ENVIRON

SIMTA Intermodal Terminal Facility- Stage 1

Air Quality Impact Assessment

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

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SIMTA Moorebank Intermodal Facility - Air Quality Impact Assessment

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This assessment builds on the previous Air Quality Impact Assessment (AQIA) (PEL, 2013) submitted as appendix to the Concept Approval (MP10_0193). This assessment includes both construction and operational phase impacts and all relevant pollutants, in accordance with the requirements outlined in the Secretary's Environmental Assessment Requirements (SEARs).

A number of residential suburbs are located in proximity to the SIMTA Project and are included as assessment locations for the Stage 1 Proposal. The key emissions to air during the construction phase are fugitive dust or particulate matter (PM), generated during demolition, site clearing and earthworks. During operations, the key emissions are associated with the combustion of diesel fuel from trucks, locomotives and container handling equipment. For the operation phase, the following scenarios are presented:

- Scenario 1: manual loading and unloading of trains and trucks using reach stackers and/or large forklifts at an operational capacity of 250,000 TEU per annum.
- Scenario 2: unloading and loading of trains and trucks via an electric gantry crane system at an operational capacity of 250,000 TEU per annum.
- Cumulative Scenario: taking into account the first stage of construction and operations for the MIC Proposal and the operation of the Stage 1 Proposal at operational capacity of 250,000 TEU per annum.

To address the requirement for the completion of a Best Practice Review, ENVIRON reviewed emission reduction measures and recommended reasonable and feasible air quality management measures for the Stage 1 Proposal.

The modelling predictions for the construction phase indicate that the Stage 1 Proposal would comply with all relevant impact assessment criteria. The predicted increase in annual average PM_{10} (0.4 µg/m³), $PM_{2.5}$ (0.2 µg/m³), TSP (0.5 µg/m³) and dust deposition (0.1 g/m²/month) are considered minor, when compared against existing background. The highest predicted short-term impacts occur at Wattle Grove with a maximum 24-hour PM_{10} of 2.1 µg/m³ and maximum 24-hour $PM_{2.5}$ of 1.4 µg/m³. It is important to note that the modelling predictions are conservative, particularly for short-term impacts. When background values are added, there are no additional exceedances of the relevant impact assessment criteria.

The operational phase of the Stage 1 Proposal has been assessed in terms of potential impacts from PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs. The maximum increase in annual average PM (0.2 µg/m³) and 24-hour average PM (0.5 µg/m³) is minor when compared to existing background values. When background values are added, there are no additional exceedances of the relevant impact assessment criteria. For all other pollutants, the predicted concentrations are well below the impact assessment criteria. Cumulative modelling results taking into account the adjacent MIC do not result in any exceedance of the impact assessment criteria.

1 Introduction

The Sydney Intermodal Terminal Alliance (SIMTA) proposes to develop an intermodal terminal facility and warehouse/distribution facility on Moorebank Avenue, Moorebank, providing container storage and warehousing solutions (known as the SIMTA Project).

Hyder Consulting, on behalf of SIMTA, has commissioned ENVIRON Australia Pty Limited (ENVIRON) to complete an Air Quality Assessment (AQA) to support the approval of the initial stage of the SIMTA Project, known as the Stage 1 Proposal.

1.1 Background

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a rail link, within an identified rail corridor (the Rail Corridor), which connects from the southern part of the SIMTA site to the Southern Sydney Freight Line (SSFL) (the entire area, SIMTA site and Rail Corridor referred to as the Project site).

The SIMTA Project is to be developed in three key stages:

- Stage 1- Construction of the Intermodal Terminal Facility and rail link.
- Stage 2- Construction of Warehouse and Distribution Facilities.
- Stage 3- Extension of the Intermodal Terminal Facility and completion of Warehouse and Distribution Facilities.

A summary of the approvals undertaken to date for the SIMTA site, relating to the SIMTA Project, include:

- EPBC Approval (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- Concept Approval (No. 10_0193) granted by the Planning Assessment Commission (PAC) on the 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the EP&A Act.

Both of these approvals involved the preparation of design and environmental assessment documentation, including an Air Quality Impact Assessment (AQIA) (PEL, 2013). The AQIA presented dispersion modelling predictions for key transport-related pollutants (nitrogen dioxide (NO_2) and particulate matter (PM)).

This assessment builds on the previous on the previous Air Quality Impact Assessment (AQIA) (PEL, 2013) submitted as for the Concept Approval (MP10_0193). This assessment considers both construction and operational phase impacts and all relevant pollutants for the Stage 1 Proposal.

1.2 Study approach and requirements

The approach to the assessment follows guidelines recommended in the NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods") (NSW EPA, 2005a).

The assessment addresses the requirements outlined in the Secretary's Environmental Assessment Requirements (SEARs), issued for the State Significant Development (SSD) Application (SSD 14-6766) for which approval is sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The SEARs for air quality are shown in **Table 1** and include the requirement for a Best Practice Review. **Table 1** also shows the section of this report where each requirement is addressed.

Table 1. Secretary's Environmental Assessment Requirements		**Report Section**
Air quality A comprehensive air quality impact assessment including:		
a)	An assessment in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005)* (or its later version and updates)	Section 1.2
b)	Taking into account the final project design with consideration to worst-case meteorological and operating conditions	Section 5 and 7
c)	Quantitatively assessing the predicted emission of: i. Solid particles; ii. Sulphur oxides; iii. Nitrogen oxides; and iv. Hydrocarbons.	Section 7 and 9
d)	Assessing cumulative air impacts at a local and regional level (including but not limited to contemporaneous operations such as those of the proposed Commonwealth Government MIT); and	Section 9
e)	A comprehensive air quality management plan that includes at least the following information: i. Explicit linkage of proposed emission controls to the site specific best practice determination assessment and assessed emissions; ii. Explicit linkage of assumed engine standards and operational management systems; ii. The timeframe for implementation of all identified emission controls; iii. Proposed key performance indicator(s) for emission controls; iv. Proposed means of air quality monitoring including location (on and off-site), frequency and duration; v. Poor air quality response mechanisms; vi. Responsibilities for demonstrating and reporting achievement of key performanceindicator(s); vii. Record keeping and complaints response register; and viii. Compliance reporting.	Appendix D
(f)	An assessment of construction related impacts including dust and wind erosion from exposed surfaces and proposed mitigation measures and safeguards to control dust generation and other airborne pollutants and to minimise impacts on nearby receptors.	Section 7.1, Section 9.1, Appendix D

Best Practice Review Including but not limited to:		
The preparation of a comprehensive review of intermodal operational best practice process design, emission control and management measures that might feasibly and reasonably be applied to each stage of the project, and to benchmark those measures against best practice. The review should:		Best Practice Review provided in Appendix D
a)	clearly demonstrate that the Proponent will at each project stage adopt and implement best practice facility and process design and management measure to the extent that is reasonably practicable, to minimise operational air pollutant and noise emissions at the terminal and on the rail link	
b)	include a detailed evaluation of feasible and reasonable mitigation and management measures including: i. assessment of best practice international emission standards for locomotives and non-road plant and equipment; ii. assessment of retrofit opportunities for older vehicles, locomotives and equipment; iii. maintenance and operational practices for vehicles, locomotives and equipment; iv. electrification of terminal plant; v. reduction of ‘long-duration’ idling of diesel locomotives, prime movers and cargo handling equipment through: ● driver/operator training about how to reduce air quality impacts associated with ‘long-duration’ idling; ● automatic engine shut down/start up system controls whereby engine stopping or starting is implemented without operator action; ●‘shore power connection’ being electricity mains plug-in points for enabling locomotives and trucks to switch over to mains power and shut down main engines otherwise used to generate power required for: -transport refrigerated units/containers; -cabin climate control; and -other accessories and equipment. ● the application of queuing theory to minimise truck loading/unloading wait times and resultant queuing and idling in the terminal facility and on access roads.	
c)	Define an acceptable threshold where idling becomes 'long-duration' using an evidence based approach ; and	
d)	include predicted annual cumulative, daily and one minute amounts of air pollutants emitted and non-renewable fossil fuel consumed (by typical diesel locomotives, prime movers, fixed body trucks, yard trucks/holsters and cargo handling equipment expected to regularly operate at the terminal) as the basis for defining the term ‘long-term’ duration idling as it would apply to the terminal facility.	Emission estimates for all sources are presented in Section 7.

2 Project overview

The Proposal involves the construction and operation of the necessary infrastructure to support a container freight volume of 250,000 TEU (twenty-foot equivalent units) per annum. Specifically, Stage 1 includes the following key components, which together comprise the intermodal terminal facility (IMT):

- Truck processing, holding and loading areas- entrance and exit from Moorebank Avenue.
- Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively. .
- Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
- The rail link – located within the Rail Corridor, including a connection to the intermodal terminal facility, traversing of Moorebank Avenue, Anzac Creek and Georges River and connection to the SSFL.
- Ancillary works- vegetation clearing, remediation, earth works, utilities installation/connection, signage and landscaping.

An overview of the Stage 1 Proposal is shown in **Figure 1**.

Figure 1. SIMTA Stage 1 Location Plan and key area

3 Local setting

3.1 Site description

The SIMTA site, including the Stage 1 site, is located approximately 27 kilometres south-west of the Sydney Central Business District (CBD) and approximately 26 kilometres west of Port Botany. The SIMTA site is situated within the Liverpool Local Government Area (LGA), in Sydney's South West Sub-Region, approximately 2.5 kilometres from the Liverpool City Centre.

The SIMTA site is located approximately 800 metres south of the intersection of Moorebank Avenue and the M5 Motorway. The M5 Motorway provides the main road link between the SIMTA site and the key employment and industrial areas within the West and South Western Sydney Sub-Regions. The M5 Motorway connects with the M7 Motorway to the west, providing access to the Greater Sydney Metropolitan Region and NSW road network. Similarly the M5 Motorway is the principal connection to Sydney's north and north-east via the Hume Highway.

The Southern Sydney Freight Line (SSFL) is located one kilometre to the west of the proposed SIMTA site. The SSFL is a 36 kilometre dedicated freight line between Macarthur and Chullora.

The terrain elevations across the SIMTA site area vary between approximately 15 m Australian Height Datum (AHD) to 20 m AHD. Terrain elevations across residential areas to the east (Wattle Grove) and north remain at a similar elevation level. To the west, the terrain drops towards the Georges River before rising to approximately 50 AHD in the residential area of Casula (approximately 1000m from the SIMTA site).

3.2 Surrounding land use

The SIMTA site was recently operating as the Defence National Storage and Distribution Centre (DNSDC) however Defence has recently relocated this operation and vacated the SIMTA site. The majority of land immediately surrounding the SIMTA site is owned and operated by the Commonwealth and comprises:

- School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the SIMTA site.
- Holsworthy Military Reserve, to the south of the site on the southern side of the East Hills Passenger Railway Line.
- Commonwealth Residual Land, to the east between the SIMTA site and the Wattle Grove residential area.
- Defence National Storage and Distribution Centre (DNSDC), to the north and north east of the SIMTA site.

The site to immediate west of the SIMTA site which currently includes the SME is the subject of a Development Application (DA) (SSD-5066), under Part 4, Division 4.1 of the EP&A Act, for the development of an intermodal facility known as the Moorebank Intermodal Terminal Project (MIC Proposal). The EIS for the MIC Proposal has recently been prepared and publically exhibited on 8 October 2014 to 8 December 2014 (Parsons Brinkerhoff, 2014). A Preferred Project Report (PPR) is currently under preparation to respond to submissions received during public exhibition. The MIC Proposal has yet to be determined by the Department of Planning and Environment (DP&E).

3.3 Sensitive receptors

A number of residential suburbs are located in proximity to the SIMTA site, including:

- Wattle Grove, located approximately 600 metres from the Stage 1 site and 750 metres from the rail link to the east.
- Moorebank, located approximately 1,700 metres from the Stage 1 site and more than 2,700 metres from the rail link to the north.
- Casula, located approximately 1,100 metres from the Stage 1 site and 250 metres from the rail link to the west.
- Glenfield, located over 1,700 metres from the Stage 1 site and 750 metres from the rail link to the south-west.

Locations representative of these residential areas and other sensitive receptors such as schools and day care centres have also been identified and selected as discrete sensitive receptors. The locations are consistent with those reported in the EIS for the MIC Proposal to facilitate the assessment of cumulative air impacts with contemporaneous operations at the MIC, as required in the SEARs for air quality. This allows direct comparison in predictions between both assessments and a revised cumulative assessment to be presented in this report. The locations are shown in **Figure 2** and listed in **Table 2**.

Table 2: Locations of sensitive receptors surrounding the site

Name/Location	ID	Location (m MGA, Zone 55) Easting	Location (m MGA, Zone 55) Northing	Approx. distance (km) / direction from site boundary	Elevation (m AHD)
Lakewood Crescent, Casula	R1	307535	6242509	1.2 NW	13
St Andrews Boulevard, Casula	R2	307430	6242235	1.1 NW	34
Buckland Road, Casula	R3	307317	6241949	1.0 NW	41
Dunmore Crescent, Casula	R4	307044	6241551	1.0 NW	49
Leacocks Lane, Casula	R5	306397	6241264	1.7 W	57
Leacocks Lane, Casula	R6	306579	6240902	1.4 W	51
Slessor Road, Casula	R7	306145	6240139	1.8 SW	16
Canterbury Road, Glenfield	R8	305986	6239330	2.3 SW	27
Ferguson Street, Glenfield	R9	306378	6239233	1.9 SW	30
Goodenough Street, Glenfield	R10	306783	6239167	1.7 SW	16
Wallcliff Court, Wattle Grove	R11	308903	6239900	1.0 SE	21
Corryton Court, Wattle Grove	R12	309206	6240651	1.0 E	14
Martindale Court, Wattle Grove	R13	309335	6241111	1.1 E	13
Anzac Road, Wattle Grove	R14	308829	6242049	1.0 NE	16
Cambridge Avenue, Glenfield	R15	306246	6239580	1.9 SW	27
Guise Public School	R16	306200	6237359	3.6 SW	38
Yallum Court, Wattle Grove	R17	308916	6240141	0.8 SE	18
Church Road, Liverpool	R18	308643	6243069	1.8 N	10

Table 2: Locations of sensitive receptors surrounding the site

Name/Location	ID	Location (m MGA, Zone 55)		Approx. distance (km) / direction from site boundary	Elevation (m AHD)
		Easting	Northing		
Glenwood Public School, Glenfield	R19	306259	6238659	2.6 SW	40
Glenfield Public School, Glenfield	R20	305604	6239088	2.7 SW	30
Hurlstone Agricultural School	R21	305200	6239198	3.0 SW	34
Wattle Grove Public School	R22	309373	6240489	1.1 E	18
St Marks Coptic College, Wattle Grove	R23	309942	6240895	1.7 E	18
Maple Grove Retirement Village, Casula	R24	305381	6240952	2.6 W	52
All Saints Catholic College	R25	306606	6241042	1.4 W	53
Casula High School	R26	305360	6241268	2.7 W	54
Casula Primary School, Casula	R27	306749	6242073	1.5 NW	43
Lurnea High School	R28	305552	6242252	2.7 NW	43
St Francis Xaviers Catholic Church	R29	305834	6243254	2.9 NW	34
Impact Church Liverpool	R30	307828	6243646	2.3 N	19
Liverpool West Public School	R31	306552	6243980	3.0 NW	23
Liverpool Public School / TAFE NSW	R32	308289	6244388	3.0 N	25
Glenfield Rise Development, Glenfield	R34	305927	6239733	2.1 SW	22
New DNSDC Facility	R35	309117	6241571	1.0 NE	14
Playground Learning Centre Glenfield	R36	305845	6239063	2.5 SW	35
Wattle Grove Long Day Care Centre	R37	309596	6242100	1.6 NE	12
Casula Powerhouse Arts Centre	R38	307130	6241489	1.0 W	49

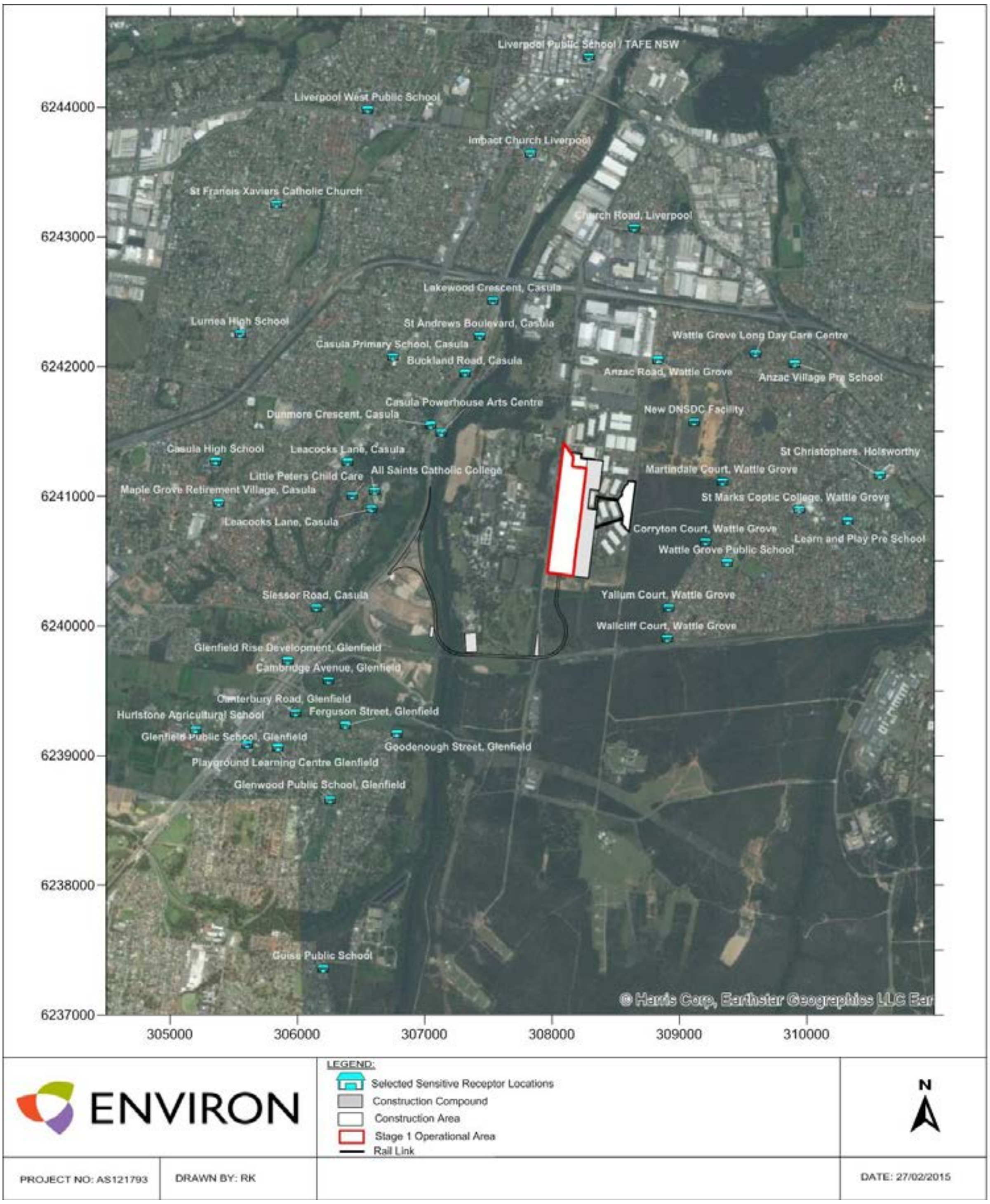

Figure 2. Sensitive receptor assessment locations

4 Impact assessment criteria

The Stage 1 Proposal is required to demonstrate compliance with the impact assessment criteria outlined in the Approved Methods (NSW EPA, 2005a). The impact assessment criteria are designed to maintain ambient air quality that allows for the adequate protection of human health and well-being.

The key emissions to air during the construction phase of the Stage 1 Proposal are fugitive dust or particulate matter (PM), generated during demolition, site clearing and earthworks. During operations, the key emissions are associated with the combustion of diesel fuel. The air quality indicators considered in this report are summarised in **Table 3**:

Table 3 Air quality indicators assessed for SIMTA Stage 1 Proposal

Phase	Key emission source	Air quality indicator
Construction	Fugitive Dust	Particulate matter (TSP[1], PM_{10}[2] and $PM_{2.5}$[3])
		Nuisance dust (dust deposition)
Operations	Diesel combustion	PM_{10} and $PM_{2.5}$
		Oxides of nitrogen (NO_x)
		Sulphur dioxide (SO_2)
		Carbon monoxide (CO).
		Volatile organic compounds (VOCs)

Note:

1) Total Suspended Particulate matter
2) Particulate matter less than 10 microns in aerodynamic diameter
3) Particulate matter less than 2.5 microns in aerodynamic diameter

The impact assessment criteria for 'criteria pollutants[1]' are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction. Both the incremental and cumulative impacts need to be considered (i.e. consideration of background is required for criteria pollutants). The impact assessment criteria for 'air toxics' are applied at, and beyond the site boundary and reported as the 99.9th percentile of the dispersion modelling predictions. Only incremental impacts for these pollutants need be reported. Air toxics include the various VOC components of diesel exhaust emissions.

4.1 Particulate matter

Air quality limits for PM are typically given for various particle size metrics, including TSP, PM_{10} and $PM_{2.5}$. PM_{10} and $PM_{2.5}$ require particular consideration due to their health impact potential.

The impact assessment criteria for TSP and PM_{10} are prescribed in the Approved Methods, however $PM_{2.5}$ is not included. Reference is therefore made to the $PM_{2.5}$ advisory reporting standards issued by the National Environmental Protection Council (NEPC) (NEPC, 2003).

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[1] 'Criteria pollutants' is used to describe air pollutants that are commonly regulated and typically used as indicators for air quality. In the Approved Methods the criteria pollutants are TSP, PM_{10}, NO_2, SO_2, CO, ozone (O_3), deposition dust, hydrogen fluoride and lead.

The National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) $PM_{2.5}$ advisory reporting standards were published in 2003 for the purpose of supporting the monitoring and evaluation of ambient $PM_{2.5}$ concentrations ahead of the setting ambient air quality standards for this pollutant.

A review of the AAQ NEPM, completed in 2011, recommended updating the air quality standards (NEPC, 2011). In 2012 the Council of Australian Governments (COAG) identified air quality as an issue of national priority (COAG, 2012), and agreed that its Standing Council on Environment and Water (SCEW) would implement a strategic approach to air quality management in the form of a National Plan for Clean Air.

On 29 April 2014, Ministers signalled their intention to vary the AAQ NEPM for particles, to reflect the latest scientific understanding on health risks. An impact statement was published in July 2014 which outlines the options considered in the variation (NEPC, 2014). In summary the variation seeks to formalise the advisory reporting standards for $PM_{2.5}$ and adopt more stringent standards for PM_{10}.

The NSW EPA's 24-hour PM_{10} assessment criterion of 50 $\mu g/m^3$ is numerically identical to the current NEPM air quality standard except that the NEPM standard allows up to five exceedances per year to provide for infrequent bushfire or dust storm incidents. No provision is made for allowable exceedances of the 24-hour PM_{10} criterion within NSW regulation.

The air quality criteria applied for PM in this assessment are presented in **Table 4**.

Table 4 Impact assessment criteria for PM

PM metric	Averaging period	Concentration ($\mu g/m^3$)	Reference
TSP	Annual	90	EPA(1)
PM_{10}	24 hour	50	EPA(1)
	24 hour	50(3)	NEPM(2)
	Annual	30	EPA(1)
$PM_{2.5}$	24 hour	25	NEPM(2)
	Annual	8	NEPM(2)

Note:

1) NSW EPA, 2005 Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales
2) NEPC, 2003, National Environment Protection (Ambient Air Quality) Measure, as amended
3) Provision made for up to five exceedances of the limit per year

4.2 Oxides of nitrogen

Oxides of nitrogen are produced when fossil fuels are combusted in internal combustion engines (such as motor vehicles). Nitrogen oxides (NO_x) emitted by fossil fuel combustion are comprised mainly of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is the regulated component. NO is much less harmful to humans than NO_2, and is not generally considered a risk at the concentrations normally found in urban environments. Concern with NO is related more to its transformation to NO_2 and its role in the formation of photochemical smog.

The main acute health outcomes identified in epidemiology studies are increased respiratory disease and its symptoms. The evidence for the chronic effects of long-term exposure to NO_2 is limited. As with acute exposure, the critical health outcomes with chronic exposure include respiratory disease and associated symptoms, and associated changes in lung function. Individuals with asthma and other chronic lung disease and cardiovascular diseases are recognised as being particularly vulnerable. Other susceptible populations include infants, children and the elderly (>65 years of age) (NEPM, 2010).

The dominant mechanism for short-term conversion of NO to NO_2 is through oxidation with atmospheric ozone (O_3) as an exhaust plume travels from source.

$$NO + O_3 \equiv NO_2 + O_2$$

Therefore, to predict the ground-level concentration of NO_2 it is important to account for the transformation of NO_x to NO_2. The Approved Methods outlines three methods to account for the oxidation. Method 1 assumes 100% conversion of NO to NO_2 and is the simplest and most conservative method. Method 2 describes the US EPA's Ozone Limiting Method (OLM), which assumes that all the available ozone in the atmosphere will react with the NO from the source until either all the O_3 or all the NO is used up[2]. Method 3 using an empirical equation developed for estimating oxidation rate, with distance, in power station plumes. The approach used in this assessment is discussed in **Section 9**.

4.3 Carbon monoxide

Carbon monoxide (CO) is produced from incomplete combustion of fuels, where carbon is only partially oxidised instead of being fully oxidised to form carbon dioxide. CO can be harmful to humans because its affinity for haemoglobin is more than 200 times greater than that of oxygen. When it is inhaled it is taken up by the blood and therefore reduces the capacity of the blood to transport oxygen, although this process is reversible. Symptoms of CO intoxication are lassitude and headaches. These symptoms are generally not apparent until relatively high ambient atmospheric concentrations are reached.

4.4 Sulfur dioxide

Sulfur dioxide (SO_2) is formed when, for instance, fuel containing sulfur (mainly coal and oil) is burned. The major health concerns associated with exposure to high concentrations of SO_2 include effects on breathing, respiratory illness, alterations in pulmonary defences, and aggravation of existing cardiovascular disease. SO_2 is a major precursor to acid rain, which is associated with the acidification of lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility. Emissions of SO_2 from diesel exhaust have progressively declined in Australia as increasingly stringent sulfur fuel standards have been introduced. Under the Fuel Quality Standards Act (2000) the maximum sulphur content of diesel fuel is now 10 ppm, which is just 2% of what it was less than 10 years ago.

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[2] Using the OLM, NO_2 concentrations are derived as follows:

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{predicted}\} + MIN\{(0.9) \times [NO_x]_{predicted}\ or\ \left({}^{46}/_{48}\right) \times [O_3]_{background}\} + [NO_2]_{background}$$

4.5 Volatile organic compounds

Volatile organic components (VOCs) refer to a collection of various compounds several of which are air toxics, including benzene, 1,3-butadiene, toluene and xylenes. Air toxics are present in the air in low concentrations, however, characteristics such as toxicity or persistence mean that they can be hazardous to human, plant or animal life.

There is evidence that cancer, birth defects, genetic damage, immuno-deficiency, respiratory and nervous system disorders can be linked to exposure to occupational levels of air toxics. Organic hydrocarbons (HC) also include reactive organic compounds which play a role in the formation of photochemical smog. Diesel exhaust emissions can contain carcinogenic organic hydrocarbons such as benzene and polycyclic aromatic hydrocarbons (PAHs).

4.6 Ozone

Ozone is a secondary pollutant formed in a chemical reaction when emissions of NO_x and VOCs react in the presence of sunlight (as follows):

$$NO + VOCs \frac{sunlight}{\gg} NO_2 + \ O_2 \frac{sunlight}{\gg} \ NO + \ O_3$$

Ozone is the principal component of photochemical smog, which is typically formed several hours after the precursors (NOx and VOCs) are emitted. This means that the highest concentrations of ozone normally occur on summer afternoons in areas downwind of major sources of the precursors. Ground-level ozone continues to be a problem in Sydney during summer months. At ground level, elevated ozone concentrations can cause health and environmental problems. As well as affecting vegetation growth and damaging materials such as rubber, fabric, masonry, and paint, it can also reduce visibility.

4.7 Summary of impact assessment criteria

The combustion of diesel fuel results in emissions of fine particles and gaseous pollutants including NO_2, SO_2, CO and VOCs. While many VOC species are emitted from combustion of fossil fuels, benzene, 1,3-butadiene and polycyclic aromatic hydrocarbons (PAHs) are selected for assessment as they are categorized in the Approved Methods as principal toxic air pollutants and are among the species with the most stringent impact assessment criteria.

The impact assessment criteria are summarised in **Table 5**.

Table 5: Criteria for gaseous air pollutants

Pollutant	Averaging period	Concentration		Reference
		μg/m³ [1]	pphm[2]	
NO_2	1-hour	246	12	NSW EPA[3]
	Annual	62	3	NSW EPA[3]
SO_2	10-minute	712	25	NSW EPA[3]
	1-hour	570	20	NSW EPA[3]
	24-hour	228	8	NSW EPA[3]
	Annual	60	2	NSW EPA[3]
CO	15-minute	100,000	8,700	
	1-hour	30,000	2,500	NSW EPA[3]
	8-hour	10,000	900	NSW EPA[3]
1,3-butadiene	1-hour	40	1.8	NSW EPA[3,4]
Benzene	1-hour	29	0.9	NSW EPA[3,4]
PAHs (as BaP)	1-hour	0.4	-	NSW EPA[3,4]

Note 1: Gas volumes for criteria pollutants expressed at 0°C and 1 atmosphere, and principal toxics at 25°C

Note 2: pphm – parts per hundred million

Note 3: *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*

Note 4: Expressed as the 99.9th Percentile Value.

4.8 Dust deposition

For the construction phase, amenity impacts for nuisance dust need to be considered. The NSW EPA impact assessment criteria for dust deposition are summarised in **Table 6**, illustrating the maximum increase and total dust deposition rates which would be acceptable so that dust nuisance could be avoided. Cumulative annual average dust deposition rates within residential areas, which are in excess of 4 g/m²/month, are generally considered to indicate that nuisance dust impacts may occur.

Table 6. Dust deposition criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust (assessed as insoluble solids)	2 g/m²/month	4 g/m²/month

Source: *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005)

5 Climate and meteorology

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. Ground level concentrations of pollutants are influenced by changes in atmospheric stability, concurrent variations in the mixing depth, and to shifts in the wind field (Oke 2003; Sturman and Tapper 2006).

To adequately characterise the dispersion meteorology of a region, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability. And brief overview of some of the key meteorological parameters that influence pollution dispersion is provided in **Table 7**.

Table 7: Brif overview of how meteorology influences ground level concentrations

Key parameter	Influence
Wind speed and direction	Defines the horizontal component of motion. Wind speed determines the distance of transport and the rate of dilution due to plume stretching. Wind direction determines the path pollutants follow and extent of crosswind spreading.
Stability and mixing depth	Define the vertical component of motion though mechanical and convective turbulence of the mixing layer. Mechanical turbulence is a function of wind speed and surface roughness while convective mixing is governed by the heat and moisture exchanges that take place at the surface.

5.1 Meteorological data selected for modelling

The Approved Methods requires that a Level 2 impact assessment be conducted using at least one year of site-specific hourly meteorological data that is at least 90% complete. If site-specific meteorological data are not available, the Approved Methods advises that representative meteorological data can be used, either from a nearby monitoring station or synthetically generated using a prognostic meteorological model such The Air Pollution Model (TAPM)[3].

Meteorological monitoring data are not available for the SIMTA site and reference is therefore made to representative data from nearby monitoring stations, supplemented with data derived using TAPM for parameters not routinely measures.

The SEARs for air quality require that the cumulative air impacts with contemporaneous operations at the MIC are presented in this assessment. To facilitate this cumulative assessment, consistency in the meteorological data is retained for this modelling assessment, including the chosen year of analysis and the input datasets referenced.

The assessment utilises data from the following sources:

- The NSW Office of Environment and Heritage (OEH) ambient air quality monitoring station at Liverpool, located approximately 2.3 km northwest of the Project site.
- The Bureau of Meteorology (BoM) Automatic Weather Station (AWS) locations at Holsworthy Control Range (Station Number 067117) and Bankstown Airport (Station

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[3] Developed by Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Number 066137), located approximately 2.3 km southeast and 6 km northeast of the Project site respectively.

- TAPM derived vertical temperature profile. The TAPM vertical temperature profile was adjusted by first substituting the predicted 10 m above ground temperature with hourly recorded temperature at 10 m (in this assessment, sourced from the OEH Liverpool station). The difference between the TAPM predicted temperature and the measured 10 m temperature was applied to the entire predicted vertical temperature profile. This modified vertical profile was used in combination with the ambient air temperature throughout the day to calculate convective mixing heights between sunrise and sunset.

The EIS (Parsons Brinckerhoff, 2014) for the MIC determined that the OEH Liverpool data are representative of the local area, largely due to the proximity of the station to the site, the elevation at which it is sited and the uncomplicated intervening topography. The other closest site (Holsworthy Control Range) is at a slightly higher and more exposed elevation.

Based on an analysis of 5 years of wind data from the Holsworthy Control Range site and three years of wind data from OEH Liverpool site, relatively little inter-annual variability in wind speed and direction was demonstrated (see **Appendix A**). The two sites also displayed similarity across all years and as a result, 2013 data from the OEH Liverpool site was selected as a representative dataset for modelling (Parsons Brinkenhoff, 2014a).

Long term climate statistics were also obtained from the BoM Bankstown Airport site (which holds the longest continuous record for the area). Cloud data (not measured at either Liverpool or Holsworthy) were sourced from Bankstown Airport.

5.2 Prevailing winds

An annual wind rose of recorded wind speed and direction data from the OEH Liverpool station during 2013 is presented in **Figure 3**. The annual recorded wind pattern is dominated by southwest to westerly airflow. The highest wind speeds recorded at the location are most frequently experienced from the southwest to westerly direction. The average recorded wind speed for 2013 was 1.8 m/s, with a frequency of calm conditions (wind speeds less than 0.5 m/s) occurring in the order of 12% of the time.

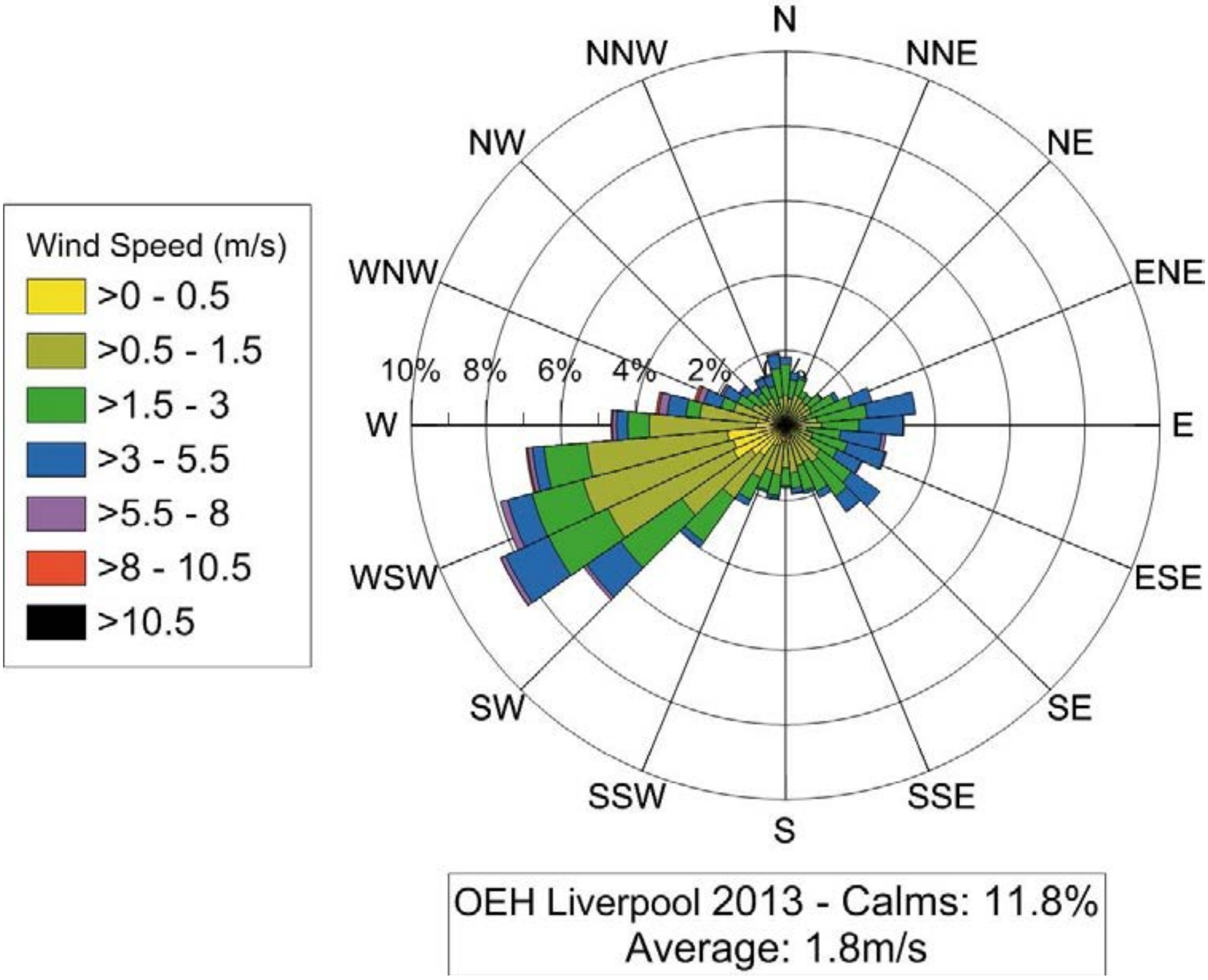

Figure 3: Annual wind rose – OEH Liverpool - 2013

Seasonal and diurnal (dividing the day into four periods) wind roses for 2013 OEH Liverpool station dataset are presented within **Appendix A**.

Seasonal variation is evident in the data recorded at the OEH Liverpool station. The dominant southwest to westerly component evident in the annual wind direction profile is most defined during the autumn, winter and spring months, while summer experiences a dominant easterly flow. Wind speed is greatest during summer and spring, while the incidence of calms is highest during the autumn and winter months.

Diurnal variation in the recorded wind regime is also notable at the OEH Liverpool site. Wind speeds are greatest during the daylight periods, with dominant easterly flow occurring between midday and late afternoon. Wind speeds are notably lower between the evening and early morning hours, with the southwesterly component the dominant wind direction.

5.3 Ambient temperature

Monthly mean minimum temperatures are in the range of 5°C to 18°C, with monthly mean maxima of 17°C to 28°C, based on the long-term average record from the BoM Bankstown Airport AWS. Peak temperature occur during summer months with the highest temperatures typically being recorded between November and March. The lowest temperatures are usually experienced between May and September.

The temperature recorded during 2013 at the OEH Liverpool station has been compared with long-term trends recorded at the BoM Bankstown Airport AWS to determine the representativeness of the dataset. **Figure 4** presents the monthly variation in recorded temperature during 2013 compared with the recorded regional mean, minimum and maximum temperatures. There is good agreement between temperatures recorded during 2013 and the recorded historical trends, indicating that the dataset is representative of conditions experienced in the region.

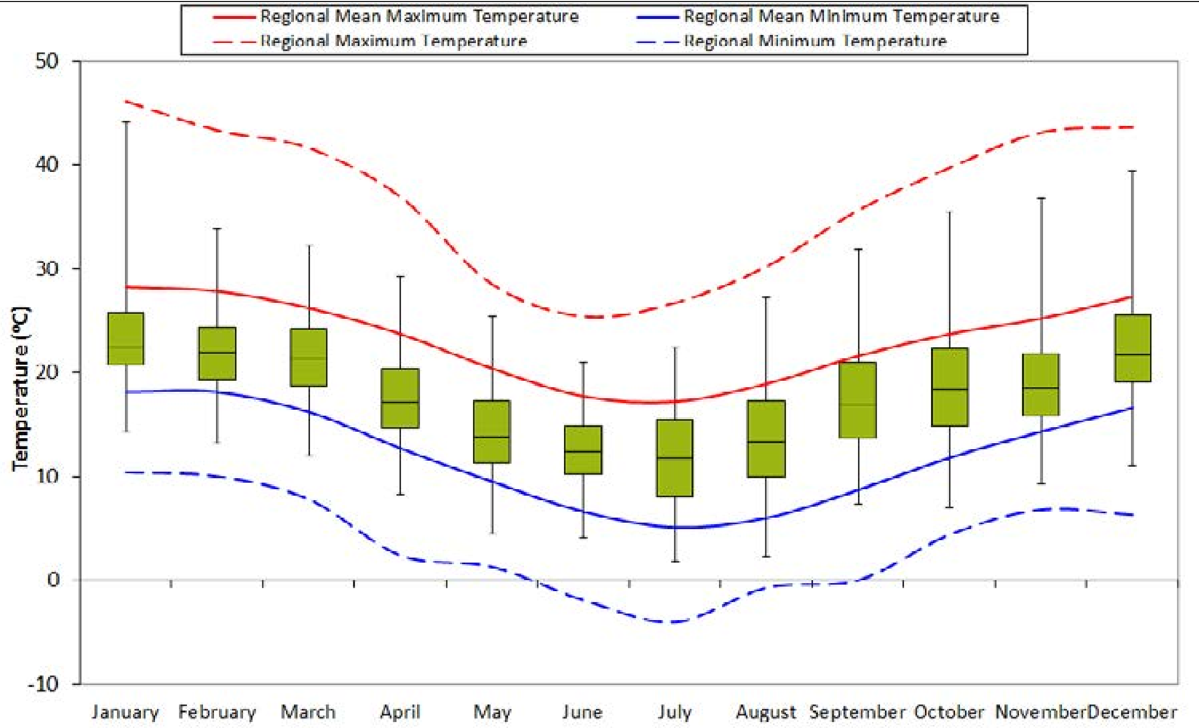

Figure 4: Temperature comparison between OEH Liverpool 2013 data and historical averages (1968-2013) – BoM Bankstown Airport

Note: Temperatures recorded during 2013 at the OEH Liverpool station are illustrated by the 'box and whisker' indicators. Boxes indicate 25th, median and 75th percentile temperature values while upper and lower whiskers indicate maximum and minimum values. Maximum and minimum temperatures from long-term measurements at BoM Bankstown Airport are depicted as line graphs.

5.4 Rainfall

Precipitation is important to air pollution studies since it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants.

Based on historical data recorded since 1968 at Bankstown Airport, the region is characterised by moderate rainfall, with a mean annual rainfall of 870 mm, and an annual rainfall range between 493 mm and 1,398 mm. There is significant variation in monthly rainfall throughout the year, with the summer and autumn months typically experiencing higher falls than the remainder of the year.

To provide a conservative (upper bound) estimate of the pollutant concentrations wet deposition (removal of particles from the air by rainfall) was excluded from the dispersion modelling simulations undertaken in this report.

5.5 Atmospheric stability and boundary layer depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of air flow due to the frictional drag of the earth's surface (mechanical mechanisms), or as result of the heat and moisture exchanges that take place at the surface (convective mixing) (Stull, 1997; Oke, 2003).

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Elevated inversions may occur for a variety of reasons including anticyclonic subsidence and the passage of frontal systems. Due to radiative flux divergence, nights are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are normally associated with low wind speeds and hence lower dilution potentials.

Hourly-varying atmospheric boundary layer depths were generated for the OEH Liverpool station by AERMET, the meteorological processor for the AERMOD dispersion model, using a combination of surface observations from the OEH Liverpool station, sunrise and sunset times and adjusted TAPM-predicted upper air temperature profile. The variation in average boundary layer depth by hour of the day for the OEH Liverpool station is illustrated in **Figure 5**.

It can be seen that greater boundary layer depths are experienced during the day time hours, peaking in the mid to late afternoon. Higher day-time wind velocities and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere respectively. As turbulence increases during the day-time, so too does the depth of the boundary layer, generally contributing to greater mixing depths and potential for atmospheric dispersion of pollutants.

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10% of the mixing height). Wharton and Lundquist (2010) provide typical value ranges for L for widely referenced atmospheric stability classes, as listed in **Table 8**.

Table 8: Monin-Obukhov length with respect to atmospheric stability

Monin-Obukhov length (L) range	Stability class
-50 < L < 0	Very Unstable
-600 < L < -50	Unstable
|L| > 600	Neutral
100 < L < 600	Stable
0 < L < 100	Very Stable

Source: Table 2, Wharton and Lundquist (2010)

Figure 6 illustrates the diurnal variation of atmospheric stability derived from the Monin-Obukhov length calculated by AERMET based on the data recorded by the OEH Liverpool station during 2013. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for atmospheric dispersion of emissions would be greatest during day time hours and lowest during evening through to early morning hours.

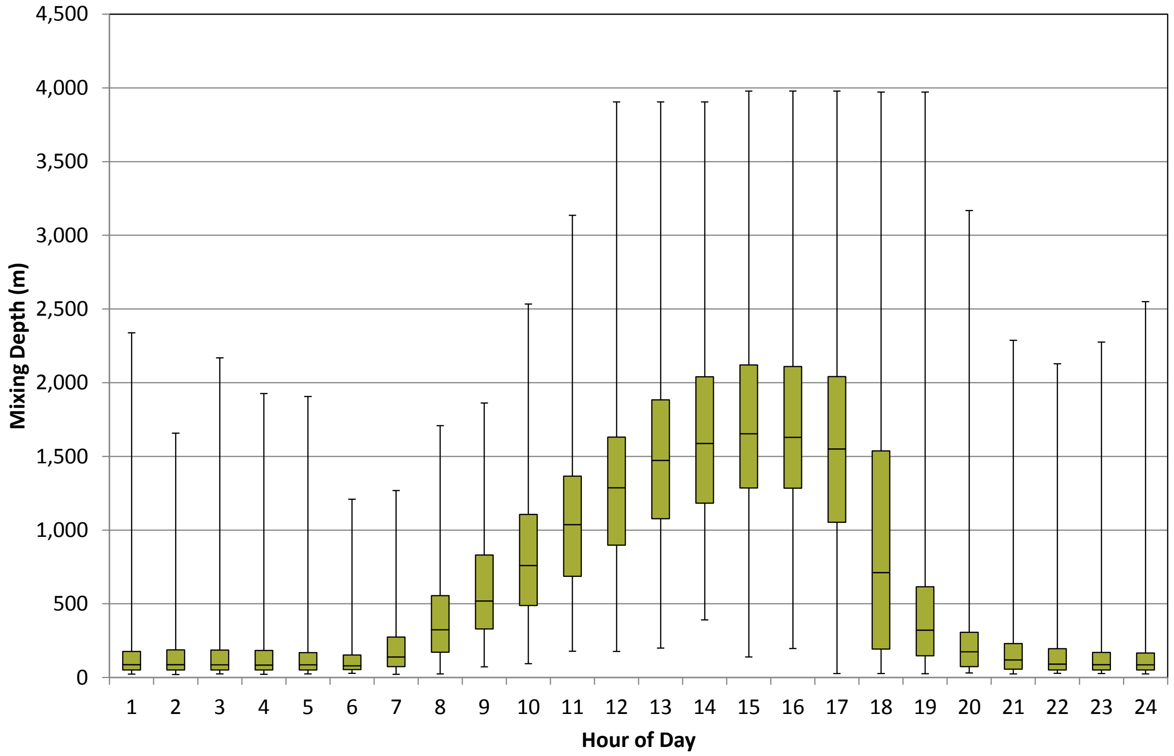

Figure 5: AERMET-generated diurnal variations in average boundary layer depth

Note: Boxes indicate 25th percentile, Median and 75th percentile of AERMET-generated mixing height data while upper and lower whiskers indicate maximum and minimum values.

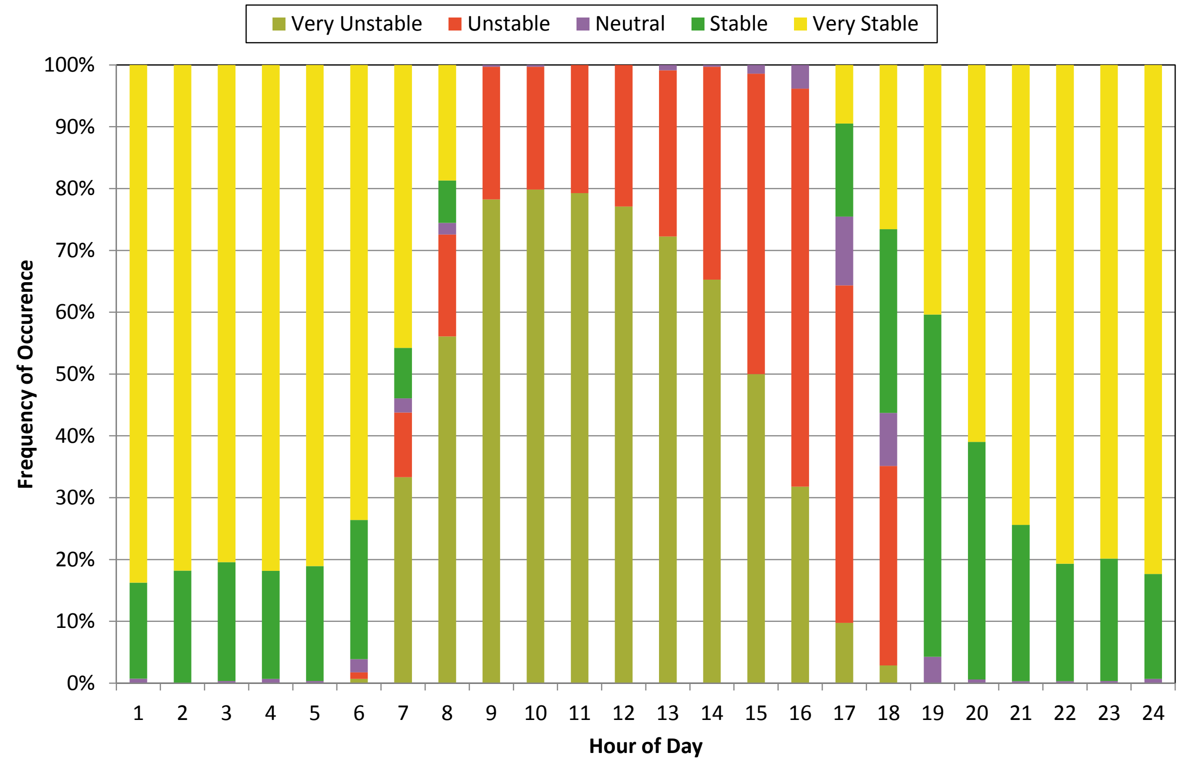

Figure 6: Diurnal variations in AERMET-generated atmospheric stability

6 Existing ambient air quality

To demonstrate compliance with the impact assessment, consideration of cumulative impact is required, including how the Stage 1 Proposal will interact with existing and future sources of air emissions. A number of existing and potential future sources in the area will influence the local air shed to varying degrees, including, but not limited to:

- Traffic emissions from the wider road network including the South Western Motorway (M5).
- Emissions from diesel locomotives using the Southern Sydney Freight Line (SSFL) and the East Hills rail line.
- Existing commercial and industrial facilities including the Greenhills Industrial Estate and Moorebank Business Park to the north.
- The Glenfield Waste Facility to the southwest of the site.
- Emissions from aircraft at Bankstown Airport to the northeast.
- The proposed MIC Proposal to the immediate west of the SIMTA site.

6.1 Overview of monitoring data

No site-specific monitoring data are available for the SIMTA site and reference is therefore made to monitoring data from nearby monitoring stations operated by the NSW Office of Environment and Heritage (OEH).

Monitoring data have also been collected closer to the SIMTA site, as part of the EIS completed for the MIC Proposal (Parsons Brinckerhoff, 2014a). The EIS compared the onsite data with the OEH Liverpool station and found that concentration recorded at the OEH Liverpool station were generally higher and concluded that the OEH Liverpool station data provided a suitable conservative dataset for use in the assessment.

The Liverpool OEH site is located on Rose Street, approximately 2.5 km northwest of the SIMTA site. It is situated in a mixed residential and commercial area in Sydney's south-west region at an elevation of 22 m AHD. The Liverpool monitoring station measures PM_{10}, $PM_{2.5}$, NO_2, O_3 and CO, however does not include monitoring for SO_2 and reference is therefore made to the OEH monitoring site at Chullora. The Chullora monitoring site is located on Worth Street, approximately 12 km northeast of the SIMTA site. It is noted that the Chullora site does not currently comply with Australian Standard siting guidelines, due to intrusion on a clear sky angle, however this is unlikely to significantly influence the measured SO_2 concentrations[4].

The number of exceedances of the applicable impact assessment criteria, recorded over the past 10 years, are presented in **Table 9**. The data indicate that the most significant air quality issues for area relate to PM and ozone (O_3). Over the past 10 years, there were no exceedances of the impact assessment criteria recorded for NO_2, CO or SO_2.

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[4] http://www.environment.nsw.gov.au/aqms/sites/chullora.htm

Further analysis of the monitoring data is presented in subsequent sections for the chosen modelling year (2013).

Table 9: Number of exceedances of the impact assessment criteria for Liverpool OEH site

	NO_2	CO	O_3	O_3	PM_{10}	$PM_{2.5}$	SO_2 [1]
Year	**1-Hr**	**8-Hr**	**1-Hr**	**4-Hr**	**24-hr**	**24-hr**	**1-Hr**
2005	0	0	3	6	2	2	0
2006	0	0	11	16	3	3	0
2007	0	0	3	7	1	-	0
2008	0	0	0	1	1	-	0
2009	0	0	3	10	8	5	0
2010	0	0	0	1	0	0	0
2011	0	0	1	5		2	0
2012	0	0	0	0	0	0	0
2013	**0**	**0**	**5**	**6**	**3**	**2**	**0**
2014	0	0	1	3	0	0	0

Note: [1] Number of exceedances at Chullora

6.2 PM_{10} and $PM_{2.5}$

Summary statistics for the 24-hour average PM_{10} and $PM_{2.5}$ datasets recorded at the OEH Liverpool monitoring station are presented in **Table 10**. A timeseries of 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in **Figure 7**.

The annual average PM_{10} concentration at the OEH Liverpool station was below the NSW EPA criterion of 30 µg/m³. Three exceedances of the NSW EPA criterion of 50 µg/m³ were experienced during 2013, most likely attributable to bushfire events in the Greater Sydney Metropolitan Region between September and November 2013.

The annual average $PM_{2.5}$ concentration during 2013 was 9.4 µg/m³, an exceedance of the NEPM advisory reporting goal of 8 µg/m³. Two short term exceedances of the NEPM goal were recorded during 2013, attributed to hazard reduction burns (late April 2013) and bushfire events in September and November 2013. The median $PM_{2.5}$ concentration in 2013 (8.1 µg/m³) is less than the mean[5], however remains slightly higher than the NEPM advisory reporting goal.

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[5] Median concentrations effectively remove these higher concentrations caused by extraordinary events.

Table 10: PM_{10} and $PM_{2.5}$ summary statitics

Parameter	PM_{10}	$PM_{2.5}$
Mean	21.1 µg/m³	9.4 µg/m³
Median	19.6 µg/m³	8.1 µg/m³
Minimum	5.2 µg/m³	1.9 µg/m³
Maximum	98.5 µg/m³	73.8 µg/m³
Number of days over goal	3	2

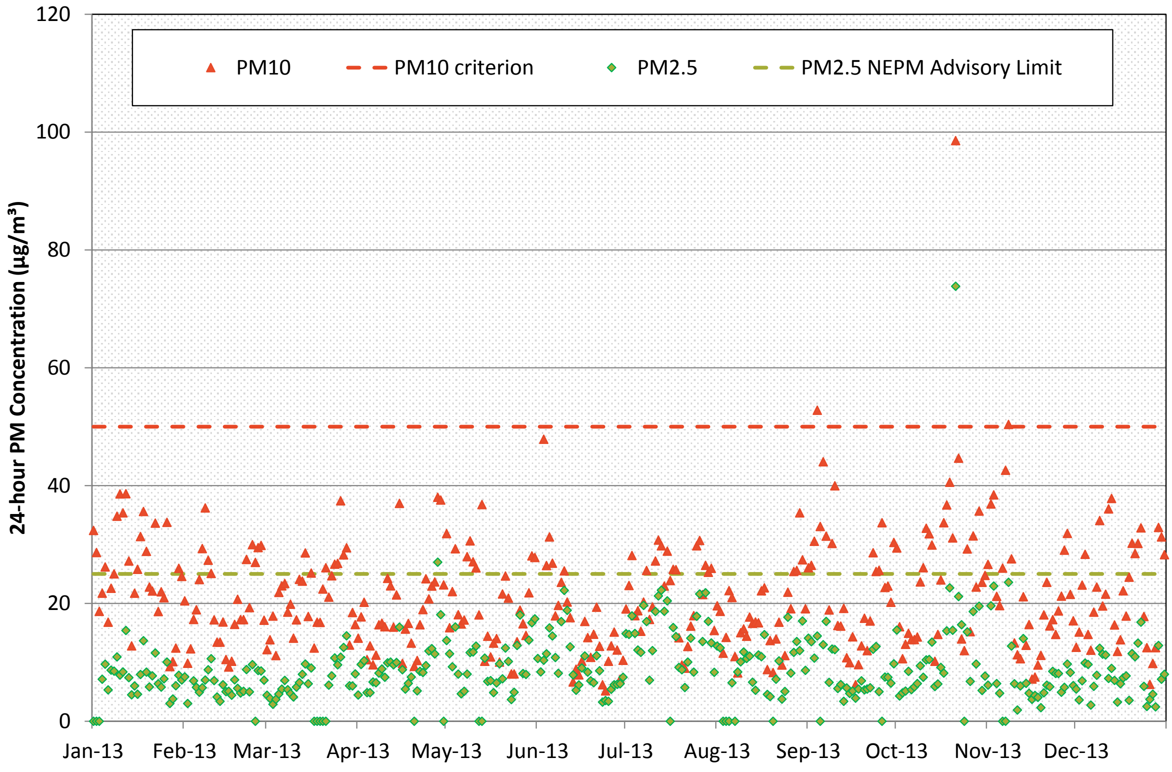

Figure 7: Daily varying 24-hour average PM concentrations

6.3 Nitrogen dioxide

Table 11 presents the 1-hour and annual average NO_2 concentrations during 2013[6]. A timeseries of the 1-hour average NO_2 concentration 2013 is presented in **Figure 8** and compared against the impact assessment criterion of 246 µg/m³.

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[6] Concentrations in µg/m³ are converted from pphm based on a temperature of 0°C.

The analysis indicates that for the majority of the time the 1-hour NO_2 concentration is below 50 µg/m³, or 20% of the criterion. The annual average for 2013 is approximately 37% of the impact assessment criterion.

Table 11: NO_2 concentration statistices for 2013

Averaging period	NO_2 concentration (µg/m³)	NSW EPA criterion (µg/m³)
1-hour max	114.8	**246**
Annual	22.9	**62**

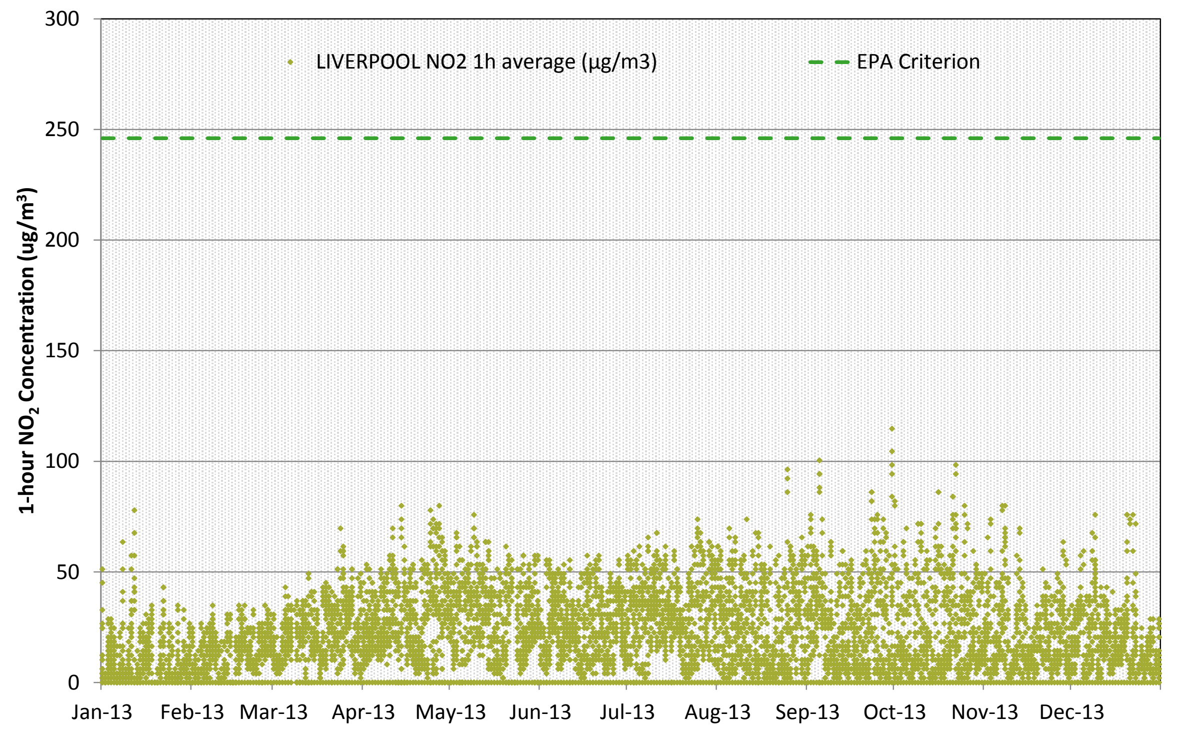

Figure 8: Timeseries of 1-hour average NO_2 concentrations – 2013

6.4 Sulfur dioxide

Reference is made to hourly average SO_2 monitoring data from the OEH Chullora monitoring station. **Table 12** presents the 1-hour, 24-hour average maximum and annual average SO_2 concentrations during 2013. A timeseries of recorded 1-hour average SO_2 concentrations is presented in **Figure 9**.

Ambient levels of SO_2 are well below the ambient criteria. The majority of the 1-hour SO_2 concentrations are below 10 µg/m³ (2% of the criterion). The annual average for 2013 is 4.6 µg/m³ or approximately 7% of the impact assessment criterion (60 µg/m³). It is clear from the data that ambient concentrations of SO_2 are not a significant air pollution issue for the area.

Table 12: SO_2 concentrations statistices for 2013

Averaging period	SO_2 concentration (µg/m³)	NSW EPA criterion (µg/m³)
1-hour max	34.3	**570**
24-hour max	10.8	**228**
Annual	4.2	**60**

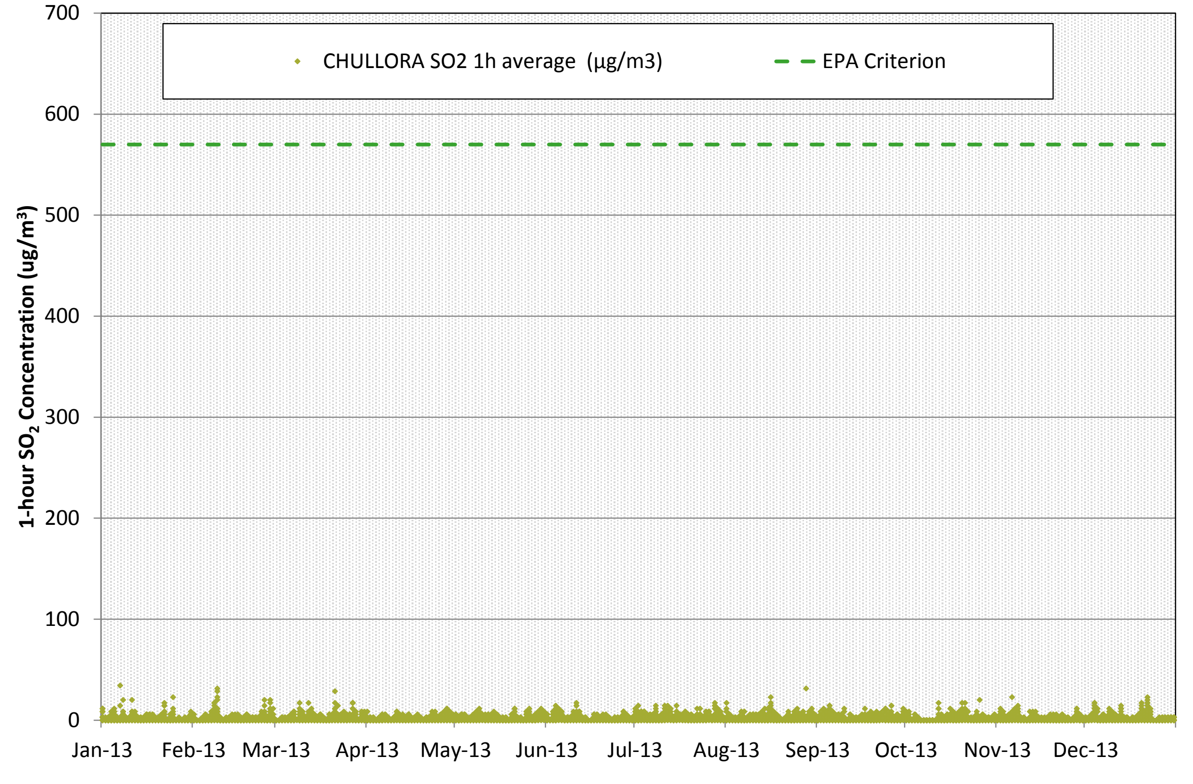

Figure 9: Timeseries of 1-hour average SO_2 concentrations – 2013

6.5 Carbon Monoxide

Table 13 presents the 1-hour and 8-hour average maximum CO concentrations for 2013. A timeseries of recorded 1-hour average CO concentrations is presented in **Figure 8**. Similar to SO_2 it is clear from the data that ambient concentrations of CO are not a significant air pollution issue for the area.

Table 13: CO concentrations statistices for 2013

Averaging period	CO concentration (µg/m³)	NSW EPA criterion (µg/m³)
1-hour max	5.0	**30**
8-hour max	2.3	**10**

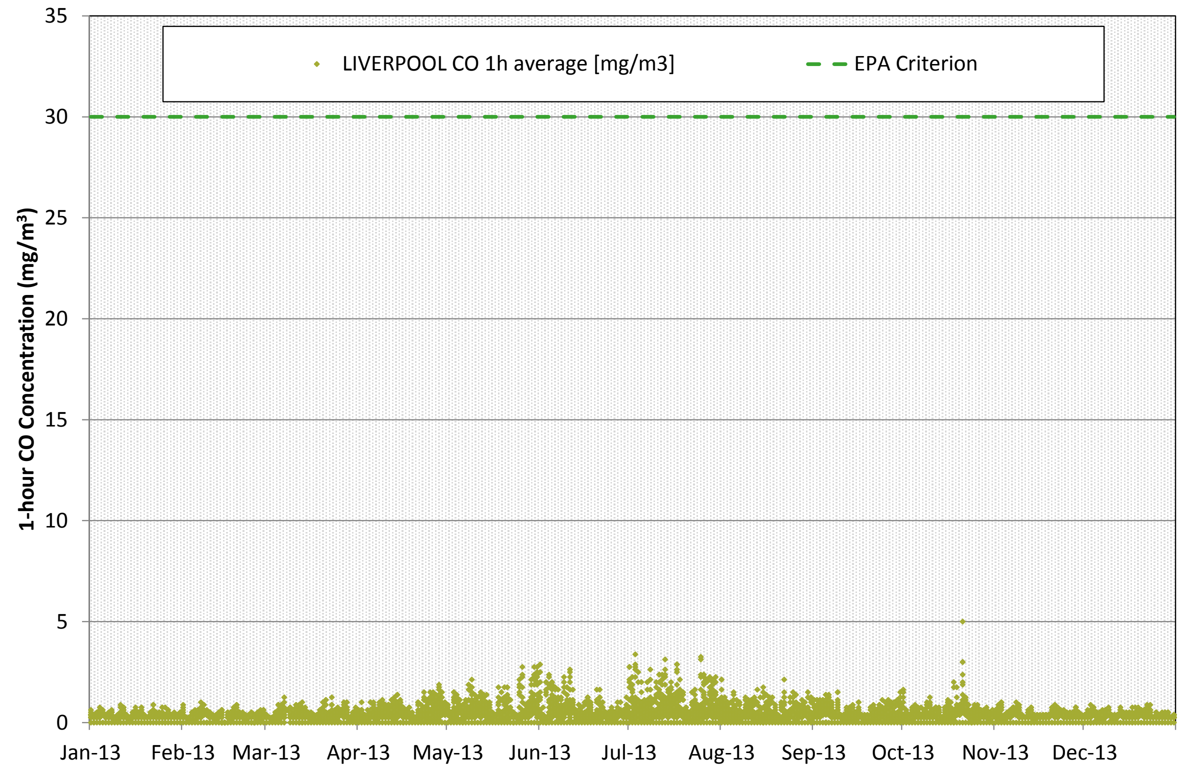

Figure 10: Timeseries of 1-hour average CO concentrations – 2013

6.6 Ozone

The O_3 exceedances presented in **Table 9** occurred on consecutive hours on a day when bushfires were occurring in the Greater Sydney Metropolitan Region (October 2013), shown in the timeseries of 1-hour average O_3 concentrations presented in **Figure 8**. The maximum 1-hour and 8-hour average O_3 concentrations recorded in 2013 are presented in **Table 14**.

Table 14: O_3 concentrations statistices for 2013

Averaging period	Maximum O_3 concentration (pphm)	NSW EPA criterion (ppb)
1-hour	11.7	**10**
4-hour	10.2	**8**

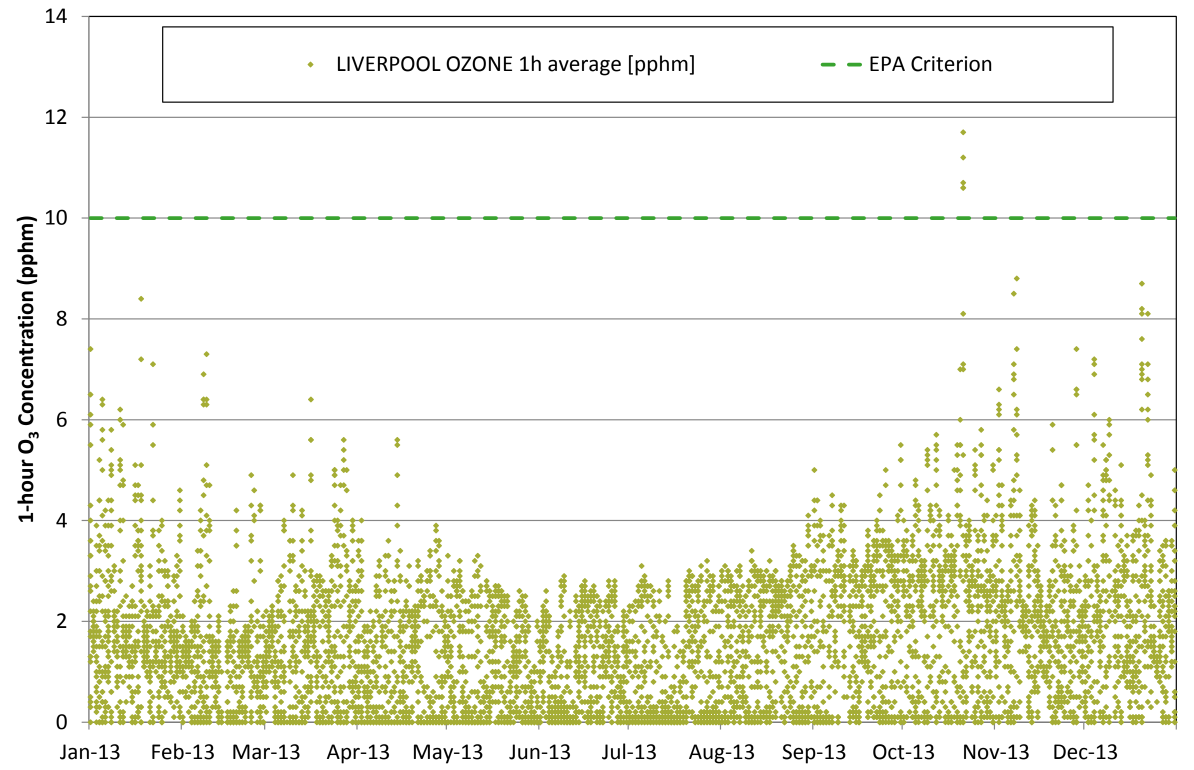

Figure 11: Timeseries of 1-hour average O_3 concentrations – 2013

6.7 TSP concentration and dust deposition

TSP concentrations are not measured in the vicinity of the SIMTA site, however historical measurements of TSP and PM_{10} in Sydney[7] indicate that PM_{10}/TSP ratios in urban areas typically range from 0.4 to 0.5. These ratios can be applied to the PM_{10} concentration data to derive an annual average TSP concentration.

Monitoring for dust deposition as part of the MIC EIS has been conducted at three locations across the suburbs of Wattle Grove, Casula and Glenfield. Dust deposition levels range from 0.6 g/m^2/month and 0.8 g/m^2/month/month, expressed as an annual average (insoluble solids).

6.8 Adopted background for assessment

To assess the cumulative impacts for criteria pollutants, the background levels in **Table 15** are adopted for this assessment. Annual average background PM concentrations are taken as a 5-year average, to account for any inter-annual variation in background due to different climate conditions. To retain consistency with the background values adopted in the EIS for the MIC proposal, the five year average is taken from the period 2009 to 2013. Since the publication of the MIC EIS, a complete year of data are available for 2014, however incorporation of this latest data in a five year average produces a slightly lower background (due to the generally higher concentrations in 2009). Therefore retaining the period 2009 – 2013 for consistency, also results in a more conservative assessment. As discussed

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[7] Reported in Quarterly Air Quality Monitoring Reports - http://www.environment.nsw.gov.au/aqms/datareports.htm#quarterlies

previously, the modelling year (2013) is also selected to retain consistency in meteorological conditions (which drive the predicted ground level concentrations) used in the MIC EIS. Daily and hourly varying background concentrations for 2013 are used to predict cumulative short-term PM and NO_x. Due to the background concentrations of SO_2 and CO being so low, the maximum short term values are selected for background and paired with maximum modelling predictions.

Table 15: Adopted background air quality

Pollutant	Averaging period	Adopted background concentration	Source / notes
TSP	Annual	42.6 µg/m³	Derived from OEH Liverpool 5 Year Average (2009-2013) for PM_{10} and a PM_{10}/TSP ratio of 0.47
PM_{10}	24-hour	Daily varying	OEH Liverpool 2013
	Annual	20.4 µg/m³	OEH Liverpool 5 Year Average (2009-2013)
$PM_{2.5}$	24-hour	Daily varying 2013	OEH Liverpool
	Annual	7.6 µg/m³	OEH Liverpool 5 Year Average (2009-2013)
Dust Deposition	Annual	1 g/m²/month	Based on monitoring presented in MIC EIS
NO_2	1-hour	Hourly varying	OEH Liverpool 2013
	Annual	22.7 µg/m³	
SO_2	1-hour	34.3 µg/m³	2013 max 1 hour OEH Chullora
	24-hour	8.9 µg/m³	2013 max 24 hour OEH Chullora
	Annual	1.9 µg/m³	OEH Chullora
CO	1-hour	5 mg/m³	2013 max 1 hour OEH Liverpool
	8-hour	2.25 mg/m³	2013 max 8 hour OEH Liverpool

NOTE: Concentrations converted from ppb or ppm to µg/m³ assuming 0°C and 1 atmosphere

7 Emission inventory

7.1 Construction

The construction works for the Stage 1 Proposal will be completed in five main works periods, as follows:

- Site Preparation – approximately 1 month duration.
- Earthworks – approximately 2 month duration.
- Engineering fill – approximately 5 month duration.
- Concrete construction and rail alignment construction – approximately 5 month duration.
- Miscellaneous structural construction, utilities, crane installation and finishing – approximately 4 month duration.

Emissions are calculated for the key dust generating activities during site preparation, earthworks and engineering fill. The last two works periods do not have significant dust generating equipment of activities. Emission factors developed by the US EPA[8], have been applied to estimate the amount of dust produced by each activity (material handling, wind erosion, hauling). Emissions are quantified for total (TSP), coarse (PM_{10}) and fine PM ($PM_{2.5}$) and are summarised in **Table 16**. Further details on the emission inventory development is provided in **Appendix B**.

7.2 Operations

The main emissions sources for the operational phase of the Stage 1 Proposal include:

- Diesel locomotives travelling along the rail link to and from site.
- Diesel locomotives idling onsite during train loading and unloading.
- Container handling equipment loading and unloading trains and trucks.
- Trucks collecting and delivering containers within the loading area.

The development of emission estimates require detailed activity data for the site (number of trucks, fleet composition, distances travelled, times in mode, equipment types, fuel usage etc). This activity data is then used to derive emission estimates, based on published emission factors, for each activity.

7.2.1 Best practice review

To investigate measures for best practice of the Stage 1 Proposal and also to address the requirement for the completion of a Best Practice Review as outlined in the SEARs, ENVIRON reviewed emission reduction and management measures for emission sources associated with the Proposal. The outcomes of the best practice review are presented in **Appendix C**, and included recommendations for reasonable and feasible quality management measures. An overview of the measures recommended in the best practice review and proposed for SIMTA Stage 1 are outlined in **Table 17** as well as details of their treatment in the emission estimated and modelling.

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[8] United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors

Table 16: Construction phase emissions estimates (kg/annum)			
Source / Activity	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Site Preparation			
Vegetation clearing - dozers	4,992	1,053	524
Scrapers/Graders	189	66	132
Demolition - dozers	6,053	1,466	636
Demolition - excavators	16.4	7.7	1.2
Mobile crusher	9.5	4.2	0.3
Earthworks			
Material handling (excavators/loaders)	1,132	535.2	81.1
Dozers	9,984	2,105	1,048
Scrapers/Graders	1,891	661	1,321
Hauling (unsealed)	17,008	4,801	480.1
Engineering Fill			
Material handling (excavators/loaders)	771.6	364.9	55.3
Dozers	7,987	1,684	839
Scrapers/Graders	3,781	1,321	2,642
Wind Erosion (total)	8,662	4,331	650
TOTAL	**62,476**	**14,070**	**7,760**

Table 17: Proposed SIMTA Stage 1 emission reduction measures and how they are treated in emissions estimates and modelling for Stage 1

Measure	Treatment in emissions estimates and modelling
Locomotives	
Electrically powered locomotive shifter to reduce the need for locomotive idling	A conservative worst case scenario of locomotive idling for 2 hours during train loading.
Development of an anti-idle policy and communication / training for locomotive operators	
Limit un-necessary long-duration idling to less than 15 consecutive minutes	
Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade.	Future improvements in emissions performance has not been incorporated
Driver training for fuel efficiency	Fuel consumption based on GMR fleet average
Container Handling Equipment	
New reach stackers to achieve best practice emissions performance to meet US EPA Tier 3 / Euro Stage IIIA standards.	Emissions based on US EPA Tier 3 emission performance
Diesel powered equipment handling equipment to transition to electric cranes in the long term	Scenario presented for cranes
Un-necessary idling avoided through driver training and site anti-idle policy	N/A
Equipment with smoky exhausts (more than 10 seconds) should be stood down for maintenance.	N/A
Trucks	
Gate appointment system, truck marshalling lanes and rejection of trucks that arrive early to minimise wait times and queuing	A conservative worst case scenario of truck idling for 30 mins in each hour.
Development of an anti-idle policy and communication through the provision of information signs	
Limit un-necessary long-duration idling to less than 15 consecutive minutes	
Trucks with smoky exhausts (more than 10 seconds) shall be rejected from the site	N/A
Loading and unloading coordinated to minimise truck trip distances as they travel through site	Maximum trip distance of 2km assumed

7.2.2 Emissions from locomotives

Emissions for locomotives travelling between the site and the SSFL are calculated based on the amount of fuel consumed and fuel-specific emission factors from the US (USEPA, 2009a; USEPA, 2009b). The Stage 1 Proposal can be serviced using an existing locomotive fleet, which are assumed to have an emissions performance equivalent to US EPA Pre-Tier 0 Line Haul Emission Factors[9], shown in **Table 18**. The use of the Pre-Tier 0 emission factors provides a conservative estimate of emissions. The US EPA emission factors, expressed in g/kW-hr (grams of pollutant emissions per kilowatt-hour), were converted to kg/kL (kilograms of pollutant per kilolitre of fuel combusted) using the conversion factors given by the US EPA (US EPA, 2009a and US EPA, 2009b) and as described in NSW EPA (2012a).

SO_2 emissions are estimated based on the sulfur content of the fuel, assuming the majority of the sulphur is oxidised to SO_2. Adjustments also made to the PM_{10} emissions to account for the lower Australian fuel sulphur content. $PM_{2.5}$ emissions are assumed to be 97% of the PM_{10} emissions and VOC emissions are estimated from the HC emissions using a conversion factor of 1.053 (US EPA 2009a).

An estimate of the fuel consumption for the trip to port (approximately 45 km), for a full and empty train has been developed. The fuel consumption for the section of the journey between the site and the SSFL is derived pro-rata based on travel distance (3km/45km) and equates to a consumption rate of 3.0 litres per gross kilotonne-kilometre for a full train and 2.9 litres per gross kilotonne kilometre for an empty train. This is slightly lower than the average fuel consumption rate of 4.03 L/kt-km described in the NSW EPA GMR emissions inventory for freight travel and therefore to be conservative, the higher fuel consumption rate is adopted.

The annual gross kilotonne-kilometre is estimated from the total train weight (both for full and empty trains), the number of trains per annum and a travel distance of 3 km (for site to SSFL). For the 250,000 TEU scenario, there would be 3,676 train movements which equates to 10 trains per day. It is assumed that approximately 50% or 5 trains per day would be import (with full container loads). Of the remaining 50% export, 75% would return to port empty and 25% would return full. The assumed locomotive, wagon and container weights are the same as those outlined in the Concept Approval AQA (PEL, 2013).

Fuel consumption for locomotives idling is estimated from an assumed consumption rate of 9.9 litres per hour[10] and an assumed 2 hour idle time for each train. The estimated fuel consumption and emission factors are presented in **Table 18**. Locomotive emissions are estimated using equation 1 and the annual emissions are shown in **Table 19**.

$$Emissions\ (kg|annum) = EF(kg|kL) \times FC(kL|annum) \qquad \text{Eq.1}$$

Where:

EF = US EPA emission factor for Pre Tier 0 locomotive in kg/kL

FC = Estimated fuel consumption in kilolitres (kL) per annum

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[9] The emissions performance of the existing fleet in Australia is dominated by locomotives with Pre Tier 0 performances (80.7%) (ENVIRON, 2013).

[10] For a 3000 HP 12 cylinder engine QR locomotive.

Table 18: US EPA Pre-Tier 0 Line Haul Emission Factors (kg/kL)

Source	Fuel Consumption (kL/annum)	NO_x	PM_{10}	CO	HC
Locomotives travelling to / from site to SSFL	80	71.43	1.33	7.03	2.64
Locomotives idling	73				

Table 19: Estimated emissions for locomotives (kg/annum)

Source	NO_x	PM_{10}	$PM_{2.5}$	CO	HC	SO_2	VOC
Locomotives travelling	5,737	107	104	565	212	1.3	223
Locomotives idling	5,200	97	94	512	192	1.2	202

7.2.3 Locomotive shifting/shunting

SIMTA will operate an electric powered locomotive shifter to move locomotives from one rail line to another. SIMTA will not operate a shifting/shunting locomotive and emissions from this source are therefore not considered.

7.2.4 Emissions from container handling

Two scenarios are considered for container handling, as follows:

- Scenario 1: manual loading and unloading of trains and trucks using reach stackers and/or large forklifts at an operational capacity of 250,000 TEU per annum.
- Scenario 2: unloading and loading of trains and trucks via an electric gantry crane system at an operational capacity of 250,000 TEU per annum.

For Scenario 2, electrified gantry cranes would be deployed, significantly reducing local emissions from container handling.

For Scenario 1, SIMTA would employ up to six (6) reach stackers or large diesel powered forklifts. On average, approximately three reach stackers would be required to strip a train and it would be rare for two trains to require simultaneous unloading/loading for the 250,000 TEU scenario, which is limited to approximately 10 trains per day. It is therefore unlikely that all six would operate concurrently, however a worst case assessment is presented whereby all six would operate concurrently 24 hours a day.

Emission estimates have been made based on the purchase of new equipment with engines that comply with US EPA Tier 3 / Euro Stage IIIA emission standards for non-road diesel engines. Emission estimates are therefore presented based on US EPA Tier 3 emission factors, as shown in **Table 20**.

Table 20: US EPA Tier 3 Non-road diesel Emission Factors (g/kWh)

Source	NO_x	PM_{10}	CO	HC
Container handling	3.6[1]	0.2	3.5	0.41

Note: 1 Emission factors are given for NOx and non-methane hydrocarbons (NMHC) combined (4.0) and is split 0.9 / 0.1 respectively.

Emissions are estimated using equation 2 and the annual emissions are shown in **Table 21**.

$$\text{Emissions } (kg|annum) = \frac{\text{EF (g/kWh)} \times \text{P (kW)} \times \text{OpHrs} \times \text{LF}}{1000} \qquad \text{Eq.2}$$

Where:

EF = Emission factor in grams per kilowatt hour (g/kWh) (Table 20)

P = Rated power in kilowatts (kW) (239 kW)

OpHrs = Operating hours for piece of equipment (8760 hours per year x 6 reach stackers)

LF = Average operational load factor (taken as 0.59 based on large diesel forklifts reported in GMR emission inventory (NSW EPA, 2012))

Table 21: Estimated emissions from container handling (kg/annum)

Source	NO_x	PM_{10}	$PM_{2.5}$	CO	HC	SO_2	VOC
Container handling	26,608	1,478	1,434	25,869	2,956	3.3	31,132

7.2.5 Emissions from road transportation

Trucks are estimated to spend approximately 40 minutes onsite. For approximately 70% of that time, trucks will be in processing, holding or unloading/loading mode. For the remaining ~30% of the time, trucks will be travelling through the terminal.

Approximately 670 daily truck trips (to and from the terminal) will be required for the 250,000 TEU scenario. During the AM peak and PM peak periods, approximately 52 and 62 truck trips per hour are expected.

Emissions from trucks have therefore been estimated based on both the PM peak 1-hour and an average daily truck trips numbers. The peak PM truck numbers are used to predict ground level concentrations for pollutants with impact assessment criteria expressed as maximum (100th percentile) 1-hour average. The average daily truck numbers are applied for averaging periods longer than 1-hour or where the 1-hour average impact assessment criteria are expressed as a 99.9th percentile.

Emission factors developed for heavy duty vehicles in the US EPA MOVES emissions model include short term idling within the typical vehicle “running” process, defined as when a vehicle is under load or in idle (for example at traffic lights). This is distinguished from extended idling periods, which are typically considered for periods of hours (i.e. overnight) rather than minutes (US EPA, 2012).

Therefore, emission estimates for trucks in travel mode would normally account for the type of short term idling expected for the Stage 1 Proposal, however to provide a conservative prediction of impact, idling emissions are considered separately. Idling emissions are calculated based on the assumption that each truck would spend a maximum of 30 minutes in idle mode at various locations onsite (processing, holding, loading, unloading). Idling emissions are estimated using emissions factors reported in US EPA (2008), developed using the MOBILE6.2 emission estimation model for a heavy duty diesel vehicles (HHDV) (long haul, semi-trailer type rig), based on US fleet averages. MOBILE6.2 has now been replaced with the EPA's latest emission factor model (MOVES2014[11]). In the absence of detailed information on truck fleet using the Stage 1 Proposal, for the purpose of this assessment the use of the previously derived default fleet average US emission factors are considered suitable. The emission factors are presented in **Table 22**.

Table 22: US EPA Emission Factors for HDDV Idling (g/hr)

Source	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**VOC**
Trucks idling	33.8	1.2	1.1	25.6	3.5

Emission factors for vehicles in travel mode are expressed in g/km. The distance travelled in a given hour (or day) is based on the number of truck trips and total travel distance per trip (assumed to be a 2 km round trip). For example, under a peak hour scenario, 62 truck trips would result in 124 km travelled per hour.

Truck emissions (in travel mode) were calculated using aggregated emission factors developed by the NSW EPA for the 2008 Greater Metropolitan Region (GMR) emissions inventory (NSW EPA, 2012b). The method for calculating hot running emissions involves the use of base 'composite' emission factors for various vehicle types (in this case articulated trucks (AT), with the emission factor for each vehicle type taking into account vehicle-kilometres travelled (VKT) by age (and associated emission factors by sub-type). For each case, the base emission factor is defined for a VKT-weighted average speed (the base speed) associated with the corresponding road type. Correction factors – in the form of 6th-order polynomial functions - are then applied to the base emission factors taking into account the actual speed on a road. The NSW EPA commissioned the development of an Air Quality Appraisal Tool (PAEHomes, 2013), a spreadsheet which incorporates the GMR emission factors as well as information on road types, default traffic mixes and base traffic speeds and allows for calculations to be made for specific years (2008, 2011, 2016, 2021 and 2026) based on available fleet data. For the Stage 1 Proposal, 2016 is selected for emissions calculations for a commercial arterial road, 2% grade and a speed limit of 10 km/hr.

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[11] Motor Vehicle Emissions Simulator

The emission estimates presented in **Table 23** are estimated based on the number of daily truck trips, for a 2km length of commercial arterial (onsite) roadway with zero grade and 10 km speed limit.

Table 23: Estimated emissions for trucks (kg/annum)

Source	NO_x	PM_{10}	$PM_{2.5}$	CO	HC	SO_2	VOC
Trucks in travel mode	8,529	286	277	1099	339	4.4	357
Truck idling	4,128	146	135	3,134	-	N/A[1]	422

Note: [1] accounted for in the assumed fuel consumption based on distance travelled.

7.2.6 Emissions Summary

A summary of the annual emissions for the Stage 1 Proposal are presented in **Table 24**. Emissions source contributions for key pollutants are presented in **Figure 12**. Based on the emission factors and activity data assumptions used in this report, the operation of container handling equipment is the largest potential source of emissions to air.

It is noted that the annual summary is based on the assumption (for a worst case modelling assessment) that all six reach stackers would operate continuously, at an average 60% load, for the entire year. In reality this would not be the case and the actual emissions across the major sources may be more evenly distributed.

Table 24: Summary of annual emissions for SIMTA Stage 1 (tonnes/annum)

Source	NO_x	PM_{10}	$PM_{2.5}$	CO	HC	SO_2	VOC
Trucks (travelling and waiting)	7.0	0.2	0.2	3.5	-	0.001	0.5
Locomotives (idling and travelling to SSFL)	10.9	0.2	0.2	1.1	0.4	0.002	0.4
Container Handling Equipment	26.6	1.5	1.4	25.9	3.0	0.003	3.1

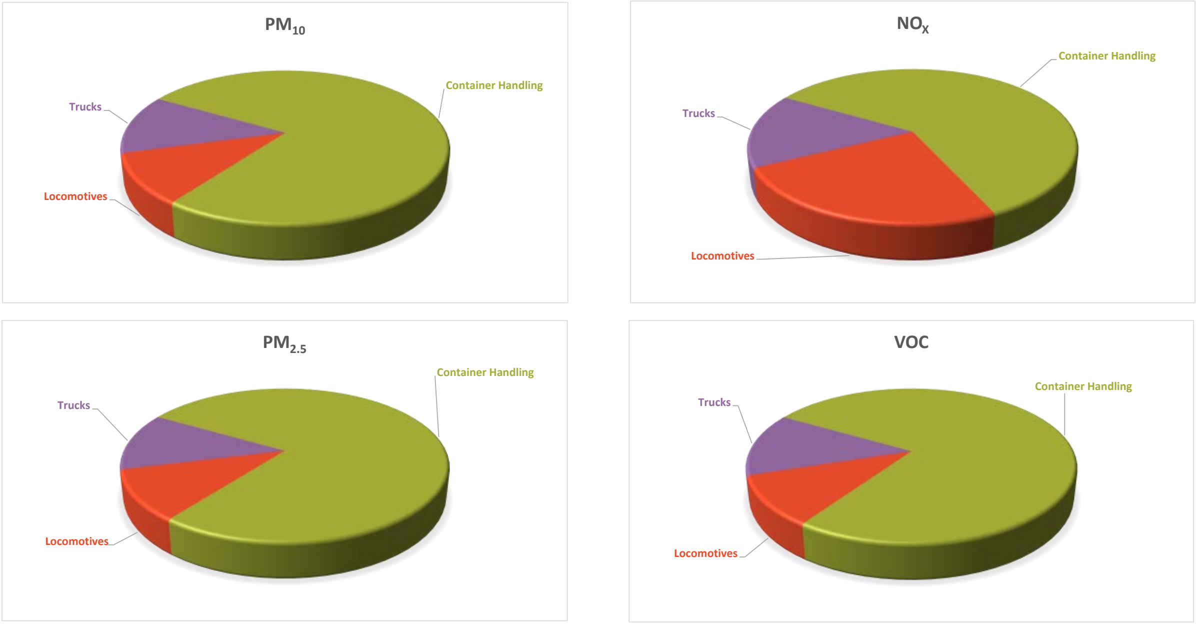

Figure 12. Summary of annual emissions breakdown by source

8 Approach to assessment

8.1 Dispersion modelling

AERMOD is the US EPA's recommended steady-state plume dispersion model for regulatory purposes. AERMOD is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain[12]. AERMOD is able to predict pollutant concentrations from point, area and volume sources in addition to 'open pit' sources.

AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it provides more realistic results with concentrations that are generally lower and more representatives of actual concentrations compared to the conservative ISC model. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and frequently used in Australia for simple near-field applications, is largely based on the ISC model. Compared to ISC and Ausplume, AERMOD represents an advanced new-generation model, which requires additional meteorological and land use inputs to provide more refined predictions. The most important feature of AERMOD, compared to ISC and Ausplume, is its modification of the basic dispersion model to account more effectively for a variety of meteorological factors and surface characteristics. In particular, it uses the Monin-Obukhov length scale rather than Pasquill-Gifford stability categories to account for the effects of atmospheric stratification. Whereas Ausplume and ISC parameterise dispersion based on semi-empirical fits to field observations and meteorological extrapolations, AERMOD uses surface-layer and boundary layer theory for improved characterisation of the planetary boundary layer turbulence structure.

Input data types required for the AERMOD model include: meteorological data (from AERMET), source data (from the compiled emissions inventory), source and receptor elevations and information on the nature of the receptor grid.

The AERMOD system is composed of two pre-processors that generate the input files required by the AERMOD dispersion model: AERMET (for the preparation of meteorological data) and AERMAP (for the preparation of terrain data). Terrain data for the modelling domain was sourced from NASA's Shuttle Radar Topography Mission (SRTM) data. This data set provided a high-resolution topography at 3 arc-second (~90 m) grid spacing.

In applying the AERMET meteorological processor to prepare the meteorological data for the AERMOD model, appropriate values for three surface characteristics need to be determined: surface roughness length, albedo, and Bowen ratio. Surface roughness length is related to the height of obstacles in the path of wind flow and is, in principle, the height at which the mean horizontal wind speed is zero based on a logarithmic profile. The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux and is used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

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[12] Under complex wind conditions and for regional applications, CALPUFF is the US EPA's recommended model for regulatory purposes.

Values for albedo and Bowen ratio were selected based on the default values for the dominant land use within 10 km of the SIMTA site. Values for surface roughness length were selected based on the dominant land use within a 1 km radius.

8.1.1 Modelling scenarios

Modelling scenarios are presented for the construction and operation of the Stage 1 Proposal. A single conservative construction scenario is presented based on the dust generating activities and emission inventory presented in **Section 7.1**.

For the operation of the Stage 1 Proposal, the following scenarios are presented:

- Scenario 1: manual loading and unloading of trains and trucks using reach stackers and/or large forklifts at an operational capacity of 250,000 TEU per annum.
- Scenario 2: unloading and loading of trains and trucks via an electric gantry crane system at an operational capacity of 250,000 TEU per annum.
- Cumulative Scenario: taking into account the first stage of construction and operations for the MIC Proposal and the operation of the Stage 1 Proposal at operational capacity of 250,000 TEU per annum.

8.1.2 Source configuration

Emissions sources for the Stage 1 Proposal are allocated according to the SIMTA Stage 1 Location Plan (refer **Figure 2**).

Locomotives travelling from the SSFL to site are represented by a series of 114 volume sources with an initial sigma Y (or lateral dimension) of 10 m, distributed along the rail link and onsite rail siding. A release height of 5m, is assumed with an initial sigma Z (or vertical dimension) of 2.3 m. Locomotives idling which are represented by a static point source at the end of the rail siding, with a release height of 5 m, temperature of 573 K and exit velocity of 5 m/s.

Trucks travelling through the site are represented by a series of 69 volume sources distributed from the site entrance to the truck processing area and both sides of the rail siding. Container handling equipment are also allocated to 27 volume sources located on each side of the rail siding. Both trucks and CHE volume sources are assigned the same 10m lateral dimension, a release height of 3 m and an initial sigma Z (or vertical dimension) of 0.9 m. The simulated line sources locations are shown in **Figure 13**.

Similar to the operation scenario, for construction potential dust sources are distributed as volumes sources according to the locations for construction, demolition and bulk earthwork activity, as shown in **Figure 14**. The emissions for construction are evenly distributed across all volume source locations.

Figure 13. Simulated source locations for operations

Figure 14. Simulated source locations for construction

8.1.3 Particle size distribution for modelling

Construction dust was modelled as three separate size fractions, TSP, PM_{10} and $PM_{2.5}$. TSP was assumed to a particle geometric mean diameter of 15 µm, PM_{10} a particle geometric mean diameter of 5 µm and $PM_{2.5}$ with a particle geometric mean diameter of 1 µm.

For diesel emissions during operations a particle geometric mean diameter of 1 µm is assumed for both PM_{10} and $PM_{2.5}$ (based on the assumption that $PM_{2.5}$ emissions are 97% of the PM_{10} emissions).

8.2 Speciation of total VOC emissions

Dispersion modelling predictions are presented for 1,3-butadiene, benzene and PAHs based on the emission estimates presented in **Section 7**. As described in **Section 7.2**, emissions factors presented as total hydrocarbons (HC) are converted to VOCs using a conversion factor of 1.053 (US EPA 2009a).

Emission rates for the individual VOCs are then derived based on the speciation profiles used in the NSW GMR emissions inventory. The percentage of total VOCs for each of the modelled compounds is summarised in **Table 23**.

Table 25: Speciation profiles for VOCs assessed

Source	**% of total VOC**		
	Benzene	**1,3-butadiene**	**PAHs**
Locomotives[1]	0.22%	0.27%	0.13%
Container Handling Equipment[2]	2.03%	0.29%	0.05%
Trucks[3]	1.07%	0.4%	1.65%

Source:

1. Based on GMR emissions presented for each compound for locomotives in Table ES-3 of NSW EPA (2012a)
2. Based on GMR emissions presented for each compound for commercial off-road vehicles in Table ES-3 of NSW EPA (2012a)
3. Based on diesel vehicle speciation data profiles for heavy duty diesel vehicles as presented in Table 4-74 of NSW EPA (2012b)

8.3 Assessment approach for regional scale impacts

Air quality impact assessment on a regional scale typically involves an assessment of the potential for the formation of photochemical smog. Ozone (O_3) is the principal component of photochemical smog and is typically formed several hours after the precursors (NO_x and VOCs) are emitted.

The relationship between ground level concentrations of ozone and emissions of precursor pollutants is nonlinear, and an increase in NO_x emissions can lead to both the formation and destruction of ozone, depending on the background concentrations of NO_x and VOCs, and the availability of sunlight. For example, in areas dominated by fresh NO_x emissions, O_3 concentrations can be lowered (for example by titration or scavenging of O_3 through reaction with NO). This can lead to local increase in NO_2 which can be transported and lead to O_3 formation further downwind. In areas with relatively low NO_x, ozone typically responds linearly with NO_x concentrations. As a general rule, reductions in NO_x can be expected to increase lower concentrations of ozone and decrease higher concentrations of ozone (US EPA, 2014).

PEL (2013) presented an assessment of regional impacts by comparing the marginal effects of the SIMTA Project on emissions from road vehicles (articulated trucks only) and railway locomotives on the Port-Botany-Moorebank corridor. The approach uses the change in total pollutant emissions as a proxy for regional air quality.The analysis showed that there would be reductions in emissions of NO_x, PM_{10} and CO_2 associated with the transfer of freight from road to rail. The absolute net effects were placed into context by comparing them with emissions from all sources in Sydney in 2008 (NSW EPA, 2012c) and found that the changes in emissions would be negligible when considered at the regional level. It was therefore concluded that the impacts on regional air quality would also be negligible. No further assessment of regional impacts is presented as part of this assessment.

8.4 Assessment of changes to local traffic

The operation of the SIMTA Stage 1 Proposal is expected to have a minimal increase in traffic on most surrounding roads, when compared with baseline traffic for 2014 (*SIMTA Intermodal Terminal Facility Stage 1- Operational Traffic Impact Assessment*, Hyder, 2015). **Table 26** shows the % increase in average daily traffic and the only significant change (4.4%) is expected along Moorebank Avenue, south of the M5.

Table 26: Projected changes in average weekday traffic from SIMTA Stage 1

Road / Location	Without SIMTA (vehicles)	With SIMTA (vehicles)	% Change
Moorebank Avenue South of M5	18,200	19,000	4.4%
M5 West of Moorebank Avenue	143,900	144,500	0.4%
M5 East of Moorebank Avenue	123,000	123,000	0.0%
Moorebank Avenue North of M5	34,900	35,000	0.3%

PEL (2013) assessed the potential air quality impacts from cumulative traffic movements, including impacts on residential receivers located closest to the M5 and Moorebank Avenue. Traffic impacts were assessed for worst case peak traffic flow, with and without the SIMTA Proposal, and predictions were made at various distances from each roadway.

The assessment found that along Moorebank Avenue (south of the M5), where the highest traffic increase was projected, the predicted ground level concentrations at 200 m would increase slightly as a result of SIMTA Project, however the incremental increases were a minor percentage of the air quality goals. It was also noted that although results were presented at distance of 20m and 200m, there are no private residential dwellings closer than 600m along Moorebank Avenue (south of the M5).

On the basis of the conclusions for the SIMTA Project, no further assessment is required for Stage 1 Proposal on the assumption that any associated impact from the Stage 1 Proposal would be similarly minor.

9 Dispersion modelling results

9.1 Construction phase

The construction phase of the Stage 1 Proposal has been assessed in terms of potential impacts from TSP, PM_{10} $PM_{2.5}$ and dust deposition. The modelling predictions for construction are presented in **Table 27** for the sensitive receptors identified in **Section 3.3**.

The modelling results indicate that the construction phase of the Stage 1 Proposal comply with all relevant impact assessment criteria. The predicted increase in annual average PM_{10} (0.4 $\mu g/m^3$), $PM_{2.5}$ (0.2 $\mu g/m^3$), TSP (0.5 $\mu g/m^3$) and dust deposition (0.1 g/m^2/month) are considered minor, when compared against existing background conditions. The highest predicted short-term impacts occur at Wattle Grove with a maximum 24-hour PM_{10} of 2.1 $\mu g/m^3$ and maximum 24-hour $PM_{2.5}$ of 1.4 $\mu g/m^3$.

It is important to note that the modelling predictions are conservative, particularly for short-term impacts. The modelling takes the annual emission total and apportions this evenly across the year. Construction activities will be staged and only a proportion of the annual emission totals will be generated during each stage, resulting in conservatively high short-term (24-hour) predictions. It is also noted that the annual emission totals are also apportioned across all modelled source locations (as the precise location of a dust generating construction activity, on a particular day, is difficult to predict).

Contour plots of predicted ground level concentrations for construction are presented in **Figure 15**, **Figure 16** and **Figure 17**.

Cumulative predictions are also presented in **Table 28**. Cumulative annual averages are presented by adding the background values derived in **Section 6.8**. For cumulative 24-hour impacts, modelling predictions are paired with daily background PM_{10} and $PM_{2.5}$ concentrations.

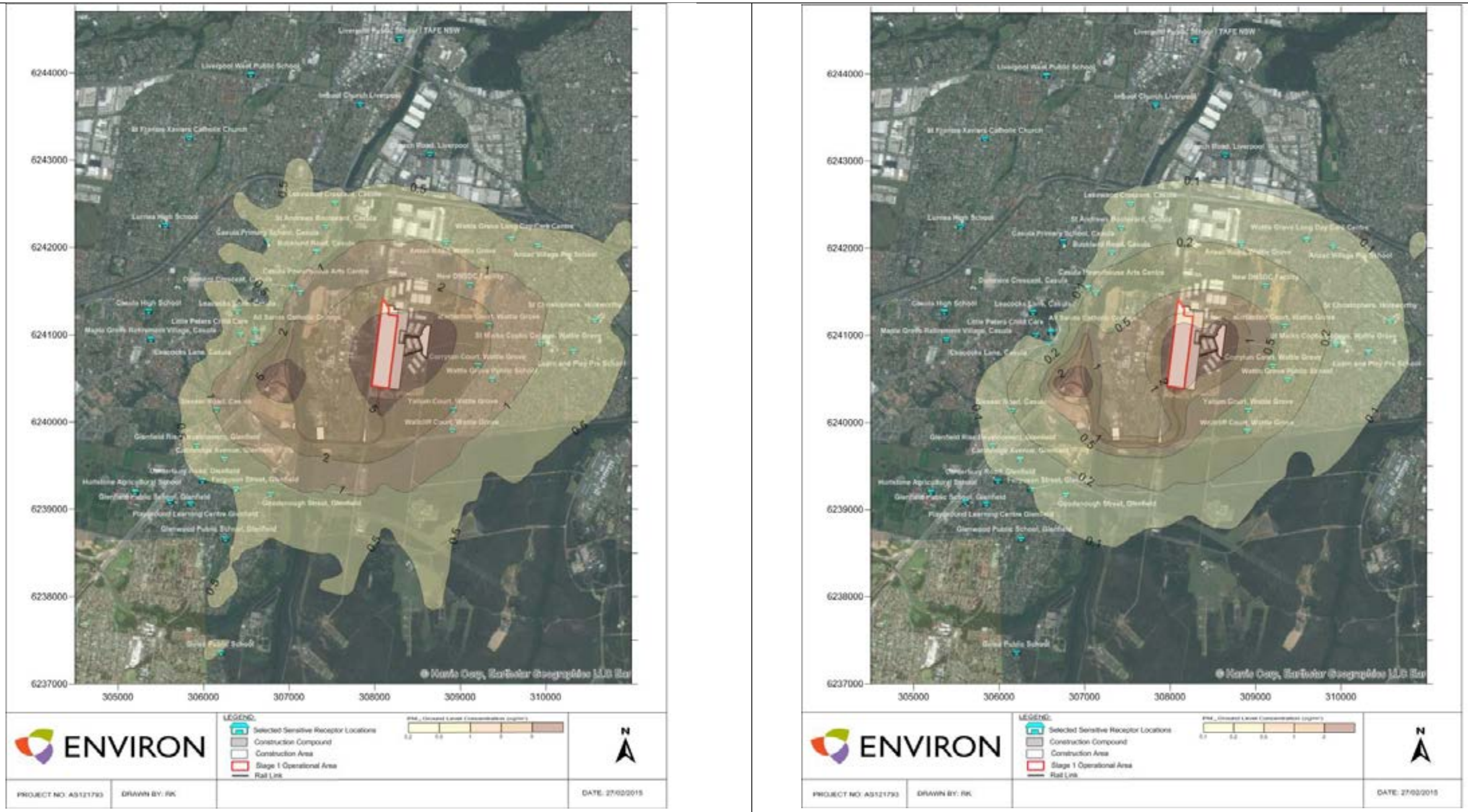
As discussed in **Section 6.2** the background dataset contains existing exceedances of the impact assessment criteria (three days for PM_{10} and two days for $PM_{2.5}$). The cumulative 24-hour average PM_{10} is therefore presented as the 4th highest (excluding the three days already over). The cumulative 24-hour average $PM_{2.5}$ is presented as the 3rd highest (excluding the two days already over). The results indicate that the construction for the Stage 1 Proposal would result in no additional days over the criteria.

Table 27. Construction phase – modelling predictions for selected sensitive receptors

Receptor	PM$_{10}$ (µg/m^3)				PM$_{2.5}$ (µg/m^3)				TSP (µg/m^3)		Dust Deposition	
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave		Annual Ave		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m^3		30 µg/m^3		25 µg/m^3		8 µg/m^3		90 µg/m^3		2g/m^2/m	4g/m^2/m
Receptor Max	**2.1**	**48.2**	**0.4**	**20.8**	**1.4**	**24.2**	**0.2**	**7.8**	**0.5**	**43.1**	**0.1**	**1.1**
R1	0.6	47.9	0.1	20.5	0.4	23.7	0.1	7.7	0.1	42.7	0.02	1.0
R2	0.7	47.9	0.1	20.5	0.6	23.8	0.1	7.7	0.1	42.7	0.02	1.0
R3	0.9	47.9	0.2	20.6	0.7	23.8	0.1	7.7	0.2	42.8	0.03	1.0
R4	0.8	47.9	0.2	20.6	0.5	23.8	0.1	7.7	0.2	42.8	0.05	1.0
R5	0.5	47.9	0.1	20.5	0.3	23.6	0.0	7.6	0.1	42.7	0.04	1.0
R6	1.0	47.9	0.1	20.5	0.6	23.6	0.1	7.7	0.3	42.9	0.09	1.1
R7	1.0	47.9	0.2	20.6	0.7	23.8	0.1	7.7	0.2	42.8	0.04	1.0
R8	0.5	47.9	0.1	20.5	0.4	23.7	0.1	7.7	0.1	42.7	0.01	1.0
R9	0.5	47.9	0.1	20.5	0.4	23.7	0.1	7.7	0.1	42.7	0.02	1.0
R10	0.8	47.9	0.1	20.5	0.6	23.8	0.1	7.7	0.1	42.7	0.02	1.0
R11	1.5	47.9	0.3	20.7	1.1	24.0	0.2	7.8	0.3	42.9	0.05	1.1
R12	2.1	47.9	0.4	20.8	1.4	24.2	0.2	7.8	0.5	43.1	0.09	1.1
R13	2.1	48.1	0.4	20.8	1.4	23.9	0.2	7.8	0.5	43.1	0.08	1.1
R14	0.9	47.9	0.2	20.6	0.7	23.8	0.1	7.7	0.2	42.8	0.03	1.0
R15	0.7	47.9	0.1	20.5	0.5	23.8	0.1	7.7	0.1	42.7	0.02	1.0
R16	0.5	47.9	0.0	20.4	0.3	23.6	0.0	7.6	0.0	42.6	0.01	1.0
R17	1.9	47.9	0.4	20.8	1.3	24.1	0.2	7.8	0.4	43.0	0.07	1.1
R18	0.4	47.9	0.1	20.5	0.3	23.7	0.1	7.7	0.1	42.7	0.01	1.0
R19	0.4	47.9	0.0	20.4	0.2	23.7	0.0	7.6	0.1	42.7	0.01	1.0
R20	0.3	47.9	0.1	20.5	0.2	23.7	0.0	7.6	0.0	42.6	0.01	1.0
R21	0.3	47.9	0.0	20.4	0.2	23.7	0.0	7.6	0.0	42.6	0.01	1.0

Table 27. Construction phase – modelling predictions for selected sensitive receptors

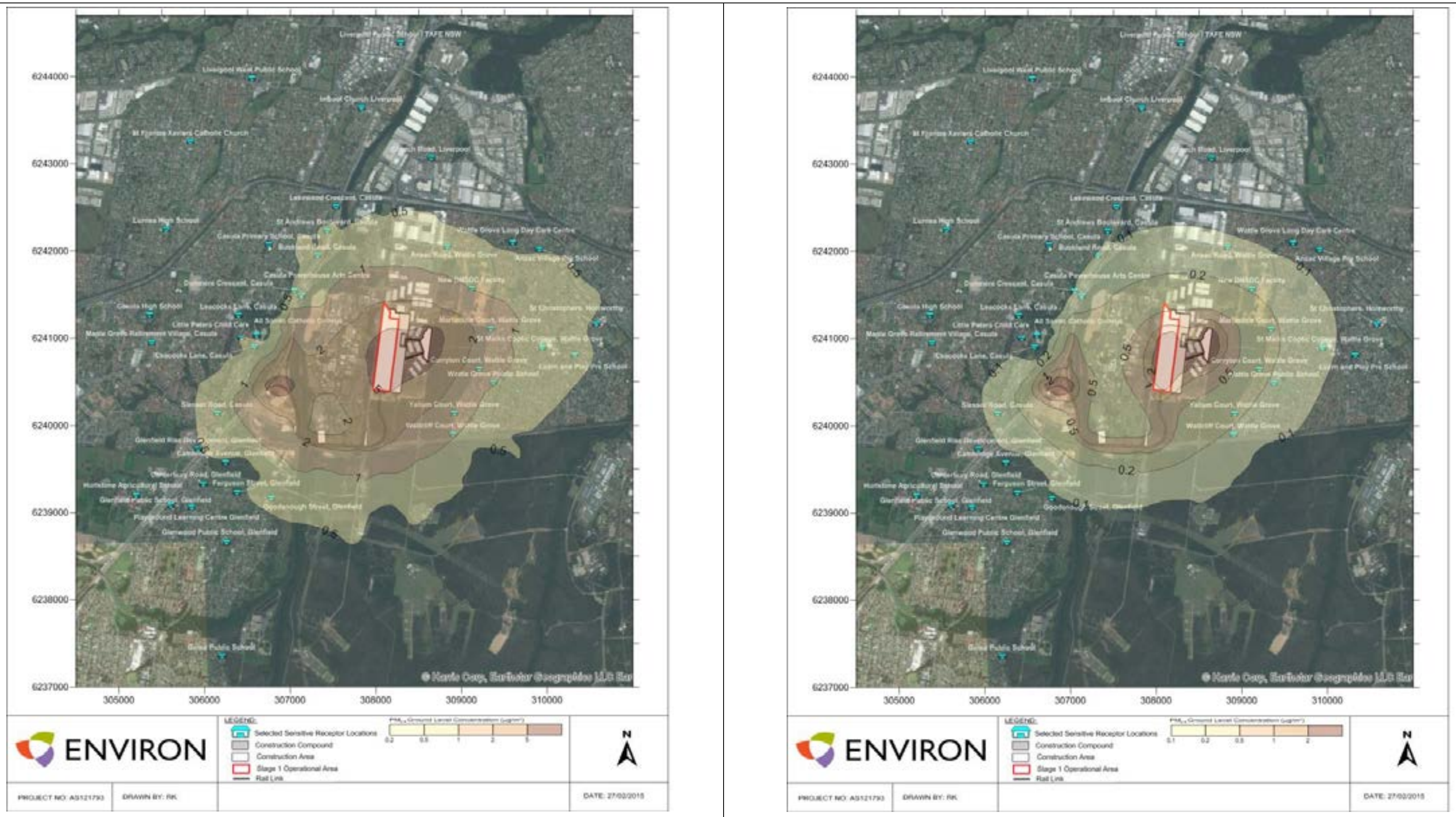
Receptor	PM10 (µg/m³)				PM2.5 (µg/m³)				TSP (µg/m³)		Dust Deposition	
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave		Annual Ave		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m³		30 µg/m³		25 µg/m³		8 µg/m³		90 µg/m³		2g/m²/m	4g/m²/m
Receptor Max	**2.1**	**48.2**	**0.4**	**20.8**	**1.4**	**24.2**	**0.2**	**7.8**	**0.5**	**43.1**	**0.1**	**1.1**
R22	1.5	47.9	0.3	20.7	1.0	24.0	0.2	7.8	0.3	42.9	0.06	1.1
R23	1.0	47.9	0.2	20.6	0.7	23.8	0.1	7.7	0.2	42.8	0.04	1.0
R24	0.2	47.9	0.0	20.4	0.1	23.6	0.0	7.6	0.1	42.7	0.02	1.0
R25	0.7	47.9	0.1	20.5	0.4	23.6	0.0	7.6	0.2	42.8	0.07	1.1
R26	0.3	47.9	0.0	20.4	0.2	23.6	0.0	7.6	0.1	42.7	0.02	1.0
R27	0.6	47.9	0.1	20.5	0.3	23.7	0.0	7.6	0.1	42.7	0.02	1.0
R28	0.4	47.9	0.0	20.4	0.2	23.6	0.0	7.6	0.1	42.7	0.01	1.0
R29	0.3	47.9	0.0	20.4	0.2	23.6	0.0	7.6	0.0	42.6	0.01	1.0
R30	0.3	47.9	0.1	20.5	0.2	23.7	0.0	7.6	0.0	42.6	0.01	1.0
R31	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6	0.0	42.6	0.01	1.0
R32	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6	0.0	42.6	0.01	1.0
R34	0.6	47.9	0.1	20.5	0.5	23.8	0.1	7.7	0.1	42.7	0.02	1.0
R35	1.4	48.2	0.3	20.7	1.0	23.9	0.2	7.8	0.4	43.0	0.07	1.1
R36	0.4	47.9	0.1	20.5	0.3	23.7	0.0	7.6	0.1	42.7	0.01	1.0
R37	0.6	48.0	0.1	20.5	0.4	23.7	0.1	7.7	0.1	42.7	0.03	1.0
R38	1.3	47.9	0.3	20.7	0.9	23.9	0.2	7.8	0.3	42.9	0.05	1.1



Maximum 24-hour average PM_{10}

Annual average PM_{10}

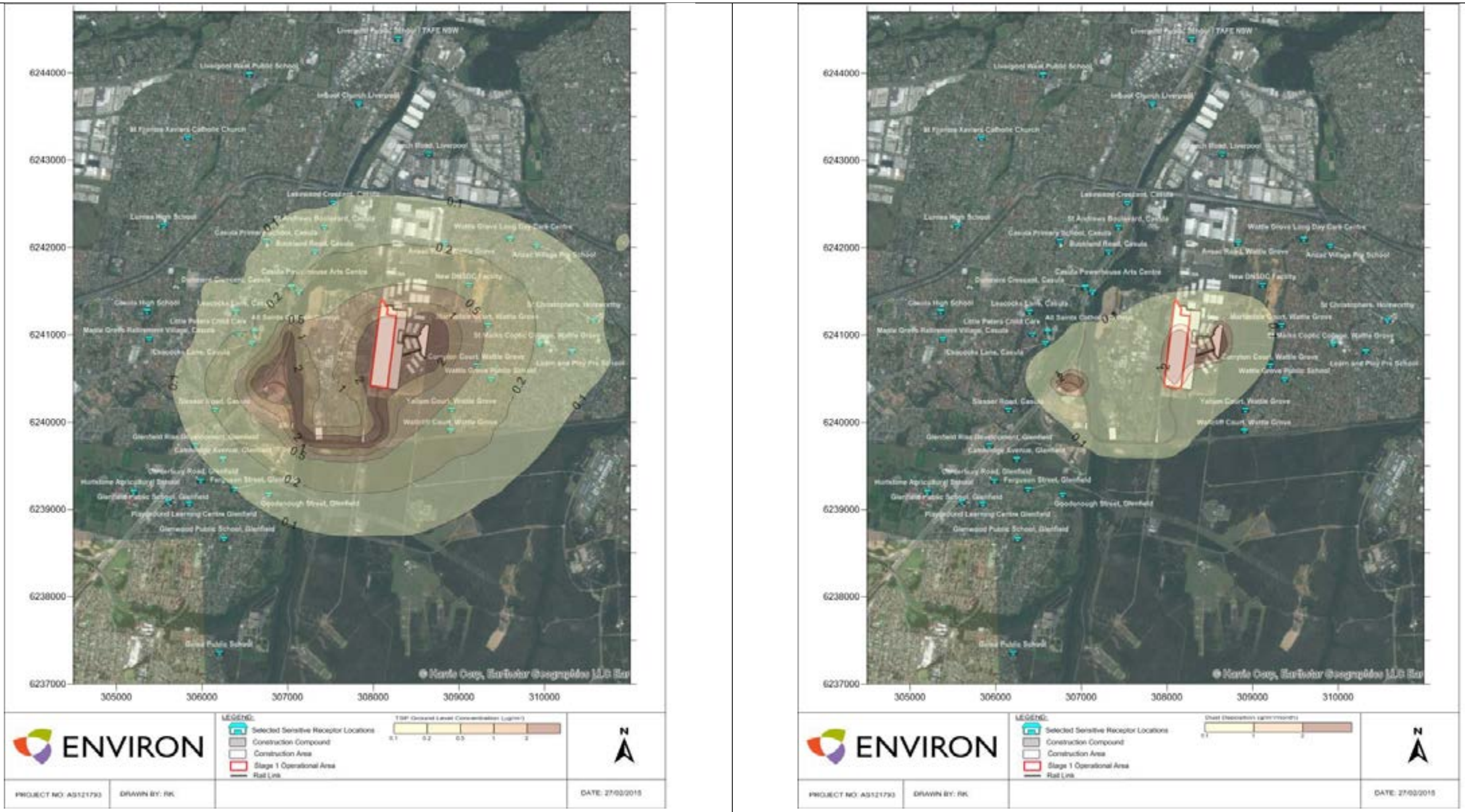
Figure 15. Incremental ground level concentration contour – PM_{10} during construction



Maximum 24-hour average $PM_{2.5}$

Annual average $PM_{2.5}$

Figure 16. Incremental ground level concentration contour – $PM_{2.5}$ during construction



Annual average TSP

Annual average dust deposition

Figure 17. Incremental ground level concentration contour – TSP and dust deposition during construction

9.2 Operational Scenario

The operational phase of the Stage 1 Proposal has been assessed in terms of potential impacts from PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs.

The predicted PM_{10} and $PM_{2.5}$ concentrations are presented in **Table 28**. As described in **Section 9.1**, cumulative results are based on the addition of the background values derived in **Section 6.8** and for 24-hour PM_{10} and $PM_{2.5}$ exclude days already over the criteria. The predicted increase in ground level PM_{10} and $PM_{2.5}$ concentrations are effectively the same (because the majority of PM in diesel exhaust in contained within the $PM_{2.5}$ size fraction). The maximum increase in annual average PM (0.2 µg/m³) and 24-hour average PM (0.5 µg/m³) is minor when compared to existing background conditions. When background is added, there are no additional exceedances of the relevant impact assessment criteria.

The predicted NO_2, CO and SO_2 concentrations are presented in **Table 29**. The predicted NO_2 concentrations presented in **Table 29** are based on the conservative assumption that 100% of NO is converted to NO_2, both for short-term and annual average predictions. This simplified (and conservative) conversion method can be applied in this case because predictions are well below the relevant impact assessment criteria.

Cumulative results for NO_2 are derived by adding the background values derived in **Section 6.8** to the predicted NO_x concentrations. The cumulative 1-hour NO_2 is derived by pairing each 1-hour average modelling prediction with the corresponding background for that hour.

Cumulative concentrations presented for CO and SO_2 (1 hour, 8 hour and 24-hour) are derived by adding the maximum predicted short term concentration to the maximum background concentration. Notwithstanding this conservative assumption (that the maximum modelled concentration occurs at the same time as the maximum background), all predicted concentrations are well below the impact assessment criteria. As discussed previously in Section 6, ambient concentrations of CO and SO_2 are not a significant air quality issue for the area.

Contour plots of predicted incremental ground level concentrations are presented in **Figure 18** (PM_{10}), **Figure 19** ($PM_{2.5}$) and **Figure 20** (NO_2). Contour plots for CO and SO_2 are not presented as the predicted concentrations are too low to display.

Table 28. Stage 1 operations – PM_{10} and $PM_{2.5}$ modelling predictions for selected sensitive receptors

Receptor	PM_{10} concentration (µg/m³)				$PM_{2.5}$ concentration (µg/m³)			
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m³		30 µg/m³		25 µg/m³		8 µg/m³	
Receptor Max	**0.5**	**48.1**	**0.2**	**20.6**	**0.5**	**23.9**	**0.2**	**7.8**
R1	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R2	0.3	48.0	0.1	20.5	0.3	23.7	0.1	7.7
R3	0.3	48.0	0.1	20.5	0.3	23.7	0.1	7.7
R4	0.4	48.0	0.1	20.5	0.4	23.7	0.1	7.7
R5	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6
R6	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6
R7	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R8	0.1	47.9	0.1	20.5	0.1	23.7	0.0	7.6
R9	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R10	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R11	0.4	48.0	0.2	20.6	0.4	23.8	0.2	7.8
R12	0.5	48.0	0.2	20.6	0.4	23.8	0.2	7.8
R13	0.4	48.1	0.2	20.6	0.4	23.8	0.2	7.8
R14	0.3	48.0	0.1	20.5	0.3	23.7	0.1	7.7
R15	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R16	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R17	0.5	48.0	0.2	20.6	0.5	23.9	0.2	7.8
R18	0.1	47.9	0.1	20.5	0.1	23.7	0.1	7.7
R19	0.2	47.9	0.0	20.4	0.2	23.7	0.0	7.6

Table 28. Stage 1 operations – PM_{10} and $PM_{2.5}$ modelling predictions for selected sensitive receptors

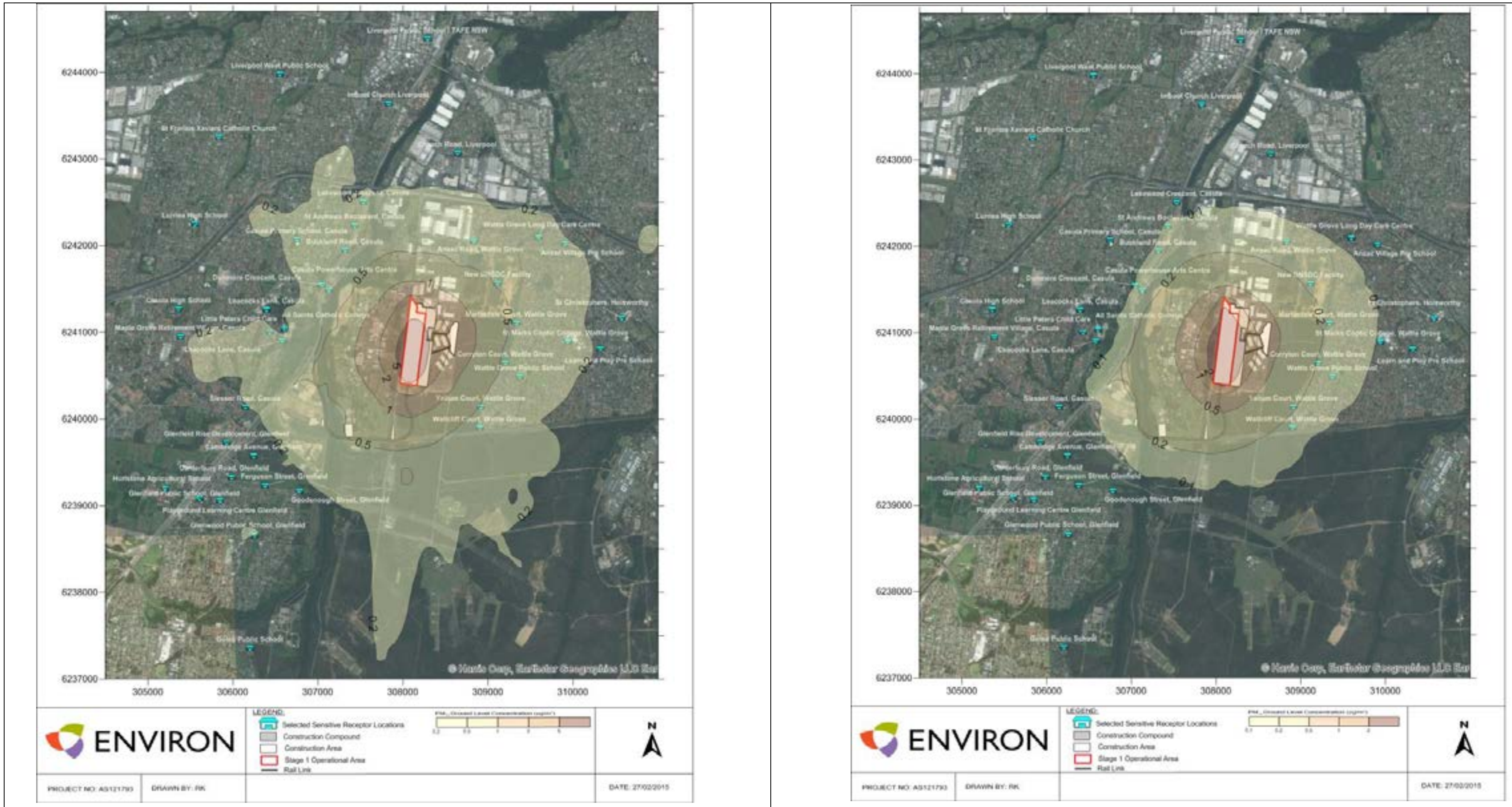
Receptor	PM_{10} concentration (µg/m³)				$PM_{2.5}$ concentration (µg/m³)			
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m³		30 µg/m³		25 µg/m³		8 µg/m³	
Receptor Max	**0.5**	**48.1**	**0.2**	**20.6**	**0.5**	**23.9**	**0.2**	**7.8**
R20	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R21	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R22	0.4	48.0	0.2	20.6	0.4	23.8	0.1	7.7
R23	0.3	48.0	0.1	20.5	0.2	23.7	0.1	7.7
R24	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6
R25	0.2	47.9	0.0	20.4	0.2	23.6	0.0	7.6
R26	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R27	0.3	47.9	0.0	20.4	0.2	23.6	0.0	7.6
R28	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R29	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R30	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R31	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R32	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R34	0.2	47.9	0.1	20.5	0.1	23.7	0.1	7.7
R35	0.5	48.1	0.2	20.6	0.5	23.8	0.2	7.8
R36	0.1	47.9	0.0	20.4	0.1	23.6	0.0	7.6
R37	0.2	47.9	0.1	20.5	0.2	23.7	0.1	7.7
R38	0.4	48.0	0.2	20.6	0.4	23.8	0.2	7.8

Table 29. Stage 1 operations – NO2, CO and SO2 modelling predictions for selected sensitive receptors

Receptor	NO$_2$ concentration (µg/m^3)				CO concentration (mg/m^3)				SO$_2$ concentration (µg/m^3)					
	1-Hour Max		Annual Ave		1-Hour Max		8-Hour Max		1-Hour Max		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	246 µg/m3		62 µg/m3		30 mg/m3		10 mg/m3		570 µg/m3		228 µg/m3		60 µg/m3	
Receptor Max	**81.7**	**102.3**	**5.1**	**27.8**	**0.05**	**5.1**	**0.02**	**2.27**	**0.01**	**34.3**	**0.002**	**8.9**	**0.001**	**1.9**
R1	34.2	78.1	2.3	25.0	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0004	1.9
R2	52.4	78.1	2.9	25.6	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0005	1.9
R3	58.6	79.7	3.5	26.2	0.04	5.04	0.01	2.26	0.01	34.3	0.002	8.9	0.0006	1.9
R4	70.9	102.3	3.1	25.8	0.05	5.05	0.02	2.27	0.01	34.3	0.002	8.9	0.0006	1.9
R5	35.5	79.7	0.5	23.2	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0001	1.9
R6	38.4	79.3	1.0	23.7	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0002	1.9
R7	39.4	78.2	2.7	25.4	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0005	1.9
R8	27.6	78.0	1.4	24.1	0.02	5.02	0.00	2.25	0.01	34.3	0.001	8.9	0.0003	1.9
R9	42.3	78.0	1.5	24.2	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0003	1.9
R10	35.0	78.1	2.1	24.8	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0004	1.9
R11	74.7	82.9	4.1	26.8	0.05	5.05	0.01	2.26	0.01	34.3	0.002	8.9	0.0007	1.9
R12	67.7	85.0	4.7	27.4	0.04	5.04	0.01	2.26	0.01	34.3	0.002	8.9	0.0008	1.9
R13	55.6	86.2	4.4	27.1	0.03	5.03	0.01	2.26	0.01	34.3	0.002	8.9	0.0008	1.9
R14	56.0	79.0	3.4	26.1	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0006	1.9
R15	37.6	78.1	1.9	24.6	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0004	1.9
R16	32.5	78.0	0.5	23.2	0.02	5.02	0.00	2.25	0.01	34.3	0.000	8.9	0.0001	1.9
R17	81.7	88.9	5.1	27.8	0.05	5.05	0.02	2.27	0.01	34.3	0.002	8.9	0.0009	1.9
R18	31.8	78.0	1.4	24.1	0.02	5.02	0.00	2.25	0.01	34.3	0.001	8.9	0.0003	1.9
R19	54.5	78.0	0.8	23.5	0.04	5.04	0.01	2.26	0.01	34.3	0.001	8.9	0.0001	1.9

Table 29. Stage 1 operations – NO2, CO and SO2 modelling predictions for selected sensitive receptors

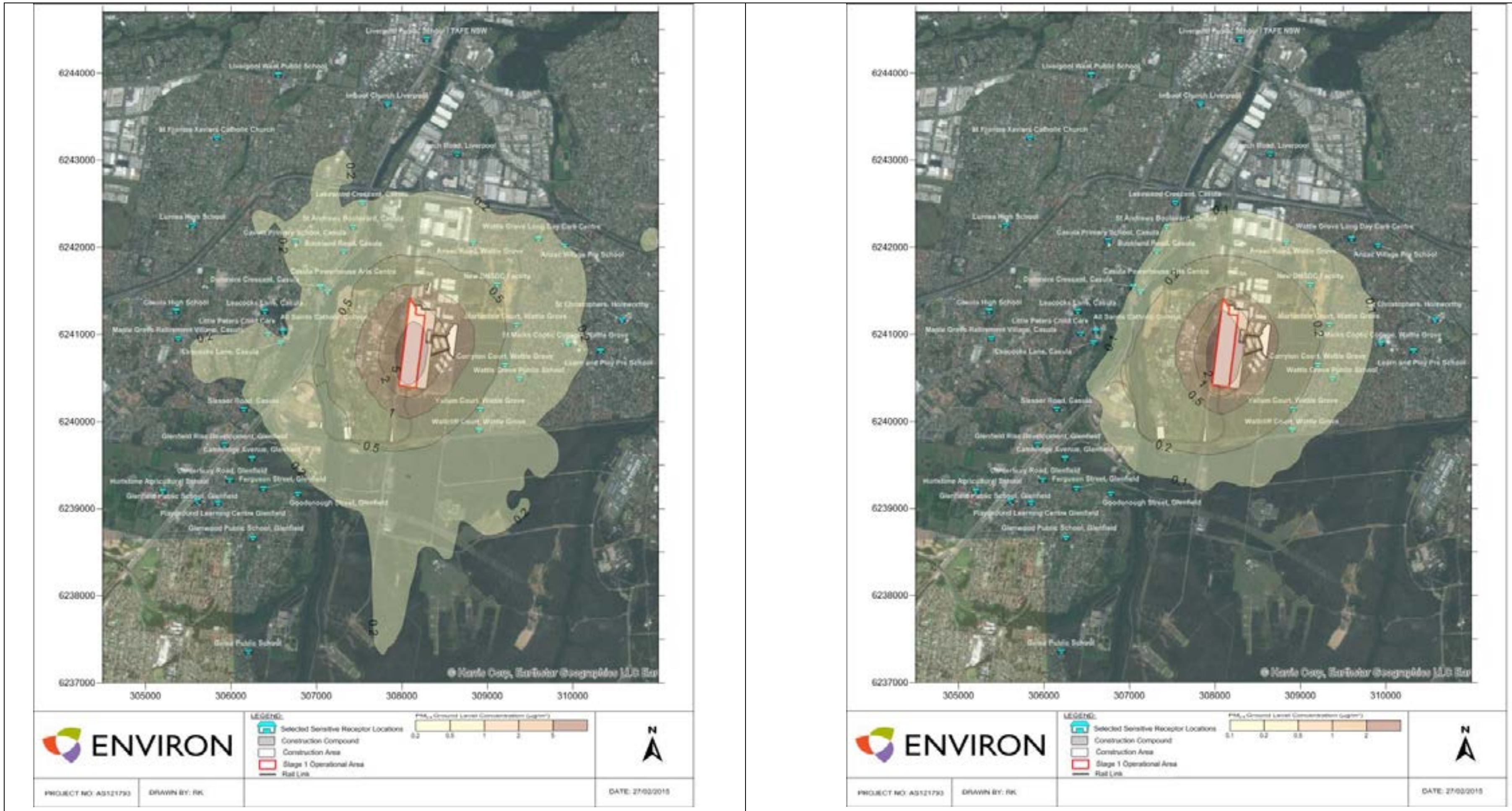
Receptor	NO_2 concentration (µg/m³)				CO concentration (mg/m³)				SO_2 concentration (µg/m³)					
	1-Hour Max		Annual Ave		1-Hour Max		8-Hour Max		1-Hour Max		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	246 µg/m3		62 µg/m3		30 mg/m3		10 mg/m3		570 µg/m3		228 µg/m3		60 µg/m3	
Receptor Max	**81.7**	**102.3**	**5.1**	**27.8**	**0.05**	**5.1**	**0.02**	**2.27**	**0.01**	**34.3**	**0.002**	**8.9**	**0.001**	**1.9**
R20	29.6	78.0	1.0	23.7	0.02	5.02	0.00	2.25	0.01	34.3	0.000	8.9	0.0002	1.9
R21	41.6	78.0	0.8	23.5	0.02	5.02	0.00	2.25	0.01	34.3	0.001	8.9	0.0001	1.9
R22	59.6	79.7	3.7	26.4	0.04	5.04	0.01	2.26	0.01	34.3	0.002	8.9	0.0006	1.9
R23	41.6	78.1	2.4	25.1	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0004	1.9
R24	34.0	78.8	0.5	23.2	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0001	1.9
R25	38.8	79.6	0.8	23.5	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0002	1.9
R26	32.7	79.1	0.4	23.1	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0001	1.9
R27	61.3	85.5	1.3	24.0	0.04	5.04	0.01	2.26	0.01	34.3	0.001	8.9	0.0002	1.9
R28	42.6	78.6	0.7	23.4	0.03	5.03	0.00	2.25	0.01	34.3	0.000	8.9	0.0001	1.9
R29	37.5	78.0	0.8	23.5	0.02	5.02	0.00	2.25	0.01	34.3	0.001	8.9	0.0001	1.9
R30	22.5	78.0	1.1	23.8	0.01	5.01	0.00	2.25	0.00	34.3	0.001	8.9	0.0002	1.9
R31	14.7	78.0	0.8	23.5	0.01	5.01	0.00	2.25	0.00	34.3	0.000	8.9	0.0001	1.9
R32	16.8	78.0	0.7	23.4	0.01	5.01	0.00	2.25	0.00	34.3	0.000	8.9	0.0001	1.9
R34	31.3	78.0	1.8	24.5	0.02	5.02	0.00	2.25	0.01	34.3	0.001	8.9	0.0003	1.9
R35	61.5	92.5	4.6	27.3	0.04	5.04	0.02	2.27	0.01	34.3	0.002	8.9	0.0008	1.9
R36	48.6	78.0	0.9	23.6	0.03	5.03	0.01	2.26	0.01	34.3	0.001	8.9	0.0002	1.9
R37	34.4	78.1	2.3	25.0	0.02	5.02	0.01	2.26	0.01	34.3	0.001	8.9	0.0004	1.9
R38	63.5	85.9	4.6	27.3	0.04	5.04	0.01	2.26	0.01	34.3	0.002	8.9	0.0008	1.9



Maximum 24-hour average PM_{10}

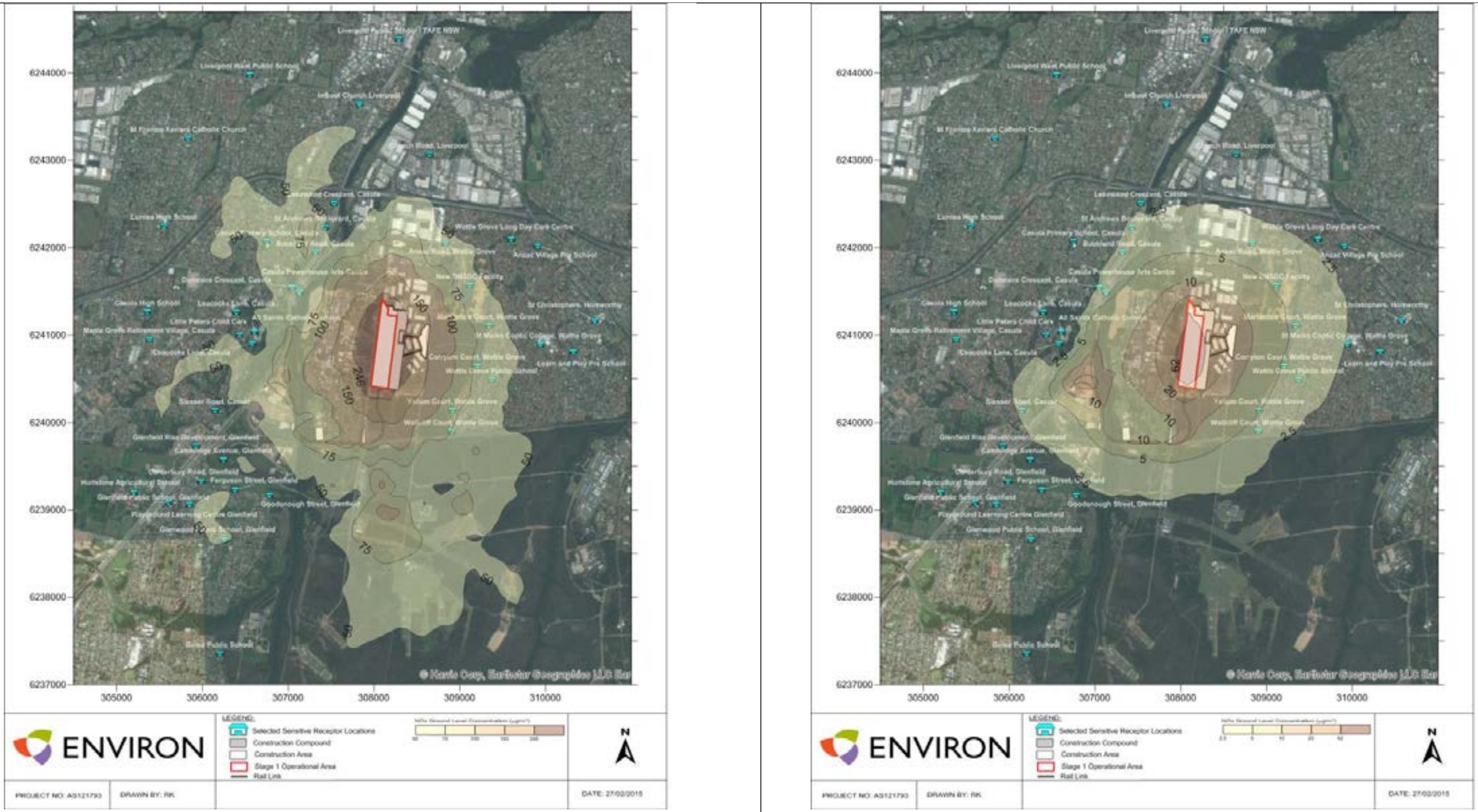
Annual average PM_{10}

Figure 18. Incremental ground level concentration contour – PM_{10} during Stage 1 operations



Maximum 24-hour average $PM_{2.5}$	Annual average $PM_{2.5}$

Figure 19. Incremental ground level concentration contour – $PM_{2.5}$ during Stage 1 operations



Maximum 1-hour average NO_2

Annual average NO_2

Figure 20. Incremental ground level concentration contour – NO_2 during Stage 1 operations

9.3 Short-term averaging periods for SO_2 and CO

Dispersion models are typically used to predict ground level concentrations for averaging periods of 1-hour or greater. As outlined in **Table 5**, impact assessment criteria are prescribed for averaging periods shorter than 1 hour, including SO_2 (10-minute) and CO (15-minute).

To assess against these impact assessment criteria, the maximum cumulative 1-hour concentrations presented in **Table 29** are converted to 10-minute and 15-minute peak concentrations using a power law adjustment as follows:

$$C_{t2} = C_{t1}\left({}^{t1}/_{t2}\right)^{p}$$

Where:
t_2 = 10-minute or 15-minute
t_1 = 60 minutes
p = 0.1 (Best et al, 2000)

The results are presented in **Table 30** and compared against the relevant impact assessment criteria. There are no exceedances of the short-term impact assessment criteria.

Table 30. Short-term predictions for SO_2 and CO

Pollutant	Criteria	Predicted concentration	
		Receptor maximum 1-hour	Short term concentration
SO_2 (10-minute)	712 µg/m^3	34.3 µg/m^3	41.0 µg/m^3
CO (15-minute)	100 mg/m^3	5.1 mg/m^3	5.8 mg/m^3

9.4 Assessment of VOCs

The maximum predicted incremental concentrations of 1,3-butadiene, benzene and PAHs (expressed as 99.9th percentiles) are presented in **Table 31**. Impact assessment criteria are applied at, and beyond the site boundary and therefore results presented as the grid maximum (the highest prediction across the entire modelling grid) can be used to determine compliance. All VOCs are below the relevant assessment criteria.

Table 31. Assessment of VOC concentrations from SIMTA Stage 1

Pollutant	Criteria µg/m^3	Predicted concentration (µg/m^3)	
		Receptor maximum	Grid maximum
1,3 Butadiene	40	0.01	0.2
Benzene	29	0.07	1.1
PAHs	0.4	0.02	0.2

9.5 Operational scenario using gantry cranes

Initially the unloading and loading process would be undertaken using reach stackers or container forklifts. In the long term, overhead gantry cranes would be installed to undertake the unloading and loading process.

The use of gantry cranes would be deployed progressively, resulting in a reduction in the use of diesel powered container handling equipment and an associated reduction in emissions.

Under a scenario where gantry cranes are used, there may still be a potential need for diesel powered reach stackers or forklifts.

Therefore a scenario was investigated whereby the number of reach stackers continuously operating was reduced from six (6) to two (2) (assuming the majority of container handling would be via electrified gantry cranes). Under this scenario emission reductions of approximately 50% would be achieved for PM and approximately 30% for NO_x. This would result in a reduction in annual average ground level concentrations for PM of approximately 40-45% and a reduction in annual average ground level concentrations for NO_2 of approximately 35%.

9.6 Cumulative scenario with MIC

The EIS for the MIC Proposal included a cumulative scenario with the SIMTA site, based on SIMTA operations as presented in the Concept Approval. Three different cumulative scenarios where considered based on various options to split the capacity-constrained maximum TEU throughput between the two sites. The cumulative scenarios considered were:

- 1.5 million TEU at MIC with warehousing and northern rail access. No TEU throughput at SIMTA (warehousing only).
- 1.0 Million TEU at MIC with warehousing and southern rail access. 0.5 million TEU at SIMTA plus warehousing.
- 0.5 Million TEU at MIC with warehousing and southern rail access. 1 million TEU at SIMTA plus warehousing.

Under all cumulative scenarios, there were no additional exceedances of the impact assessment criteria at any of the surrounding receptors described in **Section 3.3**. The MIC EIS` did report additional exceedances of the PM_{10} and $PM_{2.5}$ impact assessment criteria at the receptor R33, however this is a location within the SIMTA site and is not considered a sensitive receptor for the purposes of this report.

The MIC EIS did not include a cumulative scenario for 250,000 TEU at SIMTA, although considering that a higher TEU throughput was assessed, including warehousing, it stands to reason that a cumulative scenario for the 250,000 TEU scenario would not result in exceedances of the impact assessment criteria.

The receptors locations assessed in this report are the same as those presented in the MIC EIS, which allow additional cumulative scenarios to be easily presented. A cumulative scenario is therefore presented by combining the SIMTA Stage 1 modelling predictions with the MIC EIS predictions for the first stage of construction and operations of the MIC site.

Receptor maximum predictions for the MIC are added to the cumulative SIMTA predictions presented in **Section 9.2**.

The cumulative modelling scenario shows similar results to that presented in the MIC EIS, that is, the addition of the MIC Proposal does not result in any exceedance of the impact assessment criteria. Cumulative results are presented for PM_{10}, $PM_{2.5}$ and NO_2 in **Table 32**, **Table 33** and **Table 34**.

For SO_2 and CO the incremental modelling results for both the MIC and SIMTA developments are very low and when added to the low background described in **Section 6**, would not result in cumulative concentrations above the relevant impact assessment.

Table 32. Predicted PM$_{10}$ concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	**PM$_{10}$ concentration (μg/m^3)**							
	24-Hour Max				**Annual Ave**			
	SIMTA Increment	**SIMTA Cumulative**	**MIC Increment**	**Cumulative with MIC**	**SIMTA Increment**	**SIMTA Cumulative**	**MIC Increment**	**Cumulative with MIC**
Goal	50 μg/m3				30 μg/m3			
Receptor Max	**0.5**	**48.1**	**1.4**	**49.4**	**0.2**	**20.6**	**0.1**	**20.7**
R1	0.2	47.9	0.3	48.2	0.1	20.5	0.1	20.6
R2	0.3	47.9	0.4	48.3	0.1	20.5	0.1	20.6
R3	0.3	48.0	0.7	48.7	0.1	20.5	0.1	20.6
R4	0.4	48.0	1.4	49.4	0.1	20.5	0.1	20.6
R5	0.2	47.9	0.9	48.8	0.0	20.4	0.1	20.5
R6	0.2	47.9	0.8	48.7	0.0	20.4	0.1	20.5
R7	0.2	47.9	0.5	48.4	0.1	20.5	0.1	20.6
R8	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5
R9	0.2	47.9	0.2	48.1	0.0	20.4	0.1	20.5
R10	0.2	47.9	0.2	48.1	0.1	20.5	0.1	20.6
R11	0.4	48.0	0.5	48.5	0.2	20.6	0.1	20.7
R12	0.5	48.0	0.6	48.6	0.2	20.6	0.1	20.7
R13	0.4	48.1	0.6	48.7	0.2	20.6	0.1	20.7
R14	0.3	48.0	0.9	48.9	0.1	20.5	0.1	20.6
R15	0.1	47.9	0.2	48.1	0.1	20.5	0.1	20.6
R16	0.1	47.9	0.2	48.1	0.0	20.4	0.1	20.5
R17	0.5	48.0	0.6	48.6	0.2	20.6	0.1	20.7
R18	0.1	47.9	0.2	48.1	0.1	20.5	0.1	20.6
R19	0.2	47.9	0.2	48.1	0.0	20.4	0.1	20.5
R20	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5

Table 32. Predicted PM_{10} concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	PM_{10} concentration (µg/m³)							
	24-Hour Max				Annual Ave			
	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC
Goal	50 µg/m3				30 µg/m3			
Receptor Max	**0.5**	**48.1**	**1.4**	**49.4**	**0.2**	**20.6**	**0.1**	**20.7**
R21	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5
R22	0.4	48.0	0.5	48.5	0.1	20.5	0.1	20.6
R23	0.2	48.0	0.4	48.4	0.1	20.5	0.1	20.6
R24	0.2	47.9	0.3	48.2	0.0	20.4	0.1	20.5
R25	0.2	47.9	0.9	48.8	0.0	20.4	0.1	20.5
R26	0.1	47.9	0.4	48.3	0.0	20.4	0.1	20.5
R27	0.3	47.9	0.5	48.4	0.0	20.4	0.1	20.5
R28	0.1	47.9	0.3	48.2	0.0	20.4	0.1	20.5
R29	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5
R30	0.1	47.9	0.2	48.1	0.0	20.4	0.1	20.5
R31	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5
R32	0.1	47.9	0.1	48.0	0.0	20.4	0.1	20.5
R34	0.1	47.9	0.2	48.1	0.1	20.5	0.1	20.6
R35	0.5	48.1	0.7	48.8	0.2	20.6	0.1	20.7
R36	0.1	47.9	0.2	48.1	0.0	20.4	0.1	20.5
R37	0.2	47.9	0.5	48.4	0.1	20.5	0.1	20.6
R38	0.4	48.0	1.3	49.3	0.2	20.6	0.1	20.7

Table 33. Predicted $PM_{2.5}$ concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	**$PM_{2.5}$ concentration (µg/m³)**							
	24-Hour Max				**Annual Ave**			
	SIMTA Increment	**SIMTA Cumulative**	**MIC Increment**	**Cumulative with MIC**	**SIMTA Increment**	**SIMTA Cumulative**	**MIC Increment**	**Cumulative with MIC**
Goal	25 µg/m3				8 µg/m3			
Receptor Max	**0.5**	**23.9**	**0.2**	**24.5**	**0.2**	**7.8**	**0.1**	**7.9**
R1	0.2	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R2	0.3	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R3	0.3	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R4	0.4	23.7	0.2	23.9	0.1	7.7	0.1	7.8
R5	0.15	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R6	0.2	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R7	0.2	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R8	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R9	0.2	23.7	0.1	23.8	0.0	7.6	0.1	7.7
R10	0.2	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R11	0.4	23.8	0.1	23.9	0.2	7.8	0.1	7.9
R12	0.4	23.8	0.1	23.9	0.2	7.8	0.1	7.9
R13	0.4	23.8	0.1	23.9	0.2	7.8	0.1	7.9
R14	0.3	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R15	0.1	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R16	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R17	0.5	23.9	0.1	24.0	0.2	7.8	0.1	7.9
R18	0.1	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R19	0.2	23.7	0.1	23.8	0.0	7.6	0.1	7.7
R20	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7

Table 33. Predicted $PM_{2.5}$ concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	$PM_{2.5}$ concentration (µg/m³)							
	24-Hour Max				Annual Ave			
	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC
Goal	25 µg/m3				8 µg/m3			
Receptor Max	**0.5**	**23.9**	**0.2**	**24.5**	**0.2**	**7.8**	**0.1**	**7.9**
R21	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R22	0.4	23.8	0.1	23.9	0.1	7.7	0.1	7.8
R23	0.2	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R24	0.2	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R25	0.2	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R26	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R27	0.2	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R28	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R29	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R30	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R31	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R32	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R34	0.1	23.7	0.1	24.5	0.1	7.7	0.1	7.9
R35	0.5	23.8	0.1	23.9	0.2	7.8	0.1	7.9
R36	0.1	23.6	0.1	23.7	0.0	7.6	0.1	7.7
R37	0.2	23.7	0.1	23.8	0.1	7.7	0.1	7.8
R38	0.4	23.8	0.2	23.9	0.2	7.8	0.1	7.9

Table 34. Predicted NO_2 concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	NOx concentration (µg/m^3)							
	24-Hour Max				Annual Ave			
	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC
Goal	246 µg/m3				62 µg/m3			
Receptor Max	**79.7**	**101.8**	**12.2**	**148.2**	**4.9**	**27.6**	**0.3**	**27.8**
R1	33.3	78.1	6.7	84.8	2.1	24.8	0.2	25.0
R2	50.8	78.1	7.8	85.9	2.7	25.4	0.2	25.6
R3	56.5	78.4	9.7	88.1	3.2	25.9	0.3	26.2
R4	70.2	101.8	12.2	114.0	2.7	25.4	0.2	25.6
R5	34.4	79.6	9.0	88.6	0.4	23.1	0.1	23.2
R6	36.9	79.2	10.1	89.3	0.8	23.5	0.1	23.6
R7	32.4	78.2	7.5	85.7	1.9	24.6	0.1	24.7
R8	28.7	78.0	4.3	82.3	1.2	23.9	0.1	24.0
R9	43.9	78.0	7.7	85.7	1.3	24.0	0.1	24.1
R10	33.0	78.1	4.6	82.7	1.9	24.6	0.1	24.7
R11	72.7	82.3	5.0	87.3	4.0	26.7	0.1	26.8
R12	65.1	84.3	7.2	91.5	4.5	27.2	0.2	27.4
R13	53.3	85.4	5.6	91.0	4.2	26.9	0.2	27.1
R14	55.4	78.2	7.9	86.1	3.3	26.0	0.2	26.2
R15	38.2	78.0	4.6	82.6	1.5	24.2	0.1	24.3
R16	33.1	78.0	7.1	85.1	0.4	23.1	0.0	23.1
R17	79.7	88.3	6.7	95.0	4.9	27.6	0.2	27.8
R18	31.0	78.0	10.8	88.8	1.4	24.1	0.1	24.2
R19	54.3	78.0	10.1	88.1	0.7	23.4	0.0	23.4
R20	30.0	78.0	4.5	82.5	0.8	23.5	0.0	23.5

Table 34. Predicted NO_2 concentrations for selected sensitive receptors – MIC cumulative scenario

Receptor	NOx concentration (µg/m^3)							
	24-Hour Max				Annual Ave			
	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC	SIMTA Increment	SIMTA Cumulative	MIC Increment	Cumulative with MIC
Goal	246 µg/m3				62 µg/m3			
Receptor Max	**79.7**	**101.8**	**12.2**	**148.2**	**4.9**	**27.6**	**0.3**	**27.8**
R21	39.1	78.0	5.2	83.2	0.7	23.4	0.0	23.4
R22	57.5	79.1	7.1	86.2	3.6	26.3	0.1	26.4
R23	40.2	78.1	5.1	83.2	2.3	25.0	0.1	25.1
R24	32.8	78.6	7.2	85.8	0.5	23.2	0.1	23.3
R25	37.4	79.5	9.6	89.1	0.6	23.3	0.1	23.4
R26	31.6	79.0	6.6	85.6	0.4	23.1	0.1	23.2
R27	60.2	84.4	11.6	96.0	1.1	23.8	0.1	23.9
R28	42.0	78.5	6.3	84.8	0.6	23.3	0.1	23.4
R29	37.5	78.0	4.4	82.4	0.7	23.4	0.0	23.4
R30	21.9	78.0	3.6	81.6	1.0	23.7	0.1	23.8
R31	14.2	78.0	2.5	80.5	0.7	23.4	0.0	23.4
R32	16.4	78.0	4.0	82.0	0.7	23.4	0.0	23.4
R34	27.3	78.1	6.2	148.2	1.4	24.1	0.1	26.9
R35	59.8	91.3	6.0	97.5	4.4	27.1	0.2	27.2
R36	48.8	78.0	6.0	84.0	0.8	23.5	0.0	23.7
R37	33.5	78.1	4.7	84.1	2.1	24.8	0.1	24.8
R38	59.7	83.5	10.0	88.2	4.0	26.7	0.3	26.8

10 Mitigation and monitoring

10.1 Construction phase

The principal emissions during the construction of SIMTA Stage 1 will be dust from activities including:

- Vegetation clearing / earthmoving during site preparation and road and rail construction.
- Handling (loading / unloading) of spoil/demolition material.
- Handling (loading / unloading) of fill material, soils, aggregate, ballast.
- Demolition of existing structures.
- Movement of heavy plant and machinery within the site on unsealed areas.
- Wind erosion from exposed surfaces.

The construction dust emission estimates and modelling presented in this report has assumed that water carts would operate on unsealed travel routes and areas where scrapers and graders are operating.

In addition to these measures, good site environmental practice and commonly applied dust management measures would be implemented to minimise dust generation. The standard dust controls for construction will be outlined in a Construction Environmental Management Plan (CEMP), prepared by the construction contractor prior to commencement of work.

The proposed construction dust control measures are listed in the Air Quality Management Plan (AQMP) presented in **Appendix E**, which also outlines:

- Procedures for controlling / managing dust.
- Roles, responsibilities and reporting requirements.
- Contingency measures for dust control where standard measures are deemed ineffective.

10.2 Operational phase

Air quality mitigation measures for the operation of the Stage 1 Proposal include:

- Implementation and communication of anti-idling policy for trucks and locomotives.
- Complaints line for the community to report on excessive idling and smoky vehicles used within the SIMTA site.
- Procedures to reject excessively smoky trucks visiting the site based on visual inspection.

Further details are provided in the Air Quality Management Plan (**Appendix E**).

10.3 Monitoring

The modelling predictions presented in the report indicate that the risk of adverse air quality impacts from the Stage 1 Proposal are low. The incremental increase in key pollutants (PM_{10} and $PM_{2.5}$) at the surrounding residential areas would be largely indistinguishable from the existing background and project specific air quality monitoring is therefore not warranted.

11 Conclusion

This air quality assessment (AQA) for the SIMTA Stage 1 Proposal builds on the previous Concept Approval and assesses the construction and operation of the necessary infrastructure to support a container freight volume of 250,000 TEU (twenty-foot equivalent units) throughput per annum. The AQA addresses the requirements outlined in the Secretary's Environmental Assessment Requirements (SEARs).

A number of residential suburbs are located in proximity to the SIMTA site and are included as assessment locations for the Stage 1 Proposal. Key emissions are assessed for construction (fugitive dust) and operations (diesel exhaust). For the operation phase, the following scenarios are presented:

- Scenario 1: manual loading and unloading of trains and trucks using reach stackers and/or large forklifts at an operational capacity of 250,000 TEU per annum.
- Scenario 2: unloading and loading of trains and trucks via an electric gantry crane system at an operational capacity of 250,000 TEU per annum.
- Cumulative Scenario: taking into account the first stage of construction and operation for the MIC Proposal and the operation of the Stage 1 Proposal at operational capacity of 250,000 TEU per annum.

The modelling results indicate that both the construction phase and operation of the SIMTA Stage 1 Proposal comply with all relevant impact assessment criteria.

During construction, the maximum predicted increase in annual average PM_{10} (0.4 µg/m³), $PM_{2.5}$ (0.2 µg/m³), TSP (0.5 µg/m³) and dust deposition (0.1 g/m^2/month) is minor, when compared against existing background. The highest predicted short-term impacts occur at Wattle Grove with a maximum 24-hour PM_{10} of 2.1 µg/m³ and maximum 24-hour $PM_{2.5}$ of 1.4 µg/m³. It is important to note that the modelling predictions are conservative, particularly for short-term impacts. When background is added, there are no additional exceedances of the relevant impact assessment criteria.

During operations, the maximum increase in annual average PM (0.2 µg/m³) and 24-hour average PM (0.5 µg/m³) is minor when compared to existing background. When background is added, there are no additional exceedances of the relevant impact assessment criteria. For all other pollutants, the predicted concentrations are well below the impact assessment criteria.

The use of gantry cranes would reduce the use of diesel powered container handling equipment and achieve emission reductions of approximately 50% for PM and approximately 30% for NO_x. This would result in a reduction in annual average ground level concentrations for PM of approximately 40-45% and a reduction in annual average ground level concentrations for NO_2 of approximately 35%.

Cumulative modelling results taking into account the adjacent MIC Proposal do not result in any exceedance of the impact assessment criteria.

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Appendix A

Wind Roses

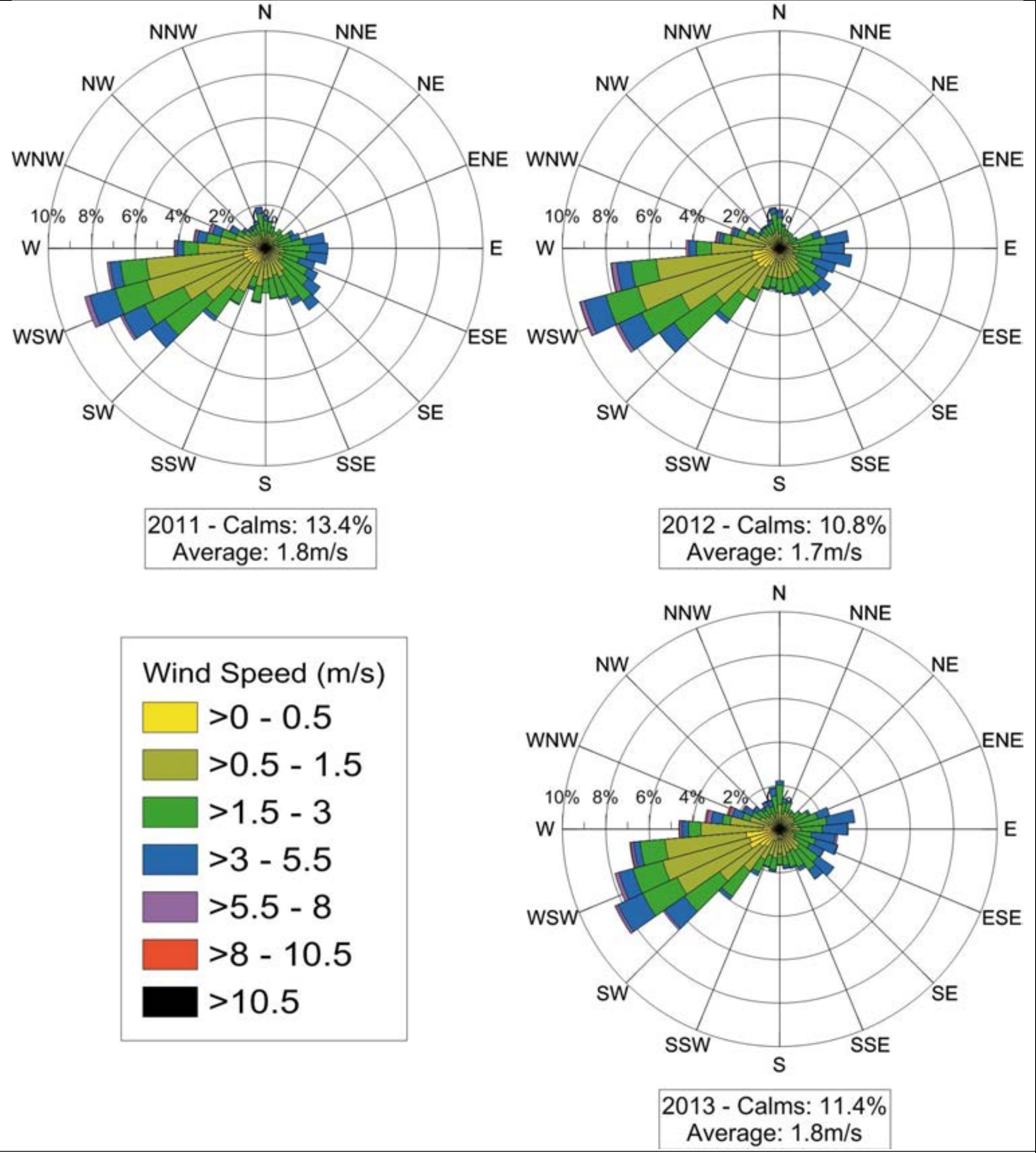

Figure A1 – Interannual Comparison – OEH Liverpool Station – 2011-2013

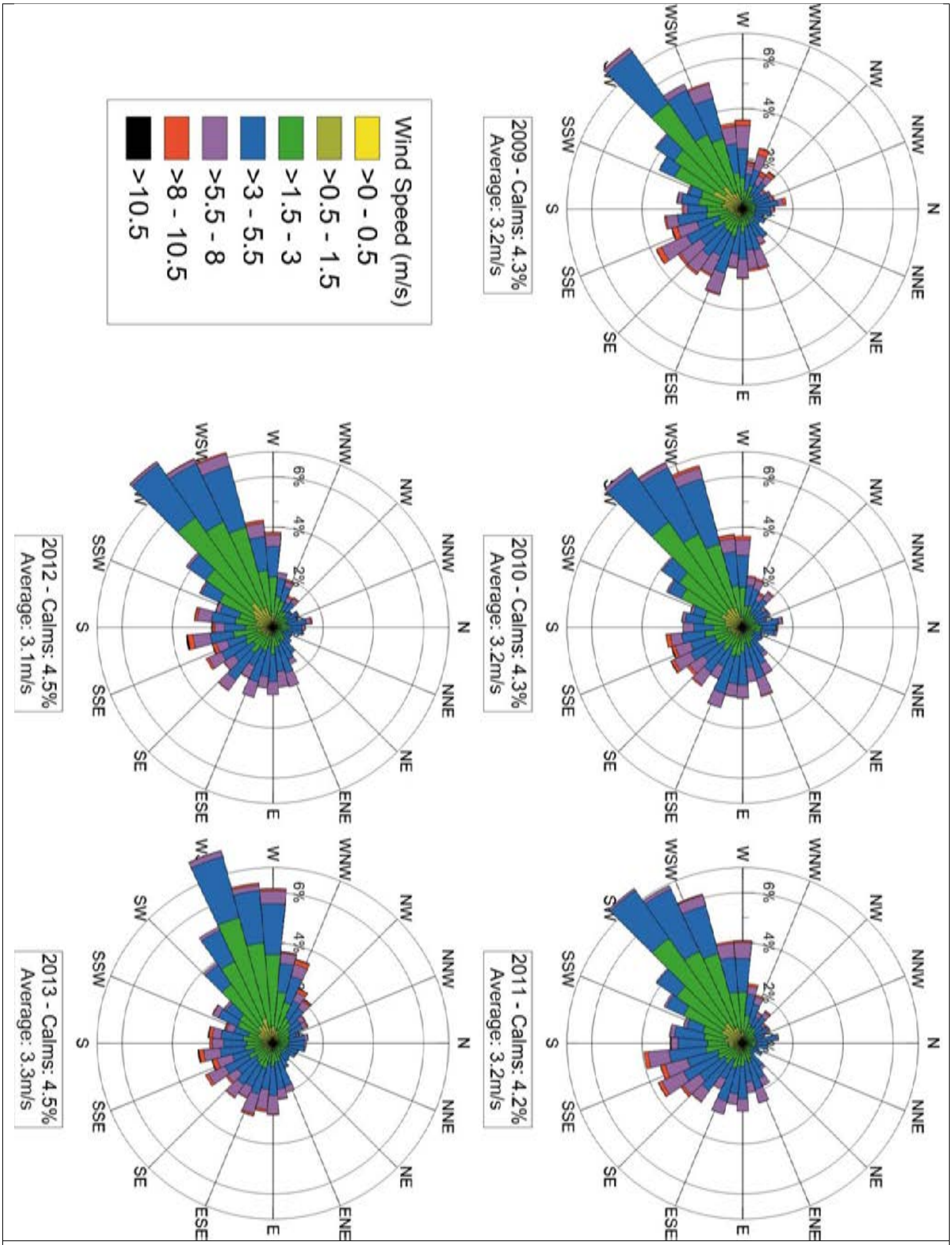

Figure A2 – Interannual Comparison – BoM Holsworthy Control Range AWS – 2009-2013

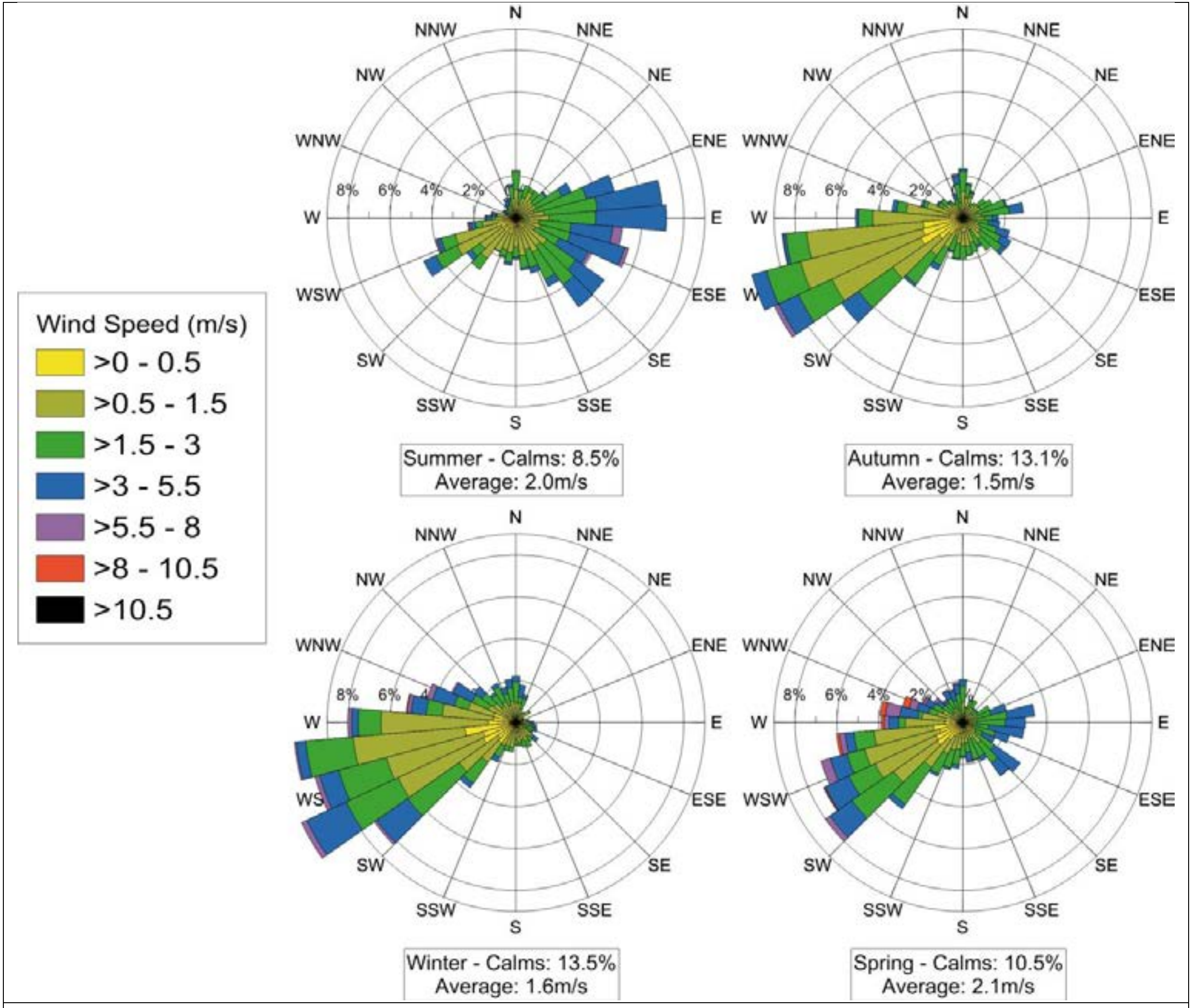

Figure A3 – Seasonal Wind Roses – OEH Liverpool Station – 2013

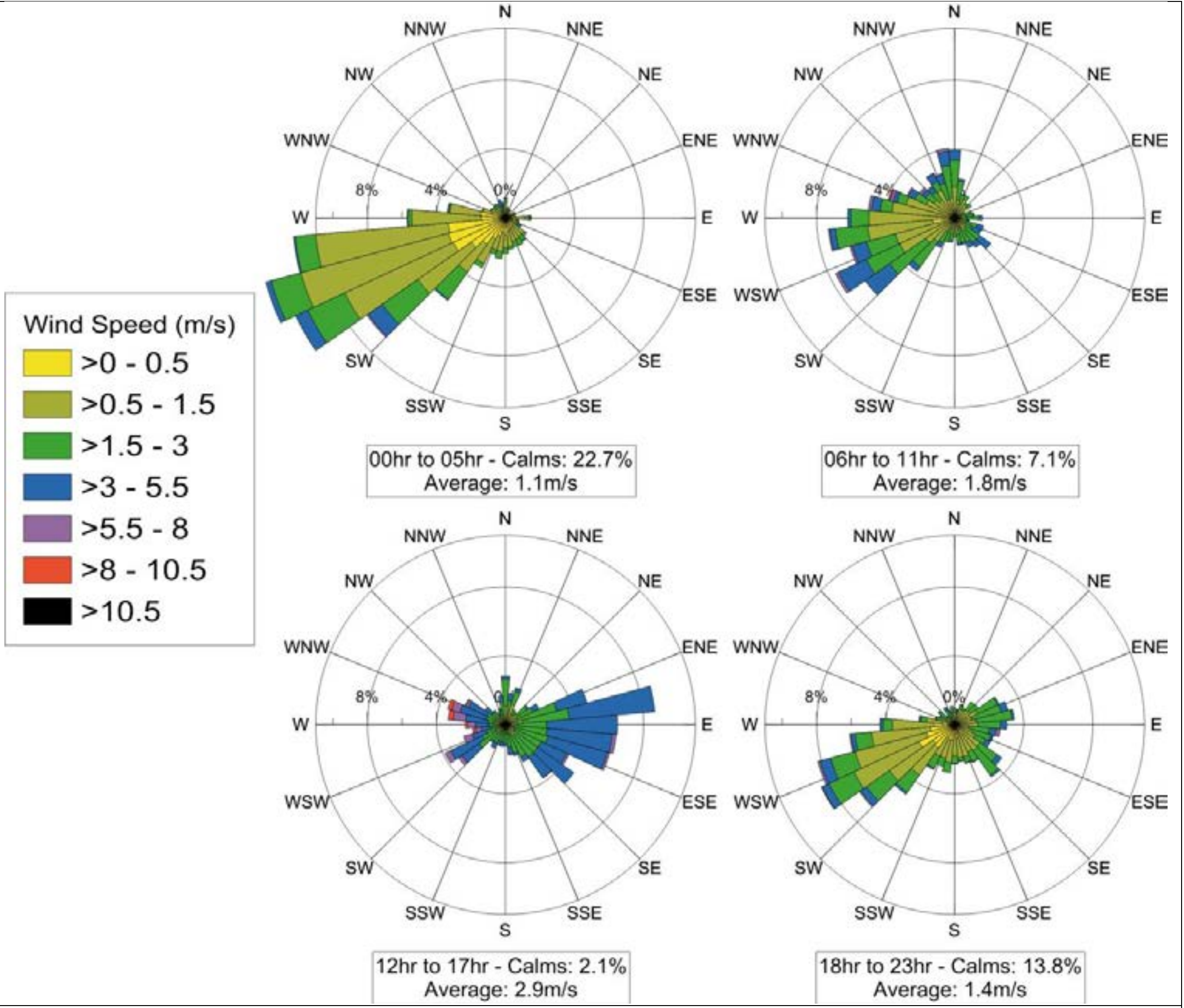

Figure A5 – Diurnal Wind Roses – OEH Liverpool Station – 2013

Appendix B

Emissions Inventory

Construction emission inventory

Dust emissions were estimated using United States Environmental Protection Authority (USEPA) AP-42 emission factors and predictive equations listed below, taken from the following chapters:

- Chapter 11.9 Western Surface Coal Mining.
- Chapter 13.2.2 Unpaved Roads.
- Chapter 13.2.4 *13.2.4* Aggregate Handling and Storage Piles
- Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing.
- Chapter 13.2.5 Industrial Wind Erosion.

Inventory activity	**Units**	**TSP emission factor/equation**	**PM_{10} emission factor/equation**	**$PM_{2.5}$ emission factor/equation**	**Input variables**		**EF source**
					Parameter	**Value**	
MATERIAL HANDLING							
Excavators on demolition material	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	U (wind speed) M (moisture content) Demo material Earthworks, Fill	1.8 m/s 1.0 % 4.0 %	AP42 Chapter 13.2.4
Excavators / loaders on earthworks							
Excavators / loaders on fill							
DOZERS							
Vegetation clearing	kg/hr	$2.6 \times \frac{s^{1.2}}{M^{1.3}}$	$0.3375 \times \frac{s^{1.5}}{M^{1.4}}$	0.105 x TSP	S (silt content) M (moisture content) Demo material Soil, Earthworks, Fill	7 % 1.0 % 4.0%	AP42 11.9 Table 11.9-2
Demolition							
Earthworks							
Engineering fill							
WIND EROSION							
Exposure areas	kg/ha/h	0.1	0.5 * TSP (0.5 from AP42 13.2.5)	0.075 * TSP (0.075 from AP42 13.2.5)			AP42 11.9 Table 11.9-2
UNSEALED HAUL ROADS							
Hauling	kg/VKT	$\left(\frac{0.4536}{1.6093}\right) \times 4.9 * \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 1.5 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 0.15 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	Silt content (s) Mean vehicle weight (W)	8% 90 tonnes	AP42 11.9
Graders/scrapers	kg/VKT	$0.0034 \times S^{2.5}$	$0.00336 \times S^{2.0}$	$0.0001054 \times S^{2.5}$	S (speed)	8 km/hr	AP42 11.9 Table 11.9-2

PM10 Emission Inventory

Source	Emissions (kg/year)	Activity Intensity	Units	Emission Factor	Units	Equation Input Variables										Control %
Site Preparation																
Vegetation clearing - dozers	1,053	960	h/y	1.1	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	66	614	km	0.2	kg/km	8.0	speed of graders in km/h	77	grader hours							50
Demolition - dozers	1,466	192	h/y	7.6	kg/h	1.0	moisture content in %	8.0	silt content in %							
Demolition - excavators	4.0	3,500	t/yr	0.0011	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Mobile crusher	4.2	3,500	t/y	0.0012	kg/t											
Earthworks																
Material handling (excavators/loaders)	275.5	242,000	t/yr	0.0011	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	2,105	1,920	h/y	1.1	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	661	6,144	km	0.2	kg/km	8.0	speed of graders in km/h	768	grader hours							50
Hauling (unsealed)	4,801	242,000	t/y	0.04	kg/t	50	t/load	90	Vehicle gross mass (t)	1.4	km/return trip	1.4	kg/VKT	8.0	% silt content	50
Engineering Fill																
Material handling (excavators/loaders)	187.9	165,000	t/yr	0.0011	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	1,684	1,536	h/y	1.1	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	1,321	12,288	km	0.2	kg/km	8.0	speed of graders in km/h	1536	grader hours							50
Misc																
Wind Erosion	4,331	9.888	ha	0.05	kg/ha/h	8,760	h/y									

PM2.5 Emission Inventory																
Source	**Emissions (kg/year)**	**Activity Intensity**	**Units**	**Emission Factor**	**Units**	**Equation Input Variables**										**Control %**
Site Preparation																
Vegetation clearing - dozers	524	960	h/y	0.5	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	132	614	km	0.2	kg/km	8.0	speed of graders in km/h	77	grader hours							
Demolition - dozers	636	192	h/y	3.3	kg/h	1.0	moisture content in %	8.0								
Demolition - excavators	0.6	3,500	t/yr	0.0002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Mobile crusher	0.3	3,500	t/y	0.00008	kg/t											
Earthworks																
Material handling (excavators/loaders)	41.7	242,000	t/yr	0.0002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	1,048	1,920	h/y	0.5	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	1,321	6,144	km	0.2	kg/km	8.0	speed of graders in km/h	768	grader hours							
Hauling (unsealed)	480.1	242,000	t/y	0.00	kg/t	50	t/load	90	Vehicle gross mass (t)	1.4	km/return trip	0.1	kg/VKT	8.0	% silt content	50
Engineering Fill																
Material handling (excavators/loaders)	28.4	165,000	t/yr	0.0002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	839	1,536	h/y	0.5	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	2,642	12,288	km	0.2	kg/km	8.0	speed of graders in km/h	1536	grader hours							
Misc																
Wind Erosion	650	10	ha	0.01	kg/ha/h	8,760	h/y									

TSP Emission Inventory

Source	Emissions (kg/year)	Activity Intensity	Units	Emission Factor	Units	Equation Input Variables										Control %
Site Preparation																
Vegetation clearing - dozers	4,992	960	h/y	5.2	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	189	614	km	0.6	kg/km	8.0	speed of graders in km/h	77	grader hours							50
Demolition - dozers	6,053	192	h/y	31.5	kg/h	1.0	moisture content in %	8.0								
Demolition - excavators	8.4	3,500	t/yr	0.002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Mobile crusher	9.5	3,500	t/y	0.003	kg/t											
Earthworks																
Material handling (excavators/loaders)	583	242,000	t/yr	0.002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	9,984	1,920	h/y	5.2	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	1,891	6,144	km	0.6	kg/km	8.0	speed of graders in km/h	768	grader hours							50
Hauling (unsealed)	17,008	242,000	t/y	0.14	kg/t	50	t/load	90	Vehicle gross mass (t)	1.4	km/return trip	5.0	kg/VKT	8.0	% silt content	50
Engineering Fill																
Material handling (excavators/loaders)	397.2	165,000	t/yr	0.002	kg/t	1.0	moisture content in %	0.8	(wind speed/2.2)^1.3							
Dozers	7,987	1,536	h/y	5.2	kg/h	4.0	moisture content in %	8.0	silt content in %							
Scrapers/Graders	3,781	12,288	km	0.6	kg/km	8.0	speed of graders in km/h	1536	grader hours							50
Misc																
Wind Erosion	8,662	9.9	ha	0.10	kg/ha/h	8,760	h/y									

Appendix C

Best Practice Review

ENVIRON

SIMTA Intermodal Terminal Facility- Stage 1

Best Practice Review - Air

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

May 2015

SIMTA Moorebank Intermodal Facility - Best Practice Review for Air Quality

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1 Introduction

The objective of this report is to address the requirement for the completion of a Best Practice Review for the Sydney Intermodal Terminal Alliance (SIMTA) Project, as outlined in the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development application (SSD 14-67660) (shown in **Table 1**). The review focuses on the most significant emission sources associated with the SIMTA Stage 1 operations and also those emissions sources over which SIMTA have operational control. The emission reduction and management measures covered by the review include:

- Emission standards for new locomotives and emission reduction options for existing in-service locomotives (i.e. repower, retrofit).
- Emission standards for non-road diesel equipment and emission reduction options for container handling equipment (CHE).
- Queuing and idle reduction strategies.

Table 1. Secretary's Environmental Assessment Requirements

	Best Practice Review Requirement	**Report Section**
	The preparation of a comprehensive review of intermodal operational best practice process design, emission control and management measures that might feasibly and reasonably be applied to each stage of the project, and to benchmark those measures against best practice. The review should:	
a)	clearly demonstrate that the Proponent will at each project stage adopt and implement best practice facility and process design and management measure to the extent that is reasonably practicable, to minimise operational air pollutant and noise emissions at the terminal and on the rail link	Summary of best practice emission controls for SIMTA provided in Section 6
b)	include a detailed evaluation of feasible and reasonable mitigation and management measures including:	
	i. assessment of best practice international emission standards for locomotives and non-road plant and equipment;	Section 2
	ii. assessment of retrofit opportunities for older vehicles, locomotives and equipment	Section 3
	iii. maintenance and operational practices for vehicles, locomotives and equipment;	Section 3
	iv. electrification of terminal plant;	Section 4
	v. reduction of 'long-duration' idling of diesel locomotives, prime movers and cargo handling equipment through: ● driver/operator training about how to reduce air quality impacts associated with 'long-duration' idling; ● automatic engine shut down/start up system controls whereby engine stopping or starting is implemented without operator action; ●'shore power connection' being electricity mains plug-in points for enabling locomotives and trucks to switch over to mains power and shut down main engines otherwise used to generate power required for: -transport refrigerated units/containers; -cabin climate control; and -other accessories and equipment. ● the application of queuing theory to minimise truck	Idle and queuing management covered in Section 5.

	loading/unloading wait times and resultant queuing and idling in the terminal facility and on access roads.	
c)	Define an acceptable threshold where idling becomes 'long-duration' using an evidence based approach ; and	Discussed in Section 6.4
d)	include predicted annual cumulative, daily and one minute amounts of air pollutants emitted and non-renewable fossil fuel consumed (by typical diesel locomotives, prime movers, fixed body trucks, yard trucks/holsters and cargo handling equipment expected to regularly operate at the terminal) as the basis for defining the term ‘long-term’ duration idling as it would apply to the terminal facility.	Emission estimates for all sources are presented in the AQMP, however not necessarily linked to definition of long duration idling. This is discussed in Section 6.4

1.1 Defining best practice

The Victoria State Environment Protection Policy (SEPP) (Air Quality Management) provides a definition of best practice as:

> ‘*the best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity*’.

The term ‘best practice’ implies a degree of pragmatism and cost effectiveness and decisions with regard to practicability, when assessing best practice, should have regard to technical, logistical and financial considerations and be proportional to the environmental risk EPA Victoria (2013).

2 Emission standards and regulation for new locomotives

There are no air emission limits for locomotives in NSW or Australia. In contrast, emission standards for locomotives have been implemented for decades in the United States (US) and European Union (EU), trending towards more stringent standards and increased harmonisation.

A summary of the US and EU emissions standards is provided below. Emissions standards exist in other jurisdictions (i.e. the state of California and Canada), however for the purpose of this review, the US and EU standards are taken as current best practice because when emissions standards for locomotives are introduced in Australia, it is expected that they would be harmonised with the US or EU (Commonwealth of Australia, 2013).

2.1 United States

The US Environmental Protection Agency (US-EPA) follows a tiered approach for regulating emissions from newly manufactured and re-manufactured locomotives, based on the power and purpose of the locomotive.

The first set of standards (Tier 0) is applied to locomotives originally manufactured and re-manufactured prior to 2001. However, a revision of the tiered standards was conducted in 2008 and based on that any Tier 0 engine re-manufactured after 2008 would have to comply with the Tier 0+ standards.

Similar principles apply to Tier 1 engines, which have been originally manufactured between 2002-2004. The 2008 revision of the tiered standards resulted in Tier 3 and Tier 4 standards being introduced. Tier 3 standards are classified as near-term engine-out emission standards for newly built locomotives after 2009. Tier 4 standards, also termed as long-term standards, will come into effect from 2015 onwards and require additional after treatment technology to be applied to locomotive engines (ENVIRON, 2013).

US Tier 0 to Tier 4 emission standards for low and high power engines are given in **Table 2** for line haul and switch/shunting locomotive applications.

Table 2: US-EPA Tiered Standards for Line Haul and Switch Haul Locomotives

Line Haul Emission Standards (g/kW-hr)

Tier Classification	PM_{10}	HC	NO_x	CO
Uncontrolled	0.43	0.64	17.43	1.72
Tier 0	0.43	0.64	11.53	1.72
Tier 0+	0.27	0.40	9.66	1.72
Tier 1	0.43	0.63	8.98	1.72
Tier 1+	0.27	0.39	8.98	1.72
Tier 2	0.24	0.35	6.64	1.72
Tier 2 + and Tier 3	0.11	0.17	6.64	1.72
Tier 4	0.02	0.05	1.34	1.72

Switching Shunting Emission Standards (g/kW-hr)

Tier Classification	PM_{10}	HC	NO_x	CO
Uncontrolled	0.59	1.35	23.33	2.45
Tier 0	0.59	1.35	16.90	2.45
Tier 0+	0.31	0.76	14.21	2.45
Tier 1	0.58	1.35	13.28	2.45
Tier 1+	0.31	0.76	13.28	2.45
Tier 2	0.25	0.68	9.79	2.45
Tier 2 +	0.15	0.35	9.79	2.45
Tier 3	0.11	0.35	6.03	2.45
Tier 4	0.02	0.11	1.34	2.45

2.2 European Union (EU)

The EU Non-Road Diesel Machinery Directive incorporated emission standards for railroad locomotive engines in their Stage III standards (Stages IIIA and IIIB) (EU, 2004). Stage IIIB entered into effect from 1 January 2011 for railcars and locomotives. The standards apply to new locomotives, cover different engine rating categories and distinguish between rail cars and railroad locomotives (**Table 3**).

Table 3: European Union (EU) Standards for Locomotive Engines

Category (kW)	PM	HC + NO_x	HC	NO_x	CO
Stage III A Standards (g/kW-hr)					
130 <kW (Railcars)	0.2	4.0	-	-	3.5
130 ≤kW≤560 (Railroad Locomotives)	0.2	4.0	-	-	3.5
kW > 560 (Railroad Locomotives)	0.2	-	0.5	6.0	3.5
kW > 2000 and Swept Volume > 5l/cylinder (Railroad Locomotives)	0.2	-	0.4	7.4	3.5
Stage III B Standards (g/kW-hr)					
130 <kW (Railcars)	0.025	-	0.19	2.0	3.5
130 <kW (Railroad Locomotives)	0.025	4.0	-	-	3.5

2.3 Diesel fuel regulation

Diesel exhaust emissions are not only dependent on the emission performance of engines but also on operational factors and fuel composition. Lowering the sulfur content of fuel reduces both the SO_2 and particle emissions and improves the effectiveness of emission control equipment, especially the efficiency of catalysts (ENVIRON, 2013).

In Australia, Commonwealth Fuel Quality Standards mandate fuel quality for petrol, automotive diesel, biodiesel (B100) and autogas (*Fuel Standard (Automotive Diesel) Determination 2001*, incorporating the *Fuel Standard (Automotive Diesel) Amendment Determination 2009 (No. 1)*). No separate fuels standards apply for locomotives. The sulfur content of diesel has been progressively regulated down from 500 ppm to 10 ppm. Amendments have also been made to allow up to five per cent biodiesel in diesel fuel without a labelling requirement from 1 March 2009. A 20 per cent biodiesel (B20) fuel standard is currently being developed.

In the US, the implementation of Tier 4 standards, which incorporate sulfur-sensitive control technologies such as catalytic particulate filters and NO_x adsorbers, necessitated the mandated reduction of sulfur content.

The US Clean Air Nonroad Diesel Rule of 2004 reduced sulphur levels to 500 ppm, effective June 2007 and to 15 ppm (ultra-low sulfur diesel) for non-road fuel (effective June 2010) and locomotive and marine fuels (effective June 2012).

3 Emission reduction for in-service locomotives

A range of initiatives have been implemented in Australia and internationally to address air emissions from in-service locomotives, including fleet upgrades, repowering, fuel efficiency improvements and retrofitting of after-treatment systems.

The NSW Environment Protection Authority (EPA) are working with other states and the Commonwealth government towards national standards, however they recognise that they need to act independently and are developing a strategy for managing and reducing non-road diesel emissions NSW (NSW EPA, 2014a). To work towards a strategy for locomotives, the EPA commissioned the Locomotive Emissions Project (ENVIRON, 2013), which identified potential measures to reduce emissions from new and in-service locomotives in NSW and Australia.

Some of the initiatives underway in Australia and identified in ENVIRON (2013) are:

- The Australasian Railway Association (ARA) Rail Industry Safety and Standards Board (RISSB) developed *Draft Exterior Environment Standards* in 2008, although have not progressed since then. Recommendations were made for locomotives meeting Euro Stage IIIA or US EPA Tier 3 limits and other technologies such as auxiliary power and electrical shore power were recommended for new vehicles.
- The ARA also reviewed short and longer term opportunities for improving the environmental performance of the rail industry, as documented in *Draft Environmental Solutions for Freight Rail.* The review highlights the need for funding support from government to reduce the age of the Australian rail fleet encouraging introduction of the latest clean and efficient technology and facilitating the transition of the industry to a secure, low emission, natural gas energy alternative.
- The Australian Government Department of Innovation Industry Science and Research (DIISR) "*On Track to 2040*" initiative is aimed at progressing future technologies and emission reduction strategies within the Rail Industry.
- Energy efficiency opportunities for the rail sector through collaboration between rail operators and Department of Resources, Energy and Tourism (DRET).
- Various voluntary measures for industry operators[1] including the implementation of driver advice systems, commitments to emissions standards for new locomotives, alternative fuel trials, driver training programs, automatic engine shutdown systems.

In August 2013 the Commonwealth of Australia Senate Community Affairs Reference Committee published the outcomes of a Senate inquiry into the impacts on health of air quality in Australia (Commonwealth of Australia, 2013).

The report recommended that the Commonwealth develop a national emission standard for diesel engines and implement an emission standard for small non-road engines equivalent to the US EPA standards.

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[1] Includes voluntary initiatives by Aurizon (referred to in the Locomotive Emissions Project as QR National)

3.1 Engine upgrades and repowering

Fleet upgrades focus on locomotives with older engine configurations to be upgraded to the best Tier achievable at their next overhaul. There are a number of potential repowering and rebuilding schemes under consideration in Australia at present including repowering of older and low powered locomotives and specific classes of locomotives using modern high speed diesel engines. The emission reductions achieved through repowering are dependent on the class and age of the locomotives (ENVIRON, 2013).

In-service locomotives are generally overhauled every 10 years or so and therefore depending on the age of the locomotive and time since last overall, these options may have limited applicability for commencement of Stage 1, but could be considered in as part of a staged upgrade plan for subsequent development stages of the project. For example, accelerated replacement programs of old (25+ year) locomotives and accelerated overhaul of other existing locomotives to achieve the highest tier achievable. Alternative drivetrain technologies that could be considered by SIMTA during scheduled overhaul programs are presented in **Table 4**. Some have limited applicability for Stage 1 due to the longer timeframes expected before commercially viable options are available for some of the technologies.

Table 4. Alternative drivetrain technologies

Technology	Advantages	Disadvantages	Suitability for SIMTA Stage 1
Gen Set Switch Locomotive Battery electric hybrid switch locomotive (Green Goat)	Classified as ultra low-emitting switch locomotives (ULESL) Low implementation difficulty, technically viable and suitable for short term implementation	More expensive than traditional switch locomotives.	Not applicable as switch locomotives are not proposed for SIMTA
Alternative fuels (LNG/CNG) for switching locomotives	High emission reductions.	Implementation difficulty is medium and requires design modification for existing locomotives. Medium to high economic cost and long term implementation	Long term implementation makes this not suitable for Stage 1
AC Traction	Replacement of conventional DC traction motors leads to efficiency gains	Low emissions improvement.	Long procurement process expected for Australia which means not practical for Stage 1
Battery storage for smaller switch locomotives	Very high emission reduction and fuel savings.	Commercially viable systems currently unavailable	Not applicable as switch locomotives are not proposed for SIMTA
Track electrification	Local emissions benefit.	Would require SSFL to be full electrified, requiring significant upgrade.	Not applicable.

Modified after ENVIRON, 2013

3.2 Fuel efficiency improvements

Fuel efficiency improvements for locomotives are summarised in **Table 5**. A number of fuel efficiency improvements are considered applicable to the SIMTA project.

Table 5. Options for fuel efficiency improvements

Technology	Advantages	Disadvantages	Suitability for SIMTA Stage 1
Driver Assistance Systems which assists driver in fuel efficient driving (i.e. slower acceleration and gradual deceleration) and optimal notch setting selection.	Medium emission reductions and fuel savings. Already implemented in Australian and low cost.	N/A	Existing locomotive fleet to be deployed. Considered as part of maintenance upgrade programs.
Idle reduction technologies, including: • Automatic engine shutdown/startup systems (AESS) • Auxiliary power units (APU)/ Generator sets • Electrification (on board or shore connection systems) Anti-idling operational policies are discussed further in Section 5.	Low / medium emissions reduction with moderate fuel savings. Implementation difficulty and cost are low, depending on the system.	N/A	Existing locomotive fleet to be deployed. Considered as part of maintenance upgrade programs.
Electronically Controlled Pneumatic (ECP) Brakes	Low / medium emissions reduction and fuel savings. Implementation difficulty and cost are considered low.	Emphasis to date has been on new rolling stock.	No, existing rolling stock to be deployed
Improved Aerodynamics - effects are greatest when applied along the whole train length (e.g. ordering freight cars to optimise aerodynamic profile, minimising gaps between cars).	Improvement opportunities are greatest for intermodal container trains due to these trains being characterised by significantly higher aerodynamic drag.	Low emissions reduction potential	Yes

Modified after ENVIRON, 2013

3.3 Retrofitting of after-treatment

Potential after-treatment systems which may be retrofitted to existing locomotives include:

- Diesel particulate filters (DPF). A control device which physically captures diesel particulates preventing their discharge from the tailpipe. Collected particulates need to be removed from the filter, usually by thermal regeneration. DPF can achieve significant reductions (in excess of 90%).
- Selective catalytic reduction (SCR). An active emissions control measure that injects a reducing agent (usually urea) through a catalyst into the exhaust stream of a diesel engine, reducing NOx emissions to N2, CO2 and H2O.
- Selective catalytic reduction with diesel particulate filters (SCR+DPF). A control measure which combines DPF with SCR to achieve reductions in both PM and NOx.
- Exhaust gas recirculation (EGR). A control technology that reduces NOx through lowering the oxygen concentration in the combustion chamber, as well as through heat absorption.

The feasibility of these abatement measures for locomotives depends on the age and existing emission performance of the fleet. The size and weight of the after treatment devices are also important considerations and can result in increased fuel consumption.

3.4 Case Study: Best practice implementation in California

Since the early 1990s, the California Air Resources Board (CARB) have been leading the way in best practise measures to reduce locomotive emissions. CARB best practice measures include state regulations, voluntary agreements and incentive programs. Some examples of how California is progressing towards best practice are as follows:

- Goods Movement Emission Reduction Program (GMERP). Aimed at devising strategies to reduce emissions from shipping and rail to improve air quality, the GMERP goal is to reduce locomotive NO_x and PM emissions by up to 90% by 2020 with emission reduction options mainly focused on replacing, repowering or rebuilding old engines with newer technologies and installation of CARB-approved locomotive emission capture and control systems to minimise NOx and PM emissions from locomotives.
- Yard locomotive replacement program, introducing gen-set and electric hybrid yard locomotives.
- Voluntary state-wide agreement with two participating rail operators to reduce PM emissions at California rail yards, primarily through the installation of idling devices on most (99%) California-based locomotives by June 2008 and addressing excessive smoke issues. The automatic idling-reduction devices limit locomotive idling to no more than 15 minutes. For locomotives, without the automatic idling devices, the participating railroad companies are required to limit the non-essential idling of locomotives, with no non-essential idling being permitted for more than 60 minutes. Toll free complaints lines have also been established to enable local residents to report locomotives that do not comply with smoke limits or idling restrictions.
- Technical Options Report (CARB, 2009) to evaluate options to further reduce locomotive and railyard emissions, based on short, medium and long implementation time frames. Included measures for locomotives, cargo handling equipment and dayage trucks. The options report evaluated options in terms of technical feasibility, potential

emission reductions, costs and cost-effectiveness and prioritised measures including repowering and retrofitting of switch and medium horsepower locomotives (short to medium term) and the introduction of Tier 4 interstate line haul engines (long term measure).

Further examples and other regulatory and industry measures are outlined in ENVIRON (2013).

3.5 Case Study: Investigations into emission reductions in Europe

The International Union of Railways (UIC) commissioned the Rail Diesel Study in 2006 (Kollamthodi, 2006) to identify measures for reducing exhaust emissions from existing locomotives and assess the practicability of engines implementing the Stage III A and Stage III B standards. Abatement measures investigated for existing fleet included the after treatment described in **Section 3.3** (diesel particulate filters (DPF), Selective catalytic reduction (SCR) and exhaust gas recirculation (EGR). Also considered was "re-engining", which refers to a re-build or overhaul of the existing engine.

It was noted that for pre-1990 rail cars, the feasible abatement measure would be DPF only and re-engining, whereas with the post-1990 rail cars, SCR and SCR+DPF, may be possible. Similarly, for pre-1990 mainline locomotives, feasible measures included DPF and re-engining and for post-1990 mainline engines, DPF, SCR and DPF+SCR could be possible. The use of EGR was concluded to be a technical option for new railcar and locomotive engines to meet Stage IIIA limit values.

Assessment of abatement measures for future fleet focussed on assessing options that could aid in meeting the Stage III A and Stage III B limits. Based on information gathered from engine and vehicle manufacturers, it was concluded that Stage III A limits would be achieved by using internal engine measures and low-sulphur fuels. It was envisaged that exhaust-after treatment technologies may not be required. To comply with the Stage III B limits, DPF would be required to meet the PM_{10} limits, however the study could not ascertain whether SCR would be required to comply with the Stage III B NO_X limits or it could be achieved using internal design changes.

A follow up initiate (CleanER-D) was launched by the European rail sector to find solutions to challenges faced in the meeting the Stage IIIB limits. A number of demonstration projects were launched to determine the cost effectiveness of the various measures included in the Rail Diesel Study, as well as emerging technologies. A series of recommendations have come out of the CleanER-D initiative to manage the transition to Stage III B limits. Fleet renewal is identified as the most feasible and economic path to compliance by 2030, with existing control technologies described above seen as an interim measure to meet emissions reductions.

4 Container handling equipment

Typical mobile container handling equipment i.e. reach stackers and container forklifts are generally powered by off-road compression-ignition diesel engines. Similar to locomotives, there are no existing regulations of standards in place in Australia that limit emissions from non-road diesel engines. In contrast, regulated emissions for non-road diesel engines have been in force in the US and EU since the mid 1990's. China, India, Japan and Canada also have regulated emissions limits for non-road diesel engines. US emissions standards are based on engine horse power and model year and progressive standards (Tier 1, Tier 2, Tier 3 and Tier 4) have been phased in between 1996 to 2004.

In addition to the regulated emissions standards, the CARB have regulated diesel emissions from more than 4,000 pieces of mobile container handling equipment in California. The regulation took effect in 2007 and aims to achieve up to 80% reduction in PM and NO_x emissions from CHE by 2020.

In Australian the NSW EPA is working with the Commonwealth Government Department of Environment on national measures to support the supply and purchase of lower emissions non-road diesel equipment. In addition and as part of the EPA strategy on diesel emissions, there are a number of initiatives underway for non-road diesel. For example, the EPA is running a Clean Machine Program, a partnership with industry aimed at reducing diesel emissions.

Policies and strategies for non-road diesel that the EPA are investigating include:

- Ensuring new equipment complies with international emission standards.
- Implementing policies such as anti-idling.
- Retrofitting older equipment with diesel particulate filters.

The EPA is looking in particular at proposed actions for non-road diesel vehicles used at NSW coal mines and have developed a benchmarking study looking at best practice measures for reducing non-road diesel exhaust emissions (NSW EPA, 2014b). The review looked at the costs and benefits associated with upgrading equipment with Tier 2/3 and 4 compliance equipment and in service retrofit of exhaust after treatment.

Emissions reduction options for CHE, in addition to imposing emission limits for non-road diesel, are described in **Table 6**.

Table 6. Emission reduction options for container handling

Category	Technology	Comment
Alternative fuels	LNG	While reductions in PM can be expected, studies comparing on-road diesel to on-road LNG yard trucks, showed significantly higher NO_x emissions from the LNG engines (CARB, 2009). Other considerations are a reduction in fuel efficiency, increased weight requirements for fuel tanks and re-fueling infrastructure. Commercially available for yard trucks and forklifts.
	Electrification	Diesel-electric hybrid technology commercially available for rubber tired gantry (RTG) cranes and reach sackers. Electric rechargeable technologies limited to small forklifts Electrified gantry crane systems would come close to eliminating all container handling emissions (although some diesel equipment may be needed). Generally, WSG crane systems are implemented at facilities designed to handle a large volume of containers (i.e, more than 750,000 per year) (CARB, 2009). Energy storage systems (ESS) can be used to capture regenerated energy that would otherwise be lost as heat in crane breaking. As the crane lowers a container, the hoist motor act as a generator, using regenerative braking, to capture the energy and use it to reduce the load of the engine through the duty cycle.
Idle reduction	Idle reduction devices	More commonly implemented on locomotives and yard truck, however demonstration projects underway for ports in the US, for example installation of preheaters on reach stackers and container forklifts.
	Anti-idling policies	Anti-idling policies may also effectively reduce emissions from CHE, although the extent of emission reduction would depend on the extent of un-necessary idling for these types of equipment.
Exhaust after treatment		Options include diesel oxidation catalysts (DOC) and diesel particulate filters (DPF).

5 Queuing and idle management

5.1 Intermodal terminal operational management

Operational strategies such as automation technologies and truck reservation/appointment systems may improve operational efficiency at intermodal terminals and reduce truck idling time (Corry and Kozan, 2006; Bektas and Crainic, 2007; Morais and Lord, 2006).

Automation technologies employed at ports and intermodal terminals include:

- Optical character recognition to identify trucks and containers.
- GPS systems to increase efficiency of container stacking and retrieval.
- CCTV to monitor traffic and container activity.
- Radio frequency identification devices, electronic seals and barcode for equipment and container identification and localisation.
- Variable message signs to assign and direct traffic.

Gate appointment is a truck reservation system that provides a certain number (limited by capacity of the terminal) of reserved transactions during a specified time slot (usually one hour). Gate appointment systems are reported as effective in controlling the random arrival of trucks, modifying the peak hours of demand, minimising congestion of idling trucks, and improving the utilisation of the terminals' capacity although studies have found that there is no evidence of appointment systems affecting queuing times (Giuliano et al, 2008).

Modern distribution centers that are fully automated have appointment systems for trucks in use for pick up and drop off of cargo, with trucks arriving at a facility with appointments processed in dedicated lanes.

Train planning systems are used to determine optional arrangement of containers along a train. The primary objective is to minimise the number of wagons and total mass of train, minimising energy consumption. The secondary objective is to move the centre of weight further to the front of the train. This minimises tension during acceleration and compression during braking, thereby reducing mechanical stress (Corry and Kozan, 2006, Rare Consulting, 2012).

5.2 Idle reduction strategies / best practices

Idling may be required for technological reasons or for passenger/worker comfort. Locomotives are left to idle due to the difficulty and time taken to re-start the engine, for example in cold weather, or to maintain air pressure for braking to maintain safety. In some cases, idling is used to maintain an appropriate cab temperature, for both trucks and locomotives.

Un-necessary or long duration idling can be reduced through technology and / or behavior change. The technological options for locomotives were listed in **Table 5** and include AESS, APUs and shore connection. Idle reduction technologies options for trucks include APUs, fuel operated heaters, battery air conditioning systems, thermal storage systems.

Locomotives and trucks servicing the SIMTA facility may be independently operated and will not fall under operational control of SIMTA[2]. However, SIMTA is able to implement operational strategies to reduce idle times for locomotives and trucks dispatched to the IMT facility, focused on driver behavior through the implementation of idle limits.

5.3 Idle limits

Truck and bus anti-idling regulations have been imposed in North America, based either visible smoke emissions, opacity levels or time limits for idling. Various states have imposed time limits for truck idling ranging from 3 minutes to 30 minutes with provisions in place for ambient temperatures, for example not applicable in subzero conditions.

CARB has a California statewide ban on idling of diesel trucks with post 2007 models limited to 5 minutes idling with requirements to have an idle shutdown device.

Morais & Lord (2006) assumed long duration idling for trucks corresponds to the truck propulsion engine not engaged in gear for a period greater than 15 consecutive minutes, citing a number of EPA studies, and defined long and short-term idling as follows.

- Short idling occurs when vehicles move regularly such as in traffic, gate wait, etc. (<15 min).
- Long idling occurs when vehicles stay stationary for a long period of time, such as during train crossing, waiting for a load, sleeping, etc. (> 15 min).

The US EPA define long duration idling for yard locomotives as greater than 15 consecutive minutes (US EPA, 2009). Also, the CARB require AESS systems for yard locomotives to limit idling to 15 minutes.

5.4 Community reporting

State regulators operate complaints hotline to allow the community to report excessive idling and smoky vehicles. As part of their air quality management plan, SIMTA could provide a toll free complaint line and register to enable the community to report smoking or idling locomotives and trucks.

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[2] On-road trucks are regulated under the Motor Vehicles Standards Act 1989 and Fuel Quality Standards Act 2000 and emission standards are set at the national level.

6 Implementation of best practice for SIMTA

A summary of the best practice review for SIMTA is provided in **Table 7**. The recommended outcomes from the best practice review have been considered in the context of the modelling predictions presented in the Air Quality Assessment (AQA) for Stage 1 operations.

Modelling predictions indicate that the maximum increase in annual average PM (0.2 µg/m³) and 24-hour average PM (0.5 µg/m³) is minor relative to existing background. When background is added, there are no additional exceedances of the relevant impact assessment criteria. The predicted NO_2 concentrations are based on the assumption that 100% of NO is converted to NO_2, and even under this conservative assumption, the cumulative predictions are well below the impact assessment criteria.

Based on the low predicted risk and the conservative modelling assumptions applied, the following emission reduction measures are recommended as reasonable and feasible for Stage 1. Subsequent stages of the SIMTA site will continue to progress towards best practice, as outlined in **Table 7.**

6.1 Locomotives

- Electrically powered locomotive shifter to reduce the need for locomotive idling.
- Anti-idle policy and communication / training for locomotive operators.
- Un-necessary idling avoided through driver training and site anti-idle policy
- Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade.
- Driver training for fuel efficiency

6.2 Container Handling

- New reach stackers to achieve best practice emissions performance to meet US EPA Tier 3 / Euro Stage IIIA standards.
- Electric RMG cranes to replace diesel powered equipment in the long term.
- Un-necessary idling avoided through driver training and site anti-idle policy
- Equipment with smoky exhausts (more than 10 seconds) should be stood down for maintenance.

6.3 Trucks

- Gate appointment system, truck marshalling lanes and rejection of trucks that arrive early to minimise wait times and queuing
- Development of an anti-idle policy and communication through the provision of information signs
- Un-necessary idling avoided through driver training and site anti-idle policy
- Trucks with smoky exhausts (more than 10 seconds) shall be rejected from the site
- Loading and unloading coordinated to minimise truck trip distances as they travel through site

6.4 Long duration idling threshold

The AQA incorporates a number of conservative assumptions related to idling for locomotives and trucks. Locomotives were assumed to idle continuously during loading / unloading, which is estimated to take up to two hours. Emissions were therefore estimated based on every train idling for two hours, modelled for every hour of the year. Trucks were assumed to spend approximately 30 minutes of every visit either processing, waiting or loading/unloading, although this does not necessarily mean continuous idling.

The SEARs include an evidence based approach to determine an acceptable threshold where idling becomes long duration. The evidence presented in AQA indicate that the air quality risk is low using the conservative assumptions for locomotive and truck idling. It is therefore not considered necessarily to present any additional evidence for a specific long duration idling threshold, different to what has been assumed and modelling in the AQA.

Table 7. Summary of best practice management (BPM) for SIMTA Stage 1

Emission source	BPM	Reasonable / feasible?	Implemented?	Comment	Progression to best practice
Locomotives	New locomotives to meet best practice international emission standards	No	No	The Stage 1 Proposal will be serviced with the existing SIMTA fleet and no new locomotives are required for Stage 1.	New locomotives purchased for future development stages would aim to meet Tier 3/Euro Stage IIIA emission performance.
	Upgrade / repowering existing fleet to best achievable Tier at next overhaul.	Yes	Yes	Upgrades will be as per scheduled upgrade program on existing fleet and where possible upgrades will consider best achievable emission performance. SIMTA maintenance plans for existing fleets will include requirements for review of air emissions performance	Accelerated upgrade program for SIMTA fleet for future development stages would be considered. Operational Environmental Management Plans to include benchmarks for air emissions to be implemented progressively where reasonable and feasible.
	Retrofit of exhaust after treatment	No	No	Not practical for existing fleet and considered reasonable or feasible based on a risk based approach.	The implementation of after treatment would be subject to a statutory legislative requirement for locomotives to meet Tier 4 or Euro Stage IIIB standards.
	Electrification	Yes	Yes	An electrically powered locomotive shifter is proposed with no switching or shunting locomotives required at the northern end of the Proposal.	
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary 'long-duration' idling to be avoided through driver training and the use of an electrified locomotive shifter. SIMTA idle reduction policy will be outlined in operational management plans for the site.	As locomotives are replaced and / or overhauled, the installation of automatic engine shut down/start up systems (AESS) will be considered as part of the upgrade.

Table 7. Summary of best practice management (BPM) for SIMTA Stage 1

Emission source	BPM	Reasonable / feasible?	Implemented?	Comment	Progression to best practice
	Fuel efficiency	Yes	Yes	Implemented through driver training programs.	Driver Assistance Systems which assist driver in fuel efficient driving and optimal notch setting selection will be considered as locomotives are replaced and / or overhauled.
Container handling equipment	New equipment to meet best practice international emission standards	Yes	Yes	New container handling equipment would be selected to have engines that comply with US EPA Tier 3 / Euro Stage IIIA.	New equipment purchased for future development stages would meet Tier 3/Euro Stage IIIA emission performance as a minimum.
	Electrification	Yes	Yes	Initially the unloading and loading process would be undertaken using reach stackers or container forklifts. In the long term, the overhead gantry cranes would be installed to undertake the unloading and loading process.	In the long term, gantry cranes would operate and be maintained throughout the operation of the intermodal terminal facility.
	Alternative fuels/technology	Yes	No	LNG powered forklifts and / or diesel electric reach stackers and container forklifts would offer no emissions benefit above a gantry crane system being considered as part of the Proposal application. Replacement of diesel container handling equipment not reasonable or feasible for the Proposal, based on a risk based approach.	Any new reach stacker and container forklifts purchased for future development stages would consider practicality of alternative fuels and technologies. All smaller forklifts used within warehousing and container unpacking will aim to use alternative fuels

Table 7. Summary of best practice management (BPM) for SIMTA Stage 1

Emission source	BPM	Reasonable / feasible?	Implemented?	Comment	Progression to best practice
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary idling avoided through driver training. SIMTA idle reduction policy will be outlined in operational management plans for the Proposal.	
	Retrofit of exhaust after treatment	No	No	Not reasonable or feasible for Stage 1 based on a risk based approach.	The implementation of after treatment would be subject to a statutory requirement for off-road mobile equipment to meet Tier 4, Euro Stage IIIB or equivalent standards.
Truck queueing	Gate Appointment System	Yes	Yes	Will minimise truck loading/unloading wait times and resultant queuing. Trucks will be rejected if too early, avoiding unnecessary idling.	
	Truck marshalling lanes	Yes	Yes	Will minimise congestion and queuing	
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary idling for non-SIMTA employees avoided through provision of information signs and communication of SIMTA idle reduction policy.	
General	Automated terminal operating system	No	No	Not practical for the low throughput proposed for Stage 1 as manual systems can be more efficient at lower throughput.	Automation technologies planned for future development stages with practical operational throughput where reasonable and feasible.
	Use of low sulphur diesel fuel	Yes	Yes	As required under the Fuel Standard (Automotive Diesel) Determination 2001	
	Air Quality Assessment	Yes	Yes	Air quality assessment to inform the risked based approach to BPM and required air quality management measures for the site.	

Table 7. Summary of best practice management (BPM) for SIMTA Stage 1

Emission source	BPM	Reasonable / feasible?	Implemented?	Comment	Progression to best practice
	Air quality management plan	Yes	Yes	SIMTA will develop and implement an air quality management plan for the construction and operation of Stage 1 Proposal	
	Community complaints line	Yes	Yes	SIMTA will establish a toll free complaints line where the community can report long duration idling and smokey vehicles operating on the SIMTA site.	
	Use of low sulphur diesel fuel	Yes	Yes	As required under the Fuel Standard (Automotive Diesel) Determination 2001	

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Appendix D

Air Quality Management Plan

D1 INTRODUCTION

The Secretary’s Environmental Assessment Requirements (SEARs) for air quality include a requirement for an air quality management plan (AQMP) to be included as part of the air quality assessment. The SEARs for air quality are listed in **Section 1.2** and the specific requirements for the AQMP are presented again in **Table 35**.

The following proposed air quality management measures are outlined based on the predicted risk presented in the AQA and linked, where appropriate, to the recommended outcomes from the best practice review. A summary of each SEARs and how they are addressed is provided in in **Table 35**.

Table 35. SEARs for AQMP

SEARs	Response
Explicit linkage of proposed emission controls to the site specific best practice determination assessment and assessed emissions;	The proposed emissions controls listed in **Section D3.1** are taken from the best practice determination and are informed by the AQA.
Explicit linkage of assumed engine standards and operational management systems;	The proposed emissions controls listed in **Section D3.1** are consistent with engine standards and operational management systems recommended in the best practice determination and assumed in the AQA.
The timeframe for implementation of all identified emission controls;	Timeframes for emissions controls are outlined in **Section D3.1**.
Proposed key performance indicator(s) for emission controls;	Environmental inspection reports, response log and communities complaints log will be used to track environmental
Proposed means of air quality monitoring including location (on and off-site), frequency and duration;	The AQA indicates that the risks associated with the operation of Stage 1 proposal are low. The modelled increment concentrations for all pollutants are at a level that would be unlikely to be clearly distinguishable from background. Air quality monitoring is therefore not proposed for Stage 1 but will be reviewed for subsequent stages.
Poor air quality response mechanisms;	Similar to the comment above, there is little SIMTA can do to respond to poor air quality, which based on the modelling presented in the AQA will be primarily driven by background.
Responsibilities for demonstrating and reporting achievement of key performance indicator(s);	Responsibilities outlined in the following AQMP
Record keeping and complaints response register; and	Record keeping, complaints management and reporting outlined in the following AQMP
Compliance reporting.	

D2 Construction Phase

D2.1 Dust Management Measures

The principal emissions during the construction of SIMTA Stage 1 will be dust from the following activities:

- Vegetation clearing / earthmoving during site preparation and road and rail construction.
- Handling (loading / unloading) of spoil/demolition material.
- Handling (loading / unloading) of fill material, soils, aggregate, ballast.
- Demolition of existing structures.
- Movement of heavy plant and machinery within the site on unsealed areas.
- Wind erosion from exposed surfaces.

Prior to commencement of construction work, the construction contractor will prepare a Construction Environmental Management Plan (CEMP). The air quality management measures for the CEMP are outlined below.

Clearing, site preparation and excavation

Emissions from site clearing, vegetation removal, topsoil clearing and excavation, particularly during dry and windy conditions, can be effectively controlled by increasing the moisture content of the soil / surface. The contractor would deploy water carts periodically during construction to ensure exposure areas and topsoils/subsoil are kept moist. Other controls that will be implemented as necessary are:

- Modifying working practices by limiting clearing, stripping and spoil handling during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site.
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.

Construction of rail link and Georges River crossing

Dust generated during the construction of the rail link and Georges River railway bridge will be controlled as follows:

- Modifying working practices by limiting clearing, stripping and spoil handing during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site.
- Limiting the extent of vegetation removal and topsoil to the designated footprint required for the rail corridor.
- Using water sprays during rail construction for dusty activities such as scraper/grader operations, ballast dumping and compacting.

Demolition of existing structures

Where possible, materials and structures will be dampened using water sprays prior to demolition. During adverse weather (hot, dry and windy conditions), consideration will be given to modify demolition activities when dust is seen leaving the site. Special consideration, including boundary monitoring will need to be given to the demolition of buildings containing asbestos in accordance with relevant guidelines and legislation.

Haulage and heavy plant and equipment movements

Vehicles travelling over paved or unpaved surfaces produce wheel generated dust and can result in dirt track-out on paved surfaces surrounding the work areas. Mitigation measures implemented for construction include:

- Operation of a water cart on all unsealed internal roadways and travel routes.
- All vehicles on-site should be confined to a designated route with a speed limit of 30km/hr enforced.
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.
- Dirt track-out should be managed using shaker grids and / or wheel cleaning. Dirt that has been tracked onto public roads should be cleaned as soon as practicable.
- All trucks delivering fill or leaving the site with spoil material will have their load covered.

Wind erosion

Wind erosion from exposed ground should be limited by avoiding unnecessary vegetation and topsoil clearing and limiting to the minimum footprint required. Wind erosion from temporary stockpiles will be limited by minimising the number of work faces on stockpiles and through temporary stabilisation (compaction of surface, water sprays, seeding, veneering).

D2.2 Site Environmental Responsibility

During construction, environmental management will be the responsibility of the construction contractor. The Construction Manager (CM) will be responsible for the day to day operation of the site, including the implementation of dust controls. The CM will:

- Oversee the implementation of environmental management plans and policies.
- Consider and advise senior management on compliance obligations.
- Have the authority to recommend reasonable steps to manage adverse impacts.
- Have the authority to recommend cessation of activities on-site.

The management and reporting of environmental aspects will be the responsibility of the CM, with specific tasks delegated to on-site personnel. All site personnel will undergo appropriate induction training and individual responsibilities for ensuring that procedures are adhered to will be clearly identified. The relevant roles and responsibility should be outlined in the Construction Environmental Management Plan.

D2.3 Construction dust monitoring

Visual checks would be made and reported on an environmental inspection report. The daily visual checks will:

- Inspect and report on excessive dust being generated at source (wheel generated dust, scrapers/graders, dozers, excavators, wind erosion).
- Inspect and report on water cart activity and effectiveness.
- Inspect and report on dust leaving the site.

Non-conformance (dust leaving the site) would be reported immediately to the CM or management.

D3 Site operations

D3.1 Air Quality Management Measures

The principal emissions during the operation of SIMTA Stage 1 will be diesel vehicle exhaust from the following sources:

- Diesel locomotives travelling from the SSFL to the site and rail siding.
- Diesel locomotives idling on-site during unloading / loading.
- Contained handling equipment (reach stackers or forklifts) moving containers from trains to trucks.
- Trucks travelling through the site to pick up / drop off containers.
- Truck idling while being processed, loaded or unloaded.

The Best Practice Review considered all potential emission reduction and management options for the Stage 1 Proposal and recommended the following feasible and reasonable air quality management measures. The measures and timing for implementation are outlined in **Table 36**, **Table 37** and **Table 38**.

Table 36. Emission management measures for Locomotives

Measure	**Timing**
Electrically powered locomotive shifter to eliminate the need for a shunting locomotive and reduce the need for locomotive idling.	Commencement of Stage 1 operations
Development of an idle reduction policy and communication / training for locomotive operators.	Developed prior to commencement of Stage 1 operations and training delivered on an on-going basis.
Un-necessary idling avoided through driver training and site idle reduction policy.	As above
Ensure locomotives are well maintained in accordance with the manufacturer's specification or relevant operational plan. Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade.	Ongoing from commencement of Stage 1 operations.
Driver training for fuel efficiency.	Ongoing from commencement of Stage 1 operations.

Table 37. Emission management measures for Container Handling Equipment

Measure	Timing
New reach stackers to achieve best practice emissions performance to meet US EPA Tier 3 / Euro Stage IIIA standards.	Commencement of Stage 1 operations
Development of an idle reduction policy and communication / training for operators.	Developed prior to commencement of Stage 1 operations and training delivered on an on-going basis.
Un-necessary idling avoided through operator training and site idle reduction policy.	As above
Ensure equipment is well maintained in accordance with the manufacturer's specifications or relevant operational plan. Equipment with smoky exhausts (more than 10 seconds) should be inspected for maintenance/repair.	Ongoing from commencement of Stage 1 operations.
Electric gantry cranes to replace diesel powered equipment in the long term.	Initially the unloading and loading process would be undertaken using reach stackers or container forklifts. In the long term, the overhead gantry cranes would be installed to undertake the unloading and loading process.

Table 38. Emission management measures for Trucks

Measure	Timing
Gate appointment system, truck marshalling lanes and rejection of trucks that arrive excessively early to minimise wait times and queuing.	Commencement of Stage 1 operations
Development of an idle reduction policy and communication through the provision of information signs.	Developed prior to commencement of Stage 1 operations and training delivered on an on-going basis.
Un-necessary idling avoided through communication through, provision of information signs and site idle reduction policy.	As above
Trucks with smoky exhausts (more than 10 seconds) shall be rejected from the site	Ongoing from commencement of Stage 1 operations.
Loading and unloading coordinated to minimise truck trip distances as they travel through site	Ongoing from commencement of Stage 1 operations.

D3.2 Site Environmental Responsibility

Designated operations personnel (such as Project Manager (PM) or Environmental Representative (ER) will be responsible for the day to day operation of the site, including air quality management. The PM or ER will:

- Oversee the implementation of environmental management plans and policies.
- Consider and advise management on compliance obligations.
- Have the authority to recommend reasonable steps to manage adverse impacts.
- Have the authority to recommend cessation of activities on-site.

The purpose of this structure is to ensure that the roles, responsibilities, and the tasks to be performed are clearly defined. The intended outcome is that minimal off-site impacts are experienced due to adverse air quality impacts. The management and reporting of environmental aspects will be the responsibility of the PM, with specific tasks delegated to on-site personnel. All site personnel will undergo appropriate induction training and individual responsibilities for ensuring that procedures are adhered to will be clearly identified.

D3.3 Monitoring

The modelling predictions presented in the report indicate that the risk of adverse air quality impacts from the Stage 1 Proposal are low. The incremental increase in key pollutants at the surrounding residential areas would be largely indistinguishable from the existing background and project specific air quality monitoring is therefore not considered necessary.

Visual checks would be made by on-site personnel and reported on a regular environmental inspection report. The visual checks will:

- Inspect and report on smoky vehicles.
- Inspect and report on long-duration idling.

Any non-conformance would be reported immediately to the PM or management.

D3.4 Complaints Management

SIMTA will establish a toll free complaints line where the community can report long duration idling and smoky vehicles operating within the Stage 1 site. Following receipt of a complaint, an investigation shall determine the likely cause of the complaint and appropriate corrective action. The corrective action might include standing down of smoky vehicles or determining the reasons for long duration idling, of SIMTA control vehicles.

Complaints would also trigger a review/update of policies and procedures relevant to the investigation.

D3.5 Record Keeping and Reporting

The results of the regular visual inspections will be documented in an environmental inspection report, including any identified non-compliance. A response log will document the actions taken in response to non-complaints.

A record of community complaints will be maintained, including results of the investigation into the complaint and action taken.