THE NEW SYDNEY FISH MARKET

Concept and Stage 1 Works (SSD 8924)
Air Quality Impact Assessment

Prepared for: UrbanGrowth NSW Development Corporation

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BASIS OF REPORT

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

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

SLR was commissioned by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW) to perform an Air Quality Impact Assessment (AQIA) for the proposed development of the new Sydney Fish Market (the site). The site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe, situated less than 2 km west of Sydney's CBD and is partially within the City of Sydney Local Government Area.

This report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEAR's) for Concept and Stage 1 Works of the development of the site, which includes the demolition and site preparation works for the subsequent construction phases of the development.

The main potential sources of air emissions were identified as dust impacts during the demolition works and odour impacts due to the decomposition of marine growth on the underwater structures should they be stored on-site for an extended period.

The potential for off-site dust impacts was assessed using a qualitative risk-based approach prescribed by the Institute of Air Quality Management (IAQM). The results of this assessment indicate that dust impacts due to the Stage 1 works can be adequately managed with the implementation of site-specific mitigation measures, and that the residual impacts are likely to be low for demolition and earthworks activities and negligible for trackout activities.

The potential for off-site odour impacts due to decomposition of marine growth was also assessed using a qualitative risk-based approach. The results of this assessment concluded that these odour impacts can be managed by either removing the marine growth before it is stored or stockpiled on-site, or by ensuring the materials are transported off-site without delay. Assuming these measures are implemented, the residual off-site odour impacts are anticipated to be of neutral significance.

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1 INTRODUCTION AND OVERVIEW

1.1 Background

SLR Consulting (SLR) has been commissioned by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW) to perform an Air Quality Impact Assessment (AQIA) for the development of the new Sydney Fish Market (the site).

Sydney Fish Market is the largest of its kind in the Southern Hemisphere and among the three largest seafood markets in terms of variety in the world. The market sources product both nationally and internationally and trades approximately 14,500 tonnes (t) of seafood annually with up to one hundred sustainable seafood species traded every day and approximately 500 species traded annually. The site attracts over 3 million visits each year.

In November 2016, the NSW Premier announced a new fish market at the head of Blackwattle Bay, adjacent to the existing Fish Market. In June 2017, the NSW Premier announced the appointment of Danish architects 3XN to lead the design team, which includes Sydney firms BVN and Aspect Studios. They have been working with key stakeholders, including UrbanGrowth NSW and Sydney Fish Market Pty Ltd (SFM), to develop the design for the new fish market. As announced by the NSW Premier, works are planned to commence in late 2018.

1.2 Site and Context

The site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe, situated less than 2 kilometres (km) west of Sydney's CBD and partially within the City of Sydney Local Government Area. **Figure 1** illustrates the location of the existing Fish Market and new Sydney Fish Market sites.

Land to which the development application relates comprises Lots 3 - 5 in DP 1064339 part of lot 107 in DP 1076596 and part Lot 1 in DP835794. Works to connect to the existing waterfront promenade to the west of the site are located on Lot 3 in DP1018801. The development footprint is irregular in shape and has an area of approximately 36,800 m^2. The site is partly on land above mean high water mark and partly on water below mean high water mark.

The site has a frontage to Bridge Road to the south and Blackwattle Bay to the north. Pyrmont Bridge Road is an arterial road that links to the Anzac Bridge to the north west of the site. Sydney Secondary College Blackwattle Bay Campus is immediately south west of the site and the existing Fish Market immediately north east. Located directly opposite the site to the south is Wentworth Park, separated by Bridge Road.

Approximately 400m walking distance from the site are the Fish Market, Wentworth Park, and Glebe Light Rail stops which are serviced by the Dulwich Hill Line which is a 23 stop, 12.8-kilometre route running from Dulwich Hill to Central station via Pyrmont.

Currently the site's uses include a concrete batching plant at the Western end and concrete hardstand and wharf area at the Eastern end, which is currently vacant. The site includes wharves and land-based structures and part of the site is the water of Blackwattle Bay. Works will be undertaken on Bridge Road and its intersections with Wattle Street and Wentworth Park Road.

Figure 1 New Sydney Fish Market Location

1.3 Approval Strategy

Pursuant to the provisions of the *Environmental Planning and Assessment Act 1979* and *State Environmental Planning Policy (State and Regional Development) 2011* ("SEPP SRD"), the new Sydney Fish Market development is a State Significant Development and the Minister for Planning is the consent authority.

To deliver the new Sydney Fish Market, the following applications will be lodged:

1. A concept development application seeking approval for concept proposals for the new fish market. This is to meet the requirements for a master plan contained in clause 40 of SREP26. This concept development application will also set out details of the first stage of the development being the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing sea wall;
2. A development application for the construction of the new fish market;
3. An application to amend the planning controls applying to the site to enable the proposed development to be a permissible use on all of the site. This is to be achieved by an amendment to *Sydney Regional Environmental Plan No 26—City West* ("SREP26").

These applications are to be lodged concurrently.

1.4 Summary of the Development

The proposal is to build a new fish market with a contemporary urban design, provide unique experiences for visitors and world-class auction and wholesale facilities. The new facility will be set within an improved public domain including the creation of a waterfront promenade with improved access to Blackwattle Bay and linking to surrounding areas and to public transport.

This development will expand and improve the functions of the existing in a new setting designed to achieve design excellence, functional performance and environmental sustainability.

Included in the new fish market will be retail and food and beverage premises, wholesale facilities and auction rooms, offices and commercial space, Sydney Seafood Schools, back-of-house facilities and car, truck and coach parking spaces. The new facility is to include a new foreshore promenade and wharves. The new fish market will be purpose built and will be supported by a state of the art back-of-house plant and recycling/waste management facilities.

1.4.1 Concept Development Application

The Concept development application seeks approval for:

- the use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses;
- a gross floor area of up to 30,000 m^2 contained within a defined building envelope;
- waterfront structures such as wharves;
- concepts for improvements to the public domain including promenades, access to Blackwattle Bay and landscaping;
- pedestrian cycle and road access and circulation principles;
- principles for infrastructure provision and waste management.

This concept development application will also set out details of the first stage of the development being the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing sea wall, and related services relocations.

1.1.1 Main Works Development Application

The Main Works development application seeks approval for:

- The construction of a new fish market including land and water-based structures.
- The use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses;
- A gross floor area of approximately 26,000 m^2 as calculated according to the definition of GFA under SREP 26 (approximately 25,600 m^2 as calculated according to the definition of GFA under the Standard Instrument).
- Public domain works including promenades access to Blackwattle Bay and landscaping;
- Pedestrian, cycle and road access and circulation;
- infrastructure provision and waste management;
- Associated works as required.

The proposed uses comprise:

- Below Ground Level
  - Parking for service and delivery, and private vehicles up to approximately 417 vehicles;
  - Plant and storage;
  - Waste Management facilities; and
  - End of journey facilities.
- Ground Level - Outside of Building Envelope
  - Up to three operational wharves for fishing fleet servicing and product unloading/loading, multi-purpose wharf space, private-operated ferry stop, recreational vehicles and the like;
  - Vehicular access driveways; and
  - Publicly accessible promenade.
- Ground Level - Within Building Envelope
  - Wholesale services space including product storage and processing; and
  - Auction floor and associated refrigeration and handling space.
  - Loading dock including time-limited delivery and service vehicle parking area;
  - Waste management facilities;
  - Office space including buyers room;
  - Staff amenities, plant and storage.

- Upper Ground Level (L1)
  - Retail premises including fresh food retail, food and drink premises including harbourside dining;
  - External/shared dining space;
  - Ancillary back of house space and staff amenities; and
  - Circulation areas.
- Upper Level 2 (Mezzanine)
  - Catering space;
  - The Sydney Seafood School;
  - Tenant and subtenant office space; and
  - Plant and storage space.

1.5 Purpose of this Report

The purpose of this report is to address the Secretary's Environmental Assessment Requirements (SEARs) pertaining to potential air quality and odour impacts as shown in **Table 1**. The scope of this AQIA is limited to the Stage 1 Works of the development, which as noted in **Section 1.3** relate to the demolition of land and water-based structures on the site, including removal of marine piles and any resulting repairs to the existing sea wall. Separate air quality assessments will be performed for the subsequent stages of the development.

Table 1 Secretary's Environmental Assessment Requirements – Air Quality and Odour

Key Issue	Assessment Requirement	Addressed in
Air Quality and Odour	Provide an air quality impact assessment to address the impacts of demolition and early works on air quality in accordance with the relevant EPA guidelines.	**Section 3.2.3**
	Identify the key air emission generating sources and activities from the proposed demolition and early works.	**Section 1.5**
	Identify measures to minimise and mitigate potential air quality, including dust control, and odour impacts on surrounding development.	**Section 3.2.5**; and **Section 3.3.2**

Source: SEAR for application number SSD 8924, 22 December 2017.

1.6 Approach to Assessment

For the assessment of impacts from the proposed Stage 1 works, the *Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM) (Holman *et al* 2014) has been used to provide a qualitative assessment method (see **Appendix A** for full methodology).

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

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

2 Project Description

1.2 Stage 1 Works

The first stage of the development seeks consent for the demolition of land- and water-based structures on the site, including removal of marine piles. Specifically, the following structures are proposed to be demolished (BBC 2017);

- A wharf structure comprising a reinforced concrete deck supported by 250 x 250 hardwood girders;
- A finger jetty;
- A concrete jetty;
- Piles supporting the existing wharves and jetty structures;
- The former Jones Brothers Coal Loader; and
- All other associated land and water based structures.

Stage 1 works construction activities will be undertaken by a combination of floating and land-based plant and equipment.

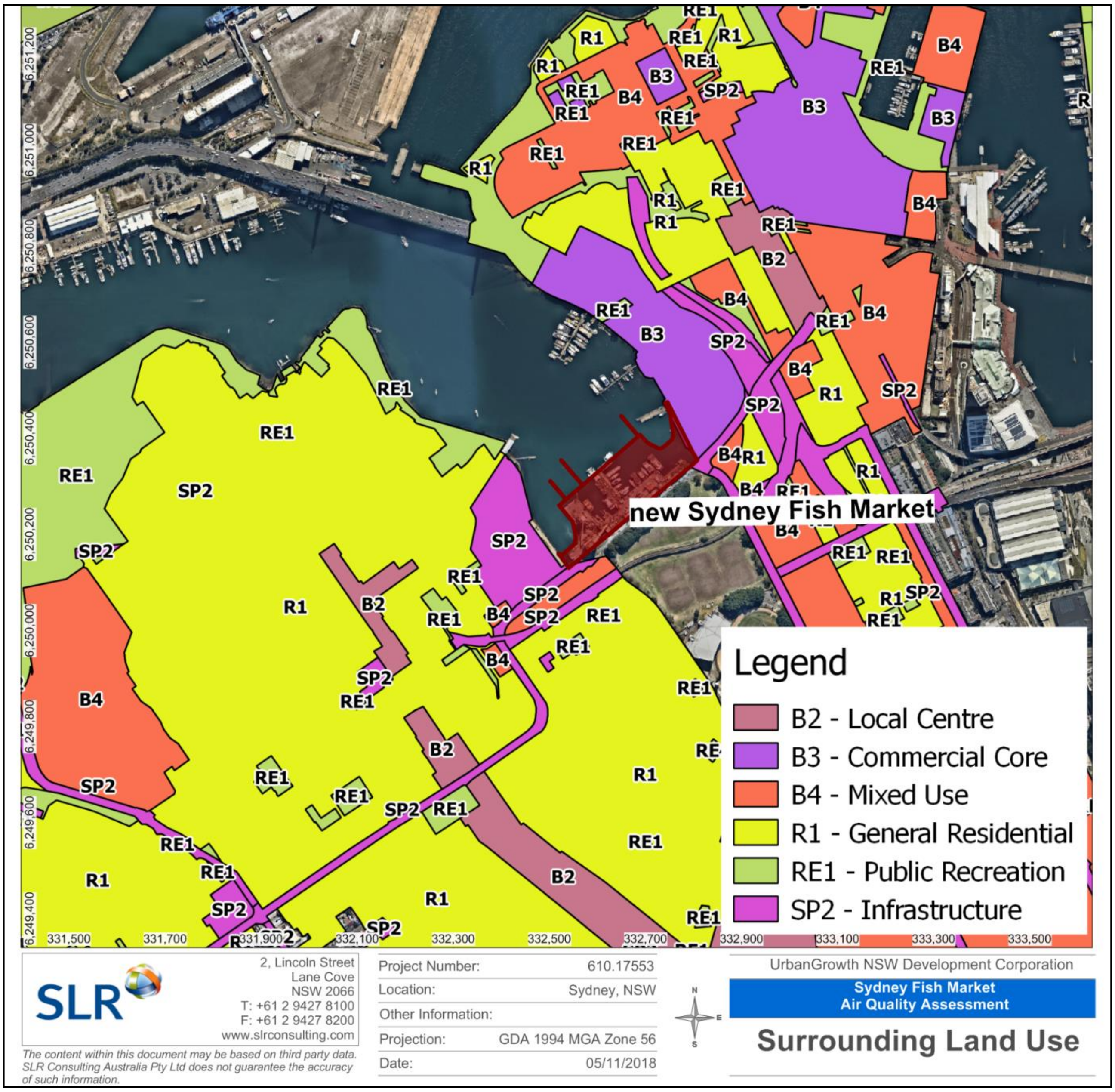
The indicative construction schedule for the Stage 1 works suggests that the works will be completed within a period of approximately 7.5 months (BBC 2017).

1.3 Sensitive Receptors

The area surrounding the site includes lands zoned as local centre, commercial core, mixed use, general residential, public recreation and infrastructure as seen in **Figure 2.**

There are a number of existing residences located southwest and west of the site. The nearest existing residential receptor is located approximately 50 m from the site boundary, at the corner of Bridge Road and Wentworth Park Road.

Figure 2 City of Sydney Local Environmental Plan – Land Zoning Map



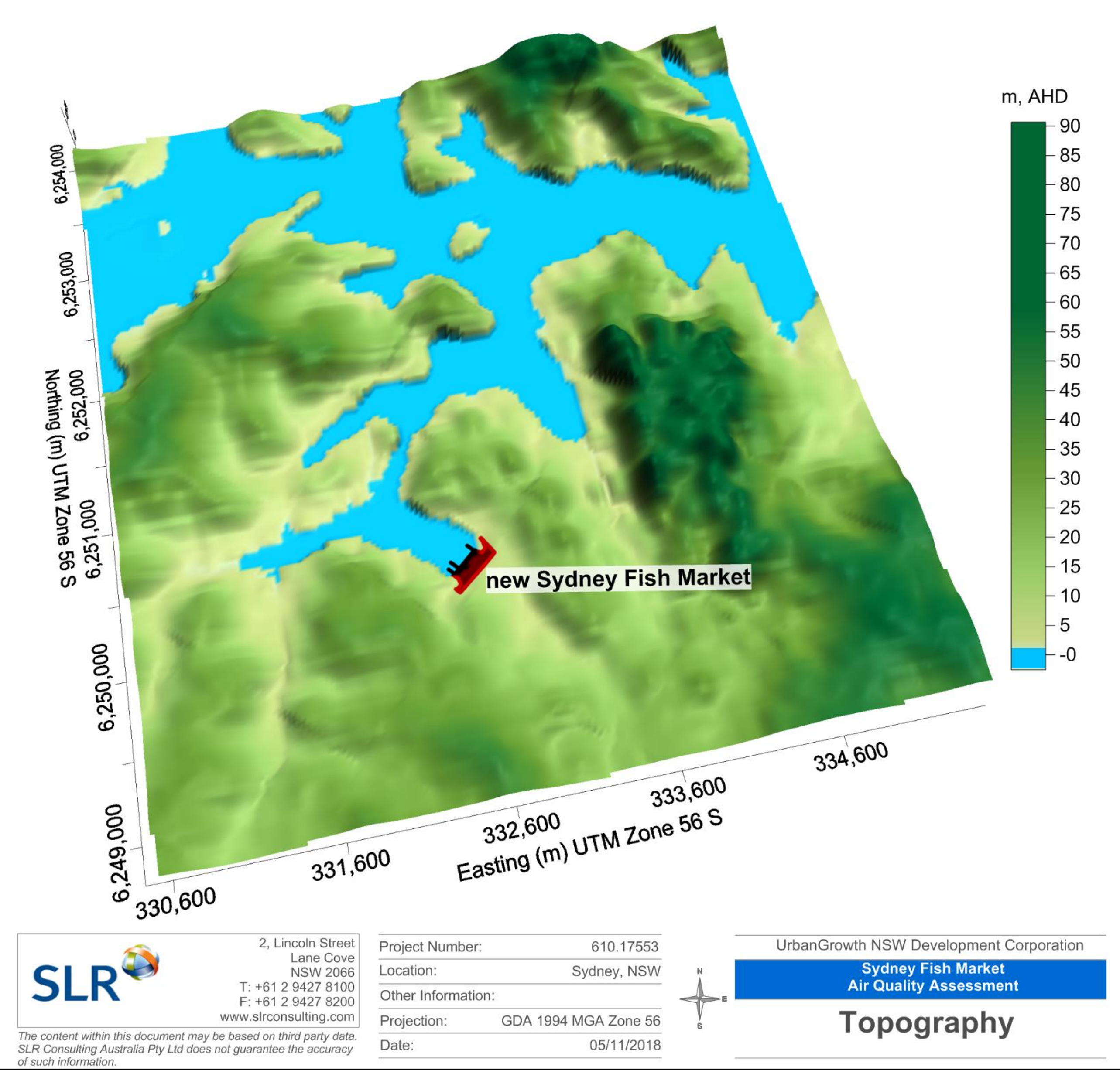
1.4 Local Topography

Topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies around the site.

A three dimensional representation of the area surrounding the site is given in **Figure 3**. The topography of the local area within a 2 km radius of the site ranges from an approximate elevation of -2 metres (m) to 90 m Australian Height Datum (AHD).

The area immediately surrounding the site gently slopes towards Blackwattle Bay and is relatively open, which will facilitate dispersion of air emissions and prevent 'pooling' of air pollutants.

Figure 3 Topography of Area Surrounding the Site



3 Pollutants of Concern

1.5 Identification of Air Emission Sources

Potential air quality impacts associated with the Stage 1 works may arise from:

- Dust emissions from Stage 1 works, including:
  - site clearance;
  - site preparation and grading;
  - demolition of existing buildings;
  - construction of services and temporary structures; and
  - windblown materials from demolished materials stockpiles.
- Emissions of products of combustion (as well as odours) from plant and machinery used during the demolition works;
- Odour from the decomposition of marine growth and silt attached to piles and other underwater structures stockpiled on-site.

1.5.1 Dust Emissions from Stage 1 Works

During the Stage 1 works, the potential for dust to be emitted from the site will be directly influenced by the nature of the activities being performed. Excavation works in particular have the potential to cause short-term emissions of dust and would require the application of suitable dust control measures. Other activities that may generate short-term emissions of dust include:

- Loading and unloading of demolition materials;
- Wheel-generated dust from trucks moving across the site and on adjacent public roads; and
- Wind erosion from exposed surfaces.

1.5.2 Products of Combustion from Stage 1 Works

Diesel and petrol fuelled trucks, excavators, dozers and other equipment associated with the demolition of the site will emit products of fuel combustion during Stage 1 works. A review of the National Pollutant Inventory Emission Estimation Technique Manual (NPI EET) for Combustion Engines (DEWHA 2008) identifies the primary pollutants from combustion engines as:

- Carbon monoxide (CO).
- Oxides of nitrogen (NO_x).
- Particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$).
- Particulate matter less than 10 µm in aerodynamic diameter (PM_{10}).
- Sulfur dioxide (SO_2).
- Total Volatile Organic Compounds (TVOCs).

Other substances are also emitted in trace amounts as products of incomplete combustion, such as metallic additives which contribute to the particulate content of the exhaust (DEWHA 2008).

1.5.3 Odour Emissions from Stage 1 Works

As listed in **Section 1.2**, the piles supporting the existing wharves and jetty structures are to be removed as part of the Stage 1 works. It can be expected that after years of submersion, the underwater structures at the site will have been colonised by marine organisms (marine growth). During handling and storage of these materials on-site there is potential for this marine growth to be dislodged and/or to die and decompose. A potential odour source associated with the Stage 1 works is therefore odour from the decomposition of marine growth attached to these underwater structures when they are brought to the surface and stockpiled on-site.

To understand the potential for odour generation, reference has been made to a study completed by the University of Hull on the causes and consequences of odours from marine growth organisms (Dr Alvarez M.C. et al 2012). This study was performed as one of three studies completed to inform the management of marine growth during decommissioning of off-shore oil and gas installations.

The frequency and intensity of odours experienced on-site or at nearby sensitive receptors will depend on several factors, such as ambient temperatures and wind conditions. The nuisance odour risk assessment due to the decomposing marine growth at the site is assessed in **Section 3.3.1** and the relevant mitigation measures to reduce nuisance odours are proposed in **Section 3.3.2**.

The VOCs emitted from the combustion of fuel in plant and equipment on-site also have the potential to result in localised odours, however these emissions will be minor in comparison to that generated by existing traffic on Bridge Road and therefore they have not been considered further.

1.6 Relevant Air Quality Criteria

Ambient air quality criteria for the pollutants identified in **Section 1.5** are prescribed by the NSW Environment Protection Authority document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (hereafter 'the Approved Methods') (EPA 2017).

Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for each of the above pollutants. The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting.

1.6.1 Carbon Monoxide

Carbon monoxide (CO) is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. CO bonds to the haemoglobin in the blood and reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs, in particular the heart and the brain.

CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. The highest concentrations are found at the kerbside, with concentrations decreasing rapidly with increasing distance from the road.

The goals specified within the Approved Methods for CO are provided in **Table 2**.

Table 2 Assessment Criteria for Carbon Monoxide (CO)

Pollutant	Averaging Period	Criterion
CO	15-min	87 ppm (100 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)

Note: ppm = parts per million

1.6.2 Oxides of Nitrogen

Oxides of nitrogen (NO_X) is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry NO_X generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2).

NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease.

NO will be converted to NO_2 in the atmosphere after leaving a car exhaust. The goals specified within the Approved Methods for NO_2 are provided in **Table 3**.

Table 3 Assessment Criteria for Nitrogen Dioxide (NO_2)

Pollutant	Averaging Period	Criterion
NO_2	1-hour	12 pphm (246 µg/m^3)
	Annual	3 pphm (62 µg/m^3)

Note: pphm = parts per hundred million

1.6.3 Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP).

The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air (µg/m^3). The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW EPA PM_{10} assessment goals set out in the Approved Methods are as follows:

- a 24-hour maximum of 50 µg/m^3; and,

- an annual average of 25 µg/m^3.

The NSW EPA $PM_{2.5}$ assessment goals set out in the Approved Methods are as follows:

- a 24-hour maximum of 25 µg/m^3; and,
- an annual average of 8 µg/m^3.

3.1.1 Deposited Particulate

Section 1.6.3 is concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts also need to be considered, mainly in relation to deposited dust.

In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month (g/m^2/month).

Table 4 presents the impact assessment goals set out in the Approved Methods for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level to avoid dust nuisance.

Table 4 EPA Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Source: Approved Methods, EPA 2017

1.6.4 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless, pungent gas with an irritating smell. When present in sufficiently high concentrations, exposure to SO_2 can lead to impacts on the upper airways in humans (i.e. the noise and throat irritation). SO_2 can also mix with water vapour to form sulphuric acid (acid rain) which can damage vegetation, soil quality and corrode materials.

Main sources of SO_2 in the air are industries that process materials containing sulphur (i.e. wood pulping, paper manufacturing, metal refining and smelting, textile bleaching, wineries etc.). SO_2 is also present in motor vehicle emissions, however since Australian fuels are relatively low in sulphur, high ambient concentrations are not common.

Table 5 Assessment Criteria for Sulphur Dioxide (SO_2)

Pollutant	Averaging Period	Criterion
SO_2	10-min	25 pphm (712 µg/m^3)
	1-hour	20 pphm (570 µg/m^3)
	24-hour	8 pphm (228 µg/m^3)
	Annual	2 pphm (60 µg/m^3)

Note: pphm = parts per hundred million

1.6.5 Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are organic compounds (i.e. contain carbon) that have high vapour pressure at normal room-temperature conditions. Their high vapour pressure leads to evaporation from liquid or solid form and emission release to the atmosphere.

VOCs are emitted by a variety of sources, including motor vehicles, chemical plants, automobile repair services, painting/printing industries, and rubber/plastics industries. VOCs that are often typical of these sources include benzene, cyclohexane, ethylbenzene, toluene and xylenes. Biogenic (natural) sources of VOC emissions are also significant (e.g. vegetation).

Impacts due to emissions of VOCs can be health or nuisance (odour) related. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels.

1.6.6 Odour

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve “no odour”.

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines one odour unit (ou). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver’s reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 ou to 10 ou depending on a combination of the following factors:

- **Odour quality**: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- **Population sensitivity**: any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it contains.
- **Background level**: whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- **Public expectation**: whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- **Source characteristics**: whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment. Point sources tend to be located in urban areas, while diffuse sources are more often located in rural locations.
- **Health effects**: whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 ou is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours). On this basis, the NSW OEH recommends within the Technical framework: Assessment and Management of odour from stationary sources in NSW (hereafter the 'Odour Framework') (DEC 2006) that, as design goal, no individual be exposed to ambient odour levels of greater than 7 ou. This is expressed as the 99^{th} percentile value, as a nose response time average (approximately one second).

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours, using a statistical approach which depends on the size of the affected population. As the affected population size increases, the number of sensitive individuals is also likely to increase, which suggests that more stringent goals are necessary in these situations. In addition, the potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

For urban areas such as that surrounding the site, the relevant odour impact assessment criterion set by the Approved Methods for complex mixtures of odorous air pollutants is 2 ou (nose-response-time average, 99^{th} percentile).

The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

2 Baseline Conditions

2.1 Local Meteorological Conditions

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

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station to the site is the Sydney Observatory Hill Automatic Weather Station (AWS), which is located approximately 1.8 km to the northeast of the site. However, this station does not record high definition data. Moreover, due to the location of the station within Sydney Harbour, the data would most likely not be representative of conditions at the site.

Other nearby BoM weather stations include the Sydney Airport AWS (approximately 8 km south-southwest of the site) and Canterbury Racecourse AWS (approximately 8 km west-southwest of the site). Given the variable topographical features of the land between the site and these two BoM weather stations, the recordings from these stations are also not considered to be a reasonable representation of the wind conditions experienced at the site. Therefore, The Air Pollution Model (TAPM) and CALMET meteorological models have been used to compile a site-representative dataset. A summary of the methodology used to model wind patterns using TAPM and CALMET, including the long term meteorological analysis to select an appropriate modelling year, are presented in **Appendix A**.

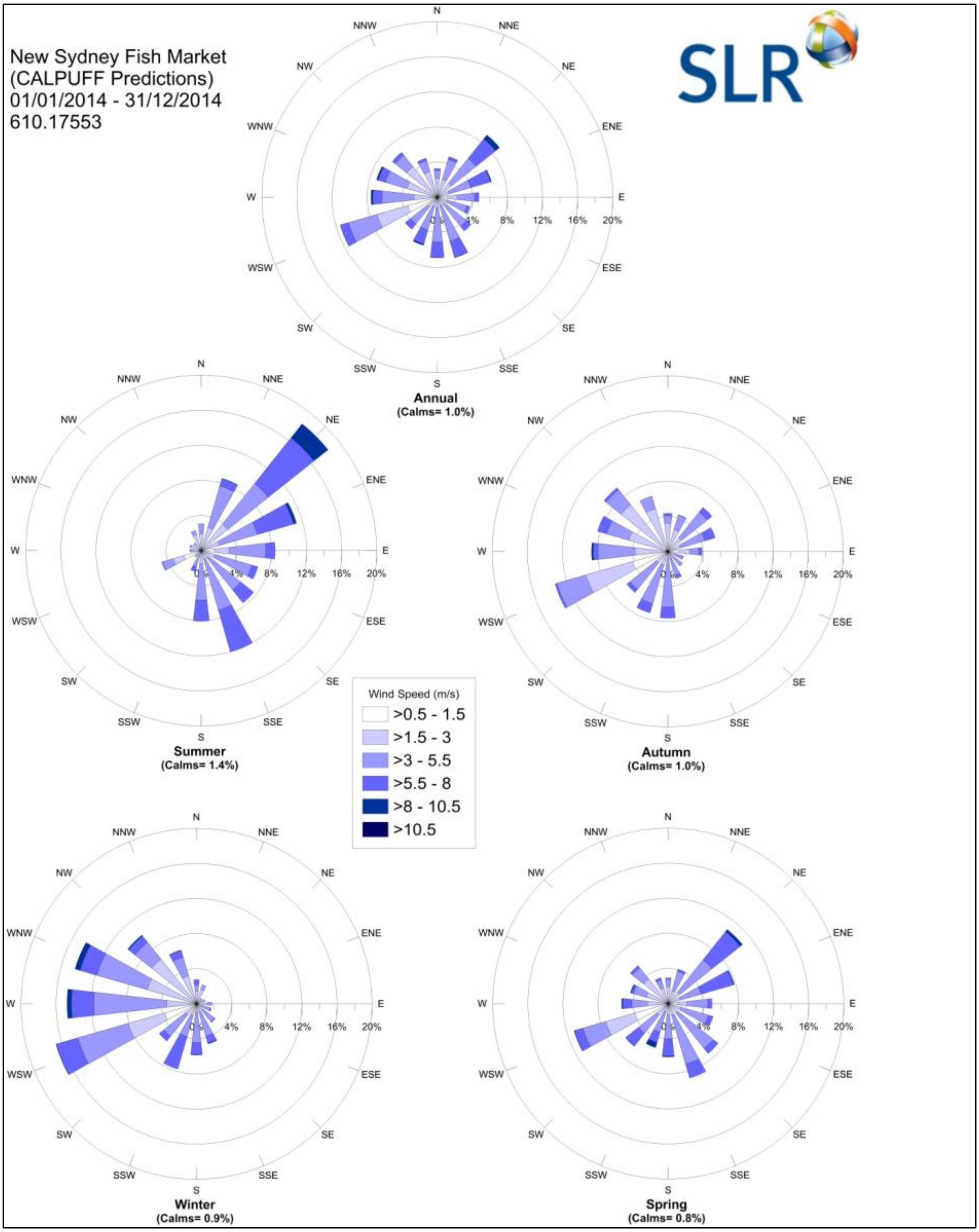
A summary of the annual wind behaviour predicted by CALMET for the modelled year (2014) at the site is presented as wind roses in **Figure 4**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The annual wind rose indicates the predominant wind directions in the area are from west-southwest and northeast. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 1% of the time throughout the modelling period. The seasonal wind roses for the year 2014 indicate that:

- In summer, winds are mostly gentle to moderate (between 3.0 m/s and 8 m/s) predominantly from the northeast, with very few winds from the northwest and southwest quadrants. Calms were predicted to occur 1.4% of the time during the summer months.
- In autumn, winds are light to moderate (between 0.5 m/s and 8 m/s) predominantly from the west-southwest directions. Calms were predicted to occur 1.0% of the time during the autumn months.
- In winter, winds are mostly gentle to moderate (between 3.0 m/s and 8 m/s) and are from the western quadrant with very few winds from the eastern quadrant. Calms were predicted to occur 0.9% of the time during the winter months.
- In spring, winds are mostly gentle to moderate (between 3.0 m/s and 8 m/s) and predominantly blow from the northeast, west-southwest and south-southeast. Calms were predicted to occur 0.8% of the time during the summer months.

As identified in **Section 1.3**, the sensitive receptors are located towards southwest and west of the site boundary. Winds from between the north and east directions, which would blow air emissions from the site towards the existing residences, occur approximately 28% of the time.

Figure 4 New Sydney Fish Market Annual and Seasonal Wind Roses 2014



2.2 Surrounding Sources of Emissions to Atmosphere

2.2.1 Road Traffic and Marine Vessels

The primary sources of air emissions in the area immediately surrounding the site is expected to be vehicles travelling along Bridge Road. Engine exhaust emissions will also be generated by marine traffic within Blackwattle Bay and the wider Sydney Harbour, including ferries and water taxis, fishing trawlers, cruise ships visiting Darling Harbour and recreational boating.

The rate and composition of air pollutant emissions from road vehicles and boats is a function of a number of factors, including the type, size and age of the vehicles/boats, the type of fuel combusted, number and speed of vehicles/boats and (for road traffic) the road gradient.

2.2.2 Industrial Sources

Industrial sites located in the area surrounding the site with the potential to be significant emitters of air pollutants were identified through:

- Desktop mapping of industrial sites regulated by the EPA;
- A review of facilities required to report to the National Pollutant Inventory (NPI); and
- A site visit.

Environment Protection Licences (EPL) are issued under the POEO Act and are regulated by the NSW EPA. EPLs stipulate emission limits to water, land and/or air and provide operational protocols to ensure emissions/operations comply with relevant standards. General requirements of EPLs relating to air quality include:

- Plant and equipment to be maintained and operated in a proper and efficient manner.
- Emissions of dust and odour from the premises are to be minimised/prevented.

The NPI database provides details on industrial emissions of over 4,000 facilities across Australia. The requirement to return annual reports to the NPI quantifying a facility's emissions is determined by the activities/processes being undertaken at the facility, and also whether those processes exceed process-specific thresholds in terms of activity rates (i.e. throughput and/or consumption). It is not intended to make a statement that the emissions associated with those activities will be significant in terms of their potential for impact and/or generation of complaint, however it provides a tool to identify significant emission sources in a specific area that then may be investigated further to assess their potential to impact on local air quality.

A search of the EPA public register and NPI database within a 3 km radius of the site identified several industries which could potentially impact local air quality. Details of these facilities are presented in **Table 6** and their location relative to the site is illustrated in **Figure 5**.

In addition to the facilities identified from the search of the EPA public register and NPI database, **Table 6** also includes the Hymix concrete batching facility, which is located inside the boundaries of the Blackwattle Bay investigation area. According to the NSW EPA POEO Public Register, the Environment Protection Licence for this facility has been surrendered and is no longer in force. However it is understood that concrete batching and possibly bulk shipping activities occur at the Hymix facility.

Table 6 Identified Sources of Air Emissions in the Vicinity of the Site

Licence Holder / Facility	Type of Activity	Approximate Distance from the Site	Air Pollutants Potentially Emitted	Likelihood of Significant Cumulative Impact
Malt Shovel Brewery	Brewing and packaging of beer	1.9 km (SW)	Odour	Low
Enwave Central Park Pty Ltd	Generation of electrical power from gas	1.4 km (SSE)	Products of gas combustion	Low
Hanson Construction Materials Pty Ltd	Shipping in bulk / concrete works	0 km	Particulate matter, products of combustion	High
Newcastle Port Corporation	Shipping in bulk	1.2 km (NE)	Particulate matter	Low
Sydney Ship Repair & Engineering Pty Ltd	Boat construction/maintenance (general)	2.5 km (NE)	TVOCs from painting/antifouling, particulate matter from sanding/blasting	Low
Cement Australia Holdings Pty Ltd	Cement or lime handling	1.4 km (NW)	Particulate matter	Low
Gypsum Resources Australia Pty. Limited	Shipping in bulk	1.5 km (NNW)	Particulate matter	Low
Harbour City Ferries Pty Ltd	Boat construction/maintenance (dry/floating docks)	2.0 km (N)	TVOCs from painting/antifouling, particulate matter from sanding/blasting	Low
Sydney City Marine Pty Limited	Boat construction/maintenance (general)	1.0 km (NNW)	TVOCs from painting/antifouling, particulate matter from sanding/blasting	Low
Roads And Maritime Services	Boat construction/maintenance (general)	1.0 km (NW)	TVOCs from painting/antifouling, particulate matter from sanding/blasting	Low
Rozelle Bay Pty Ltd	Boat mooring and storage	1.3 km (NW)	Products of combustion, TVOCs from fuel storage	Low
Sugar Australia Pty Limited	General agricultural processing / Shipping in bulk	1.3 km (NNW)	Particulate matter	Low
White Bay 6 Pty Ltd	Boat construction/maintenance (general)	1.5 km (N)	TVOCs from painting/antifouling, particulate matter from sanding/blasting	Low
Hymix Australia (not currently licenced)	Concrete batch plant	0.3 km (NNE)	Particulate matter	Low

Figure 5 Location of Nearby Industrial Sources

It is noted that the Hanson Construction Materials facility, which is located within the Site, will be relocated prior to the commencement of the Stage 1 works and will no longer operate in the Site. This which will result in reduced particulate concentrations within the Site.

As shown in **Table 6**, considering the separation distances and activity types associated with the identified emission sources, significant cumulative air quality impacts from the identified facilities with the anticipated air emissions from the site are considered unlikely.

2.3 Background Air Quality

The NSW Office of Environment and Heritage (OEH) maintains a network of air quality monitoring stations (AQMS) across NSW. The nearest such OEH station is located at Rozelle, approximately 2.6 km to the northwest of the site (see **Figure 3**).

The Rozelle AQMS was commissioned in 1978 and is located in the grounds of Rozelle Hospital, off Balmain Road, Rozelle. It is situated in a residential area in the Parramatta River valley and is at an elevation of 22 m.

Due to the presence of trees within 20 m of the Rozelle AQMS, the clear sky angle is less than 120°, which means this station does not currently comply with Australian Standard AS/NZS 3580.1.1:2007 - *Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment*. However, in the absence of any other monitoring data and considering the qualitative nature of this assessment, the Rozelle AQMS data has been adopted for use as a background air quality dataset for this study.

A number of air pollutants and meteorological variables are currently measured by the Rozelle AQMS including:

- Ozone (O_3);
- Oxides of nitrogen (NO, NO_2 & NO_X);
- Sulphur dioxide (SO_2);
- Fine particles less than 10 microns (PM_{10});
- Fine particles less than 2.5 microns ($PM_{2.5}$); and
- Carbon monoxide (CO).

Air pollutant data recorded by the Rozelle AQMS was obtained for the calendar years 2012 - 2016 and is summarised in **Table 7**. To be consistent with the annual NSW compliance monitoring reports, the data for gaseous pollutants are presented in parts per hundred million (pphm) or parts per million (ppm), rather than $\mu g/m^3$ and mg/m^3.

A review of the data shows that exceedances of the 24-hour average PM_{10} criterion were recorded by the Rozelle AQMS in 2013, 2015 and 2016. A review of the compliance monitoring reports for the years 2013 (OEH 2014) and 2015 (OEH 2017) indicate that the exceedances recorded by the Rozelle AQMS were due to a bushfire emergency and as a result of a state-wide dust storm, respectively. For the year 2016 (OEH 2018), the compliance monitoring report states that the increase in the PM_{10} levels across NSW during May '*was due to a number of hazard reduction burns*'.

Exceedances of the 24-hour average $PM_{2.5}$ criterion were also recorded by the Rozelle AQMS in both 2015 and 2016 (the only two years during which $PM_{2.5}$ monitoring was performed by the Rozelle AQMS). Ambient $PM_{2.5}$ concentrations often exceed the 24 hour and annual average criteria set out in the Approved Methods across the Sydney Greater Metropolitan Area.

Ambient concentrations of the gaseous pollutants SO_2, NO_2, and CO were all below the relevant criteria for all years that data are available.

Table 7 Summary of Rozelle AQMS Data (2012 – 2016)

Pollutant	Averaging Period	Criteria	Year	Rozelle AQMS		Units
				Maximum Daily Level	Days Criteria Exceeded	
CO	1-hour	8 ppm	2012	2	0	ppm
			2013	2	0	ppm
			2014	1	0	ppm
			2015	1	0	ppm
			2016	1	0	ppm
NO_2	1-hour	12 pphm	2012	6.2	0	pphm
			2013	7.0	0	pphm
			2014	5.5	0	pphm
			2015	6.0	0	pphm
			2016	5.0	0	pphm
	Annual	3 pphm	2012	1.2	0	pphm
			2013	1.1	0	pphm
			2014	1.1	0	pphm
			2015	1.1	0	pphm
			2016	1.1	0	pphm
PM_{10}	24-hour	50 µg/m^3	2012	41	0	µg/m^3
			2013	59[1]	3	µg/m^3
			2014	44	0	µg/m^3
			2015	60[2]	1	µg/m^3
			2016	59[3]	1	µg/m^3
	Annual	25 µg/m^3	2012	17	0	µg/m^3
			2013	18	0	µg/m^3
			2014	18	0	µg/m^3
			2015	17	0	µg/m^3
			2016	17	0	µg/m^3
$PM_{2.5}$	24-hour	25 µg/m^3	2012	ND	ND	µg/m^3
			2013	ND	ND	µg/m^3
			2014	ND	ND	µg/m^3
			2015	33[4]	1	µg/m^3
			2016	49[5]	5	µg/m^3
	Annual	8 µg/m^3	2012	ND	ND	µg/m^3
			2013	ND	ND	µg/m^3
			2014	ND	ND	µg/m^3
			2015	7.2	0	µg/m^3
			2016	7.4	0	µg/m^3

Pollutant	Averaging Period	Criteria	Year	Rozelle AQMS		Units
				Maximum Daily Level	Days Criteria Exceeded	
SO_2	1-hour	20 pphm	2012	ND	ND	pphm
			2013	ND	ND	pphm
			2014	ND	ND	pphm
			2015	2.8	0	pphm
			2016	2.0	0	pphm
	24-hour	8 pphm	2012	ND	ND	pphm
			2013	ND	ND	pphm
			2014	ND	ND	pphm
			2015	0.5	0	pphm
			2016	0.5	0	pphm
	Annual	2 pphm	2012	ND	ND	pphm
			2013	ND	ND	pphm
			2014	ND	ND	pphm
			2015	0.1	0	pphm
			2016	0.1	0	pphm

Notes:
ND- No data
[1] For 2013, the maximum 24-hour average PM_{10} was recorded on 8 November 2013 at Rozelle AQMS.
[2] For 2015, the maximum 24-hour average PM_{10} was recorded on 6 May 2015 at Rozelle AQMS.
[3] For 2016, the maximum 24-hour average PM_{10} was recorded on 7 May 2016 at Rozelle AQMS.
[4] For 2015, the maximum 24-hour average $PM_{2.5}$ was recorded on 21 August 2015 at Rozelle AQMS.
[5] For 2016, the maximum 24-hour average $PM_{2.5}$ was recorded on 22 May 2016 at Rozelle AQMS.

It is noted that the Port Authority of NSW also runs an air monitoring program in the vicinity of the site. The location of the monitoring site in relation to the site is shown in **Figure 6**. The pollutants being monitored as part of this program are SO_2 and $PM_{2.5}$ only, in addition to the metrological parameters.

The data from this station was not utilised for this report, due to the monitoring location's proximity to the cruise ship terminal and berths. The pollutant concentrations recorded at this monitoring station are affected by emissions from fuel combustion in cruise ships and other industrial activities surrounding the white bay terminal, which are not considered to be a representative of the emission sources at the site.

Figure 6 Location of White Bay Cruise Terminal Monitoring Stations and Berths

Source: PEL 2017

3 Assessment of Impacts

3.1 Products of Combustion due to Fuel Combustion

Ambient air quality monitoring performed in the Sydney area over the last few decades has shown that the city's air quality has improved and is continuing to improve. A major driver of this improvement in urban air quality is the fact that newer vehicles produce significantly less emissions than older vehicles. This is in part as a result of improvements in the quality and composition of fuels as well as improved engine designs and fuel efficiency. According to Trends in Motor Vehicles and their Emissions (EPA 2014), cars built from 2013 onwards emit only 3% of the NO_X emissions compared to vehicles built in 1976, and diesel trucks built from 2011 onwards emit just 8% of the particles emitted by vehicles built in 1996. Thus even as Sydney's population and total vehicle kilometres travelled each year have increased (EPA 2014), key measures of air pollution have dropped significantly and this trend is expected to continue.

The results from the background air quality concentrations show that the monitored concentrations have been below the respective criteria for CO, NO_2 and SO_2 for five years running (2012-2016) (see **Section 2.3**).

Given the nature of the Stage 1 works, it is considered that the emissions generated due to the combustion of fuel in construction plant and machinery will be short term and small compared to the emissions generated by road traffic on Bridge Road. Given the short term and low level of emissions of these pollutants from the site during the Stage 1 works, they are considered unlikely to have significant impacts on local air quality and have not been considered any further in this assessment.

3.2 Dust Impacts from Stage 1 Works

The key potential air pollution and amenity issues associated with fugitive dust emissions from the proposed demolition activities at the Project Site are:

- Annoyance due to dust deposition (soiling of surfaces) and visible dust plumes; and
- Elevated suspended particulate concentrations (PM_{10}).

Modelling of dust from demolition activities is generally not considered appropriate, as emission rates can vary significantly depending on a combination of the activity and prevailing meteorological conditions (i.e., rainfall and wind speed), which cannot be reliably predicted. The following sections therefore present a qualitative assessment of the potential risks to air quality associated with dust from demolition activities at the Project Site. Details of the IAQM methodology used to perform the risk assessment are provided in **Appendix A**.

3.2.1 Step 1 – Screening Based on Separation Distance

The nearest existing residential receptors have been identified as being located approximately 50 m of the Project Site boundary, at the corner of Bridge Road and Wentworth Park Road.

As the sensitive receptors are located within 350 m from the boundary of the site, and within 500 m from the site entrance, further assessment is required.

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

Based upon the above assumptions and the IAQM definitions presented in **Appendix A**, the dust emission magnitudes have been categorised as presented in **Table 8**.

Table 8 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Demolition	Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level. *Note: The building volumes for the Hanson concrete batching plant and the former Jones Brothers coal loader are calculated to be approximately 14,400 m^3 (36 m x 20 m x 20 m) and 2,500 m^3 (50 m x 5 m x 10 m). The volume of other buildings on-site is estimated to be approximately 770 m^3 (11 m x 7 m x 10 m). So the total building volume is calculated to be approximately 17,670 m^3. Even though the total building volume is less than 20,000 m^3, the demolition activities are likely to occur at 10-20 m above ground level. Based on this, it is conservatively assumed that magnitude for dust emissions during demolition will be 'medium'.*
Earthworks	Medium	Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (eg silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t. *Note: The total concrete pad area to be demolished is approximately 11,500 m^2. Assuming a depth of 1.25 m for the whole pad, the volume of the pad material to be demolished is calculated to be approximately 14,375 m^3. Assuming the average density of material to be 1,500 kg/m^3, the total material moved is estimated to be ~21,500 tonnes. Even though the earthworks area is greater than 10,000 m^2, it is based on conservatively high 1.25 pad depth, therefore the dust emissions magnitude has been categorised based on the total material moved.*
Trackout	Small	Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length. *Note: The whole surface at the Project Site is paved. Therefore, dust emissions magnitude for track-out is considered to be 'small'.*

3.2.3 Step 2b – Risk Assessment

3.2.3.1.1 Receptor Sensitivity

Based on the criteria listed in **Table A1** in **Appendix A**, the sensitivity of the identified receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as they include residential areas where people may be reasonably expected to be present continuously as part of the normal pattern of land use.

3.2.3.1.2 Sensitivity of an Area

Using the classifications shown in **Table A2** in **Appendix A**, the sensitivity of the area to dust soiling is classified as '*medium* and the sensitivity of the surrounding area to health effects (**Table A3** in **Appendix A**) has also been classified as '*medium*'. This categorisation has been made taking into account the individual receptor sensitivities derived above, the annual mean background PM_{10} concentration of 17-18 µg/m^3 recorded at the Rozelle AQMS (see **Table 7**) and the anticipated number of receptors present, i.e 10-100 within 50 m for both dust soiling and health impacts. It is noted that the closest residence identified at the corner of Bridge Road and Wentworth Park Road is a multi-apartment building. It has been assumed that it contains at least ten (10) apartments.

3.2.4 Risk Assessment

Given the sensitivity of the general area is classified as '*medium*' for dust soiling and '*medium*' for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 8**, the resulting risk of air quality impacts is as presented in **Table 9**.

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

Table 9 Preliminary Risk of Air Quality Impacts from Stage 1 Works (Uncontrolled)

Impact	Sensitivity of Area	Dust Emission Magnitude			Preliminary Risk		
		Demolition	Earthworks	Trackout	Demolition	Earthworks	Trackout
Dust Soiling	Medium	Medium (**Table 8**)	Medium (**Table 8**)	Small (**Table 8**)	Medium Risk	Medium Risk	Negligible Risk
Human Health	Medium				Medium Risk	Medium Risk	Negligible Risk

3.2.5 Step 3 - Mitigation Measures

Table 10 lists the relevant mitigation measures designated as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a development shown to have a low risk of adverse impacts.

Not all these measures would be practical or relevant to the proposed works at the site, hence a detailed review of the recommendations should be performed as part of the development of the Construction Environmental Management Plan (CEMP) and the most appropriate measures adopted.

Table 10 Site-Specific Management Measures Recommended by the IAQM

	Activity	
1	**Communications**	
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.2	Display the head or regional office contact information.	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.	D
2	**Site Management**	
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
2.2	Make the complaints log available to the local authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H

	Activity	
3	**Monitoring**	
3.1	Perform daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary.	D
3.2	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
4	**Preparing and Maintaining the Site**	
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	H
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	D
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	D
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D
5	**Operating Vehicle/Machinery and Sustainable Travel**	
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
5.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable	H
5.4	Impose and signpost a maximum-speed-limit of 25 km/hr on surfaced and 15 km/hr on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).	D
6	**Operations**	
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.3	Use enclosed chutes and conveyors and covered skips	H
6.4	Minimise drop heights from loading shovels and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D

	Activity	
7	**Waste Management**	
7.1	Avoid bonfires and burning of waste materials.	H
8	**Demolition**	
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H
9	**Trackout**	
9.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D
9.2	Avoid dry sweeping of large areas.	D
9.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
9.4	Record all inspections of haul routes and any subsequent action in a site log book.	D
9.5	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D

H = Highly recommended; D = Desirable

3.2.6 Step 4 - Residual Impacts

A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies. These are termed 'residual impacts'. The results of the reappraisal are presented below in **Table 11**.

Table 11 Residual Risk of Air Quality Impacts from Stage 1 Works

Impact	Sensitivity of Area	Earthworks	Construction	Trackout
Dust Soiling	Medium	Low Risk	Low Risk	Negligible Risk
Human Health	Medium	Low Risk	Low Risk	Negligible Risk

The mitigated dust deposition and human health impacts for earthworks, construction activities and trackout are anticipated to be *negligible*. For almost all construction activity, the IAQM Methods notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

3.3 Odour Impacts from Stage 1 Works

3.3.1 Risk Assessment

As discussed in **Section 1.5.3**, odours could potentially occur from the decomposition of marine growth on the underwater structures in the event that their off-site transportation is delayed and they are stored on-site. At the time of writing this report, no site-specific details are available that would indicate the likelihood of such odours occurring, such as the type or amount of marine growth expected, the anticipated storage requirements and transportation schedule for these materials etc.

Qualification of the frequency, intensity, duration, offensiveness, and location of odour sources and their emissions is necessary when appraising potential future odour nuisance impacts on sensitive land uses. The following broad "risk based" approach has been adopted.

The integration of sensitivity with impact magnitude is used to derive the predicted significance of that change. The full details of the methodology can be found in **Appendix C**.

3.3.1.1.1 Receptor Sensitivity

The nearest sensitive receptors to the site are located approximately 50 m from the closest boundary (see **Section 1.3**).

With regards to the methodology outlined in **Appendix C**, the sensitivity of the surrounding residential areas to odour emissions generated by the site has been classified as ***high***.

3.3.1.1.2 Magnitude

By addressing the FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) factors, the potential for odour impacts from this source at the sensitive receptors may be determined.

- Frequency – the closest residential areas have the potential to experience impacts whenever the structures with decomposing marine growth are left onsite for long time (such as overnight) and when the wind direction is from between the north and east directions. These conducive winds are likely to occur approximately 28% of the time during the year (see **Section 2.1**), therefore there is a medium likelihood they would experience frequent potential odour impacts.
- Intensity – depending on the amount of decomposing marine growth and the high temperatures, it is conservatively assumed that the intensity of odour generated by the decomposing marine growth is likely to be medium.
- Duration – the duration of a potential odour impact may last as long as the decomposing marine growth is left onsite and for as long as the wind blowing in a direction over the site to the receptors. Given that conductive wind directions only occur approximately 28% of the time, the duration of any odour impacts is likely to be medium.
- Offensiveness – as noted above, emissions from decomposing marine growth, therefore the offensiveness is likely to be high.
- Location – the impact of location on the acceptability of odours from the site has been accounted for by the receptor sensitivity classifications discussed in the preceding section, as high.

Given that three of the FIDOL factors are medium, the magnitude of odour is predicted to be of **moderate** magnitude (i.e. Impact is predicted to possibly cause statutory objectives/standards to be exceeded, **Table C2**).

3.3.1.1.3 Assessment of Odour Impacts

Given the **high sensitivity** of the potentially affected receptors and the **moderate magnitude** of the potential odour impact of the decomposing marine growth, the potential impact significance for the local receptors is concluded to be of ***intermediate significance*** for the closest receptors.

Table 12 Risk Assessment of Odour Impacts – Stage 1 Works

Sensitivity		Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
[Defined by Table C1]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

3.3.2 Mitigation Measures

The potential for odours from the decomposing marine growth onsite would be reduced significantly, if:

- the marine growth was removed while the structures are in situ;
- the marine growth was removed as soon as the structures are brought to surface, before they are stored onsite, or
- in the case of non-removal of marine growth, if the on-site storage time of underwater structures is minimised (i.e., they are transported off-site on the day of removal).

The practicalities of the options available to minimise the potential for odours from this source will need to reviewed and the selected measures incorporated into the CEMP. If the removal of marine growth from the structures is anticipated to be too time and labour intensive, then provided the structures are removed within the same day and are not stored overnight, the residual risk of odour impacts would reduce to ***neutral significance***.

4 Conclusions

SLR was commissioned by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW) to perform an Air Quality Impact Assessment (AQIA) for the proposed development of the new Sydney Fish Market (the site). The site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe, situated less than 2 km west of Sydney's CBD and is partially within the City of Sydney Local Government Area.

This report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEAR's) for Stage 1 of the development of the site, which includes the demolition and site preparation works for the subsequent construction phases of the development.

The main potential sources of air emissions were identified as dust impacts during the demolition works and odour impacts due to the decomposition of marine growth on the underwater structures should they be stored on-site for an extended period.

The potential for off-site dust impacts was assessed using a qualitative risk-based approach prescribed by the Institute of Air Quality Management (IAQM). The results of this assessment indicate that dust impacts due to the Stage 1 works can be adequately managed with the implementation of site-specific mitigation measures, and that the residual impacts are likely to be low for demolition and earthworks activities and negligible for trackout activities.

The potential for off-site odour impacts due to decomposition of marine growth was also assessed using a qualitative risk-based approach. The results of this assessment concluded that these odour impacts can be managed by either removing the marine growth before it is stored or stockpiled on-site, or by ensuring the materials are transported off-site without delay. Assuming these measures are implemented, the residual off-site odour impacts are anticipated to be of neutral significance.

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APPENDIX A

TAPM AND CALMET MODELLING PARAMETERS

Meteorological Modelling - TAPM

TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia, is a prognostic model which can be used to compile a site-representative meteorological dataset in areas where there is limited observational data available, and has been widely used for meteorological and pollutant dispersion modeling studies throughout Australia. The model allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

The CSIRO has a global data set of synoptic meteorological data that is required as input to the TAPM model. It is derived from analysis data used by meteorological services for weather forecasting. The synoptic meteorological data used in the modelling has been obtained from the CSIRO for the Asia Pacific region for the years of 2012-2016 (inclusive). **Table A1** details the parameters used in the TAPM meteorological model for this assessment.

TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. However, given that TAPM is known to under-predict calm wind conditions, the wind speed and direction observations obtained from the nearest BoM stations have also been used in the subsequent CALMET component of the modelling as described below.

Table A1 TAPM Input Parameters Used in this Study

Parameter	Value
Modelling Period	1 January 2014 to 31 December 2014
Centre of analysis	332750mE 6250232mN (UTM Coordinates)
Number of grid points	35 × 35 × 35
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Data assimilation	Sydney Airport AWS (Station # 66037) Canterbury Racecourse AWS (Station # 66194)
Terrain	AUSLIG 9 second DEM

The three dimensional upper air data from TAPM output was used as input for the diagnostic meteorological model (CALMET).

Meteorological Modelling - CALMET

In the simplest terms, CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects the influences of local topography and current land uses.

CALMET modelling was conducted using the 'with Obs' CALMET approach. TAPM generated upper air data and available surface weather observations in the area were used to refine the wind field predetermined by TAPM data. Hourly surface meteorological data from the nearest BoM stations were incorporated in the CALMET modelling. This includes meteorological data collected by the OEH monitoring site at St Marys through the use of the revised meteorological dataset compiled in response to comments from OEH on the Stage 1 AQIA. The use of the St Marys meteorological observational data in the meteorological modelling was shown in the Stage 1 Response to Submissions to not have a material impact on the results of the Stage 1 assessment, but it has been used in this updated modelling study for completeness.

A horizontal grid spacing of 100 m was used to adequately represent the important local terrain features and land use. **Table A2** details the parameters used in the meteorological modelling.

Table A2 CALMET Configuration Used for this Study

Modelling Period	1 January 2013 to 31 December 2013
Centre of analysis	325,362 mE 6,241,993 mN (UTM Coordinates)
Meteorological grid domain (Meteorological grid resolution)	8.2 km x 10.12 km (40 m)
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)
Data Assimilation	Sydney Airport AWS (Station # 66037) Canterbury Racecourse AWS (Station # 66194) TAPM - upper air data (331,750 mE; 6,248,232 mS)

APPENDIX B

CONSTRUCTION RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

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

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

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

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

- ***Large***: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

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

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

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

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and

- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table B1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table B1 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM10.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

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

- any history of dust generating activities in the area;

- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;
- any conclusions drawn from local topography;
- the duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table B2**. The sensitivity of the area should be derived for each of activity relevant to the project (ie construction and earthworks).

Table B2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

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

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

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table B3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (ie an annual average of 20 µg/m^3 for PM_{10}) the IAQM method has been modified slightly.

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

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

- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table B3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor Sensitivity	Annual mean PM_{10} conc	Number of receptors [a,b]	Distance from the source (m)			
			<20	<50	<100	<350
High	15-22.5 $\mu g/m^3$	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<15 $\mu g/m^3$	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium		>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
Low		>1	Low	Low	Low	Low

Notes:
(a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.
(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table B4** (earthworks and construction) and **Table B5** (track-out) to determine the risk category with no mitigation applied.

Table B4 Risk Category from Earthworks and Construction Activities

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

Table B5 Risk Category from Track-out Activities

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

Table B6 Risk Category from Demolition Activities

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

Step 3 - Site-Specific Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low, medium or high risk site.

Step 4 – Residual Impacts

Following Step 3, the residual impact is then determined after management measures have been considered.

APPENDIX C

ODOUR ASSESSMENT METHODOLOGY

The risk-based assessment takes account of a range of impact descriptors, including the following:

- **Nature of Impact**: does the impact result in an adverse or beneficial environment?
- **Sensitivity**: how sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: what is the anticipated scale of the impact?

The integration of receptor sensitivity with impact magnitude is used to derive the predicted **significance** of that change.

Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment:

- **Beneficial**: the predicted impact will cause a beneficial effect on the receiving environment.
- **Neutral**: the predicted impact will cause neither a beneficial nor adverse effect.
- **Adverse**: the predicted impact will cause an adverse effect on the receiving environment.

Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. A receptor may be determined to have varying sensitivity to different environmental changes, for example, a high sensitivity to changes in air quality, but low sensitivity to noise impacts. Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with the broad categories outlined in **Table C1**, which has been used in this assessment to define the sensitivity of receptors to air quality impacts.

Table C1 Methodology for Assessing Sensitivity of a Receptor to Air Quality Impacts

Sensitivity	Criteria
Very High	Receptors of very high sensitivity to air pollution (e.g. dust or odour) such as: hospitals and clinics, retirement homes, painting and furnishing businesses, hi-tech industries and food processing.
High	Receptors of high sensitivity to air pollution, such as: schools, residential areas, food retailers, glasshouses and nurseries, horticultural land and offices.
Medium	Receptors of medium sensitivity to air pollution, such as: farms, outdoor storage, light and heavy industry.
Low	All other air quality sensitive receptors not identified above.

Magnitude of Impact

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions. **Table C2** outlines the methodology used in this assessment to define the magnitude of the identified potential air quality impacts.

Table C2 Methodology for Assessing Magnitude of Impacts

Magnitude	Description
Substantial	Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial)
Moderate	Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse)
Slight	Predicted impact may be tolerated.
Negligible	Impact is predicted to cause no significant consequences.

Significance of Impact

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table C3 Impact Significance Matrix

	Magnitude	[Defined by Table C2]			
Sensitivity		Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
[Defined by Table C1]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

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