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Trinity Point Marina and Mixed Use Development

Air Quality Assessment

Report Number 610.14910-R1

5 March 2015

Johnson Property Group Pty Ltd
c/- ADW Johnson Pty Ltd
7/335 Hillsborough Rd
Warners Bay
NSW

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Trinity Point Marina and Mixed Use Development

Air Quality Assessment

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Executive Summary

The potential air quality impacts associated with the construction and operation of the Trinity Point Marina and Mixed Use Development (as sought to be modified) have been reviewed and a qualitative risk-based impact assessment undertaken to identify a range of suitable control measures available to mitigate those impacts. Applicable guidelines and policies have also been identified.

The risk assessment has determined that where dust impacts and impacts associated with fuel combustion are unmitigated during the construction phase, an impact significance of ***intermediate*** exists for residential receptors situated greater than 10 m from the site. These impacts can be mitigated through the application of a range of air quality control measures to result in a final impact of ***neutral*** significance. Given the potential absolute increase in traffic volumes, an impact significance of ***intermediate/minor*** exists during the operational phase with impacts mitigated through improvements in vehicle design resulting in a reappraised ***neutral*** impact significance. Unmitigated impacts associated with odour from sewage, dust and combustion products from vessel operation, and VOCs from fuel delivery, storage and dispensing, result in an impact of ***neutral*** significance for those residential receptors located greater than 10 m of the site.

The predicted air quality impacts are anticipated to be largely controllable through a range of mitigation and control measures including good site management and housekeeping, vehicle maintenance and through application of appropriate air quality mitigation measures where required. Site specific mitigation measures have been detailed in **Section 8**.

The reappraisal of the predicted air quality impacts has been undertaken assuming that site specific and site appropriate mitigation measures will be employed at the Development during the construction and operational phases. The results of the reappraisal show that reduced impact significance may be achieved for all emission sources where site specific mitigation measures are effectively employed (refer to **Section 9)**.

It is considered that the proposed modification will result in a slight reduction to the predicted impacts upon surrounding receptor locations when compared to the approved concept design (as summarised in **Table 22**, **Section 10**). No new sources of air impacts are identified in the proposed modification. Given the magnitude of construction activities, the impacts predicted for the approved and modified concepts would be similar. During operation, impacts on air quality are likely to be lower than those approved in the concept design given the removal of the boat repair facility.

It is considered that the predicted negligible impact significance would result through good site management practices and ongoing vehicle emission improvement. It is also a function of the good air quality currently experienced at the Development site, and the capacity of the receiving environment to assimilate any additional emissions without resulting in exceedances of health based air quality criteria.

Table of Contents

Table of Contents

Table of Contents

Table of Contents

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

ADW Johnson Pty Ltd has been commissioned by Johnson Property Group Pty Ltd to prepare numerous Section 75W modifications and development applications for a proposed 188 Berth Marina (staged) and Mixed Use Development with associated building, parking, services, structures and ancillary works including stormwater and landscaping at Trinity Point, Morisset Park, NSW.

The vision of Johnson Property Group Pty Ltd (JPG) is to create a world class land and water based destination development that forms part of an experience and interaction with Lake Macquarie. The proposal is being undertaken in accordance with the Trinity Point Marina and Mixed Use Development Concept Approval (06_0309), which was granted by the NSW Minister for Planning on 5 September 2009 and currently includes the following (subject to modifications, further details below):

- 188 berth marina, associated offices, maintenance and facilities;
- 150 accommodation units comprised of 75 tourist units and 75 residential units;
- Restaurant, café, function centre, shops and office; and
- Parking, landscaping and boardwalk.

1.1 Background

ADW Johnson Pty Ltd, on behalf of Johnson Property Group Pty Ltd, has commissioned SLR Consulting Australia Pty Ltd (SLR) to perform an Air Quality Impact Assessment (AQIA) of the Development Concept Approval (06_0309) and all subsequent Section 75W Modification (MOD) applications for the Development. To date, a total of five modification applications have been made since initial Development Concept Approval was granted. This report supports the modification applications as a consolidated package and considers the potential air quality impacts of the proposed Development as proposed to be modified other than Mod 3 (refer below). NSW Department of Planning and Environment (DPE) requested a revised air quality assessment relating to Mod 5 (refer below). The modification applications made by the proponent to date include:

- MOD 1 & MOD 4 - To extend the lapse date of the Concept Plan approval to align with Schedule 6A(11)(3) of the *Environmental Planning & Assessment Act (EP&A Act) 1979* (which is 5 years after the repeal of Part 3A resulting in a modified lapse date of 1 October 2016).

  MOD 1 and MOD 4 were approved by the NSW DPE on 1 April and 26 August 2014, respectively.

- MOD 2 - Was lodged with the NSW DPE in September 2013 relating to the staging of the marina and the timing of several condition requirements. Since lodgement, the marina design has been reviewed, improved and further developed by the proponent with involvement from industry experts and operators. On 15 August 2014, the proponent updated the MOD 2 application before the NSW DPE to incorporate the Condition B1 approved concept layout and a range of other modifications.

  Assessment of MOD 2 by NSW DPE has recently been completed, with a recommendation supporting the modification forwarded to the Planning Assessment Commission during March 2015.

- MOD 3 – Was submitted to the NSW DPE for the addition of a helipad to the Concept Plan approval. Environmental Assessment Requirements for the modification and preparation of an EIS for an associated Development Application have been issued by the NSW DPE.

  The Environmental Assessment relating to MOD 3 is currently being prepared by the proponent.

- MOD 5 – Relates to non-marina based components of the project and primarily seeks building height and form changes and additional capacity for short stay and residential accommodation.

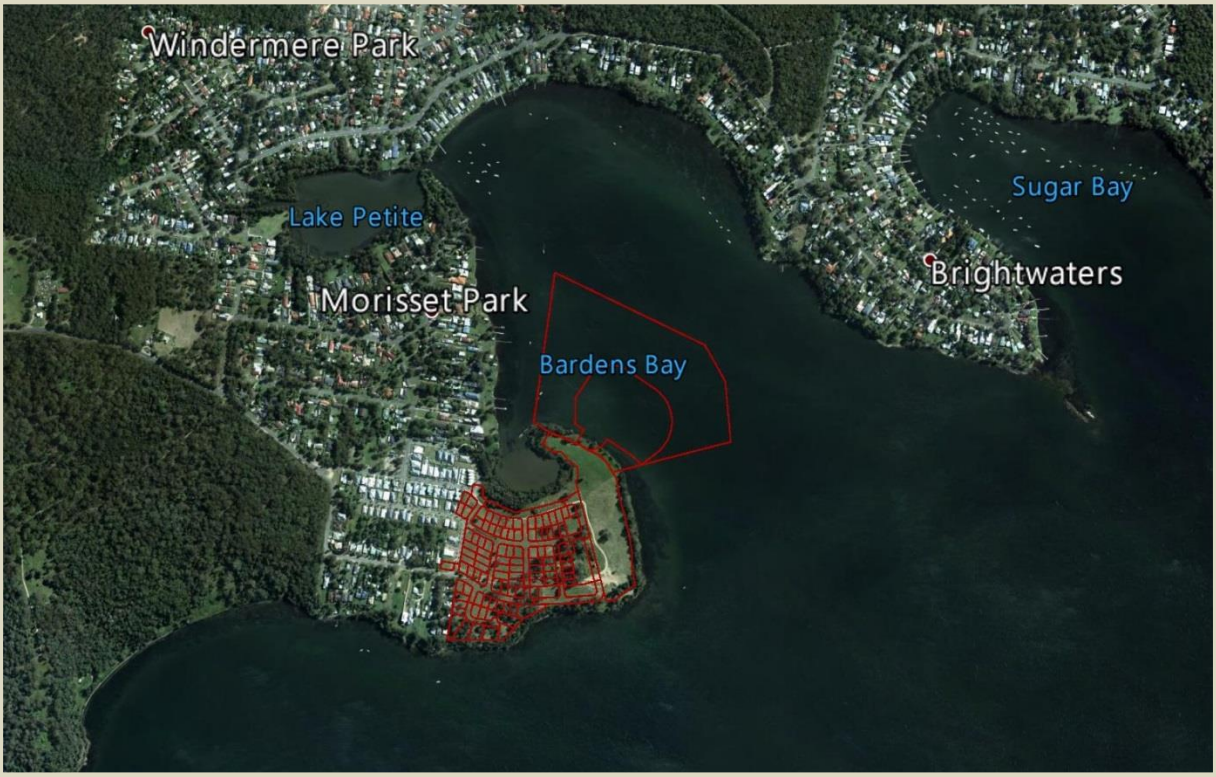
  MOD 5 is currently under assessment by the NSW DPE The request for an updated AQIA has arisen from Mod 5

1.2 Project Location

The proposed marina and mixed use development is located in Bardens Bay, approximately 5 kilometres (km) east southeast of Morisset, 125 km north of Sydney and 30 km southwest of Newcastle within the Local Government Area (LGA) of Lake Macquarie.

The Development site is located on the Morisset peninsula and is bound by public reserve and the waters of Lake Macquarie to the north and east, and an unnamed bay to the west. An approved and currently under construction residential subdivision is also located to the immediate west of the Development site. The location of the Development site, current residential areas and the residential subdivision currently under construction is presented in **Figure 1**.

Figure 1 Trinity Point Marina and Mixed Use Development - Location



Source: ADW Johnson Pty Ltd, January 2015

The proposed marina and mixed use Development site is primarily Lot 31 DP 1117408 but also includes Part of Lot 32 and Lot 34 DP 1117408 (Public Reserve) and part of Lake Macquarie (Crown Land Reserve 10121129).

1.3 Objective

The objective of this assessment is to assess the impact upon air quality of the construction and operation of the proposed Development in accordance with the Director General's Requirements (DGRs) as provided to the proponent on 17 March 2008. As identified above, a number of modifications to the Development Concept Approval have been submitted since the provision of the DGRs in 2008. This report has been requested to be provided to consider the resulting impact of these modifications upon air quality (excluding Mod 3).

The DGRs as provided in 2008 required the proponent to:

- Address the potential marina impacts on air quality including dust generation during construction activities and boat maintenance and repairs.

It is noted that the emphasis of the 2008 DGRs (and the AQIA that accompanied the Concept Plan application) was for the marina component of the project. It is noted that subsequent to the approval of the Concept Plan, the boat maintenance workshop, servicing and apron areas are sought to be deleted through MOD 2 and have therefore been excluded from assessment within this report. That modification effectively removes numerous previously reported potential air quality impacts for operation of the marina and the overall project.

For clarification purposes, this assessment will consider the following potential impacts upon air quality resulting from construction and operation of the:

- 188 berth marina.
- Office, chandlery, boat sales area and onshore amenities including the marina lounge.
- 300 seat function centre and 100 seat lawn area (temporary marquee)
- 200 seat restaurant.
- 40 seat café.
- 115 seat outdoor dining area (across multiple areas).
- Shops, serviced meeting rooms, sales centre and associated operational spaces.
- Up to 158 short stay hotel rooms / apartments and associated guest facilities
- Up to 157 residential accommodation units.

The proposed footprint of the Development has been altered from the Concept Plan Approval. Although not likely to result in significant changes to the air quality impact of the development, during either construction or operation, these changes to the footprint design have been considered within this AQIA report.

The proposal for a helipad is excluded from this assessment.

1.4 Approach to Assessment

The AQIA will utilise qualitative assessment techniques where it is considered reasonable that air quality management practices and techniques can control and manage the potential impacts effectively.

It is noted that Arup provided an air quality assessment of the original proposed concept (Arup, 2008). The air quality assessment provided by Arup (2008) provided a high-level, qualitative assessment of potential impacts in accordance with the DGRs as outlined above. It is noted that the concept approval was granted for a smaller concept than reported by Arup (2008), with key differences being a smaller marina, removal of the helipad and a change in site planning and built form (and associated excavation).

Given the proposed modifications to the Development, it is considered that the potential impacts resulting from the currently proposed development are likely to be less than those presented in Arup (2008) and relied upon in granting the concept approval. Furthermore, given that the performance of a quantitative assessment may be limited by data availability (e.g. tonnes material moved per hour by specific location during the construction phase etc.) it is considered that the performance of qualitative approach to this assessment is appropriate, as was accepted and relied upon for the original Arup report.

A “risk-based” approach has been adopted for the activities associated with construction and operation of the Development. 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 sensitivity with impact magnitude is used to derive the predicted significance of that change. Given the scale and nature of the operations proposed to be performed, it is considered that this approach is suitable.

1.5 Terminology

Specific air quality terminology is used within this assessment. An explanation of common air quality terms is included as **Appendix A**.

2 PROJECT DESCRIPTION

The proposed Development includes the following key elements:

- 188 berth marina.
- Office, chandlery, boat sales area and onshore amenities including the marina lounge.
- 300 seat function centre and 100 seat lawn area (temporary marquee).
- 200 seat restaurant.
- 40 seat café.
- 115 seat outdoor dining area (across multiple areas).
- Shops, serviced meeting rooms, sales centre and associated operational spaces.
- Up to 158 short stay hotel rooms / apartments and guest facilities.
- Up to 157 residential accommodation units.

2.1 Marina – Water Based

The water based components of the proposed marina are to be constructed in up to five stages (as recommended within MOD 2), with the development of berths beyond the first 94 berths dependent on the occupancy and environmental performance of the first 94 berths. For the purposes of this assessment, all stages have been assumed to be constructed.

The berths will be accessible from a floating pontoon boardwalk connected to the land via a hinged aluminium gangway and fixed jetty. The fixed jetty connects to the shore based timber platform and raised boardwalk with the platform, boardwalk and steps sited across the Council reserve. A separate fuel and sewage pump out floating pontoon wharf (which will be integrated into the final 188 berth marina pontoon system) will be available to the public.

The sewage pump out will include a purpose dockside discharge unit connected back to shore based infrastructure with infrastructure integrated into the wharf, gangway, jetty and boardwalk designs. Similarly the fuel dispenser (diesel and premium unleaded) will connect back to shore based infrastructure, with fuel transfer via appropriate double walled pipework integrated into the wharf, gangway, jetty and boardwalk designs.

Provision of services (water, power, lighting, fire hose reels) to berths will be via service conduits incorporated into the jetty, gangway and pontoon.

2.2 Marina – Land Based

The land based component of the permanent marina building and operations include:

- Marina office and chandlery, with rainwater tanks and trolley storage under facing carpark.
- En-suite bathroom facilities and separate laundry for marina users (secure).
- General public toilet facilities (male, female and accessible) (under management).
- Marina lounge
- Raised terrace along edge of building facing the foreshore, with stairs and ramp connections to marina, public shared pathway and car parking.
- Emergency shed and temporary marina ‘Back of House’ (screened and roofed) to include waste bins and storage, including general waste and recycling bins and covered storage for 1000 L waste oil tank, 1000 L waste water tank and batteries.

The proposed marina includes access driveways, car parking, stormwater and utilities including:

- Two way 6.5m wide access driveway from the corner of Trinity Point Drive around the western perimeter of the site, past the marina building and to the main marina carpark.
- Sealed 46-47 space marina carpark in northern part of site to include underground fuel and fuel and waste truck manoeuvring.
- Temporary additional sealed 5 space carpark (screened) with access to main driveway to the rear of the marina lounge building, including 2 accessible carparks.
- Stormwater management infrastructure (including water quality management) for site works, car parking and buildings, including roof water collection of rainwater to two tanks (2 x 5KL) for reuse, bio-retention basin areas, with biofiltration filter and sub soil drainage around the perimeter of the carpark.

Shore based utility infrastructure will include:

- Electrical kiosk and easements, private electrical switchboards, cabinets and lines.
- Shore based fire hydrants and required private water reticulation to external network.
- Underground fuel storage tanks and dispensing unit for diesel and premium unleaded petrol with double walled fibreglass split tank with capacity up to 30,000 L.
- Rising main to connect Dockside Sewage Discharge Unit and separate sewer gravity main connection, both to wastewater infrastructure to be built as part of the adjoining residential estate.

2.3 Tourism and Hospitality Precinct

The proposed Tourism and Hospitality Precinct will include:

- Two storey (on podium) hospitality building including restaurant, café, function centre, outdoor seating and lineal resort pool.
- Three and Four storey hotel accommodation and marina building (integrates and ‘subsumes’ marina building as described in Section 2.2 above) including parking, hotel rooms, day spa, services meeting rooms, guest facilities, shops and sales centre, with loading bay and waste storage area.
- Roundabout at site entry.
- Under croft parking area (under podium).
- Landscape podium and lawn area for temporary marquee.
- Through site and perimeter pedestrian works including public access.
- Separate temporary overflow parking area off Trinity Point Drive (south).
- Stormwater management including rainwater reuse tanks (2 x 10000L tanks per building) plus GPT and bio-retention areas
- Utility infrastructure extensions

This is likely to be constructed as one stage, potentially linked to the land based marina building and site works.

2.4 Accommodation Precinct

The proposed Accommodation Precinct will include:

- Eight (8) apartment buildings positioned through the central and southern parts of the site, consisting of six x four (4) storey and two x three (3) storey buildings, with basement/semi-basement parking and internal access ways.
- Short stay (serviced apartment) accommodation (total number being 158 less the number of hotel rooms proposed elsewhere on site), sited as part of the first three (3) apartment buildings adjoining the hospitality precinct).
- Dual use short stay/permanent residential accommodation units (total number being 157, subject to total number of short stay accommodation apartments achieved), distributed in the remaining five (5) apartment buildings and part of the first three (3) buildings.
- Through site and perimeter pedestrian works including public access, and landscaping with associated stormwater management, waste management and utility infrastructure.

This is likely to be constructed in at least two stages, of four buildings and associated basement/semi-basement parking and ground plane works per stage.

3 POTENTIAL AIR QUALITY IMPACTS

3.1 Construction Phase Emissions

Potential environmental impacts associated with the construction phase may arise from:

- Dust emissions from construction phase activities, including:
  - site clearance;
  - site preparation and grading;
  - construction of services and temporary structures; and
  - windblown materials from stockpiles.
- The emission of ground contaminants from construction phase activities, in particular excavation or other ground invasive activities.
- The emission of products of combustion from construction phase plant and machinery.

Given the current form of the site it is not considered that any demolition activities will be required to be performed.

3.1.1 Dust Emissions from Construction Phase Activities

During the construction phase, the potential for dust to be emitted from the development site will be directly influenced by the nature of the activities being performed. Excavation works in particular are anticipated to potentially cause short-term emissions of dust, which would require the application of suitable dust control measures. Additional activities may also lead to short-term emissions of dust, including:

- loading and unloading of materials.
- wheel-generated dust from trucks travelling along unpaved roads.
- wind erosion off exposed surfaces.

These activities should be managed appropriately to ensure off-site impacts are minimised.

Temporary elevation in the emissions of particulate matter and local dust is considered to be inevitable as part of the construction works, particularly where those activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration. Unlike other pollutants, the presence and deposition of dust is dependent upon the distance from source to receptor and the prevailing meteorological conditions.

Dust emissions may be effectively managed at the source through the implementation of appropriate measures. Please refer to **Section 8** for control measures.

Proactive measures for dust control are detailed within the Construction Environmental Management Plan (CEMP) for the Stage 1 marina (Section 7.2 of the Trinity Point Lake Macquarie Skeleton Construction Environmental Management Plan [Royal HaskoningDHV, 2014]). The CEMP provides a description of dust management measures, dust suppression measures (e.g. water bowsers and sprays) which may be employed to damp-down earthworks or hard-standing areas during construction and appropriate management of stockpiled materials but should also include the identification of conditions during which dust-generating activities may be curtailed or ceased, visual inspection of off-site compliance, and a clear communication strategy for the management and prompt investigation of dust complaints.

Reference should be made to Section 4.16 of the NSW EPA's Local Government Air Quality Toolkit, "*Module 1: Air pollution control techniques*" for an overview of dust suppression techniques and management strategies (see **Section 8**).

The indicative construction schedule for the Development (all Stages 1 - 4) identifies that all construction works may be completed within a period of approximately 21 months, other than the final 94 marina berths which are subject to certain hold points pending performance and occupancy of the first 94 marina berths. Given that the construction works will be staged, maximum overlap of construction on all stages will be limited to a period of approximately 5 months. Appropriate implementation of dust control measures should ensure that these works result in minimal impacts on surrounding land uses.

3.1.2 Emission of Ground Contaminants from Construction Phase Activities

An assessment of baseline sediment quality data has indicated that the lake bed sediments at the site are generally not contaminated although slightly elevated concentrations of arsenic and cadmium have been detected (Royal HaskoningDHV, 2014). Section 4.9.2 of the EIS for the Development (September 2014) identifies that during the Concept Approval for the overall site through previous contamination assessment, audit and validation that the land is not constrained by contamination and no further assessment of land contamination is necessary.

Given that no dredging or removal of marine sediment is required to develop the marina, and no contamination of land based sediment has been identified, the risk of volatilisation of ground contaminants is considered to be negligible and is not considered further.

3.1.3 Products of Combustion from Construction Phase Plant and Machinery

Exhaust emissions from cranes, trucks, plant and other equipment associated with the construction of the marina may be regarded as an additional source of emissions to air on the local network and at the site during the construction phase.

Given the nature of the development, it is considered that the number and scale of construction plant and machinery, and road traffic vehicles is considered to be small. Therefore, the potential for exhaust emissions from the construction phase is considered to be correspondingly low. Given that the current level of vehicle traffic in the area is low the potential impacts of the additional exhaust emissions associated with vehicles and plant on site is considered to be short term in nature and is unlikely to significantly impact on local air quality.

The management measures put in place for both developments would ensure that minimal cumulative impacts would exist, should the construction of the Development occur at the same time as the construction of the residential development to the west of the site. The air quality criteria relevant to products of combustion are presented in **Section 4**, and a qualitative assessment of the impacts on the surrounding environment is presented in **Section 7** with a description of mitigation measures provided in **Section 8**.

3.2 Operational Phase Emissions

During the operation of the development potential impacts to air quality may be associated with:

- Emission of products of combustion from operational phase traffic.
- Emission of products of combustion and potential odour from the operation of pump facilities associated with the sewage pump-out.
- Emission of products of combustion and dust from helipad use.
- Emission of products of combustion from vessel use.

3.2.1 Products of Combustion from Operational Phase Traffic

In order to address the potential impact upon air quality associated with the anticipated increase in traffic, reference needs to be made to the anticipated traffic numbers and associated potential congestion. The external traffic implications of this development have been assessed by Seca Solution Pty Ltd in their report*, Traffic Impact Assessment (Modification 5 to MP06_0309)*(October 2014).

The traffic and transport assessment concentrates on anticipated traffic flows to the Development during peak summer events. The projected weekday traffic generation of the Development is 245 vehicles/hour in the morning and 412 vehicles/hour in the afternoon which is within the capacity of the local road network. These increases in vehicle movements would generally coincide with school holiday and long weekend periods when background traffic movements would be lower. Heavy rigid vehicles flows are expected to be minor during operation and consist of garbage trucks and fuel supply vehicles. The majority of vehicles using the site will be cars, 4WD, "HI Ace" type delivery vehicles and occasional buses.

The traffic generation rates presented above do not take into consideration that cross-uses of facilities may occur, and the traffic assessment considers that should visitors use more than one facility at the site, trip generation rates may be reduced by 141 vehicles/hour (morning and afternoon peak periods). In addition, the impact of seasonal uses and lower occupancy are identified that peak hour traffic may reduce down to 100 vph in the morning and 253 vph in the afternoon. No queues are expected to occur at the site entrance / exit points.

In light of the conclusions of the traffic and transport assessment, the increase in anticipated traffic movements will be offset by a number of potential cross uses, trip containment and shared use within the site as well as the operational characteristics of the site itself. Given the current low levels of vehicle use on the surrounding road network, the anticipated increases in traffic generation and impact of traffic exhaust emissions would be low. The impact of the increased traffic upon air quality is therefore not considered to represent a significant constraint to the development or sufficient to warrant a quantitative assessment.

3.2.2 Products of Combustion and/or Odour from the Sewage Pump-out

It is anticipated that sewage pump out will be available via a floating pontoon wharf. The sewage pump out will be connected back to shore based infrastructure, specifically the rising main and sewer gravity main which will be built as part of the development and extended to infrastructure constructed in the adjoining residential estate.

The design of the pump out system should be fully contained and therefore there is unlikely to be any residual odour from the pump out of waste from the sewage pump out system. However, in the event of failure, odour may be released.

The associated pump will be electric or gas powered. Given the transient use of the pump out facility it is unlikely that the products of combustion emitted from a gas fired pump would be significant. An electric powered pump would not produce any exhaust emissions to atmosphere.

The relevant air quality criteria are presented in **Section 4**, and a qualitative assessment of the impacts on the surrounding environment is presented in **Section 7.4** with a description of mitigation measures provided in **Section 8**.

3.2.3 Volatile Organic Compounds (VOCs) from Fuel Delivery, Storage and Dispensing

The fuel storage system will include up to a 30,000 litre (L) underground double walled fibreglass tank (split between 20,000 L diesel and 10,000 L unleaded petrol). The fuel storage and dispensing facility will be designed to Australian Standard AS 1940-2004 *The storage and handling of flammable and combustible liquids*. A Construction Environmental Management Plan (CEMP) will cover all construction works inclusive of the tank.

Filling of the underground tanks will occur via a small tanker truck, which will access the tank through two filling wells located within the marina car park. At the filling location, a sealed hardstand area will be provided that drains centrally to a sump. The tank system will include its own automatic tank gauging and fuel management system that includes an automated shutoff if a leak is detected. Additional controls will include manual shut-off procedures as close of shift, such that if a leakage occurs, minimal spill occurs. The underground tanks will also have standard groundwater monitoring wells to monitor for leakage from the tanks.

Delivery to the fuel wharf is via appropriate double walled pipework integrated into the wharf, gangway, and jetty designs.

The fuel dispenser for vessels is sited on the floating pontoon wharf (on the same wharf as sewage pump out). The fuel is dispensed to yachts via electric submersible pumps. The design of the pump out system is fully contained (i.e. reciprocating pumps) and therefore there is unlikely to be fugitive emissions of VOCs from the fuel dispensing process. However, in the event of failure, fugitive emissions may be released.

Additional procedures will be implemented to manage the release of emissions from fuel dispensing including the restriction that fuel is only pumped by marina operators to limit misuse and spills. A Fuel Management Plan will be required under EPA licence to operate marina.

3.2.4 Products of Combustion from Vessel Operation

Exhaust emissions from the various vessels using the marina will vary depending on the age, condition, engine size and fuel type of vessels. Such emissions are difficult to control by the proponent, although it is anticipated that the number of vessels in operation at any one time will be small and the resulting impact on local air quality will be minor.

4 RELEVANT AIR QUALITY CRITERIA

A general overview of key pollutants associated with the proposed Development is provided below. These pollutants are primarily associated with the potential for airborne particulate matter and products of combustion such as volatile organic compounds (VOCs), oxides of nitrogen (NO_X), sulphur dioxide (SO_2) and carbon monoxide(CO) to be generated during construction, and products of combustion and odour emissions to be emitted during the operation of the Development.

State air quality guidelines adopted by the NSW EPA are published in the *Approved Methods and Guidance For the Modelling and Assessment of Air Pollutants in New South Wales* (NSW DEC, 2005) (The Approved Methods). The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Development. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, WHO and ANZEEC). 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.

4.1 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 30 µg/m^3.

The Approved Methods do not set any assessment goals for $PM_{2.5}$. In December 2000, the National Environment Protection Council (NEPC) initiated a review to determine whether a national ambient air quality criterion for $PM_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

- there are health effects associated with these fine particles;
- the health effects observed overseas are supported by Australian studies; and,
- fine particle standards have been set in Canada and the USA, and an interim criterion is proposed for New Zealand.

The review concluded that there is sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003, a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5}$, setting the following Interim Advisory Reporting Standards for $PM_{2.5}$:

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

It is noted that the NEPM Advisory Reporting Standards relating to $PM_{2.5}$ particles are reporting guidelines only at the present time and not intended to represent air quality criteria. A summary of the particulate guidelines is shown in **Table 1**.

Table 1 EPA Goals for Particulates

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual	50 µg/m^3 30 µg/m^3
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)

4.2 Nuisance Impacts of Fugitive Dust Emissions

The preceding section is concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also 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 2 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 2 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, NSW DEC 2005.

4.3 Oxides of Nitrogen (NO_X)

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 soon 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

4.4 Carbon Monoxide (CO)

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.

It can be a common pollutant at the roadside and highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow.

The goals specified within the Approved Methods for CO are provided in **Table 4**.

Table 4 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

4.5 Sulphur Dioxide (SO_2)

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

4.6 Volatile Organic Compounds (VOCs)

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. Impacts due to emissions of VOCs can be health or nuisance (odour) related.

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. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels. Biogenic (natural) sources of VOC emissions are also significant (e.g. vegetation).

4.7 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 1 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 factors including population sensitivity, background level, public expectation (considered offensive or easily tolerated), source characteristics (i.e. emitted from a stack or general area) and health effects.

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.

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.

A summary of the impact assessment criteria given for various population densities, as drawn from the Approved Methods, is given in **Table 6**. 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).

Table 6 Impact Assessment Criteria - Complex Mixtures of Odorous Air Pollutants (nose-response-time average, 99th percentile)

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (OU)
Urban area ($\geq$ 2000)	2
~500	3
~125	4
~30	5
~10	6
Single residence ($\leq$ 2)	7

Source: Approved Methods 2005

4.8 Summary of Air Quality Impact Assessment Criteria

The air quality goals adopted for this assessment, which confirm to current EPA and Federal air quality criteria, are summarised in **Table 7**.

Table 7 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3 (NSW EPA)
PM_{10}	24-hour	50 µg/m^3 (NSW EPA)
	Annual	30 µg/m^3 (NSW EPA)
$PM_{2.5}$	24-hour	25 µg/m^3 (NEPM interim advisory reporting standard only)
	Annual	8 µg/m^3 (NEPM interim advisory reporting standard only)
Dust Deposition	Annual	Maximum Incremental (Project only) increase of 2 g/m^2/month Maximum Total of 4 g/m^2/month (Project and other sources)
NO_2	1-hour	246 µg/m^3 (NSW EPA)
	Annual	62 µg/m^3 (NSW EPA)
CO	15-min	100 mg/m^3 (NSW EPA)
	8-hour	10 mg/m^3 (NSW EPA)
SO_2	10-min	712 µg/m^3 (NSW EPA)
	1-hour	570 µg/m^3 (NSW EPA)
	24-hour	228 µg/m^3 (NSW EPA)
	Annual	60 µg/m^3 (NSW EPA)
Odour	Nose response time, 99th percentile	2 OU

Source: Approved Methods, NSW DEC 2005, WHO 2005.

Note: Criteria adopted from the Approved Methods, as per the Arup (2008) assessment

These air quality criteria are presented for information only as this assessment considers impacts on a qualitative basis.

5 AIR QUALITY POLICY AND GUIDANCE

The following Air Quality Policy and Guidance documents have been referenced within this assessment.

5.1 Approved Methods

The EPA's Approved Methods publication lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2002 for assessment of impacts of air pollutants.

The air quality criteria outlined in the Approved Methods have been reproduced and discussed in **Section 4**.

5.2 Odour Technical Framework and Notes

The EPA's Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework and Technical Notes) publications provide a policy framework for assessing and managing activities that emit odour and offers guidance on dealing with odour issues. These documents are required to be referenced when assessing any odour issue in NSW.

5.3 Separation Distances Guidelines

In situations where the specifics of a development are unknown (i.e. the potential locations of residential developments, or the nature, scale and potential impact of industrial or commercial land uses), the application of buffer distances provide a valuable 'screening' tool to judge whether a detailed assessment is required to evaluate the potential risk of conflicting land uses.

The NSW EPA has not published buffer distances that may be used to reduce the possibility of conflicting land uses in NSW. In lieu of relevant NSW guidance, reference has been made to Victoria Environment Protection Authority (VIC EPA) documentation for buffer distances. In accordance with Clause 13.04-2 (Air Quality) of Victoria's State Planning Policy Framework, all planning must consider VIC EPA's "Recommended Separation Distances for Industrial Residual Air Emissions" (2013). In their document, VIC EPA makes recommendations for assessing appropriate separation distances where amenity may be reduced for sensitive or incompatible land uses. Sensitive land uses which warrant protection from amenity-reducing off-site effects of industry by maintenance of a buffer distance include residential areas and zones, hospitals and schools. Unfortunately, no buffer distance has been established for the operation of marinas or boating facilities in the Victorian document.

The Clean Air Society of Australia and New Zealand (CASANZ) has published draft guidelines for the use of regulators, planning authorities, developers, planning consultants and the community as a tool in the development application process for new or expanding developments. The recommended separation distances are used to ensure that incompatible land uses are located in a way to minimise the impact caused by odorous activities.

The CASANZ (Clean Air Society of Australia & New Zealand) draft document "*Odour Separation Distances Guidelines*" (March 2008) provides recommendations on odour separation distances for various activities as described in Table 8. These buffer distances are also listed in the SA EPA "*Guidelines for Separation Distances*" (December 2007), and apply to the emissions of air pollutants and odour.

Table 8 Recommended Separation Distances

Activity	Description	Recommended Separation Distance (m)
Marinas and Boating Facilities	Storage	100
	Repair and Maintenance	300

Source: CASANZ (2008), SA EPA (2007)

The separation distances above are provided for initial guidance where site-specific information is not available that adequately describes the various activities that may give rise to nuisance issues (e.g. nuisance odour that may be associated with the emission of volatile organic compounds (VOCs) and other odorous compounds).

In relation to the proposed Development, the scale of activities are considered to be minor, and that the overly-conservative approach, as presented by the separation distances, would over-estimate the potential area of impact. The following assessment has reviewed potential odour sources on a case-by-case basis to determine the potential for odour impacts on the surrounds.

6 THE EXISTING ENVIRONMENT

6.1 Existing Air Quality

6.1.1 NSW OEH Air Quality Monitoring Data

The NSW Office of Environment and Heritage (OEH) maintains a network of air quality monitoring stations (AQMS) across NSW. The nearest OEH AQMS to the proposed Development is located at Wallsend, approximately 28 km to the north northeast of the site.

The Wallsend AQMS was commissioned in November 1992 and is located in the grounds of the Newcastle City Council Swimming Pool, off Frances Street, Wallsend. The monitoring site is situated at an elevation of 8 metres Australian Height Datum (AHD) in a residential area in the OEH's Lower Hunter region.

A number of air pollutants and meteorological variables are currently measured at Wallsend AQMS including:

- Ozone (O_3).
- Oxides of nitrogen (NO, NO_2 & NO_X).
- Sulphur dioxide (SO_2)
- Fine particles (by nephelometry).
- Fine particles (PM_{10} and $PM_{2.5}$ using a Tapered Element Oscillating Microbalance [TEOM]).
- Wind speed, direction and sigma theta.
- Ambient temperature.
- Relative Humidity.
- Nett radiation.

Air quality data collected at the Wallsend AQMS has been chosen as representative data available for the assessment of background conditions.

NSW OEH verified data was obtained for the Wallsend AQMS for the calendar years 2009 - 2013. This data is summarised in **Table 9** below and shows no exceedances of the relevant OEH criteria were measured for these pollutants during 2010, 2011 and 2012. Exceedances of the 24-hour average PM_{10} concentrations occurred in 2009 and 2013 due to a dust storm and bushfires, respectively.

Table 9 Wallsend AQMS Data

Year	NO_2 (pphm)		SO_2 (pphm)			PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)	
	Hourly Max	Annual Average	Hourly Max	24 hour Max	Annual Average	24 hr Max	Annual Average	24 hr Max	Annual Average
2013	4.3	0.8	5.0	0.5	0.1	52.5	17.4	37.0	7.7
2012	3.4	0.8	3.5	0.5	0.1	38.1	14.9	16.2	5.1
2011	3.7	0.8	4.4	0.7	0.1	38.9	14.2	16.2	4.8
2010	3.8	0.9	3.1	0.7	0.1	32.8	14.7	18.8	4.6
2009	4.0	0.8	4.4	0.7	0.1	179.5	19.9	50.5	6.8
Criterion	***12***	***3***	***20***	***8***	***2***	***50***	***30***	***25***	***8***

Notes:

1. Exceedances in 2009 associated with major dust storm activity
2. Exceedances in 2013 associated with bushfire activity

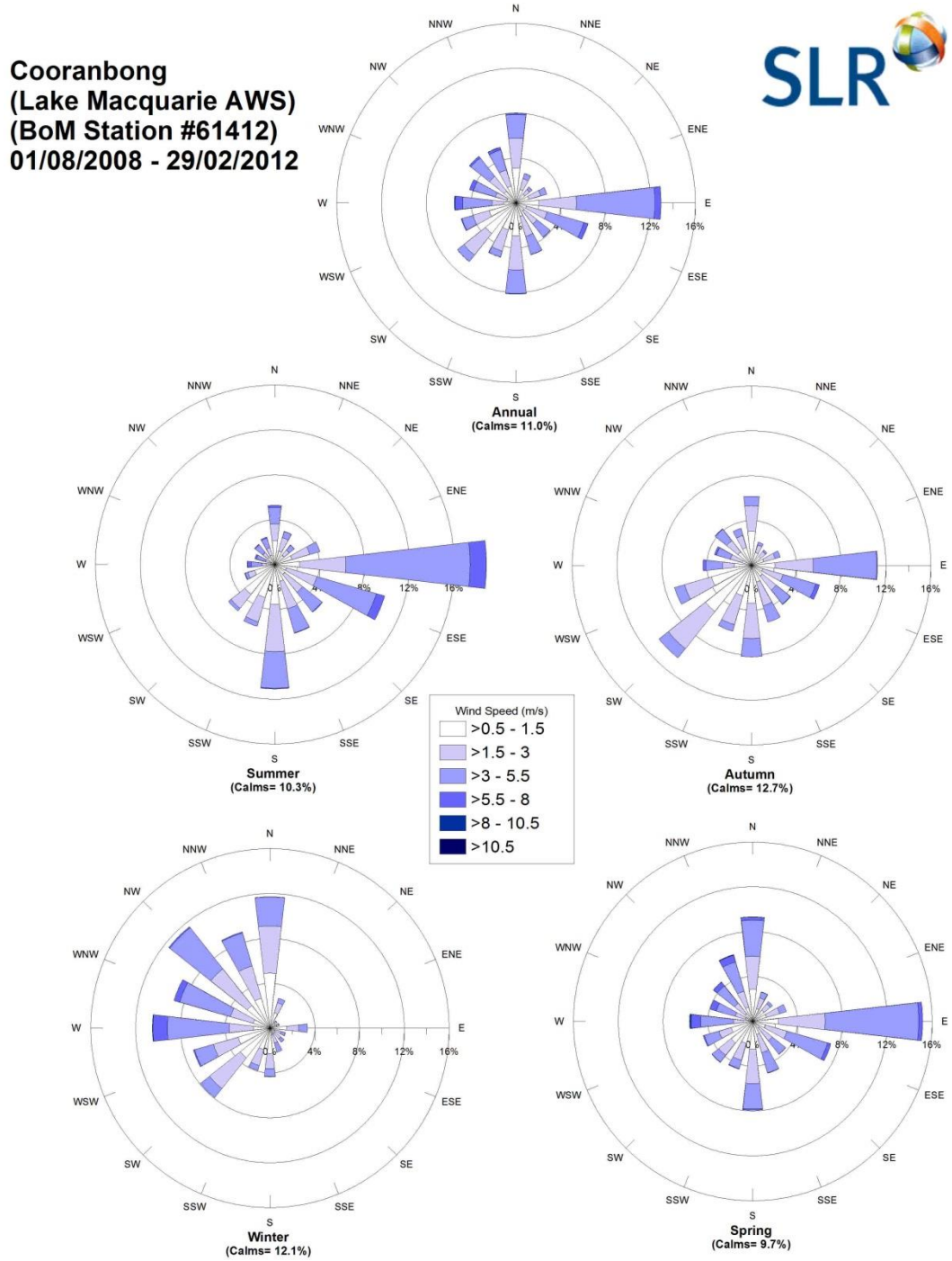
6.2 Local Meteorology

6.2.1 Local Wind Conditions

The nearest and most representative Bureau of Meteorology (BoM) Automated Weather Station (AWS) to the site is located at Cooranbong (Lake Macquarie) (Station Number: 0061412) approximately 8 km to the northeast. Cooranbong (Lake Macquarie) AWS is situated at an elevation of 6 m Australian Height Datum (AHD).

In the absence of site specific data, data from the Cooranbong (Lake Macquarie) AWS was chosen as the most representative meteorological data available for the proposed development site. The AWS begun operation in 2010 and an analysis of wind data for 2010 to 2013 at Cooranbong (Lake Macquarie) AWS indicates that easterly winds are the predominant winds experienced at the site (refer to **Figure 2** for annual and seasonal wind roses).

Figure 2 Cooranbong (Lake Macquarie) AWS Annual and Seasonal Wind Roses, 2010 to 2012



6.3 Surrounding Sources of Emissions to Atmosphere

6.3.1 Licensed Activities

No sources located within a nominal 5 km from the Development are regulated under the National Pollutant Inventory (NPI) or by an Environmental Protection Licence (EPL). It is noted that a number of operating coal mining activities are present within the area surrounding the proposed Development although given the separation distance of >5 km, it is not anticipated that any significant cumulative air quality impacts would be experienced.

6.4 Road Traffic

Road traffic in the local area using the local and arterial road networks are summarised by Seca Solution Pty Ltd in their report*, Traffic Impact Assessment (Modification 5 to MP06_0309)* (October 2014).

Road traffic in the urbanised environment forms a significant source of air pollution. Studies have shown that in urban areas, road traffic exhaust emissions may contribute a significant proportion of particulate emissions, and are also associated with emissions of:

- Oxides of nitrogen (NO_X).
- Carbon monoxide (CO).
- Particulate matter (as PM_{10}).
- Volatile organic compounds (VOCs), particularly benzene (C_6H_6) and 1-3, butadiene (C_4H_6).

Existing and proposed traffic flow data is presented below in **Table 10**. This data has been sourced from the Seca Solution Pty Ltd (2014) report.

Table 10 Summary of Current and Projected Worst Case Daily Traffic Movements

Road	Morisset Park Road	Fishery Point Road	Trinity Point Drive
Existing daily	2,300	10,650	540
Development flows	1,548 – 2,319	1,548 – 2,319	1,548 – 2,319
Adjacent residential flows	1,107	1,107	630
Total flows	4,955 – 5,726	13,305 – 14,076	2,718 – 3,489
Classification capacity (average)	5,000	13,000	5,000

Source: Seca Solution Pty Ltd, Traffic Impact Assessment (Modification 5 to MP06_0309) (October 2014)

7 QUALITATIVE ASSESSMENT OF AIR QUALITY IMPACTS

Given the above description of the construction and operation of the proposed Development, the following describes the potential impacts on the air quality and odour environment surrounding the Development.

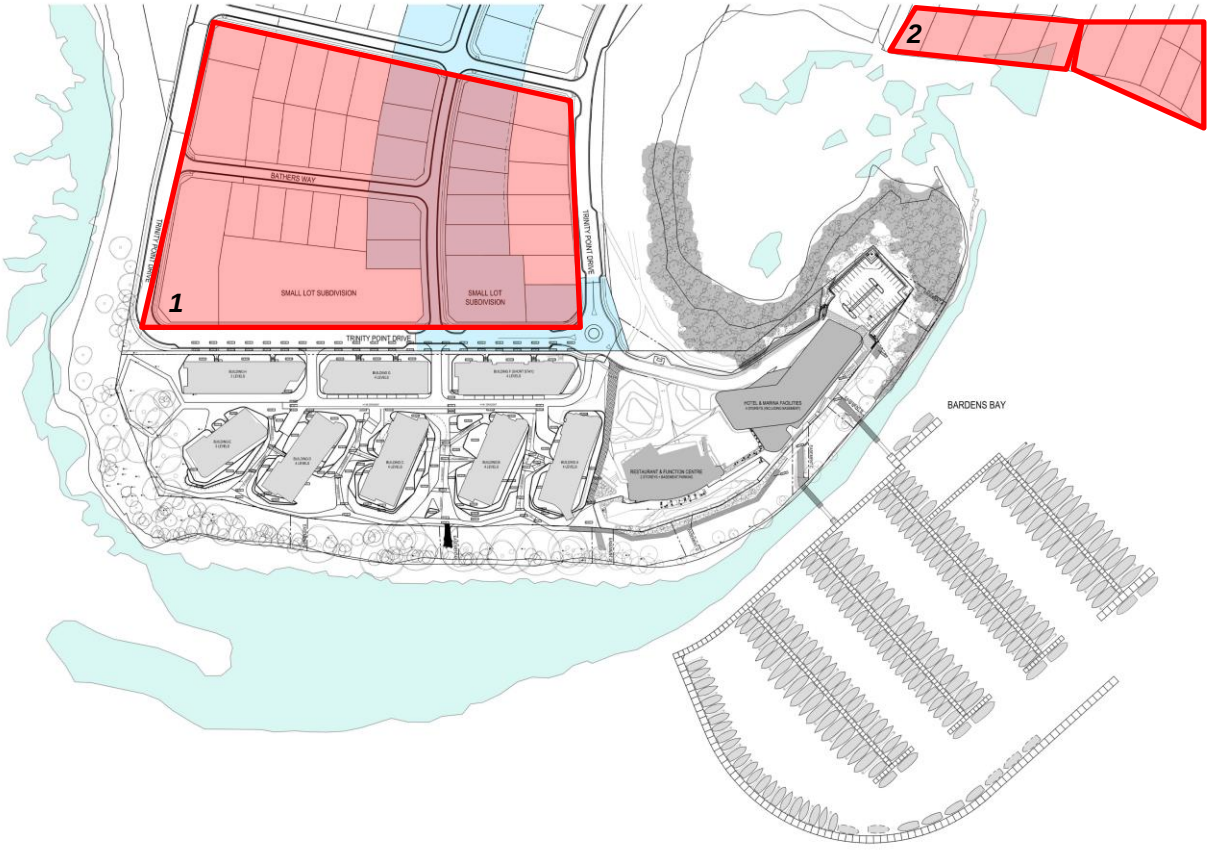
7.1 Sensitive Receptors

Non-Project related residences are located between approximately 20 m and 125 m to the east of the proposed Development (see **Table 11** and **Figure 3**). The residences located to the immediate east of Trinity Point Drive are currently (as of February 2015) under construction although it is conservatively assumed that these will be completed and occupied by the time construction commences on the Development.

Table 11 Sensitive Receptor Locations

Location	Address	Brief Description	Approximate Distance from Development Overlay (m)
1	Trinity Point Drive (new subdivision)	Residential	20
2	Lakeview Road	Residential	125

Figure 3 Indicative Location of Sensitive Receptors



Note: Areas outline are estimation only

7.2 Air Quality Impact Assessment Methodology

A *qualitative* risk-based assessment has been carried out according to the methodology detailed in the subsequent sections. This approach is considered appropriate for the purposes of the project (see justification of this method below). No dispersion modelling or air quality monitoring has been undertaken as part of this assessment.

7.2.1 Overall Approach

Predictions of air quality impacts are necessary when appraising potential future impacts on potentially sensitive land uses. Specific methodologies are described in further detail in the relevant sections of this document however the following broad "risk based" approach has been adopted.

A general construction and operational scenario has been assumed for the Development, based on the information outlined in **Section 3**. A *qualitative* risk-based impact assessment has been undertaken of potential air quality impacts to identify a range of suitable or required control measures available to mitigate those impacts.

Given that these control measures are to be considered for implementation at the source of the potential air pollution (i.e. on site), a significant level of control during site preparatory works may be realised through effective construction site design and management. Qualitative assessment is therefore deemed appropriate to assess the potential for air quality impacts associated with the proposed Development preparatory and construction works. A qualitative approach is also considered to be appropriate for the assessment of operational impacts.

The assessment criteria for receptor sensitivity, impact magnitude and the resultant impact significance have been developed by SLR.

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

- **Nature of impact**: is the impact anticipated to result in an adverse or beneficial effect on the receiving environment?
- **Receptor Sensitivity**: how sensitive is the receiving environment to the anticipated impacts?
- **Magnitude of Impact**: what is the anticipated scale of the impact?

The integration of sensitivity with impact magnitude is used to derive the predicted significance of that impact, and may be adverse or beneficial in nature.

These terms, and the qualifying justification for each attributed value are described below.

7.2.2 Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment. Terms such as "positive" and "negative" are not used to avoid complication (i.e. a positive increase in air pollutant concentration would have a negative impact, for example):

- **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.

7.2.3 Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. For example, a receptor may be determined to have varying sensitivity to different environmental changes (i.e. high sensitivity to changes in air quality, but low sensitivity to noise impacts, for example). 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 following broad categories:

- Very high.
- High.
- Medium.
- Low.

Table 12 outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table 12 Methodology for Assessing Receptor Sensitivity

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

7.2.4 Magnitude

Magnitude describes the anticipated scale of the predicted environmental change in terms of how that impact may cause a change to existing (baseline) conditions, and may be described quantitatively or qualitatively (refer **Table 13**).

Where an impact is defined by qualitative assessment, suitable justification is provided in the text.

Table 13 Magnitude of Impacts

Magnitude	Description	Examples
Substantial	Impact is predicted to cause significant consequences on the receiving environment	• A significant change which involves a variation in predicted concentration by > 10% of a long-term criterion or 50% of short-term criterion. • Substantial risk that the impacts will generate nuisance complaints, resulting in regulatory action. • Area affected is < 10m from an active construction site.

Magnitude	Description	Examples
Moderate	Impact is predicted to possibly cause statutory objectives / standards to be exceeded	• A noticeable change which involves a variation in predicted concentration of 5% to 10% of long-term criterion or 25% to 50% of short-term criterion. • Moderate risk that the impacts will generate nuisance complaints, resulting in regulatory action. • Area affected is < 100m from an active construction site.
Slight	Predicted impact may be tolerated.	• A barely measureable change which involves a variation in predicted concentration of 2.5%-5% of short-term criterion or 10% to 25% of long-term criterion. • Slight risk that the impacts will generate nuisance complaints, resulting in regulatory action. • Area affected is < 1km from an active construction site.
Negligible	Impact is predicted to cause no significant consequences.	• A negligible change which involves a variation in predicted concentration of < 2.5% of the short-term criterion or < 10% of the long-term criterion. • Negligible risk that the impacts will generate nuisance complaints, resulting in regulatory action. • Area affected is > 1km from an active construction site, and the construction site has adequate dust controls.

7.2.5 Significance

The risk-based matrix provided in **Table 14** illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table 14 Impact Significance Matrix

	Magnitude	[Defined by Table 13]			
Sensitivity		**Substantial Magnitude**	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

It is noted that the above approach is designed to provide an overall impact risk, and is not the defining determination for the requirement for mitigation and control. Impacts with a lower determined significance should also be minimised wherever possible.

The approach also may underestimate the impact significance in environments which are assessed as having low sensitivity to impacts of a substantial or moderate magnitude, and therefore a pragmatic approach to the assessment significance should be applied.

Any impacts identified as having a substantial magnitude should receive detailed appraisal of mitigation options as outlined in **Section 8**.

7.3 Construction Impact Assessment

This section provides a framework for the assessment of risks associated with sensitive receptors. The impact assessment uses the methodology presented in **Section 7.2** of this report. In the context of this methodology, the risk is termed "*impact significance*".

The nearest sensitive receptors to the proposed Development overlay are residential areas between 20 m to ~125 m away. In accordance with the methodology presented in **Section 7.2**, receptor sensitivity is considered to be ***high***.

7.3.1 Potential Dust Impacts due to Construction Works on Residential Land Uses

Dust generated by activities during the construction of the Development may be experienced at these residential receptors and impacts are assessed as being *adverse* in nature, *short term* (for the duration of the construction works) and *reversible*. However, given the proximity of some of the receptors to the construction areas (notably the new residential subdivision to the immediate east of the site), there is a moderate risk that the impacts will generate nuisance complaints, and possibly result in regulatory action. The construction works are unlikely to be in close proximity to each individual receptor for the full duration of construction activities.

For residential receptors the potential impact of dust from construction activities is considered to be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives / standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (**Table 14**).

Mitigation measures (as detailed in **Section 8**) should be considered and adopted where applicable throughout the construction of the Development, particularly where activities are located along site boundaries facing residential areas (particularly during Stage 3 and Stage 4 of construction) and during adverse weather conditions.

The high frequency of easterly winds, especially during the summer and spring may impact concentrations of dust reaching the Receptor 1 area (new residential subdivision). A small proportion of these winds are at speeds greater than 5.5 m/s which would limit the generation of wind-blown dust.

Table 15 Impact Significance of Dust Impacts from Construction Activities on Receptors

	Magnitude / Sensitivity	[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

7.3.2 Potential Impacts of Products of Combustion from Machinery on Residential Land Uses

Products of combustion generated from machinery used in the construction of the Development may be experienced at residential receptors and impacts are assessed as being *adverse* in nature, *short term* (for the duration of the construction works) and *reversible*. The number of pieces of equipment operating in one area at one time is likely to be small, although the minimum distance from the Development boundary to residential receptors is approximately 20 m. Given the short distance between the source and receptor, there is a slight risk that the exhaust emissions will impact the air quality experienced at the sensitive receptors.

For residential receptors the potential impact of products of combustion from construction equipment is considered to be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives / standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (**Table 16**). Mitigation measures (as detailed in **Section 8**) should be considered and adopted where applicable throughout the Development construction, especially when machinery is operating in close proximity (<100 m) from residential areas.

Table 16 Impact Significance of Impacts from Products of Combustion from Machinery on Receptors

	Magnitude / Sensitivity	[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

7.4 Operational Phase Impact Assessment

This section provides a framework for the assessment of risks associated with sensitive receptors. The impact assessment uses the methodology presented in **Section 7.2** of this report. In the context of this methodology, the risk is termed "*impact significance*".

The nearest sensitive receptor locations to the proposed marina development when operational are residential areas approximately 20 m to ~125 m away. In accordance with the methodology presented in **Section 7.2**, receptor sensitivity is considered to be ***high***.

7.4.1 Potential Impact of Products of Combustion due to Increased Traffic on Receptors

The traffic assessment (refer **Section 3.2.1**) indicates that existing traffic flow levels are highest along Fishery Point Road. Additional daily traffic numbers are likely to increase during the worst case periods although these coincide with periods of lower existing traffic, such as school holidays and public holiday period.

For residential receptors located between 10 m and 1 km of the marina, the potential impact is considered to be ***slight*** (i.e. there is a slight risk that a variation in predicted concentration of 2.5%-5% of short-term criterion or 10% to 25% of long-term criterion would be experienced.) This conclusion has been reached as the existing traffic flows are low, existing air quality is good and the addition of the anticipated traffic volumes from the development are highly unlikely to result in any exceedances of the air quality criteria or change in short term criterion of 25%).. Correspondingly, the impact significance should be considered to be ***intermediate/minor***. It is reinforced that whilst the degree of change may be considered to be significant, the actual quantum of vehicles is low and is highly unlikely to cause an exceedance of the relevant air quality criteria.

Mitigation measures (as detailed in **Section 8**) should be considered and adopted where applicable throughout the operation of the Development.

Table 17 Impact Significance of Impacts from Products of Combustion from Traffic on Receptors

Sensitivity \ Magnitude		[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

7.4.2 Potential Impacts from Products of Combustion and Odour due to Sewage Pump-out on Receptors

Odour and products of combustion may be generated by pump-out of sewage (if a gas fired pump is used and if odour escapes the anticipated closed system) and may be experienced at the residential receptors. The pump-out operations occur infrequently and, in terms of odour, are contained in a reciprocating, closed transfer system. The products of combustion are highly localised emissions close to the source and are likely to disperse before reaching the receptors.

For residential receptors located between 10 m and 1 km of the marina, the potential impact is considered to be ***negligible*** (i.e. the impacts are unlikely to result in complaints or regulatory action). Correspondingly, the impact significance should be considered to be ***neutral***. Mitigation measures (as detailed in **Section 8**) should be considered and adopted where applicable throughout the marina construction.

Table 18 Impact Significance of Impacts from Products of Combustion/Odour from Sewage Pump-out on Receptors

Sensitivity \ Magnitude		[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

7.4.3 Potential Impacts from Volatile Organic Compounds (VOCs) due to Fuel delivery, Storage and Dispensing on Receptors

Fugitive emissions of VOCs may be generated by delivery, storage and dispensing of fuel and may be experienced at the residential receptors. Emissions of VOCs from fuel delivery, storage and dispensing are likely to be infrequent as the fuel transfer and storage are contained in a reciprocating, closed transfer system. Any residual emissions are highly localised close to the source and are likely to disperse before reaching the receptors.

For residential receptors located between 10 m and 1 km of the marina, the potential impact is considered to be ***negligible*** (i.e. the impacts are unlikely to result in complaints or regulatory action). Correspondingly, the impact significance should be considered to be ***neutral***. Mitigation measures (as detailed in **Section 8**) should be considered and adopted where applicable throughout the marina construction.

Table 19 Impact Significance of Impacts from VOCs from Fuel Delivery, Storage and Dispensing on Receptors

Sensitivity \ Magnitude		[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

7.4.4 Potential Impacts from Products of Combustion due to Vessel Operation

Products of combustion may be generated by vessels using the marina. For residential receptors located between 10 m and 1 km of the marina, the potential impact is considered to be ***negligible*** (i.e. the impacts are unlikely to result in complaints or regulatory action). Correspondingly, the impact significance should be considered to be ***neutral***.

Table 20 Impact Significance of Impacts from Products of Combustion from Vessel use on Receptors

Sensitivity \ Magnitude		[Defined by Table 13]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 12]	**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

8 AIR QUALITY MITIGATION MEASURES

Based on the qualitative assessment presented in **Section 7**, the significance of impacts from dust and combustion related pollutants from construction activities at the Development is considered to be ***intermediate***. During the operation of the Development, the significance of impacts of traffic generated pollution is considered to be ***intermediate/minor*** with impacts associated with the removal of sewage, helipad use, and vessel operation likely to lead to impacts of ***neutral*** significance.

During construction mitigation measures will need to be employed, and potentially, if impacts are perceived, during operation. The following sections outline a number of mitigation measures.

8.1 Construction

The potential for atmospheric emissions during construction works and the predicted impact on surrounding sensitive receptors (as highlighted in **Section 7**) are anticipated to be largely controllable through a range of mitigation measures including good site management, good housekeeping measures, vehicle maintenance and applying appropriate dust mitigation measures where required.

8.1.1 Best Available Techniques (BAT)

Best Available Techniques (BAT) was introduced as a key principle of the European Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC). The European Commission produced BAT Reference Documents (BREFs) for a number of industries which are intended to be used as an input into determination of BAT for specific cases.

The essence of BAT is that the selection of techniques to protect the environment should achieve an appropriate balance between realising environmental benefits and the costs incurred by the person carrying out the activities. In other words, it would be possible to spend infinite time and money to attempt to reduce dust impacts to zero but the cost involved may be grossly disproportionate to the benefit gained.

While no legislative driver exists in Australia at present, some of the relevant BAT mitigation measures for dust control are summarised below:

- Water sprays are a commonly used control method for particulate matter emissions. The addition of dust control suppressants such as polymers and acrylics to the water increases the effectiveness of the spraying.
- Stockpiles can be sprayed with a lime slurry (or similar polymer) which forms a hard crust and prevents dust emissions.
- Spraying of the shovel / bucket for excavators / FELs when loading trucks.
- Spraying the bucket of trucks before loading.
- Direct water spraying of trucks.
- Sprays / atomisers to moisten ambient air during operations with the potential to generate high volumes of dust.
- Wheel-wash / shaker grids and visual inspection of trucks prior to exiting construction sites onto public roads.
- Vacuuming / sweeping of dirt track-out out onto public roads.

8.1.2 NSW EPA Guidance

The NSW EPA guidance is provided in the Local Government Toolkit, Module 3, Part 1, Section 4.16 *Dust Suppression*.

This guidance lists the following generic measures:

- Avoiding exposure of loose dust particles to winds of sufficient velocity to lift the particles from the surface they are resting on.
- Minimising the unnecessary formation of dusty materials through abrasion and crushing of solids due to moving and handling equipment.
- Avoiding unnecessary disturbance of surfaces that might generate dust particles.
- Avoiding free dusty material falling through air where it can be exposed to cross currents of wind.
- Maintaining sufficient moisture in dusty materials to keep surface forces strong enough to resist wind entrainment.
- Using matting or another type of covering over surfaces likely to generate dust.
- Revegetating surfaces likely to generate dust.
- Using water sprays to moisten dusty surfaces on a systematic basis to maintain moisture content at potentially dusty surfaces.
- Re-stabilising dusty surfaces by undertaking vegetative-cover planting, rehabilitation or sealing as soon as possible after the work requiring the disturbance has been completed.
- Designing and installing wind breaks, wind barriers and enclosures at key points, such as truck unloading stations to avoid falling dusty material being exposed to external winds.
- Maintaining moisture content of solid materials being transported or conveyed wherever possible.
- Using water suppression sprays at transfer points in solid material conveying systems and solids unloading or loading stations to minimise fugitive dust.
- Applying fixed water sprays to stockpiles of dusty materials to thoroughly wet and crust the stockpile surfaces for storage.
- Using careful design to ensure that wetting and agglomeration is adequate at sensitive entrainment points, such as the tops of stockpiles.
- Using agglomeration and stabilising agents in water sprays were the degree of movement is intense or the materials are particularly dusty or dry.
- Providing a mobile water spray vehicle to ensure surfaces not reached by fixed sprays can be kept moist; for surfaces unreachable by vehicle, hand-held watering can be used.
- Avoiding driving on stockpile surfaces in rubber-tyred vehicles; tracked vehicles or mechanical stacking equipment should be used for emplacement and recovery at stockpiles.
- Ensuring engine exhausts from all heavy moving machinery are not directed onto stockpile or road surfaces.
- Ceasing operations such as bulk storage loading and unloading and surface grading during strong wind conditions; an average wind speed of over 15 m/s is commonly used as the trigger for stopping certain operations, and where this is the case, a recording and alarmed anemometer should be installed, maintained and records kept.
- Practising thorough truck washing, especially washing of tyres, to prevent the tracking of dusty materials in a wet condition onto sealed roadways; once deposited on roads these materials dry out and are further reduced in size by abrasion due to multiple tyre contact, and are resuspended by tyres and local winds.
- Covering loads of dusty material transported by road in open-topped trucks.

8.1.3 Site Specific Mitigation Measures

Ambient dust emissions from wheel-generated dust, excavation and rehabilitation, clearing and grading, truck loading and unloading, and wind erosion areas will be the primary focus of dust control at the Development during construction. Typically, emissions from these processes can be minimised through the implementation of water spraying, particularly during periods of heavy on-site activity.

The use of water is a key method for the suppression of dust generation. Increasing the water content of surfaces (e.g. implementing water sprays) leads to agglomeration and weak cementation of loose particles on an unconsolidated surface. Spraying increases moisture content and bonding and, even on drying, wind entrainment will be minimised by the weak cementation or 'crusting' which results.

Dust mitigation measures (additional to those already outlined in previous sections) that may be implemented during the construction phase include:

- Silt and other material be removed from around erosion and sediment control structures to ensure deposits do not become a dust source.
- Amending of dust-generating construction activities during adverse wind conditions blowing in the direction of sensitive receptors.
- Minimising the use of material stockpiles and locating them away from sensitive receptor locations.
- Reducing the truck speeds on site will reduce wheel generated dust. It is noted that the physical size and layout of the site will act to limit truck speeds.
- If dirt track out is causing problems, manual brushing of the truck's flanks and wheels could be implemented as a further precaution. Also, trucks exiting the site should be observed to determine if the both wheels travel over the shaker grid.

8.2 Operation

The potential for atmospheric emissions during operation of the Development and the predicted impact on surrounding sensitive receptors (as highlighted in **Section 7**) are anticipated to be not insignificant given the increase in traffic. However, although the percentage increase in emissions is anticipated to be high, the actual number of vehicles is expected to be low. Given the current compliance with air quality criteria, it is considered that the airshed has capacity to assimilate this minor increase in additional emissions.

Any residual odour impacts from sewage pump-out should be largely controllable through good housekeeping measures. Emissions of products of combustion from traffic and on-site machinery can be mitigated through good site management and vehicle maintenance where required.

8.2.1 Management of Sewage Pump-out

The Department of Planning's *NSW Best Practice Odour Guideline* (Department of Planning, 2012), provides an outline of the best practice management and mitigation measures that can be incorporated into operations if odour is an issue from sewerage systems including sewage treatment plants, water recycling facilities, sewage reticulation systems and sewer mining.

To prevent septicity of sewage or sludge requires inhibition of the micro-organisms responsible or measures to prevent anaerobic conditions from developing. In most circumstances, total prevention of septicity would not be practical or economical. Hence, containment to avoid creating an odour nuisance is normally the most effective strategy. In this case, odour from the sewage pump-out can be minimised by:

- avoiding excessive accumulation of debris and grit in pipes and tanks.
- avoiding unnecessary contact of sewage and sludge with the atmosphere.

- minimising retention under anaerobic conditions.

Prevention of septicity in sewage and sludge is possible by the use of chemicals:

- injection of oxygen can be used to maintain aerobic conditions.
- addition of nitrate to provide an alternative source of energy for respiration is used widely to keep sewage and sludge anoxic.
- addition of oxidant chemicals, such as hypochlorite, hydrogen peroxide and potassium permanganate is used to reduce microbial activity and oxidise previously formed sulphides.
- iron salts added to sewage or sludge will react with sulphides to form insoluble iron sulphide and will catalyse the rate of oxidation of sulphide.

In addition, frequent pump-out of the sewage holding tank is recommended to reduce the potential for anaerobic conditions to develop. Regular clean out of the sewage pump-out infrastructure will reduce the accumulation of debris in the pipes and reduce the potential for odorous emissions.

8.2.2 Management of Traffic and On-site Machinery

On-road vehicles sold in Australia, such as passenger vehicles, and highway registered trucks and buses, are regulated to meet strict national standards. The Third Edition Australian Design Rules (ADRs) are national standards for vehicle safety, anti-theft and emissions. The standards apply to vehicles newly manufactured in Australia or imported as new or second hand vehicles, and supplied to the Australian market. Australian Design Rule 79 and 80 refer to the exhaust and evaporative emission requirements for light and heavy vehicles in order to reduce air pollution.

To reduce the emission of exhaust fumes from traffic entering the site during operation, it is recommended:

- all on-road vehicles comply with the requirements of the current Australian road vehicle emission standards.
- all vehicles switch off engines when stationary.
- on-site roads are well maintained are designed to be even, with a good gradient and with good drainage features.

The NSW EPA has instigated an initiative, the Clean Machine Program, to reduce diesel exhaust emissions from non-road diesel plant and equipment. Non-road diesel engines include equipment such as dozers, graders, forklifts and tractors. The following strategies can be applied to reduce exposure to diesel exhaust emissions:

- purchase engines that conform to the highest available US/EU standards (or other international standards).
- use cleaner, low sulphur fuels.
- ensure engines are correctly repaired and maintained.
- improve an engine's emission performance by fitting it with an exhaust-treatment device.
- restrict unnecessary engine idling.
- locate plant and equipment away from sensitive populations (e.g. schools, hospitals, child-care facilities) or using best-performing equipment near these areas.
- locate plant and equipment away from residential areas and, when onsite work occurs near residential boarders, restricting access for non-essential vehicles and machinery.
- avoid the onsite use of diesel- or petrol-powered generators by substituting mains electricity or battery powered equipment where possible.

8.2.3 Management of Fuel Delivery, Storage and Dispensing

The NSW Department of Environment and Conservation's *Environmental Compliance Report - Liquid Chemical Storage, Handling and Spill Management* (NSW Department of Environment and Conservation, 2005), provides an outline of the best environmental management practices used in storing and handling liquid chemicals and managing spills in various industries.

Wherever liquid chemicals, such as fuel, are stored and handled there is potential for air pollution to occur through spills or other releases. Other potential releases include fugitive losses or leaks from the valves, pumps, flanges and seals connected to liquid chemical storage and handling equipment.

To prevent the discharge of pollutants from liquid chemical storage and handling activities, proponents should minimise the quantities stored on-site, store materials in designated areas, install secondary containment facilities, conduct regular inspections, develop and implement emergency spill management procedures, and train employees and subcontractors.

The environmental management practices that prevent or mitigate the risks from the loss of fuel to the atmosphere include the following:

Bulk storage

- Large storage tanks containing volatile liquids should be provided with floating metal covers, an internal floating roof or an inert gas blanket to minimise air releases.
- Small storage tanks containing volatile liquids should be provided with vapour-tight connections. These connections should be placed on all liquid and vapour lines and fittings, and close automatically when disconnected to minimise air releases.
- Large storage tanks should be provided with overfill protection and alarms.
- Leak detection tests on tanks, distribution lines and seals should be conducted regularly.

Handling

- Areas for loading and off-loading liquid chemicals should be covered.
- Vapour recovery systems for loading/unloading operations should be installed and maintained where appropriate.
- Tankers should be provided with automatic shut-off mechanisms and fuel dispensing equipment.
- Valves should be kept closed unless manually opened during transfer.
- Shut-off valves used in the transfer of liquids should be of the quick-closing type.
- Hatches, manholes or covers on all tankers should be kept closed, except during loading and unloading operations.
- Regular inspections should be undertaken for losses or leaks, and valves, pumps, couplings and seals should be maintained regularly.

Spill management

- Spills must be cleaned up immediately, and waste must be disposed of in accordance with Office of Environment and Heritage requirements to mitigate emissions to air.

9 RESIDUAL AIR QUALITY IMPACTS

Table 21 presents a reappraisal of predicted unmitigated air quality impacts on sensitive receptors to demonstrate the opportunity for minimising risks associated with the construction and operational phases through the use of site specific mitigation measures. The risk after the application of mitigation measures is referred to as a "residual" risk.

Table 21 Impact Significance Residual Risks

Receptor / Air Quality Impact Type	Pollutant	Predicted Unmitigated Impact			Proposed Mitigation Methods	Predicted Residual Impact		
		sensitivity	magnitude	impact significance		sensitivity	magnitude	impact significance
Construction impacts at residential receptors (> 10m)	Dust	high	moderate	Intermediate	**Section 8.1**	high	negligible	Neutral
	Products of combustion	high	moderate	Intermediate	**Section 8.1**	high	negligible	Neutral
Operational impacts at residential receptors (> 10m)	Products of combustion	high	slight	Intermediate/ minor	**Section 8.2.2**	high	negligible	Neutral
	Odour	high	negligible	Neutral	**Section 8.2.1**	high	negligible	Neutral
	Dust	high	negligible	Neutral	**Section 8.2.2**	high	negligible	Neutral
	VOCs	high	negligible	Neutral	**Section 8.2.3**	high	negligible	Neutral

Although a qualitative assessment has been performed, given the nature and scale of the operations proposed, it is considered that the implementation of the appropriate mitigation measures identified in **Section 8** will ensure that the relevant air quality criteria outlined in **Section 4** will not be exceeded as a result of the construction or operation of the development.

10 COMPARISON WITH APPROVED CONCEPT

The air quality impacts associated with the original concept design were assessed by Arup (2008). A smaller concept was approved in 2009, and whilst the air quality impacts were not reassessed, the management and mitigation measures from Arup (2008) would likely remain relevant to the 2009 approved concept. The report presented above outlines the anticipated impacts associated with the modified design.

No additional impacts on air quality have been identified through the performance of this current assessment when compared with that performed by Arup (2008) or likely for the 2009 approved concept. One potentially significant source (the boat repair facility) has been removed from the proposed development and therefore this source of emissions has been removed.

Whilst the detail of some construction activities and overall construction programming differs between the approved concept and modified design, it is considered that no changes to the significance of impact on air quality would be experienced should the modified design be approved and subsequently constructed. However, construction management and mitigation measures would still apply.

For operational impacts on air quality, the overall risk to residents in the area surrounding the Development is likely to be broadly similar to those predicted for the approved concept. It is considered that the predicted negligible impact significance would result through good site management practices and ongoing vehicle emission improvement. It is also a function of the good air quality currently experienced at the Development site, and the capacity of the receiving environment to assimilate any additional emissions without resulting in exceedances of health based air quality criteria.

Table 22 Comparison of Qualitative Assessment of Air Quality Impacts for the Concepts

Potential Air Quality Impact	Original Concept ARUP 2008	Assumed Approved concept (2009)	Proposed Modified Residual Impact with mitigation (SLR 2015)
Construction			
Dust generation Products of combustion	Acceptable subject to management	Acceptable subject to management	Neutral impact significance
Operations relevant to Mod 5 changes			
Operational Road Traffic	Negligible	Negligible	Neutral impact significance
Operations not relevant to Mod 5 changes			
Ship Travel Lift	Negligible	Negligible	Deleted by Mod 2 Not Applicable
Surface Preparation	Negligible with management	Negligible with management	Deleted by Mod 2 Not Applicable
Painting	Negligible with management	Negligible with management	Deleted by Mod 2 Not Applicable
Fibreglass	Negligible with management	Negligible with management	Deleted by Mod 2 Not Applicable
Vessels	Negligible	Negligible	Neutral impact significance (not subject to any modification within Mod 5)
Fuel delivery, storage and dispensing	Negligible with management	Negligible with management	Neutral impact significance (not subject to any modification within Mod 5)

11 CONCLUSION

The potential air quality impacts associated with the construction and operation of the Trinity Point Marina and Mixed Use Development (as sought to be modified) have been reviewed and a qualitative risk-based impact assessment undertaken to identify a range of suitable control measures available to mitigate those impacts. Applicable guidelines and policies have also been identified.

The risk assessment has determined that where dust impacts and impacts associated with fuel combustion are unmitigated during the construction phase, an impact significance of ***intermediate*** exists for residential receptors situated greater than 10 m from the site. These impacts can be mitigated through the application of a range of air quality control measures to result in a final impact of ***neutral*** significance. Given the potential absolute increase in traffic volumes, an impact significance of ***intermediate/minor*** exists during the operational phase with impacts mitigated through improvements in vehicle design resulting in a reappraised ***neutral*** impact significance. Unmitigated impacts associated with odour from sewage, dust and combustion products from vessel operation, and VOCs from fuel delivery, storage and dispensing, result in an impact of ***neutral*** significance for those residential receptors located greater than 10 m of the site.

The predicted air quality impacts are anticipated to be largely controllable through a range of mitigation and control measures including good site management and housekeeping, vehicle maintenance and through application of appropriate air quality mitigation measures where required. Site specific mitigation measures have been detailed in **Section 8**.

The reappraisal of the predicted air quality impacts has been undertaken assuming that site specific and site appropriate mitigation measures will be employed at the Development during the construction and operational phases. The results of the reappraisal show that reduced impact significance may be achieved for all emission sources where site specific mitigation measures are effectively employed (refer to **Section 9)**.

It is considered that the proposed modification will result in a slight reduction to the predicted impacts upon surrounding receptor locations when compared to the approved concept design. No new sources of air impacts are identified in the proposed modification. Given the magnitude of construction activities, the impacts predicted for the approved and modified concepts would be similar. During operation, impacts on air quality are likely to be lower than those approved in the concept design given the removal of the boat repair facility.

It is considered that the predicted negligible impact significance would result through good site management practices and ongoing vehicle emission improvement. It is also a function of the good air quality currently experienced at the Development site, and the capacity of the receiving environment to assimilate any additional emissions without resulting in exceedances of health based air quality criteria.

12 REFERENCES

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Abbreviations and Acronyms

%	percent
°C	degrees Celsius
µg	microgram (g x 10^{-6})
µg/m^3	microgram per cubic metre
µg/Nm^3	microgram per normalised cubic metre (273K, 101.3kPa)
µm	micrometre or micron (metre x 10^{-6})
AHD	Australian Height Datum
AQMS	air quality monitoring station
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CASANZ	Clean Air Society of Australia and New Zealand
CO	carbon monoxide
CSIRO	Australian Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DP&E	Department of Planning and Environment
DGRs	Director-General's Requirements
EETM	Emission Estimation Technique Manual
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
g	gram
km	kilometre
km E	kilometres east
km N	kilometres north
LGA	Local Government Area
m/s	metre per second
m^3	cubic metre
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NO	nitrous oxide
OEH	NSW Office of Environment and Heritage
OU	odour unit
PM_{10}	particular matter with an equivalent aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particular matter with an equivalent aerodynamic diameter of 2.5 microns or less
SO_2	sulphur dioxide
T	tonnes
TAPM	The Air Pollution Model
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VIC EPA	Victoria Environment Protection Authority
VKT	vehicle kilometres travelled
VOC	volatile organic compounds
WHO	World Health Organization

Commonly Used Terminology

air dispersion model	A computer-based software program that provides a mathematical prediction of how pollutants from a source will be distributed in the surrounding area under specific conditions of wind, temperature, humidity and other environmental factors.
airshed	The geographical area associated with a given air supply
ambient	Pertaining to the surrounding environment or prevailing conditions
anemometer	An instrument for measuring wind force and velocity
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
atmospheric pressure	The force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere
background air quality	The existing air quality in the project area excluding the impacts from the proposed development
baseline monitoring program	A monitoring program designed to measure the ambient concentration levels which currently exist prior to the proposed development
calms	Refers to calm wind speeds of less than 0.5 m/s.
climatological	The science that deals with climate and climatic phenomena
combustion	The process of burning. A chemical change, especially oxidation, accompanied by the production of heat and light
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwind	The direction from which the wind is blowing
emission factor	A measure of the average amount of a specific pollutant or material emitted by a specific process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed.
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
greenhouse gas	A gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g., carbon dioxide.
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action.
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mitigate	To moderate (a, quality or condition) in force or intensity; alleviate
mixing height	The height to which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass.
modelling domain	The area over which the model is making predictions.
odour units	Concentration of odorous mixtures. The number of odour units is the concentration of a sample divided by the odour threshold or the number of dilutions required for the sample to reach the threshold. This threshold is equivalent to when 50% of a testing

	panel correctly detect an odour
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
plume	A space in air, water, or soil containing pollutants released from a point source
point source	A pollution source that is fixed and/or uniquely identifiable, such as a stack, chimney, outlet pipe or vent
pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource
prognostic	A prediction of the value of variables for some time in the future on the basis of the values at the current or previous times.
qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc. where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops.
spatial variation	Pertaining to variations across an area.
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
synoptic meteorology	A branch of meteorology analysing data collected simultaneously over a wide region, for the purpose of weather forecasting.
topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
volatile organic compounds	All organic compounds (substances made up of predominantly carbon and hydrogen) with boiling temperatures in the range of 50-260°C, excluding pesticides. This means that they are likely to be present as a vapour or gas in normal ambient temperatures.
wind direction	The direction from which the wind is blowing
wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time