability
Almost certain	The event is almost certain to occur in the course of normal or abnormal construction / operational circumstances.	Greater than 90%
Likely	The event is more likely than not to occur in the course of normal construction / operational circumstances.	51 to 90%
Possible	The event may occur in the course of normal construction / operational circumstances.	26 to 50%
Unlikely	The event is unlikely to occur in the course of normal construction / operational circumstances.	5 to 25%
Very unlikely	The event may occur in exceptional construction / operational circumstances only.	Less than 5%

Table 2-4 Method for determining consequence (severity), (AS/NZS ISO 31000: 2009)

Consequence level	Definition
Catastrophic	Long term (greater than three months) and irreversible impacts. Resulting in a major prosecution under relevant environmental legislation.
Major	Medium term (between one and three months) and potentially irreversible impacts. Resulting fine or equivalent penalty notice under relevant environmental legislation.
Moderate	Moderate and reversible impacts or medium term (between one and three months).
Minor	Minor and reversible, or short term impacts (less than one month)
Insignificant	Minor, negligible impacts.

Table 2-5 Method for evaluating the significance of calculated risks

Risk rating score	Risk category	Comments
1 to 7	Low	Negligible effect or implication on the environment. No injury, insignificant financial loss (i.e. less than $5,000), minimal environmental damage, no complaints. Environmental impact that would not be of concern to a reasonable person.
8 to 12	Medium	Minor effect or implication on the environment. First-aid required, on site damage immediately contained with no long-term impacts, minor financial loss (greater than $5,000 but less than $50,000), occasional complaints, possible media interest. Localised and reversible damage to the environment.
13 to 18	High	Moderate, medium-term effect or implication on the environment. Medical treatment required, containable localised damage on-site, moderate financial loss (greater than $50,000 but less than $5,000,000), low likelihood of prosecution, minimal fines, occasional complains and possible media interest. Extensive and reversible or localised and irreversible environmental damage.
19 to 22	Very High	Long-term effect or implication on the environment. Extensive injuries, project suspensions for a period of days, major financial loss (greater than $5,000,000 but less than $100,000,000), significant on-site environmental damage, very bad media coverage, community discontent, possible prosecution. Extensive and reversible or localised and irreversible environmental damage.
23 to 25	Extreme	Irreversible, extensive implications on the environment. Death, project suspensions for a period of weeks, massive financial loss (greater than $100,000,000), significant off-site environmental damage, sustained bad media coverage, sustained complaints and community discontent, probable prosecution.

Factors including the intensity and duration of activities, relative location in relation to surrounding sensitive receivers, nature of sensitive receivers, existing air quality and prevailing meteorological conditions were considered to develop likelihood and consequence ratings, and resulting initial risk ratings.

2.3.3 Develop mitigation measures and recalculate residual risks

Following the initial assessment, air quality mitigation measures were recommended, where necessary, to minimise and mitigate phases of construction where ‘moderate risks’ or higher were estimated. Residual risk ratings were calculated based on the application of recommended management measures and safeguards.

2.4 Cumulative impacts review

Where works take place at the same time and around the same general location, there is the potential for cumulative impacts. Projects with a potential cumulative impact are identified in Chapter 9 of the EIS.

Wherever possible, cumulative impacts arising from these projects have also been considered as part of this assessment.

3. Legislative and policy framework

In NSW, emissions to air are controlled by the *Protection of the Environment Operations Act 1997* (POEO Act) and the following regulations:

- *Protection of the Environment Operations (Clean Air) Regulation 2010*
- *Protection of the Environment Operations (General) Regulation 2009, Part 5.4 Air pollution*.

The *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (Approved Methods), (NSW Environment Protection Authority, 2016) provides methods for modelling and assessing emissions to air in NSW.

The Transport for NSW *Air Quality Management Guideline 9TP-SD-107/2.0* (AQMG), (TfNSW, 2015) is also applicable to this assessment. This document provides guidance for the mitigation and management of dust generation and emissions on Transport for NSW work sites.

Relevant assessment criteria for the primary pollutants associated with the construction and operational phases of the project are presented below in Table 3-1. The original sources for each criterion from the Approved Methods are also listed.

Table 3-1 Air quality impact assessment criteria

Pollutant	Averaging period	Impact assessment criteria	Source
Particulate matter (PM_{10})	24 hours	50 µg/m^3	DoE, 2016
	Annual	25 µg/m^3	DoE, 2016
Particulate matter ($PM_{2.5}$)	24 hours	25 µg/m^3	DoE, 2016
	Annual	8 µg/m^3	DoE, 2016
Total suspended solids (TSP)	Annual	90 µg/m^3	NHMRC, 1996
Deposited dust	Annual (maximum increase)	2 g/m^2/month	NERDDC, 1988
	Annual (maximum total)	4 g/m^2/month	NERDDC, 1988
Carbon monoxide (CO)	15 minutes	100 mg/m^3	WHO, 2000
	1 hour	30 mg/m^3	WHO, 2000
	8 hours	10 mg/m^3	NEPC, 1998
Nitrogen dioxide (NO_2)	1 hour	246 µg/m^3	NEPC, 1998
	Annual	62 µg/m^3	NEPC, 1998
Sulfur dioxide (SO_2)	10 minutes	712 µg/m^3	NHMRC, 1996
	1 hour	570 µg/m^3	NEPC, 1998
	24 hours	228 µg/m^3	NEPC, 1998
	Annual	60 µg/m^3	NEPC, 1998
Volatile organic compounds (VOCs) as benzene	1 hour	29 µg/m^3	VGG, 2001

These criteria relate to the 100th percentile (99.9th percentile for benzene), total cumulative concentration of pollutants in the air and not just contributions from project-specific sources. In this context, the term '100th percentile refers to the highest value at a location over a period of analysis. The '99.9th percentile' result is the 99.9th highest value at a location over a given period of analysis.

As such, ambient pollutant concentrations determined below in Section 4.2.2 must also be considered when evaluating against these criteria.

4. Existing environment

This section of the report describes the existing conditions around the project including long-term and prevailing meteorological conditions, ambient air quality conditions and the nature of different land use receivers within the vicinity of the project.

4.1 Climate and Meteorology

Meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The nearest weather station with long-term historical records operated by the BoM is the Parramatta North automatic weather station (AWS) (station number 066124). This station is located approximately 1.5 kilometres to the northeast of the Parramatta North Precinct segment of the project. Table 4-1 displays long-term temperature and rainfall averages recorded at this station from its date of commission in 1967 to December 2016. Long-term temperature and rainfall data are also displayed in Figure 4-1.

Table 4-1 Long-term temperature and rainfall data from BoM Parramatta North AWS, (BoM, 2017)

Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean rainfall (mm)	Mean number of rain days (> 1 mm)
January	28.4	17.6	105.7	9.1
February	27.8	17.6	121.2	9.1
March	26.3	15.8	106.7	9.5
April	23.8	12.9	93.6	7.3
May	20.6	9.9	69.5	7.1
June	17.8	7.6	91.2	7.5
July	17.4	6.3	46.2	5.5
August	19.1	7.1	56.9	5.3
September	21.7	9.4	52.5	5.9
October	24	12	66.7	7.5
November	25.5	14.1	85.5	8.8
December	27.4	16.2	73.6	7.7
Annual	**23.3**	**12.2**	**973.5**	**90.3**

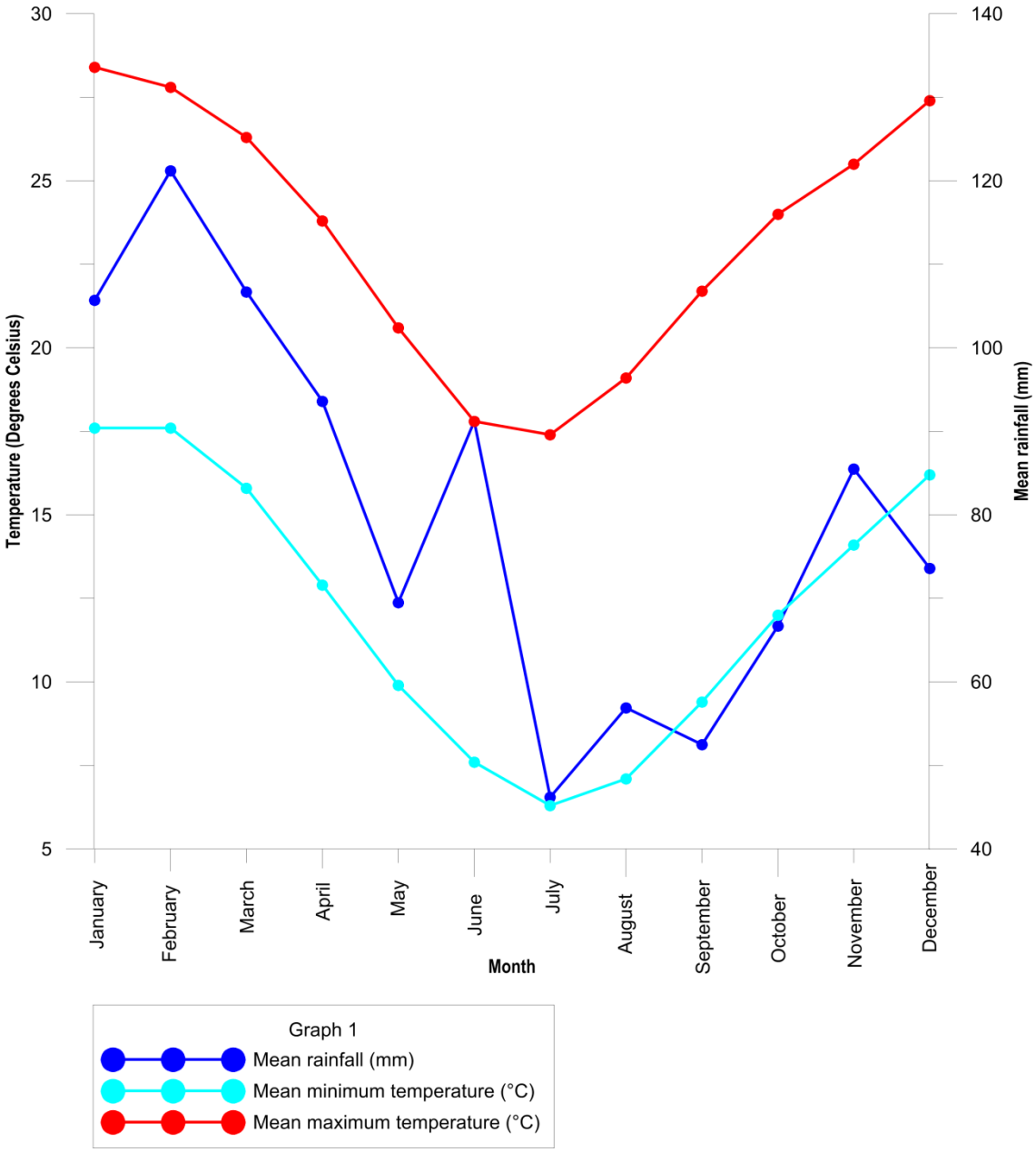

Figure 4-1 Graph of long-term temperature and rainfall data from BoM Parramatta North AWS, (BoM, 2017)

The data indicates that the locality around the project experiences warm and wet summers with mean daily maximum temperatures of around 28 degrees Celsius. Months through winter and the beginning of spring are the coldest and driest periods of the year with average monthly rainfall from July to September of around 52 millimetres (mm) per month.

To determine prevailing wind conditions around the project area, annual and seasonal wind data were reviewed for the years 2013, 2014 and 2015 at the nearby Sydney Olympic Park AWS (no. 066212). Annual and seasonal trends were are generally consistent over the three years, with winds blowing from the west northwest most common in autumn and winter, and winds from the east most prevalent in summer and spring. Calm conditions (i.e. wind speeds less than 0.5 metres per second) were most common in autumn and winter; occurring around 26 per cent of the time during these seasons. Annual and seasonal wind roses from data collected in 2015 are displayed below in Figure 4-2.

Figure 4-2 Annual and seasonal wind roses for Sydney Olympic Park AWS 2015

4.2 Ambient air quality

The NSW OEH operates a state wide air quality monitoring network which provides information on current and historical air quality. The network includes 15 air quality stations around the greater Sydney region. The nearest stations in relation to the project are located at Chullora (approximately eight and a half kilometres to the south southeast) and Prospect (around seven kilometres to the west). Data from these two stations have been used to characterise ambient air quality conditions around the Study Area.

4.2.1 Air quality index

NSW OEH developed a metric known as the 'air quality index' (AQI) to provide an indication of the overall air quality. The metric considers pollutant data measurements for ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and PM_{10}, as well as visibility against criteria presented in the *Variation to the National Environment Protection (Ambient Air Quality) Measure* and OEH standard for visibility. These readings are converted to a single overall value, known as the AQI using the formula:

$$AQI\ pollutant = \frac{Pollutant\ data\ reading}{Standard} \times 100$$

Table 4-2 provides a scale for relating AQI values to a qualitative indication of individual and relative air quality.

Table 4-2 AQI value classifications, (http://www.environment.nsw.gov.au/aqms/aqi.htm)

AQI value	Resulting classification
0 to 33	Very good
34 to 66	Good
67 to 99	Fair
100 to 149	Poor
150 to 199	Very poor
Greater than 200	Hazardous

Statistics generated from daily AQI values calculated at the nearest OEH air quality monitoring stations at Chullora and Prospect are presented below in Table 4-3. These statistics indicate that daily AQI values are generally 'good' with occasional days of 'fair' to 'poor' air quality or worse, usually driven by particulate matter concentrations.

Table 4-3 AQI value statistics, (http://airquality.environment.nsw.gov.au/aquisnetnswphp/openresult.php)

Period	Chullora AQI value statistics			Prospect AQI value statistics		
	Annual daily average	95th percentile of daily values	Annual daily maximum	Annual daily average	95th percentile of daily values	Annual daily maximum
2013	51 (Good)	87 (Fair)	716 (Hazardous)	58 (Good)	81 (Fair)	641 (Hazardous)
2014	47 (Good)	80 (Fair)	204 (Hazardous)	48 (Good)	71 (Fair)	140 (Poor)
2015	46 (Good)	74 (Fair)	443 (Hazardous)	49 (Good)	89 (Fair)	186 (Very poor)
2016	52 (Good)	99 (Fair)	347 (Hazardous)	57 (Good)	95 (Fair)	810 (Hazardous)

4.2.2 Background concentrations

As identified in section 2.2, the primary pollutants of concern during construction and operations are particulate matter, CO_2, CO, SO_2, NO_x and VOCs. Table 4-4 below summarises which of these pollutants are measured at the Chullora and Prospect air quality monitoring stations.

Table 4-4 Summary of pollutants measured at nearby OEH monitoring stations

OEH air quality monitoring station	Location	Particulate matter PM_{10}	Particulate matter $PM_{2.5}$	Nitrogen dioxide (NO_2)	Sulfur dioxide (SO_2)	Carbon monoxide (CO)	Volatile organic compounds (VOCs)
Chullora	Southern Sydney TAFE, Worth Street	✓	✓	✓	✓	✓	
Prospect	William Lawson Park	✓	✓[#]	✓	✓	✓	

[#] $PM_{2.5}$ data only available for 2015 and 2016 at Prospect.

A summary of the ambient concentrations of PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO measured at these two stations from 2013 to 2016 is shown below in Table 4-5.

Table 4-5 Summary of ambient pollutant concentrations measured from 2013 to 2016 at Chullora and Prospect, (http://airquality.environment.nsw.gov.au/aquisnetnswphp/openresult.php)

Year	Chullora	Prospect	Criterion
Maximum 24 hour averaged PM_{10} in µg/m^3			
2013	69 (32)	82 (33)	50
2014	40 (30)	44 (30)	
2015	65 (29)	69 (30)	
2016	64 (31)	110 (34)	
Maximum annually averaged PM_{10} in µg/m^3			
2013	18	19	30
2014	18	18	
2015	18	18	
2016	18	19	
Maximum 24 hour averaged $PM_{2.5}$ in µg/m^3			
2013	49 (16)	-	25
2014	23 (16)	-	
2015	37 (14)	30 (16)	
2016	49 (14)	85 (18)	
Maximum annually averaged $PM_{2.5}$ in µg/m^3			
2013	8.4	-	8
2014	9.0	-	
2015	8.0	8.2	
2016	8.0	8.7	
Maximum 1 hour averaged NO_2 in µg/m^3			
2013	103	92	246
2014	120	88	
2015	102	100	
2016	86	100	

Year	Chullora	Prospect	Criterion
Maximum annually averaged NO_2 in µg/m^3			
2013	25	20	62
2014	25	19	
2015	24	20	
2016	24	18	
Maximum 1 hour averaged SO_2 in µg/m^3			
2013	31	52	570
2014	50	50	
2015	37	71	
2016	37	55	
Maximum annually averaged SO_2 in µg/m^3			
2013	1.8	2.1	60
2014	1.3	1.6	
2015	1.3	1.3	
2016	1.6	1.6	
Maximum 8 hour averaged CO in mg/m^3			
2013	2.9	1.8	10
2014	1.5	2.0	
2015	1.6	1.7	
2016	1.8	1.7	

Considering the results presented in Table 4-5 against the assessment criteria established in Section 3, the following observations were made regarding the background concentrations for each key pollutant of interest.

Particulate matter (PM10)

- 100th percentile (maximum) 24 hour-averaged PM_{10} background concentrations were found to exceed the criterion of 50 µg/m^3 at both monitoring locations in 2013, 2015 and 2016, but were below this criterion in 2014. 95th percentile values of 24 hour-averaged concentrations ranged from 29 to 34 µg/m^3, with the highest value recorded at Prospect in 2016.
- Annually averaged PM_{10} background concentrations were consistently 18 to19 µg/m^3 across all years considered. These levels are below the assessment criterion (30 µg/m^3).

Particulate matter (PM2.5)

- 100th percentile (maximum) 24 hour-averaged $PM_{2.5}$ background concentrations were generally measured above the criterion of 25 µg/m^3, but 95th percentile 24 hour-averaged $PM_{2.5}$ concentrations were below this value, ranging from 14 to 18 µg/m^3.
- Annually averaged $PM_{2.5}$ background concentrations (8.0 ug/m3 to 9.0 ug/m3) were measured to already be at or exceeding the assessment criterion of 8 µg/m^3.

Nitrogen dioxide (NO2)

- 100th percentile 1 hour averaged NO_2 background concentrations were measured to be well below the assessment criterion (246 µg/m^3) with a maximum value of 120 µg/m^3 recorded at Chullora in 2014.
- Annually averaged NO_2 background concentrations were recorded below the assessment criterion (62 µg/m^3) during all measurements considered.

Sulphur dioxide (SO2)

- 100th percentile 1 hour averaged SO_2 background concentrations were found to be well below the criterion of 570 µg/m^3, with the highest recorded value being 71 µg/m^3 at Prospect in 2015.
- Annually averaged SO_2 background concentrations were measured well below the 60 µg/m^3 criterion.

Carbon monoxide (CO)

- 100th percentile 8 hour-averaged CO concentrations were well below the assessment criterion (10 µg/m^3) during all measurement periods considered.

Volatile organic compounds (VOCs)

VOCs are not presently measured at any NSW OEH air quality monitoring stations. As outlined in the *Western Sydney Airport Environmental Impact Statement Volume 4 Appendix F1 Local air quality and greenhouse gas,* (Pacific Environment Limited, October 2016); two historical studies have previously been completed by the NSW EPA to investigate baseline concentrations of air toxics:

- Air Toxics Monitoring Program (ATMP) involving the collection of 24 hour-averaged measurements at the Sydney CBD, Rozelle, St Marys and Blacktown from 1996 to 2001
- Ambient Air Quality Monitoring and Fuel Quality Testing Project (AAQMFQTP) where 24 hour-averaged measurements were collected from October 2008 to October 2009 at Turrella and Rozelle.

During the ATMP study, annual and 24 hour-averaged benzene concentrations of 1.4 µg/m^3 and 4.2 µg/m^3 were measured at St Marys respectively. Annual benzene concentrations of 1.4 µg/m^3 were measured at Turrella during the AAQMFQTP study.

Summary

Considering the monitoring data presented above, the following background concentrations were established for the receiving environment around the project. It is noted that the 1 hour averaged CO and VOC (as benzene) background concentrations have been approximated using the formula provided in the *AUSPLUME Gaussian Plume Dispersion Model Technical User Manual,* (Victorian Environment Protection Authority 2000) for estimating sub-hourly concentrations from hourly data. The formula was modified to estimate the 1 hour concentration from the available 8 hour and 24 hour averaged data respectively.

Table 4-6 Adopted pollutant background concentrations

Pollutant	Averaging time	Adopted background concentration
PM_{10}	24 hour	34 µg/m^3
	Annual	19 µg/m^3
$PM_{2.5}$	24 hour	18 µg/m^3
	Annual	9.0 µg/m^3
NO_2	1 hour	120 µg/m^3
	Annual	25 µg/m^3
SO_2	1 hour	71 µg/m^3
	Annual	2.1 µg/m^3
CO	1 hour	2.9 mg/m^3
	8 hour	2.0 mg/m^3
Volatile organic compounds (VOCs) as benzene	1 hour	7.9 µg/m^3

4.3 Surrounding land uses

Ambient air quality throughout the Sydney Basin is influenced by a number of factors, including topography, prevailing meteorological conditions (e.g. wind and temperature, which vary seasonally) and local and regional air pollution sources (e.g. motor vehicles, industrial facilities and bushfires). Consequently, local and regional air quality can be highly variable in nature and impacted by events occurring a significant distance away.

Facilities which release emissions or generate waste transfers that exceed National Pollution Inventory (NPI) reporting thresholds for the 93 substances listed in the *National Environment Protection (National Pollution Inventory) Measure 1998,* are required to report to the NPI database. Total emissions data is publically available for each facility which has reported to the NPI database since the 1998 to 1999 reporting, with the most recent available for the 2015 to 2016 reporting period.

A review of the NPI database identified 15 facilities which had reported emissions to air of the pollutants of concern related to this assessment within the vicinity of the proposal. Details of these facilities are summarised below.

Table 4-7 Summary of nearby facilities which reported emissions to air during the 2015 to 2015 NPI reporting period

Facility	Address	Activity	Applicable pollutant emissions to air reported in 2015/2016
Boral Plasterboard Camellia	3 Thackeray Street, Camellia	Plaster, plasterboard and cornice manufacturing	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Camellia Vinegar	15 Grand Avenue, Camellia	Manufacturing of vinegar	CO, NO_x and total VOCs
Clyde Transfer Station	322a Parramatta Road, Clyde	Hazardous waste treatment or disposal service	Total VOCs
Coca-Cola Amatil Northmead	128 Briens Road, Northmead	Soft drink manufacturing	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Daniels Health	2 Wiblin Street, Silverwater	Biomedical waste treatment by incineration or chemical treatment	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Downer EDI Works Rosehill	1 Unwin Street, Rosehill	Hot mix asphalt production	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Earth Power	35 Grand Avenue, Camellia	Hazardous waste treatment or disposal service	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
James Hardie Rosehill	10 Colquhoun Street, Rosehill	Fibre cement manufacturing and distribution	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Mauri ANZ Camellia	15 Grand Avenue, Camellia	Yeast manufacture	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Silverwater Terminal	Corner of Holker Street and Newington Street, Silverwater	Petroleum product storage and wholesaling	Benzene
Speedibake Ermington	Corner of Hughes Avenue and Hope Street, Ermington	Bread manufacturing, bakery product manufacturing	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Spotless Facility Services North Rocks	2/21 Loyalty Road, North Rocks	Laundry services	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Unilever North Rocks	219 North Rocks Road, North Rocks	Manufacturer of home and personal care products	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and total VOCs
Viva Energy Clyde Terminal	Durham Street, Rosehill	Storage of petroleum products. Waste activities	CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and benzene
Viva Energy Parramatta Terminal	Durham Street, Rosehill	Hydrocarbon storage and distribution	Benzene

In addition to these facilities a variety of other activities are likely to influence the measured background air quality conditions recorded around the proposal area. These include:

- Vehicle exhaust emissions from the existing road network
- Other light industrial activities
- Commercial businesses, such as service stations and smash repairs
- Domestic activities, such as wood-fired home heaters
- Other construction projects.

4.4 Nearby receivers

The project area traverses a highly developed area containing a variety of different land uses. The types of different sensitive receivers and their approximate distance from the project corridor are summarised by precinct below in **Table 4-8**.

Table 4-8 Summary of surrounding sensitive receivers by project precinct

Precinct	Land use type	Location	Approximate distance to project (m)
Westmead Precinct	Medical	Westmead Hospital	100 m
		Children's Medical Research Institute	15 m
		The Children's Hospital at Westmead	60 m
		The Heart Centre for Children	30 m
		Cumberland Hospital	Typically 10 m or further
	Aged Care	Uniting Mayflower Westmead	200 m
	Place of Worship	Westmead Church – Parramatta Mission	15 m
	Residential	Residents along Hawkesbury Road and Hainsworth Street	Typically 5 to 15 m
		Residents along Railway Parade, Queens Road, Caroline Street, Helen Street and Jessie Street	Typically 10 m or further
Parramatta North Precinct	Medical	Cumberland Hospital	15 m
		Sydney West Area Health Service	40 m
	Educational	Health Education and Training Institute Higher Education	70 m
		Parramatta North Public School	60 m
		Care Training and Consultants	10 m
	Place of Worship	Redeemer Methodist Church	170 m
		Saint Patrick's Cathedral Parramatta	180 m
	Residential	Residents along Factory Street, Church Street and nearby cross streets (New Street, Fleet Street, O'Connell Street, Galloway Street, Albert Street, Pennant Hills Road and Harold Street)	Typically 5 to 15 m or further

Precinct	Land use type	Location	Approximate distance to project (m)
Parramatta CBD Precinct	Educational	Australian Institute of Fitness	90 m
		University of New England Future Campus Parramatta	5 m
		Arthur Phillip High School	10 m
		Parramatta Public School	15 m
		Rowland Hassall School	20 m
		Impact Training Institute	70 m
	Medical	Parramatta Medical Centre	15 m
	Recreational	Prince Alfred Square	15 m
		Robin Thomas Reserve	20 m
	Place of Worship	Leigh Memorial Church	10 m
		Parramatta Mosque	110 m
		St Ioannis Greek Orthodox Church	60 m
	Residential	Residential/ mixed use residential receivers along Church Street, Macquarie Street, and George Street as well as nearby cross streets	Typically 5 to 15 m
Rosehill and Camellia Precinct including the Camellia maintenance depot and stabling facility	Recreational	Rosehill Gardens Racecourse	170 m
	Educational	University of Western Sydney Parramatta Campus	30 m
	Place of Worship	Dundas Ermington Uniting Church	170 m
		Sydney Young Nak Presbyterian Church	150 m
	Residential	Residents off Victoria Road	50 m
		Residents off George Street, Alfred Street, Tramway Avenue and associated cross streets	Typically 10 to 20 m
Carlingford Precinct	Educational	Dundas Public School	160 m
		Carlingford West Kindergarten	170 m
	Residential	Residential receivers near the T6 Carlingford Line	Typically 20 m or further

The project also includes activities which involve construction activities beyond the core project corridor. Of these works, activities with a high potential to generate dust impacts include:

- Excavation works for the reconfiguration of surrounding roadways
- Rail ballast storage, screening and recycling activities within the Sandown line
- The temporary construction compound site off O'Connell Street.

The nearest sensitive receivers in relation to these activities are summarised below.

Table 4-9 Summary of surrounding sensitive receiver areas around the off-corridor project sites

Activity	Receiver land use type	Location	Approximate distance from activity (m)
Excavation works for the reconfiguration of surrounding roadways	Residential	Nearest residential receivers along Hainsworth Street	Typically 10 to 20 m
		Nearest residential receivers along O'Connell Street and associated cross streets	Typically 10 to 15 m
		Nearest residential receivers along Albert Street	Typically 10 to 15 m
		Nearest residential receivers around the intersection of Pennant Hills Road and Church Street	Typically 15 to 20 m
		Residential/ mixed use residential receivers along George Street between O'Connell Street and Harris Street	Typically 5 to 15 m
		Nearest residential receivers along Macquarie Street between O'Connell Street and Church Street	Typically 5 to 15 m
		Nearest residential receivers around the intersection of Alfred Street and Noller Parade	Typically 10 to 20 m
		Nearest residential receivers along Arthur Street between Tramway Avenue and George Street	Typically 10 to 15 m
	Educational	Our Lady of Mercy College	15 m
		Parramatta North Public School	15 m
		Reggio Emilia Early Learning Centre	20 m
	Place of Worship	Saint Patrick's Cathedral Parramatta	15 m
	Recreational	Pirtek Stadium and recreational complex	60 m
O'Connell Street Compound	Recreational	Pavilion Flat recreational area	100 m
Sandown line ballast screening, crushing and recycling work area	Recreational	Rosehill Gardens Racecourse	200 m

5. Assessment of potential impacts

5.1 Overview

Potential impacts during the construction and operational phases of the project were evaluated using the risk-based approach outlined in Section 2.3. Mitigation measures were recommended based on the estimated initial, unmitigated risk level, with residual risk levels determined following the application of recommended measures.

The phases of construction considered as part of this assessment included:

- Enabling works:
- Installation of perimeter safety barriers, implementation of local bus diversions and road reconfiguration changes
- Relocation of major utilities and preparation works (including excavations) for light rail slab construction
- Remediation of excavated materials
- Storage, handling and management of excavated spoil and imported materials
- Demolition and vegetation removal activities
- Main construction works:
- Development of temporary compounds and installation of safety fencing
- Protection and relocation of utilities
- Demolition works
- Installation of project infrastructure including preparatory civil engineering works and installation of rail, stop infrastructure and overhead wiring
- Restoration of roadways affected during construction
- Bridge crossing works and construction of other major structures
- Substation construction
- Construction of Camellia maintenance depot and stabling facility.
- Landscaping and public domain works
- Additional works:
- Ballast screening, crushing and recycling activities.

Regarding operations, though negative impacts to air quality are expected to be minimal, each risk was also assessed with measures recommended as appropriate.

5.2 Assessment and findings

This assessment is presented below in Table 5-1.

As displayed, the following activities were identified as having the greatest un-mitigated potential to result in emissions to air:

- Earthworks activities during enabling road and service reconfigurations, light rail civil works and construction of the Camellia maintenance depot and stabling facility
- Storage, handling and management of excavated spoil and imported fill materials within the corridor and at the temporary construction compound areas
- Remediation of excavated materials
- Demolition activities

- Ballast screening, crushing and recycling activities within the Sandown line.

With the application of the recommended measures, the highest residual risk rating was assessed to be 8 (constituting a medium risk). This was identified for the excavation, remediation, materials storage and management, compound operations and the Camellia maintenance depot and stabling facility activities.

A residual risk of 'medium' was determined for these activities as the recommended measures are likely to limit the consequence of potential air quality impacts but would not completely remove their possibility given the urban setting of the project. As described in Table 2-5, a 'medium' risk constitutes one which may cause minor local and reversible environmental implications, and/or has the potential to result in occasional complaints. Considering this as well as the fact that such potential issues would be infrequent and temporal (i.e. limited to the period of construction), with the application of the recommended measures, air quality impacts during construction are not expected to be a material issue. That being said, particular care will be required around the more densely populated areas and locations with highly sensitive land uses such as the Westmead Precinct and around other sensitive areas identified in Section 4.3.

Table 5-1 Air quality risk assessment

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Enabling works	Enabling works including installation of safety barriers around work sites, implementation of local bus diversions, implementation of road reconfiguration changes	• Emissions to air including dust and products of combustion (from equipment operations).	Minor	Possible	8	• Inspecting the plant/equipment prior to commencement of works on site. • Conduct routine servicing and maintenance, and subsequent inspections to ensure that equipment continues to operate efficiently.	Minor	Unlikely	5

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Relocation of major utilities and preparation works (including excavations) for the light rail slab construction	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces.	Moderate	Likely	17	• Regularly water exposed and disturbed areas especially during inclement weather conditions. • Wherever possible, minimise the extent of disturbed and exposed surfaces, and restore as soon as possible. • Ensure that all loads are covered and any loose materials/debris is removed before departure from site. • Apply wheel-wash or rumble grid facilities as appropriate to remove loose material and prevent the tracking of spoil debris onto local roads. • Co-ordinate activities with other nearby projects to avoid potential cumulative impacts. • Install dust monitoring devices to quantify dust levels and determine whether control measures are adequate or whether further actions are required. • Adjust the intensity of activities based on measured dust levels, weather forecasts and the proximity and direction of the works in relation to the nearest surrounding receivers. • Co-ordinate any higher risk activities with surrounding sensitive receivers to avoid any particularly sensitive periods of operation.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Remediation of excavated contaminated materials	• Odours and emissions arising from uncovered contaminated and/or hazardous materials.	Moderate	Possible	13	• Apply odour supressing agents to materials as necessary to minimise related impacts should any contaminated or hazardous materials be uncovered during the works. • Adhere to relevant requirements for removal and disposal listed in the *Work Health and Safety Act 2011*, and *Work health and Safety Regulation 2011.* • Co-ordinate any higher risk activities with surrounding sensitive receivers to avoid any particularly sensitive periods of operation.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Storage and management of excavated spoil and imported materials	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces.	Moderate	Likely	17	• Installation of perimeter screening around long-term stockpiling locations. • Regularly water stockpiles and cover when not in use for a period of more than one month. • Wherever possible and practical, limit the amount of materials stockpiled around the site. • Ensure that all loads are covered when materials are being hauled to and from site. • Clean loose materials and debris from the tailgate of vehicles unloading materials to stockpiles prior to departure from site. • Position stockpiling areas as far as possible from surrounding receivers. • Limit stockpiling activities during conditions where winds are blowing strongly in the direction(s) from the stockpiling location to nearby receivers. • Install dust monitoring devices to quantify dust levels and determine whether control measures are adequate or whether further actions are required.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Demolition activities	• Emissions to air including dust and products of combustion (from equipment operations). • Impacts associated with hazardous materials contained within demolition wastes	Moderate	Possible	13	• Install perimeter screening around demolition areas. • Water demolition areas as necessary to minimise the generation of dust. • Plan demolition activities, and avoid weather conditions which may convey dust from the demolition area towards surrounding receivers. • Ensure that structures are inspected by a suitably qualified person to confirm that they do not contain any hazardous materials (e.g. asbestos) which could be broken and mobilised during demolition. Where such materials are identified, adhere to the requirements for removal and disposal listed in the *Work Health and Safety Act 2011*, and *Work health and Safety Regulation 2011.* • Promptly remove or cover any demolition materials that have the potential to result in the generation of dust. • Co-ordinate activities with other nearby projects to avoid potential cumulative impacts. • Co-ordinate any higher risk activities with surrounding sensitive receivers to avoid any particularly sensitive periods of operation.	Minor	Unlikely	5

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Main construction works	Temporary construction compound activities and installation of safety barriers around the overall site.	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces.	Minor	Likely	12	• Installation of perimeter screening around long-term compound sites. • Impose low speeds limits around compound sites to limit the generation of dust from vehicle movements. • Apply wheel-wash or rumble grid facilities (or equivalent) at access points to limit the tracking of materials beyond the site boundary. • Ensure that compound area surfaces are well compacted or sealed to limit the potential for dust generation. • To the level practical, limit the extent of exposed areas and amount of materials stockpiled at the compound sites. • Select compound sites which maximise the separation distance from surrounding receivers. • Select stockpiling locations at areas within compound sites which allow the greatest separation from surrounding receivers. • Reduce or halt stockpiling activities during inclement weather conditions.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Protection and relocation of utilities	• Emissions to air including dust and products of combustion (from equipment operations).	Minor	Possible	8	• Installation of perimeter screening around areas where there is a potential to generate emissions to air. • Plan activities, and avoid weather conditions which may result in the generation of off-site dust impacts.	Minor	Unlikely	5

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Demolition works	• Emissions to air including dust and products of combustion (from equipment operations). • Impacts associated with hazardous materials contained within demolition wastes	Moderate	Possible	13	• Install perimeter screening around demolition areas. • Water demolition areas as necessary to minimise the generation of dust. • Plan demolition activities, and avoid weather conditions which may convey dust from the demolition area towards surrounding receivers. • Ensure that structures are inspected by a suitably qualified person to confirm that they do not contain any hazardous materials (e.g. asbestos) which could be broken and mobilised during demolition. Where such materials are identified, adhere to the requirements for removal and disposal listed in the *Work Health and Safety Act 2011*, and *Work health and Safety Regulation 2011.* • Promptly remove or cover any demolition materials that have the potential to result in the generation of dust. • Co-ordinate activities with other nearby projects to avoid potential cumulative impacts. • Co-ordinate any higher risk activities with surrounding sensitive receivers to avoid any particularly sensitive periods of operation.	Minor	Unlikely	5

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Installation of the structural infrastructure including rail, overhead wiring, bridge crossing infrastructure and substation construction	• Emissions to air including dust and products of combustion (from equipment operations).	Minor	Possible	8	• Installation of perimeter screening around areas where there is a potential to generate emissions to air. • Plan activities, and avoid weather conditions which may result in the generation of off-site dust impacts. • Inspecting the plant/equipment prior to commencement of works on site. • Conduct routine servicing and maintenance, and subsequent inspections to ensure that equipment continues to operate efficiently.	Minor	Unlikely	5

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Preparatory civil engineering earthworks for installation of rail infrastructure	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces.	Moderate	Likely	17	• Regularly water exposed and disturbed areas especially during inclement weather conditions. • Wherever possible, minimise the extent of disturbed and exposed surfaces, and restore as soon as possible. • Ensure that all loads are covered and any loose materials/debris is removed before departure from site. • Apply wheel-wash or rumble grid facilities as appropriate to remove loose material and prevent the tracking of spoil debris onto local roads. • Co-ordinate activities with other nearby projects to avoid potential cumulative impacts. • Install dust monitoring devices to quantify dust levels and determine whether control measures are adequate or whether further actions are required. • Adjust the intensity of activities based on measured dust levels, weather forecasts and the proximity and direction of the works in relation to the nearest surrounding receivers. • Co-ordinate any higher risk activities with surrounding sensitive receivers to avoid any particularly sensitive periods of operation.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Restoration of roadways affected during construction	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces. • Dust and debris arising from haulage of materials.	Moderate	Possible	13	• Adjust the intensity of activities based on measured dust levels, weather forecasts and the proximity of and direction of the works in relation to the nearest surrounding receivers. • Ensure that all loads are covered and any loose materials/debris is removed before departure from site. • Abide by road speed limits.	Minor	Unlikely	5
	Construction of Camellia maintenance depot and stabling facility	• Emissions to air including dust and products of combustion (from equipment operations). • Impacts associated with hazardous materials contained within demolition wastes	Moderate	Likely	17	• All measures listed for each relevant phase of construction as detailed plus the additional measure below. • Co-ordination of activities with a high potential to result in the generation of dust to avoid sensitive periods at the Rosehill Gardens Racecourse.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Ballast recycling works	Recycling of ballast from the Carlingford line within the Sandown line rail corridor	• Emissions to air including dust and products of combustion (from equipment operations). • Windborne dust emanating from disturbed/exposed surfaces. • Dust and debris arising from haulage of materials.	Moderate	Likely	17	• Where possible and practical, position the ballast screening, crushing and recycling activities at a location within the Sandown line rail corridor which provides the greatest distance separation to surrounding receiver locations. • Where possible make use of water sprays to limit the generation of dust during screening, crushing and recycling activities. • Adjust the intensity of activities based on measured dust levels, weather forecasts and the proximity and direction of the works in relation to the nearest surrounding receivers. • Co-ordinate any higher risk activities with surrounding sensitive receivers including Rosehill Gardens Racecourse to avoid any particularly sensitive periods of operation. • Wherever possible minimise the extent of pre and post-treated ballast materials stored at the site or otherwise cover stockpiles. • Ensure that pre-treatment testing of the ballast is preformed to ensure that no product containing potentially hazardous materials enter the screening, crushing and recycling process.	Minor	Possible	8

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Operations	Emissions associated with train braking	• Emissions to air of particulate matter, carbon monoxide, oxides of nitrogen and VOCs generated from braking and the wearing of steel as a result of friction between the wheels and track	Insignificant	Likely	7	• Conduct routine track and train maintenance to manage and replace any wearing parts which may lead to the generation of emissions.	Insignificant	Possible	4
	Fugitive particulate matter re-entrainment as a result of air flows associated with the light rail	• Fugitive particulate matter re-entrainment	Insignificant	Possible	4	• Conduct routine maintenance to clear debris and loose materials from around the light rail operating area.	Insignificant	Unlikely	2
	Maintenance activities along the PRL alignment	• Emissions to air including products of combustion (from equipment operations) resulting from maintenance plant and equipment	Moderate	Unlikely	9	• Inspecting plant/equipment prior to commencement of maintenance activities. • Conduct routine servicing and maintenance, and subsequent inspections to ensure that the light rail transport infrastructure continues to operate efficiently.	Moderate	Very unlikely	6

Stage	Key activities	Potential impacts	Initial risk rating			Recommended mitigation measures	Residual risk rating		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
	Maintenance activities at the Camellia maintenance depot and stabling facility	• Emissions to air including products of combustion (from equipment operations) resulting from maintenance plant and equipment • Fugitive emissions arising from the storage of chemicals and fuels at the site • Emissions to air of particulate matter	Minor	Possible	8	• Conduct maintenance activities within planned enclosures as appropriate. • Wherever possible complete emission-generating maintenance activities away from the perimeter of the site. • Store fuels and chemicals in accordance with requirements set by SafeWork NSW and guidance contained within relevant Australian Standards and guidelines. • Plan and co-ordinate sanding maintenance works to avoid inclement weather conditions which may result in emissions being blown towards nearby receivers	Minor	Unlikely	5

6. Cumulative impacts

As outlined in Section 2.4 there are a number of other projects planned around the same timeframe and geography as the project which could result in cumulative air quality impacts at some receiver locations. In these circumstances, co-ordination should occur between projects where possible to avoid or otherwise minimise the potential for any cumulative air quality-related impacts at surrounding receivers. Measures for identification and co-ordination with other projects would be included in the CEMP.

7. Environmental management measures

Measures to limit and effectively manage potential air quality impacts have been developed for each phase of the proposal as listed above in Table 5-1. It is recommended that these measures, as well as those described in Section 6 are incorporated into the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP) documents developed for the project. Relevant measures presented in the AQMG should also be incorporated as applicable.

The mitigation and management measures would be reviewed once detailed design information is available, and updated as necessary.

8. Conclusion

An assessment was completed to evaluate potential air quality impacts associated with the construction and operational phases of the project. The initial risk assessment for the project indicated that air quality would not be a key issue, provided that the recommended management and mitigation measures were implemented.

To determine potential impacts to local and regional air quality a risk-based assessment method was applied which identified several activities during construction which had a medium residual risk of generating air quality impacts during the project. These activities are expected to be excavation, remediation, materials storage and management, ballast screening, crushing and recycling activities within the Sandown Line, compound operations and works at the Camellia maintenance depot and stabling facility.

Whilst the potential for impacts were considered at a project scale, it was identified that areas of the project nearest to more densely populated areas and locations with highly sensitive land uses would require the highest level of attention during the works.

Air quality impacts during operations were also evaluated using the risk-based approach. This found that impacts were expected to be minor.

A variety of different mitigation and management measures were recommended for incorporation into the CEMP and OEMP documents for the relevant phases of the project. These included appropriate work practices and scheduling, consultation/co-ordination of works, equipment selection, monitoring and preventative controls. It is recommended that the measures advised in the assessment are reviewed and updated as necessary once detailed design information is available and as the project progresses.

9. References

Commonwealth Department of Sustainability, Environment, Water, Population and Communities, 2012. *National Pollutant Inventory Emission Estimation Technique Manual for Mining version 3.1*

Commonwealth Department of the Environment, 2016. *National Environment Protection (Ambient Air Quality) Measure – as amended*

Government of Victoria, 2001. *State Environment Protection Policy (Air Quality Management) No. S 240*

ISO/TC 262, 2009. *AS/NZS ISO 3100:2009 Risk Management – Principles and Guidelines*

National Energy Research Development and Demonstration Council, 1988. *Air Pollution from Surface Coal Mining: Measurement, Modelling and Community Perception, Project No. 921*

National Environment Protection Council, 1998. *Ambient Air – National Environment Protection Measure for Ambient Air Quality*

National Health and Medical Research Council, 1996. *Ambient Air Quality Goals Recommended by the National Health and Medical Research Council*

NSW Department of Environment and Conservation, 2005. *Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW*

NSW Department of Environment and Conservation, 2007. *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*

NSW Department of Planning and Environment, 2015. *Critical State Significant Infrastructure Standard Secretary's Environmental Assessment Requirements*

NSW Department of Planning and Environment, issued 18 April 2017. *Secretary's Environmental Assessment Requirements (SSI 8285)*

NSW Environment Protection Authority, 2016. *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*

NSW Government, 2012. *Light Rail Future – Expanding public transport, revitalising our city*

Parramatta City Council, 2013. *Unlocking Western Sydney's Potential with Light Rail: Western Sydney Light Rail Feasibility Study*

Pacific Environment Limited, 2016. *Western Sydney Airport Environmental Impact Statement Volume 4 Appendix F1 Local air quality and greenhouse gas*

Transport for NSW, 2015. *Air Quality Management Guideline 9TP-SD-107/2.0*

United States Environmental Protection Authority. *AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*

Victorian Environment Protection Authority, 2000. *AUSPLUME Gaussian Plume Dispersion Model Technical User Manual*

World Health Organisation, 2000. *WHO Air Quality Guidelines for Europe, 2nd Edition*