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Vipac Engineers and Scientists Limited
Level 2, 146 Leichhardt Street, Spring Hill, QLD 4000, Australia
PO Box 47, Spring Hill, Qld, 4000 Australia
t. +61 7 3377 0400 | **e.** brisbane@vipac.com.au
w. www.vipac.com.au | A.B.N. 33 005 453 627 | A.C.N. 005 453 627

URPS

Nuclear Powered Submarine Construction Yard

Air Quality Assessment

70B-24-0388-TRP-75857-2

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URPS	Vipac Engineers and Scientists Limited Level 2, 146 Leichhardt Street, Spring Hill, QLD 4000, Australia
Contact:	
Tel:	Tel:

Author:	25 Nov 2024
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Executive Summary

Australian Naval Infrastructure (ANI) is currently planning for the construction of a Nuclear-Powered Submarine Construction Yard (the SCY) at Osborne Naval Shipyard (ONS), Adelaide. Under section 108 (1)(c) of the *Planning, Development and Infrastructure Act 2016* (PDI Act), the SCY has been declared as an impact assessed development by the Minister for Planning.

URPS are currently preparing an Environmental Impact Statement (EIS) for the SCY and have engaged Vipac Engineers and Scientists (Vipac) to prepare a high-level air quality assessment for the construction and operational phases of the SCY that is to be incorporated into the overall EIS.

The development's design is still in its early stages. A limited amount of detail is therefore known about the design of the development and various informed assumptions have been made for the air quality assessment to address knowledge gaps which are detailed in this report.

The main activities associated with the development with the potential to lead to air quality impacts if not managed correctly include:

- Construction impacts primarily as:
  - annoyance due to dust deposition (soiling of surfaces) and visible dust
  - elevated concentrations of airborne particulate matter due to dust-generating activities
  - exhaust emissions from construction equipment
  - very high levels of soiling which can also damage plants and affect the diversity of ecosystems; and
- Operational impacts which may include air emissions from activities such as:
  - Surface preparation
  - Metal plating and surface finishing
  - Painting
  - Machining and metal working
  - Associated infrastructure such as road traffic and fuel burning.

The overall approach to the assessment follows the guidelines outlined in the *Ambient Air Quality Assessment 2016* and *Evaluation distances for effective air quality and noise management,* both as prepared by the South Australian Environmental Protection Authority and the CALPUFF modelling guidance. The assessment was conducted as follows:

- An assessment of potential air quality impacts associated with construction incorporating a risk assessment following the Guidance on the Assessment of Dust from Demolition and Construction published by the Institute of Air Quality Management in the United Kingdom.
- A preliminary assessment of potential air quality impacts from the operation of the proposed SCY by comparison of distances from the nearest sensitive receptors and evaluation in accordance with the guidance provided in the *Evaluation distances for effective air quality and noise management.*
- An emissions inventory of the primary air pollutants and odour emitted by the existing and proposed ONS and proposed SCY facilities for normal and maximum operating scenarios has been developed. Air emission rates required for the modelling assessment are derived based upon manufacturer specification data, internationally recognised emissions estimation techniques (e.g. NPI EET or USEPA AP42 Methodology) and/or Vipac's database of similar projects.
- Future air emissions generated by vehicles projected to be travelling on Victoria Road, Veitch Road, Pelican Point Road and access routes were estimated for a high level assessment of forecast vehicle volumes for 2034 obtained from the Traffic Planning Assessment Report and emission factors adopted from the Composite Vehicle Emission Factors for Air Quality Modelling using COPERT Australia database.
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed by comparison with relevant assessment criteria.

The results of the air quality assessment may be summarised as follows:

- Potential impacts from the construction of the SCY have been assessed following the guidance from IAQM. It has been determined that the surrounding human (residential) receptors are considered to be 'Low Sensitivity' and ecological receptors to be 'Medium Sensitivity' due to the proximity of conservation areas and waterways. With control measures in place, potential dust emissions can be effectively mitigated such that the risks to these receptors is assessed to be minimal.
- Comparison of the separation distances from the primary activities to the closest sensitive receptors with the distances specified in the SA EPA guidance document determined that further quantitative assessment (e.g. involving dispersion modelling) is required for spray painting and fuel burning activities associated with the SCY. All other potential sources of the operational air emissions were evaluated to be sufficiently separated from the sensitive receptors such that impacts would be considered minor.
- The comparison of the atmospheric dispersion modelling predictions with relevant assessment criteria for the anticipated normal and maximum spray painting and fuel burning operational activities may be summarised as follows:
    - The modelling results show that the highest concentration of the VOCs is 294 µg/m^3 Xylenes predicted to occur during maximum activities at the industrial receptor immediately southwest of the boundary of the Precinct (R5), which is below the relevant criteria.
    - The predicted concentrations are well below the relevant toxicity-based criteria for all individual VOCs modelled for both scenarios. Furthermore, the model predictions are below the odour criteria for all individual VOCs modelled at the residential receptors.
    - The results show that the cumulative odour predictions are below the criteria of 2 OU at all residential receptors modelled and above 2 OU (i.e. 2.41 OU) at the industrial receptor (R1) for the maximum emissions scenario. However, given the conservatism of the modelling this is not considered likely. For example, the modelling has adopted continuous hourly emission rates for potential odour generating events while this emission rate could only possibly occur at once every ten paint day cycle (based on advice from experienced shipbuilders).
    - The predicted concentrations of metals are negligible (i.e. near 0 µg/m^3) and are well below criteria at all receptors modelled.
    - The maximum predicted metal and combustion gas and particulate ground level concentrations (inclusive of background, where applicable) and dust deposition rates are also well below relevant criteria at all receptors modelled.
    - The maximum predicted concentrations of the primary air pollutants associated with vehicles projected to be travelling on Victoria Road, Veitch Road, Pelican Point Road and access routes in 2034 are below relevant criteria at all receptors modelled.
- Despite the fact that the model predictions are all below relevant criteria, given the scale of the proposed development, a range of air quality mitigation measures have been recommended to minimise any potential impacts.

Whilst the air quality assessment adopted conservative assumptions (where appropriate), based upon the assumptions and methodology adopted, Vipac concludes that air quality should not be a constraint to the proposed development of the SCY.

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1 Introduction

Australian Naval Infrastructure (ANI) is currently planning for the construction of a Nuclear-Powered Submarine Construction Yard (hereafter referred to as the SCY) at a preferred site at Osborne, north west of the Adelaide CBD. Under section 108 (1)(c) of the *Planning, Development and Infrastructure Act 2016* (PDI Act), the SCY has been declared as an impact assessed development by the Minister for Planning. The scope of the development is defined in the Government Gazette Notice (15 February 2024) that declares the NPSCY as an Impact Assessed Development (refer p.171-173).

URPS are currently preparing an Environmental Impact Statement (EIS) for the SCY and have engaged Vipac Engineers and Scientists (Vipac) to prepare an air quality assessment for the construction and operational phases of the SCY that is to be incorporated into the overall EIS.

The development's design is still in its early stages. A limited amount of detail is therefore known about the design of the development and various informed assumptions have been made for the air quality assessment to address knowledge gaps which are detailed in this report. It is likely that amendments will be made to the EIS as these details emerge.

2 Project Context

2.1 Site Description

The Osborne Naval Shipyard (ONS) currently extends across over the north eastern extent of the Lefevre Peninsula, located in an industrial zoned area in Osborne approximately 19 km north of Adelaide in South Australia. ANI is responsible for the development and management of the ONS which includes naval shipbuilding infrastructure and related facilities comprising the Surface Shipyard and Common Use Infrastructure and the Collins Class Sustainment Facility (see Figure 2-1). The proposed SCY is planned to be incorporated into the existing ONS. The approximate site boundary for the SCY is illustrated in Figure 2-2.

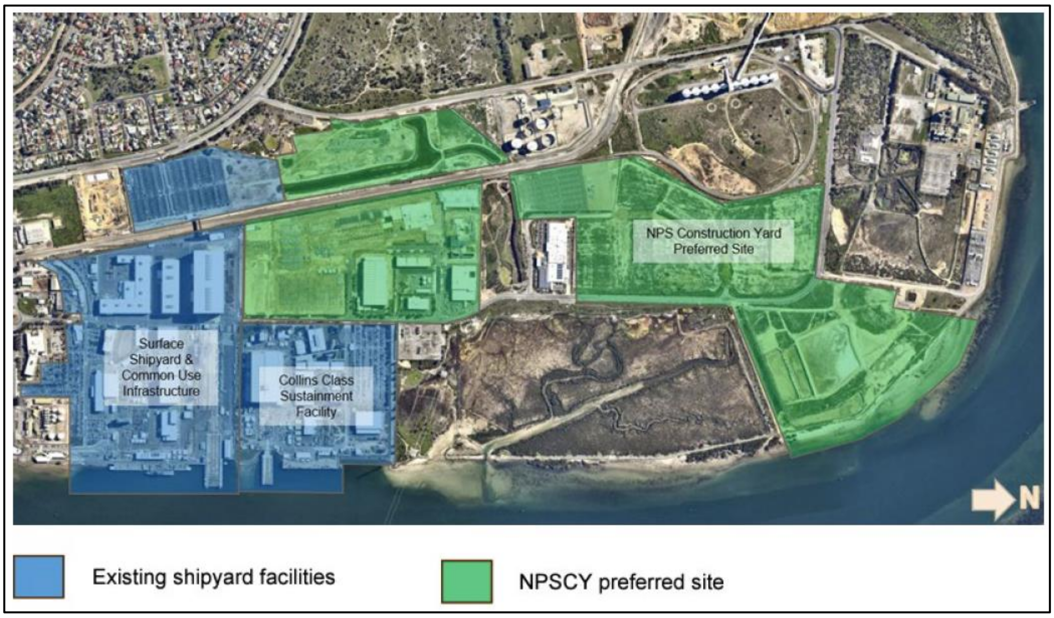


Figure 2-1: Existing Shipyard Facilities and Preferred SCY Site

Figure 2-2: Proposed SCY Site Location

The SCY will comprise three key areas shown in Figure 2-3, as follows:

- Area 1: An existing development area to the South of Falie Reserve, which contains traditional manufacturing facilities and noncritical infrastructure.
- Area 2: A parcel of land to the West of Mersey Road between PMB and the Pelican Point Power Station, which contains traditional manufacturing facilities, in addition, facilities and infrastructure which support nuclear safety functions within Area 3.
- Area 3: Parcels of land to the East of Mersey Road between Area 2 and the Port River, which forms the nuclear licensed site.

Figure 2-3: Development Site

2.2 Proposed Facilities and Infrastructure

The SCY will include new facilities and infrastructure located across Areas 1, 2 and 3 to enable the construction and commissioning of the NPS, as follows:

- hull fabrication
- abrasive blasting, painting and tiling
- submarine outfitting and consolidation
- support workshops for electrical, piping and machining
- wharf and support facilities
- submarine launch facility and wet basin
- warehousing
- offices
- multi-storey car parking
- essential services and access pathway
- laydown and external storage areas
- commercial scale canteen, amenities and health centre.

2.3 Air Pollutants of Concern

The main activities associated with the development with the potential to lead to air quality impacts if not managed correctly include:

- Construction; and
- Operation.

It is noted that dredging of the Port River channel to facilitate the movement of submarines may contribute to air quality impacts (primarily as odour) but is excluded from this assessment as it is not required for a number of years. A future assessment of the main channel dredging will apply the environmental standards and processes in place at the time of lodgement[1].

The following sections describe the primary sources of air pollutants anticipated to be associated with the construction and operation of the SCY. As discussed in section 1, a limited amount of detail is known about the design of the development and various informed assumptions have been made which are further described in section 5.2.

2.3.1 Construction

The construction schedule and associated equipment are not known at this stage. However, much of the land-based portion of the proposed subject site has been cleared in the past 10 years[2] such that emissions from this source type may be expected to be minimal.

The main air pollution and amenity impacts from construction activities are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust;
- elevated concentrations of airborne particulate matter due to dust-generating activities; and
- exhaust emissions from construction equipment.

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

In addition, painting of buildings may generate VOC emissions. However, the closest proposed buildings to the sensitive receptors that may require painting are at a sufficient distance (e.g. 400m) that potential air quality impacts from these activities are considered negligible and further assessment is not required.

Dust emissions can occur during the preparation of the land, demolition and during construction itself, for example:

- demolition of the concrete slab in Area 1;
- earthmoving including preloading of soil across the site to raise floor levels where required; and
- soil mixing for soil stabilisation in Areas 2 and 3.

These construction activities are inherently temporary and potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan. Furthermore, as noted above, much of the land-based portion of the proposed subject site has been cleared in the past 10 years such that dust emissions from these activities are expected to be minimal. As a consequence, a quantitative assessment of dust emissions (e.g. using air dispersion modelling) is not reported here. Instead, a risk assessment following the Guidance on the Assessment of Dust from Demolition and Construction published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014) has been undertaken as described in Section 6.1.

2.3.2 Operation

The Government Gazette Notice that declared the SCY as an Impact Assessed Development describes the scope of the development. Those operational activities identified by the Notice which have the potential to generate air pollutants include:

[1]. the processing of raw steel and other products to manufacture submarine components;

- *i. general steel processing including cutting, forming, welding and nondestructive evaluation;*
- *ii. general and specialist machining in support of fabrication and outfitting;*
- *iii. outfitting of submarine sections and other structures with welded components such as submarine decks and fixed pipework;*
- *iv. outfitting units and other structures with electrical, mechanical and piping components;*
- *v. assembly, testing, commissioning and services installation in support of combat system integration;*
- *vi. manufacture of pipe and electrical components;*
- *vii. assembly, testing and commissioning of the nuclear propulsion system (but excluding the manufacture of the reactor power module);*

[1] Impact Assessed Development Application ANI NPSCY, URPS
[2] Impact Assessed Development Application ANI NPSCY, URPS

viii. assembly, construction and commissioning of submarines;

ix. on-site system testing, commissioning and set-to-work activities; and

x. mechanical, hydraulic and electrical conveyance for the purpose of moving submarine components and submarine launch activities; and

[2]. facilities and works associated with abrasive blasting and surface coating of submarines.

Raw material inputs for these activities are primarily steel and other metals, paints and solvents, blasting abrasives, and machine and cutting oils. Table 2-1 summarises the potential air emissions from the activities as derived from the National Pollutant Inventory Emissions Estimation Manual – Shipbuilding Repair and Maintenance[3], which is considered consistent with many of the processes that will be required at the SCY.

Table 2-1: Potential Air Emissions

Process	Air Emissions
Surface Preparation	Particulates (metal, paint, and abrasives) and VOCs from solvent cleaners and paint strippers
Metal Plating and Surface Finishing	Metal mists and fumes, and VOCs from solvents.
Painting	VOCs from paint solvents and equipment cleaning solvents, and metal pigments in overspray where relevant.
Machining and Metal Working	VOC emissions from the use of cleaning and degreasing solvents.

In addition, potential operational air emissions from the SCY operations include those generated by associated infrastructure such as from vehicles travelling on roads and activities requiring fuel burning.

Further details regarding the potential processes, facilities, and air emission sources and assumptions in their derivation are provided in section 5.4.

[3] National Pollutant Inventory Emissions Estimation Manual – Shipbuilding Repair and Maintenance, 1999 Environment Australia

3 Relevant Legislation

On 15 February 2024, the Minister for Planning declared that the proposed development of a Nuclear-Powered Submarine Construction Yard (SCY) by proponent Australian Naval Infrastructure at Osborne be assessed as an Impact Assessed development pursuant to section 108(1)(c) of the *Planning, Development and Infrastructure Act 2016* (the PDI Act). The Project Specific Assessment Requirements for air quality are detailed in Table 3-1.

Table 3-1: Project Specific Assessment Requirements

Objective	Method of Investigation
To ensure the development does not have unacceptable adverse air quality impacts on the surrounding receiving environment, in particular sensitive receivers in proximity to polluting development.	• Provide an air quality impact assessment prepared by an appropriately qualified specialist for all potential sources of dust / particles and gaseous pollutants associated with the construction and ongoing operation of the proposed development, to identify any known or potential human health and amenity effects of air emissions (including point source and diffuse sources) on the residential population and local businesses and describe how these would be mitigated, minimised, managed and monitored. Investigations should consider historical investigations and studies, including the EPA/City of Port Adelaide Enfield *Victoria Road Air Quality Study*. • The impact assessment must include modelling undertaken in accordance with the *Environment Protection (Air Quality) Policy 2016* and the EPA's *Ambient Air Quality Assessment 2016* guidance document. Techniques used to obtain the predictions should be referenced and key assumptions and data sets explained. • Impact assessment must outline the impacts of dust / particles and gaseous pollutants on existing commercial and industrial operations and any other identified nearby sensitive receivers in the vicinity of the proposed development. The impact assessment should demonstrate how the requirements of the *Environment Protection (Air Quality) Policy 2016* (including ground level concentrations) and the 'General Environmental Duty' (as described in section 25 of the *Environment Protection Act 1993*) will be met, taking into account cumulative impacts and existing background levels of pollutants

3.1 Ambient Air Quality

The Environment Protection (Air Quality) Policy 2016 (Air Quality EPP) came into effect on 23 July 2016 and provides a legislative basis for air quality regulation and management in the state, including criteria for developing effective conditions to assist businesses and industries to improve their performance in minimising risk from air emissions through a system of licensing.

The Air Quality EPP specifies maximum ground level concentrations for a range of pollutants over prescribed averaging times applicable for assessment of air quality impacts from pollution causing activities. The ground level concentrations appropriate for the assessment of the impacts from potential pollutants generated by the SCY are outlined in Table 3-2. In the absence of ambient air quality criteria in the Air Quality EPP, the impact assessment criteria from the NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, 2022 have been adopted as a guideline.

Table 3-2: Air Quality EPP Maximum Ground Level Concentrations

Pollutant	Classification	Averaging Time	Maximum Concentration (µg/m^3)
Acetaldehyde	Odour	3 minutes	83
	Toxicity	3 minutes	6,440

Benzene	Group 1 carcinogen (IARC)	3 minutes	58
Formaldehyde	Toxicity; Group 1 carcinogen (IARC)	3 minutes	44
		24 hours	54
Toluene	Odour	3 minutes	710
	Toxicity	3 minutes	13,400
		24 hours	4,110
		12 months	410
Xylenes	Odour	3 minutes	380
	Toxicity		12,400
		24 hours	1,180
		12 months	950
Benzo(a)pyrene	Group 1 carcinogen (IARC)	12 months	0.8
Butanol	Odour	3 minutes	980
	Toxicity		5,570
Ethylbenzene	Toxicity	3 minutes	15,800
Sulphur dioxide	Toxicity	1 hour	290
		24 hour	60
Carbon monoxide	Toxicity	1 hour	31240
		8 hours	11250
Nitrogen dioxide	Toxicity	1 hour	164
		12 months	30
Particulate matter ≤10.0 μm	Toxicity	24 hour	50
Particulate matter ≤2.5 μm	Toxicity	24 hour	25
		12 months	8
Total suspended particulates (TSP)[1]	Amenity	12 months	90
Deposited dust as insoluble solids[1]	Amenity	12 months: maximum increase	$2g/m^2/month$
		12 months: maximum total	$4g/m^2/month$
Benzo(a)pyrene as a marker for polycyclic aromatic hydrocarbons	Group 1 carcinogen (IARC)	3 minutes	0.8
Arsenic and compounds	Group 1 carcinogen (IARC)	3 minutes	0.19
Beryllium and compounds	Group 1 carcinogen (IARC)	3 minutes	0.008
Cadmium and compounds	Toxicity; Group 1 carcinogen (IARC)	3 minutes	0.036
Chromium (III) compounds	Toxicity	3 minutes	19
Copper as Copper dusts and mists	Toxicity	3 minutes	36
Lead (as particles)	Toxicity	12 months	0.5
Mercury and compounds: Inorganic	Bioaccumulation	3 minutes	4
Mercury and compounds: Organic		3 minutes	0.36
Nickel and nickel compounds	Group 1 carcinogen (IARC)	3 minutes	0.36
Manganese and compounds	Toxicity	3 minutes	36
Selenium and compounds[3]	Health	24 hour	10
Zinc and compounds[2]	Health	1 hour	20
	Health	12 months	2

1. NSW EPA Approved Methods
2. VIC EPA Guidelines for Assessing and Minimising Air Pollution in Victoria
3. Ontario Ambient Air Quality Criteria

Where applicable (i.e. for Xylenes and Butanol), the odour classification criteria are adopted for the conservative assessment of impacts at the residential receivers and the toxicity criteria for assessment at the industrial/workplace receivers. In addition, as recommended by the EPA, only criteria specified as less than 24 hour averaging times (e.g. 3 minutes, 1 hour and 8 hour) are applied for industrial/commercial receptors (i.e. 24 hour and annual criteria are not applied at these receptors).

It is also noted that all criteria outlined in Table 3-2 are also conservatively adopted for the assessment of impacts upon ecological or environmental receptors.

3.2 Odour

Schedule 3 of the Air Quality EPP also specifies the impact assessment criteria for complex mixtures of odours designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. As the population density increases, the proportion of sensitive individuals is also likely to increase, indicating that more stringent criteria are necessary in these situations. Table 3-3 summarises the odour impact assessment criteria in Schedule 3. A conservative criteria of 2 OU is adopted for this assessment.

Table 3-3: Odour impact assessment criteria

Number of people	Odour units (3 minute average, 99.9% of time)
2000 or more	2
350 – 1999 (inclusive)	4
60 – 349 (inclusive)	6
12 – 59 (inclusive)	8
Single residence (fewer than 12)	10

3.3 Evaluation Distance for Effective Air Quality Management

The South Australian Environment Protection Authority (EPA) has produced guidance tools for use by planning authorities, developers, owners of licensed and unlicensed industrial plants, planning and other consultants, government departments, and the community. It encapsulates information that underpins EPA advice on proposed new or expanding developments, amendments to the Planning and Design Code, or changes to licensed industrial processes. This publication explains the type of information to be provided to the EPA to facilitate smooth processing and assessment of applications/submissions, avoiding unnecessary delays and costs to proponents.

The "Evaluation distances for effective air quality and noise management" document provides proposed evaluation distances beyond which the EPA is unlikely to request specific evaluation of impacts predicated on typical activities, except where there is a potential for ground level concentrations of pollutants to exceed criteria. Table 3-4 presents a summary of the relevant evaluation distances stipulated by the EPA.

Table 3-4: EPA Recommended Evaluation Distances

Activity	Evaluation Distance (m)
Abrasive blasting	Blasting in the open Dry abrasive cleaning – 500 Wet abrasive cleaning – 300 Blast cleaning cabinets Greater than 5 m^3 in volume – 100 Not exceeding 5 m^3 in volume or totally enclosed automatic blast cleaning units – 50
Surface Coating	Spray painting and powder coating with a capacity to use more than 100 litres/day of paint or 10 kg/day of dry powder – 300 Spray painting and powder coating with a capacity to use up to but not exceeding 100 litres/day of paint or 10 kg/day of dry powder – 100
Fuel burning	Individual assessment

Major roads	Roads with an estimated traffic volume greater than 20,000 vehicles per day– 100
Maritime construction works	300

4 Existing Environment

4.1 Local Setting

The Subject site is located in an industrial zoned area in Osborne. There are a number of industrial/commercial premises located primarily to the south of the site. The nearest residential areas are located approximately 750m to the west.

4.2 Sensitive Receptors

The site and the nearest sensitive receptors (R) are shown in Figure 4-1 and UTM coordinates provided in Appendix B. Sensitive receptors R1 to R5 are commercial/industrial receptors, R6 to R37 are residential receptors and R38 to R53 are environmental receptors inclusive of the dolphin sanctuary (R38) and Port Adelaide River. R54 (not shown for display purposes) is representative of the St Kilda township to the north east of the site.

Figure 4-1: Aerial View of Project Location and Nearest Sensitive Receptors

4.3 Dispersion Meteorology

4.3.1 Regional Meteorology

Data recorded by the nearest Bureau of Meteorology (BoM) long term weather station at Parafield Airport (located approximately 10km east of the proposed Project site) was reviewed to describe the meteorological and climatic influences in the region. Long term weather data obtained from the BOM weather station at Parafield Airport is presented in Table 4-1.

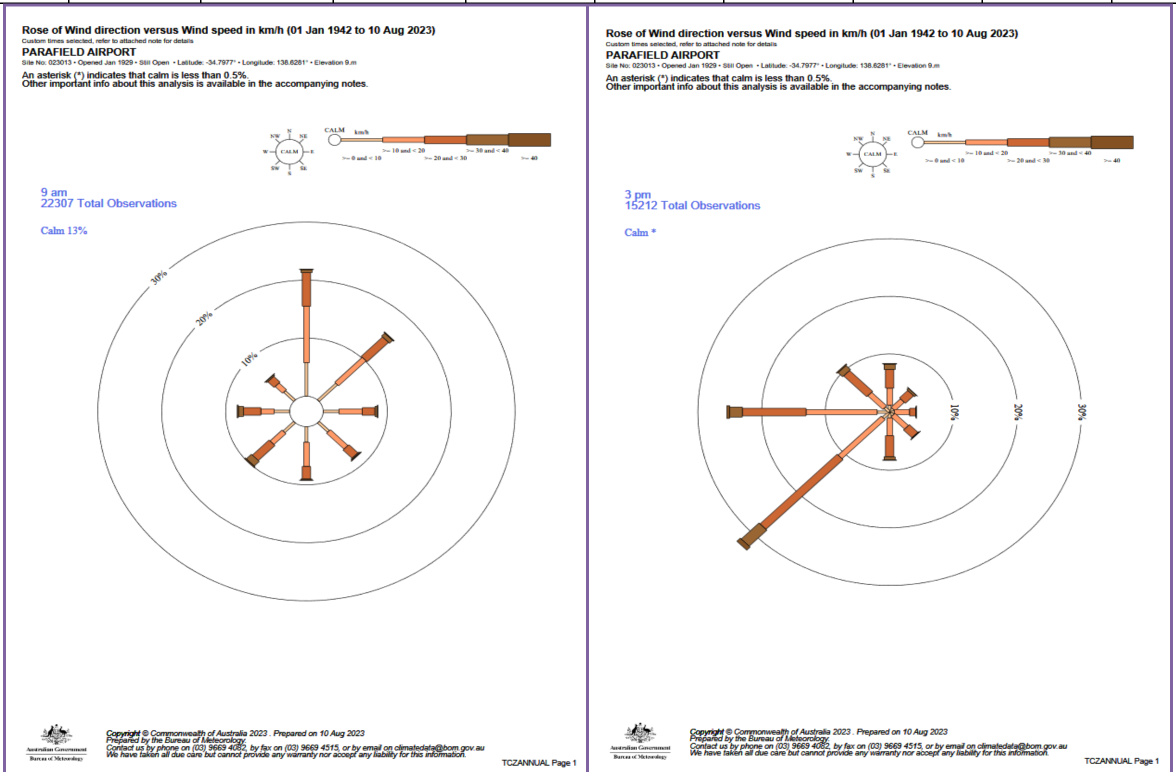
The mean temperature range is between 6.3°C and 29.9°C with the coldest month being July and the hottest, January. The rainfall in the region is variable, with most rainfall in the cooler months. On average, most of the annual rainfall is received between May and September. Rainfall is lowest between January and March. The mean annual rainfall is 447 mm.

The long term wind roses recorded daily at the Parafield Airport station at 9am and 3pm are provided Figure 4-2. Winds are shown to be primarily from the north and northeast at 9am and west and southwest directions at 3pm. Stronger winds (>40km/hr or >11.1m/s) occur infrequently mostly from the west and southwest directions at both times.

The region experiences Mediterranean climate, with mild to cool winters with moderate rainfall and warm to hot, dry summers.

Table 4-1: Mean Long-term Weather Data for Parafield Airport

Month	Mean Temperature		Rainfall (mm)	9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)		Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	Mean RH (%)	Wind Speed (km/h)
Jan	29.9	16.4	21.4	22	50	15.6	29	34	24.4
Feb	29.4	16.3	18.4	21.6	52	14.2	29	35	23.9
Mar	27	14.6	21.5	19.7	56	13.2	25.9	38	22.1
Apr	22.9	11.8	38.1	17.2	62	12.7	22.1	44	20.1
May	19	9.3	48	13.7	74	11.8	18.2	56	18.3
Jun	15.9	7	54	10.6	83	11.6	15	66	18.6
Jul	15.2	6.3	58	10	82	13.5	14.4	65	20.4
Aug	16.4	6.7	53.2	11.4	76	14.9	15.5	60	21.8
Sep	19.1	8.2	43.8	14.1	68	17.4	17.8	56	23.1
Oct	22.1	10.2	39.8	16.8	58	18.8	20.8	46	24
Nov	25.5	12.8	27	19	54	17.5	24.5	39	24.4
Dec	28	14.8	24.6	20.9	51	17.1	26.4	38	24.3
Annual	22.5	11.2	448.5	16.4	64	14.9	21.6	48	22.1



Location: Parafield Airport Station | Data Period: 1942 to 2023 | Data Type: Measured Data

Figure 4-2: Annual Wind Rose for Parafield Airport Weather Station (1942 to 2023)

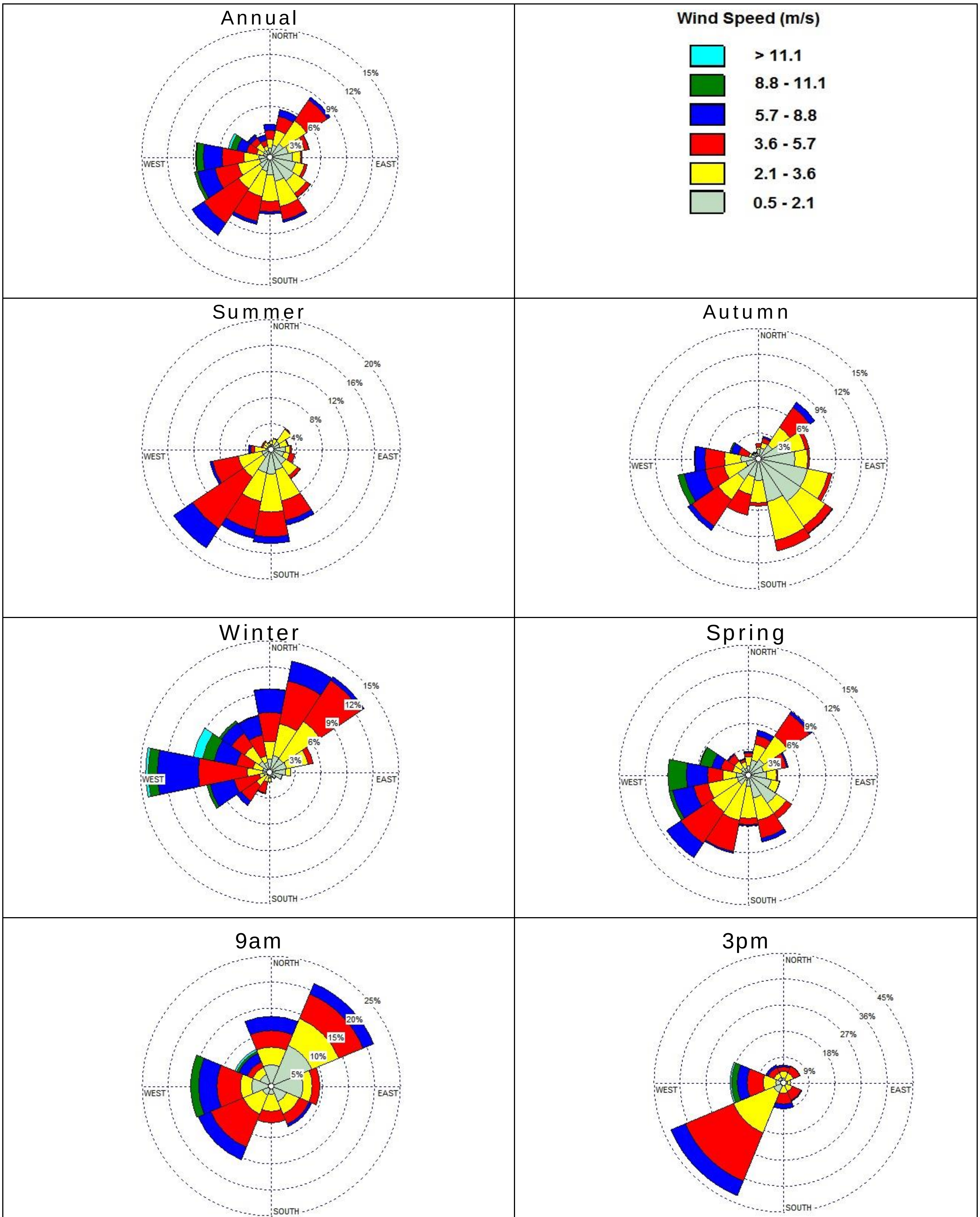
4.3.2 Local Meteorology

A three dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used as a precursor to CALMET which produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables for each hour of the modelling period. The TAPM-CALMET derived dataset for 12 continuous months of hourly data from the year 2009 and approximately centred at the proposed Project site has been used to provide further information on the local meteorological influences. Details of the modelling approach are provided in Section 5.5.

4.3.2.1 Wind Speed and Direction

Figure 4-3 presents the annual and seasonal wind roses from the TAPM-CALMET derived dataset for the year 2009 at the proposed Project site location. Wind roses from 9am and 3pm for the derived dataset are also provided in Figure 4-3 for comparison with the long term recorded data from the Parafield Airport Weather Station. Key features of the winds are:

- Winds are predominantly from the southwest with average wind speed of 3.4 m/s;
- Calm winds (<0.5m/s) are infrequent representing only 1.0% of the winds for the year;
- The strongest winds (>5.7m/s) occur from the northeast mostly in winter and spring;
- Lighter winds (<5.7m/s) primarily from the southwest and southeast occur in autumn and summer; and
- The 9am and 3pm wind roses for the TAPM-CALMET derived dataset are generally consistent with the measured data from the Parafield Airport BoM Weather Station. Winds are shown to be primarily from the north and northeast at 9am and southwest directions at 3pm.



Location: Osborne	Data Period: Jan 2009 to Dec 2009	Data Type: TAPM- CALMET extract

Figure 4-3: Wind Roses for the TAPM-CALMET Derived Dataset at the Project site, 2009

4.3.2.2 Atmospheric Stability

The Pasquill-Gifford stability classification scheme denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small. Figure 4-4 shows the stability class percentages from the TAPM-CALMET derived meteorological data for the project site. The data identifies that Stability Class F is most common; this stability class is indicative of stable atmospheric conditions.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

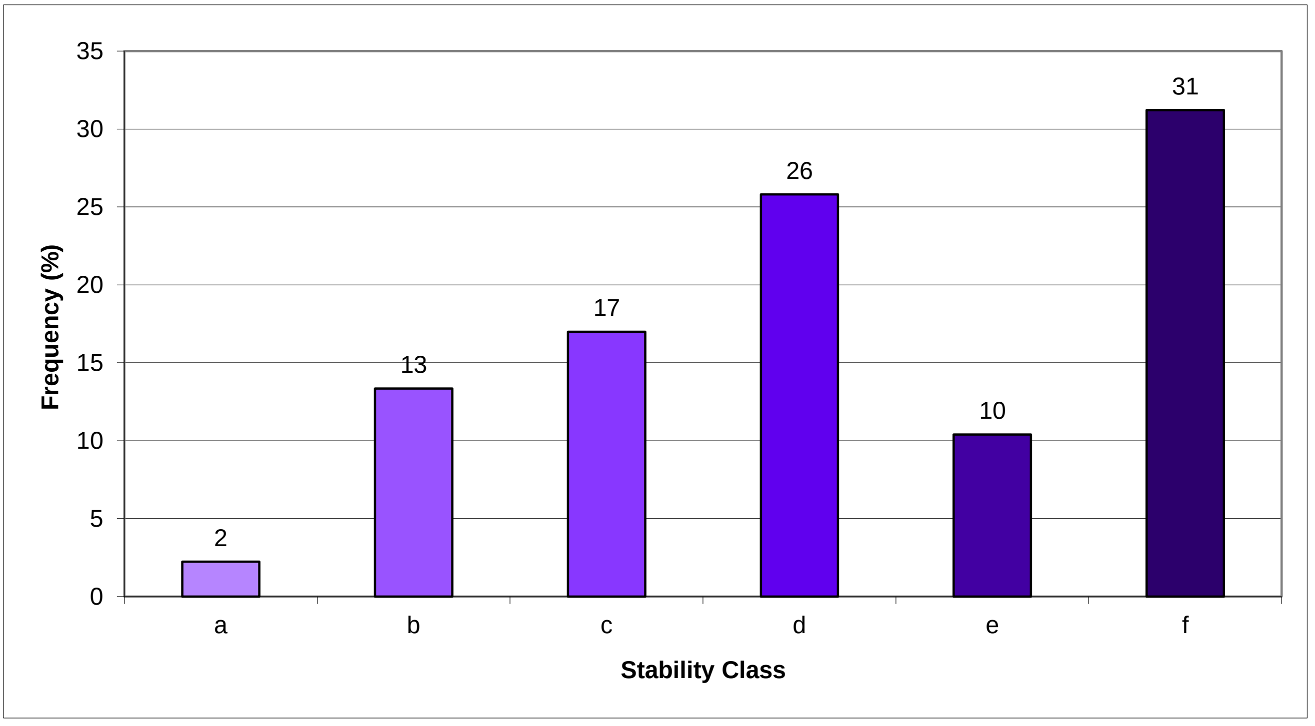


Figure 4-4: Stability Class Percentages for the TAPM-CALMET Derived Data, 2009

4.3.2.3 Mixing Height

Mixing height is defined as the height of the layer adjacent to the ground over which an emitted or entrained inert non-buoyant tracer will be mixed (by turbulence) within a time scale of about one hour or less.

Diurnal variations in mixing depths are illustrated in Figure 4-5. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

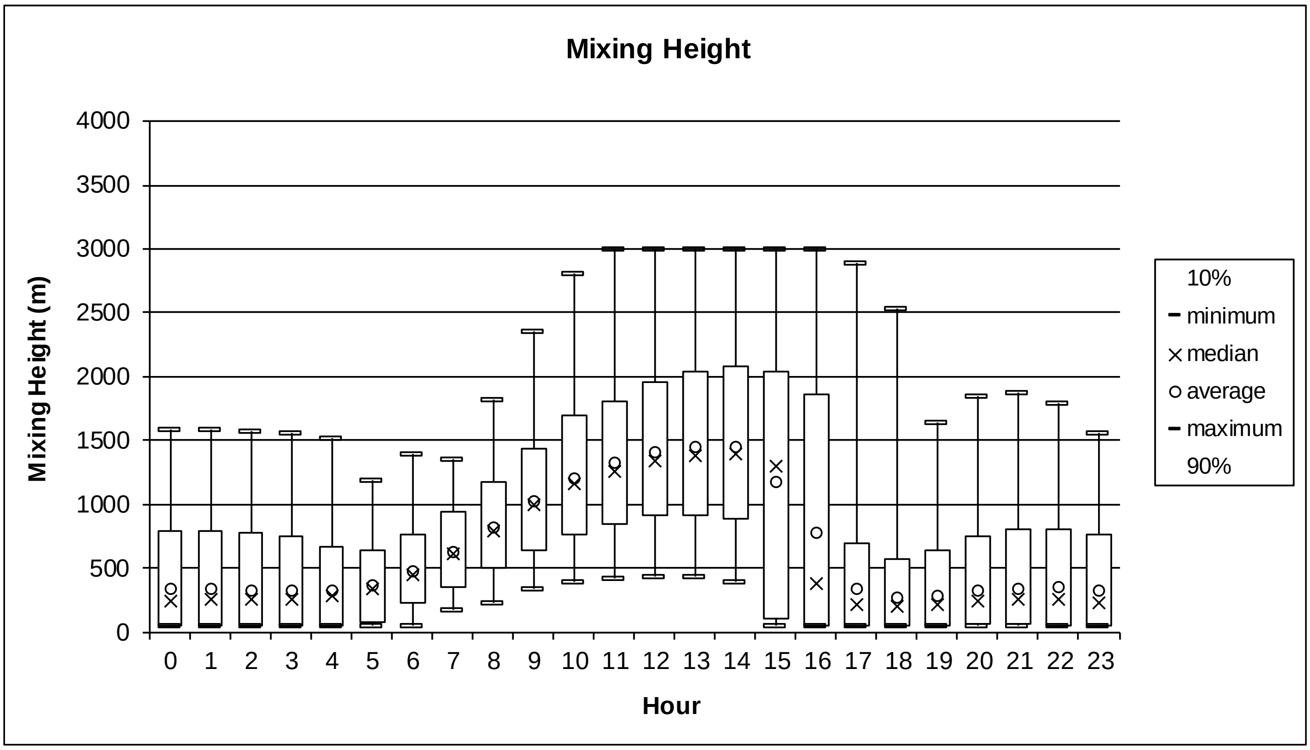


Figure 4-5: Mixing Height of the TAPM-CALMET Derived Data, 2009

4.4 Existing Air Quality

4.4.1 Existing or Proposed Potential Osborne Naval Shipyard Sources

The existing or proposed potential emission sources within the ONS Precinct are considered for the assessment of cumulative air quality impacts. Vipac has previously undertaken air dispersion modelling assessments (Vipac Ref. 70Q-18-0193-TRP-644836-4 and 70B-23-0233-TRP-60733-2) for these emission sources which are discussed below. Further discussion of the modelling of these sources for inclusion as background emissions is provided in section 0.

ANI's existing ONS precinct can be considered as three distinct sub-precincts (Figure 4-6), namely;

- Osborne Naval Shipyard Precinct – South (ONSP)
- Common User Facility (CUF)
- Australian Submarine Corporation North (ASC North).

Figure 4-6: Existing ONS Precinct

4.4.1.1 ONSP

The ONSP is the amalgamation of the previous ASC shipbuilding facility and the new shipbuilding facility completed in 2020. Whereby some of the original buildings are currently undergoing modernisation and change of purpose, and in particular, the decommissioning of the old paint facility (B03).

The main potential VOC emission sources are;

- B18 – Blast and Paint Facility
- B20 – Surface Treatment Line
- B22 – Block assembly; and
- B18a – a new Blast and Paint Facility

Vipac prepared an air quality assessment of the proposed paint and blasting facility at Mersey Rd North Osborne, South Australia (Vipac Ref. 70Q-18-0193-TRP-644836-4). The assessment was conservatively based on the design of the ship yard for the Future Frigate. However, the ship yard, for short periods of time may be used for smaller commercial applications. There are no other major existing sources of the volatile organic compounds beyond the immediate boundary of the facility. As shown in Figure 4-7, five sources of VOC emissions were identified as follows:

1. One stack source for the steel treatment line;
2. Two stack sources for the blast and paint hall;
3. One stack source for the small part paint shop;
4. The hardstand treated as an area source for outdoor painting activities; and
5. Emissions from the erection hall from painting on board the vessels. These emissions are treated as a volume source ventilated via natural ventilation.

ANI is also proposing a new potential VOC emission source, B18a – a new blast and paint facility (identified as item 6 in Figure 4-7).

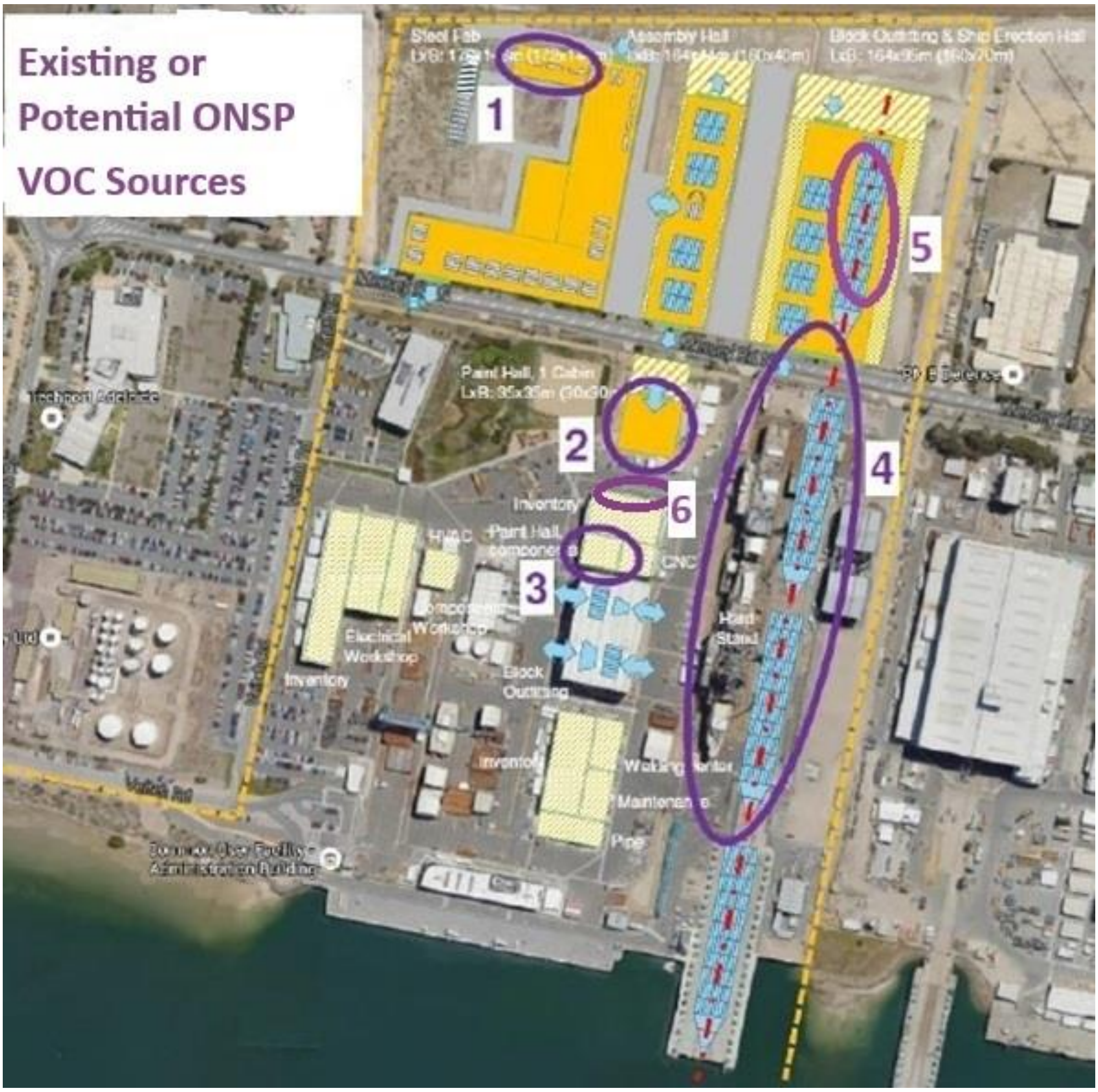


Figure 4-7: Existing or Potential ONSP VOC Sources

The new B18a will facilitate the increased blasting and painting capacity of large ship blocks prior to consolidation. B18a consists of a single dual functionality booth capable of both blasting and painting operations. The location of the proposed B18a is between existing Building 18 and Building 03 with three exhaust stacks on the southern end of the building. A schematic diagram is shown in Figure 4-8.

Operating conditions for B18 and B18a have been adopted from data provided by BAE proposed for maximum painting activities. The following operating conditions for B18 and B18a have been modelled:

- Blasting and Painting could occur during either day or night shift 7 days a week.

o Paints are assumed to be Intershield 300HS and Intergard 740. While further options were assessed in the Vipac document, the model predictions for these paints were highest and, as such, this option is adopted as the most conservative estimation of existing air quality.

- No odour mitigation measures such as carbon filters have been modelled.

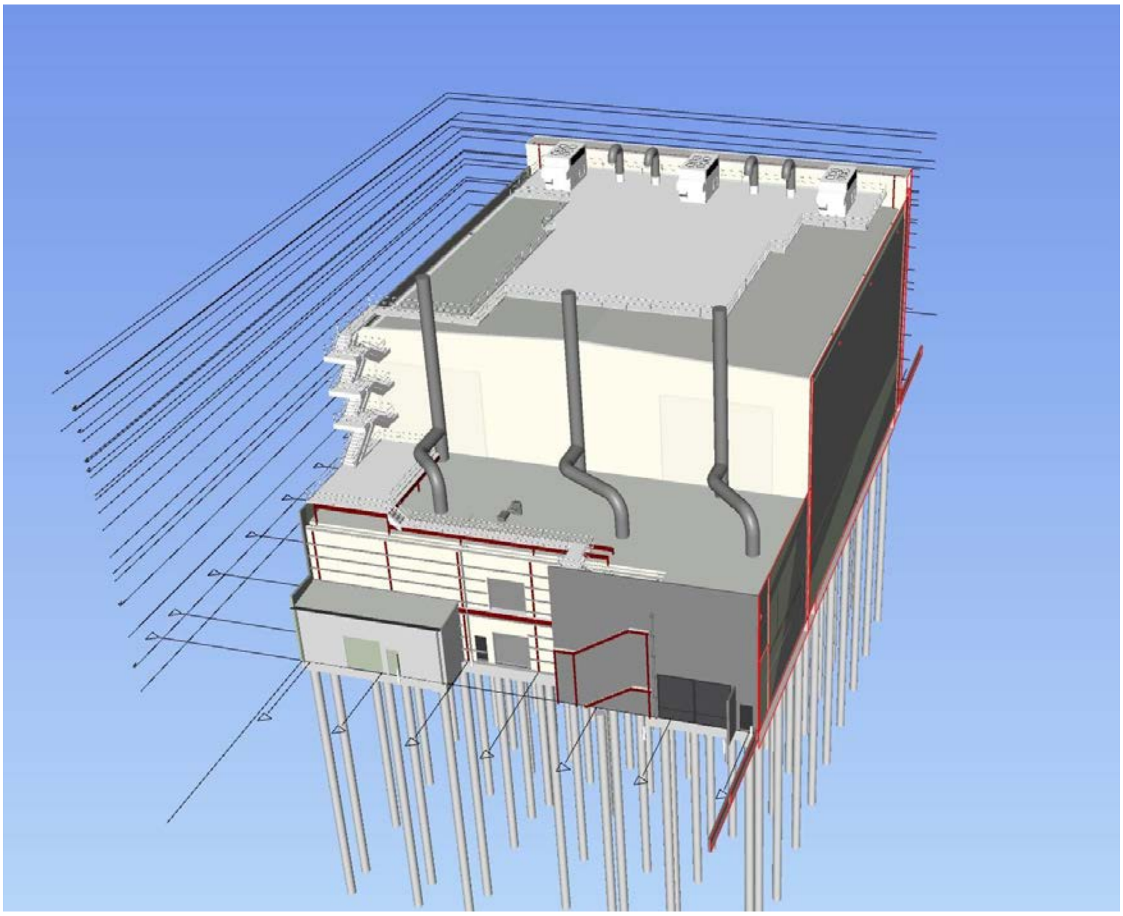


Figure 4-8: Proposed Schematic of Building B18a

4.4.1.2 Common User Facility (CUF)

The common user facility is where the new Naval Submarines and Ships will see final stage of commissioning and fit out before entering the water, and where commercial ships dry dock and undergo maintenance. The main potential VOC emission source is the Surface treatment maintenance of hulls. It is noted that the proposed new Yard will have its own transition into the water and will therefore not be using the CUF.

The CUF is the final transition location of the new Naval Ships and Submarines before entering the water, where they undergo the last of the dryland commissioning, fit-out and touch-up painting.

The vast majority of painting activities are completed in the B20 as part of the surface treatment process and B18 Blast and Paint facility of ONSP. This includes the Type 26 Frigates which were considered the primary sources of VOCs at this location and assessed in the air quality assessment of the ONSP (Vipac Ref. 70Q-18-0193-TRP-644836-4).

4.4.1.3 ASC North

ASC North is the original submarine building infrastructure that now operates as a submarine maintenance facility. The main potential VOC emission sources are;

- Blast and Paint Facility – submarine maintenance of small parts
- Main Hall – submarine surface treatment maintenance

Fabrication has ceased at this facility and going forward this precinct is for the purpose of maintaining the existing Collins class submarines. Activities that may cause VOC emissions are therefore assumed to be negligible and sporadic.

4.4.2 Other Background Sources

A review of the most recently reported NPI data identified that there are several potential industrial sources of the individual VOC species of concern (i.e. Xylenes and Ethylbenzene as identified in the selected paint MSDS) in the environment surrounding the ONS. The total combined emissions from these facilities reported for Xylenes and Ethylbenzene for the 2022/2023 NPI reporting year are approximately 3,166 kg/y and 642 kg/y, respectively. This represents less than 3% of the modelled emission rates for the ONS. In addition, these sources are more than 3km from the ONS such that emitted pollutants would be diluted in the surrounding environment. The background concentrations from these sources are therefore assumed to be minor compared with the emissions from the ONS operations.

The primary sources of air emissions in the region surrounding the ONS are industrial/commercial and vehicle generated primarily including PM10, PM2.5, CO, SO_2, NO_2. Consequentially, the majority of these pollutants (i.e. excluding VOCs) are measured at nearby SA EPA operated air quality monitoring stations. The closest representative monitoring stations to the proposed Project sites are Le Fevre for PM10, PM2.5, NO_2 and SO_2, and Adelaide CBD for CO.

In addition, the Victoria Road Air Quality Monitoring Study was initiated by the City of Port Adelaide Enfield (CPAE) and Environment Protection Authority (EPA) in response to community concerns in the Le Fevre Peninsula area regarding the health impacts of increasing traffic movements on local air quality and community health. KOALA (Knowing Our Ambient Local Air Quality) monitors were used in the study for indicative monitoring of PM10, PM2.5 and CO and a range of meteorological parameters. Whilst the KOALAs are not compliance instruments the monitoring data can be useful in understanding the trend in air pollution and are used as a useful indicator of air pollution. Overall, the concentrations of measured pollutants were similar to those observed in other parts of metropolitan Adelaide and, while it was not possible to differentiate between the industrial sources in the region, the levels of air pollutants did not exceed the national standards during the study period.

The most recent 5 years of publicly available monitoring data from SA EPA operated stations is adopted as representative of background pollutant concentrations for the assessment of cumulative impacts. The 70th percentile concentration is adopted for short term average (e.g. 1 hour, 8 hour or 24 hour) and annual average for the long term average (i.e. annual) concentrations.

Table 4-2 summarises the background concentration data measured at the relevant SA EPA stations and adopted for this assessment.

Table 4-2: Adopted Background Concentrations

Measurement Station	Parameter	Period	Applied Background[a] ($\mu g/m^3$)	Ambient Air Quality Criteria
Le Fevre	PM_{10}	24 Hour	15.3	50
	$PM_{2.5}$	24 Hour	4.7	25
		Annual	3.8	8
	NO_2	1 Hour	12.3	164
		Annual	10.0	30
	SO_2	1 Hour	2.9	290
		24 Hour	1.2	60
Adelaide CBD	CO	1 Hour	313	31,000
		8 Hour	313	11,250

a gas concentrations at 0^{o}C and 1atm

5 Methodology

5.1 Overview

The overall approach to the assessment follows the guidelines outlined in the *Ambient Air Quality Assessment 2016* and *Evaluation distances for effective air quality and noise management* prepared by the South Australian Environmental Protection Authority and the CALPUFF modelling guidance. The assessment was conducted as follows:

- An assessment of potential air quality impacts associated with construction incorporating a risk assessment following the Guidance on the Assessment of Dust from Demolition and Construction published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014).
- A preliminary assessment of potential air quality impacts from the proposed operation of the SCY by comparison of distances from the nearest sensitive receptors and evaluation in accordance with the guidance provided in the *Evaluation distances for effective air quality and noise management.*
- An emissions inventory of the primary air pollutants and odour emitted by the existing and proposed ONS facilities for normal and maximum operating scenarios has been developed. Air emission rates required for the modelling assessment are derived based upon manufacturer specification data, internationally recognised emissions estimation techniques (e.g. NPI EET or USEPA AP42 Methodology) and/or Vipac's database of similar projects.
- Future air emissions generated by vehicles projected to be travelling on Victoria Road, Veitch Road, Pelican Point Road and internal routes were estimated based on forecast vehicle volumes for 2041 obtained from the Traffic Planning Assessment Report and Technical Memorandum and emission factors adopted from the Composite Vehicle Emission Factors for Air Quality Modelling using COPERT Australia database.
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed by comparison with the assessment criteria described in Section 3.

5.2 Construction Risk Assessment

At this stage, the construction schedule and associated equipment is not known, however, construction activities are inherently temporary and potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan. A risk-based approach has been adopted to determine the magnitude of potential dust impacts upon the existing receptors and surrounding amenity and is based upon uncontrolled construction activities.

In lieu of definitive guidelines in Australia, this assessment generally follows the *Guidance on the Assessment of Dust from Demolition and Construction* published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014) to determine the level of risk from potential construction activities. Figure 5-1 presents a flow chart process applied to determine the risks, and the assessment following this procedure is outlined in the following sections.

The assessment procedure outlined in the IAQM divides construction activities into four types:

- Demolition
- Earthworks
- Construction
- Track out

And considers three separate dust impacts:

- Annoyance due to dust soiling
- Risk of health effects due to increase in exposure to PM_{10}
- Harm to ecological or environmental receptors

It is noted that the scope of construction activities is unknown; therefore, assumptions have been made, which are identified in the assessment, where justification cannot be given, a conservative approach has been adopted where applicable.

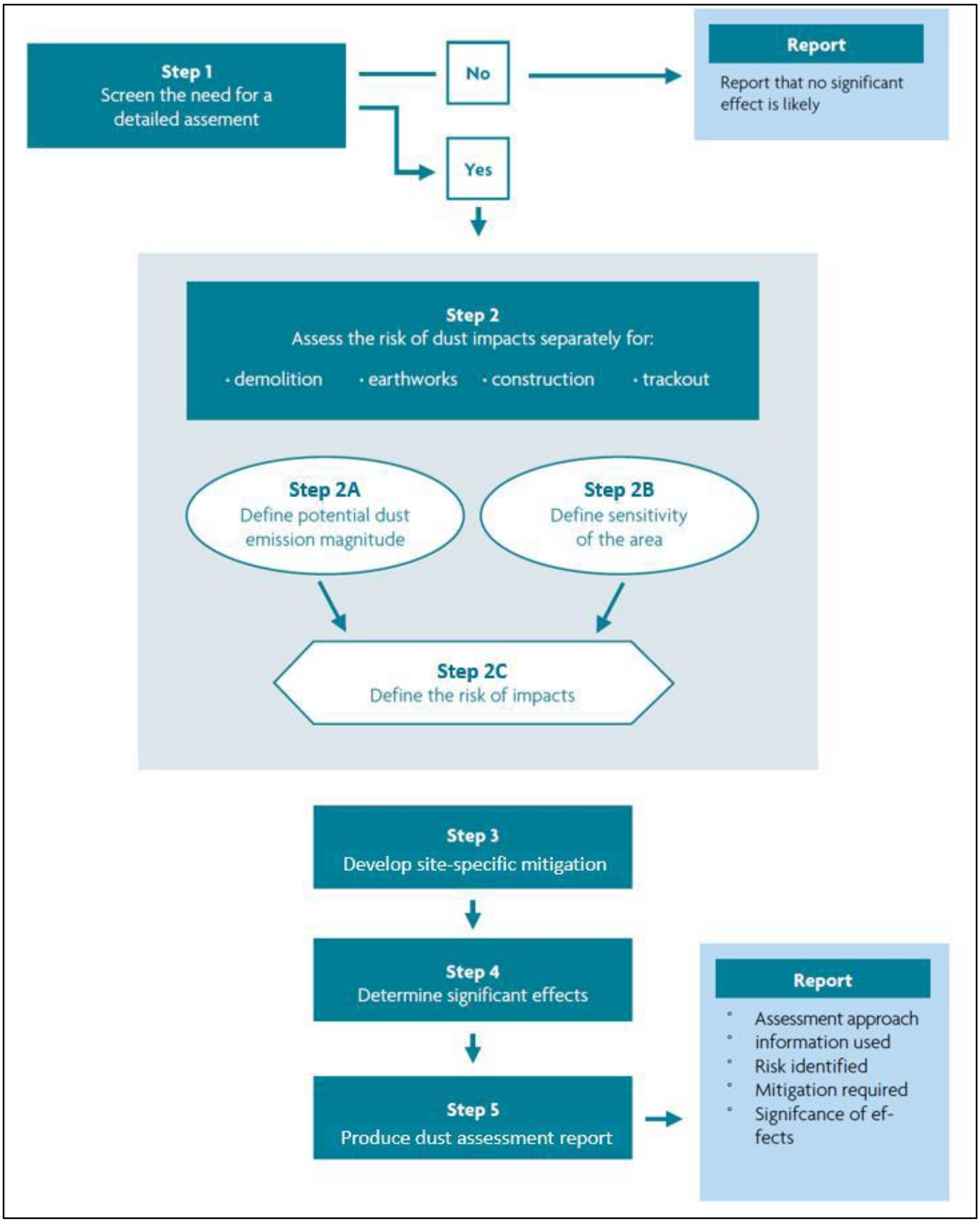


Figure 5-1: Procedure for the Assessment of Construction Impacts

5.3 Evaluation Distance Assessment

Distances from the nearest sensitive receptors to the proposed SCY operational activities have been compared with the distances specified in the *Evaluation distances for effective air quality and noise management* (see Table 3-4) for a preliminary assessment of potential air quality impacts.

5.4 Emissions Inventory

5.4.1 ONS Facilities

5.4.1.1 Emissions Scenarios

Two paint application scenarios have been modelled which are considered as representative of normal operating conditions and maximum activity within the proposed SCY and incorporating the same activities within the existing or proposed facilities of the ONS.

Whilst no odour treatment measures have been incorporated into the modelling for either blast and paint hall, it is noted that a range of source configurations were previously assessed for potential air quality impacts at the nearest sensitive receptors. The parameters outlined in Section 5.4.1.4 represent the practical optimal source configurations (e.g. location, height and velocity) as determined by modelling for minimising predicted ground level concentrations of air pollutants at the sensitive receptors, as far as reasonably practicable.

Furthermore, the paint products specified for the shipbuilding activities have been selected with a consideration of their VOC content in order to minimise emissions of these compounds and thereby odour, where possible.

Table 5-1: Proposed Paint Use

Scenario	Paint	Total Paint Applied (in each facility) in 8 Hour Shift (L)	Total VOC per Hour (kg/hr)
Normal	Intershield 300HS	140	7.21
	Intergard 740	160	16.8
Maximum	Intershield 300HS	420	10.82
	Intergard 740	480	25.2

5.4.1.2 Emission Sources

Based on the preliminary plans provided, Vipac has identified facilities that could potentially generate air emissions impacting areas beyond the precinct. The main potential air pollutant sources for the SCY are expected to arise from activities within these facilities and have been considered in the modelling assessment. For the purpose of this assessment and display in Figure 5-2.

The identified potential emission sources are:

- Fabrication Workshop (East)
- Fabrication Workshop (West)
- Fabrication Workshop Annex A
- Fabrication Workshop Annex B
- Blast, Paint and Tile Workshop
- Outfitting Workshop
- Main Workshop Complex
- Specialised Manufacturing Facility
- Boiler House
- Launch Facility
- Boiler Room
- CEPS (Central Emergency Power Station)

The following new sources of emissions have been assumed for this assessment:

- One stack source for Fabrication Workshop (East)
- One stack source for Fabrication Workshop (West)

- One stack source for Fabrication Workshop Annex – A
- One stack source for Fabrication Workshop Annex – B
- Three stack sources for Blast, Paint and Tile Workshop
- Emissions from the Outfitting Workshop from painting on board the vessels. These emissions are treated as a volume source ventilated via natural ventilation
- Emissions from the Main Workshop Complex from painting on board the vessels. These emissions are treated as a volume source ventilated via natural ventilation
- One stack source for the Specialised Manufacturing Facility
- Two stack sources for the Boiler House
- Emissions from the Launch Facility from surface treatment maintenance of hulls painting on board the vessels. These emissions are treated as an area source ventilated via natural ventilation
- Two stack sources for the Boiler Room
- One combined stack source for the CEPS (Central Emergency Power Station).
- Two stack sources for a third Boiler facility.

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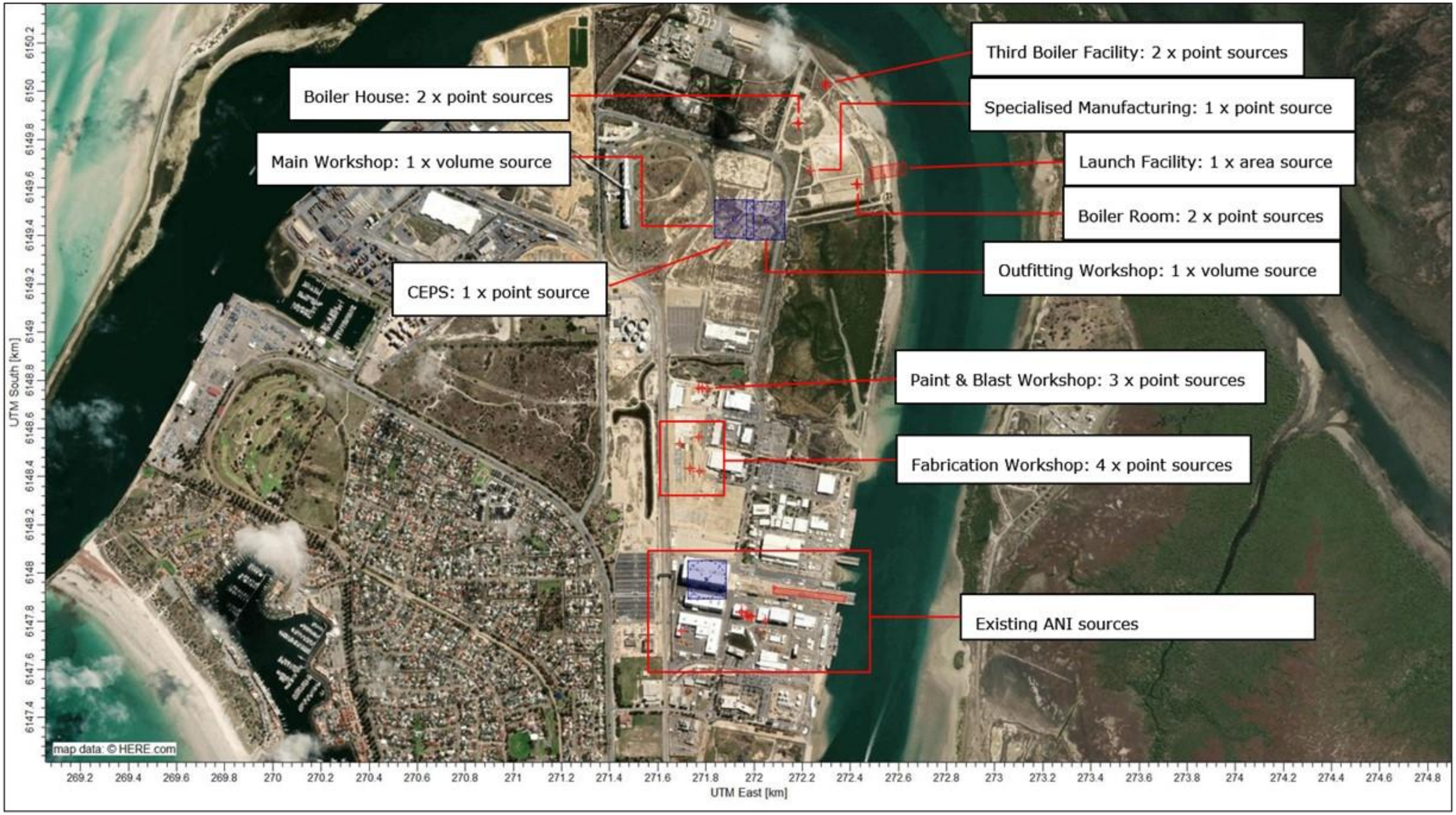

Figure 5-2: Modelled Source Locations

5.4.1.3 Modelling Assumptions

The assumptions adopted for this assessment are derived from those adopted for the previous assessments and may be summarised as follows:

- An hourly VOC emission rate of VOCs from all blast and paint halls has been conservatively adopted and while this emission rate could only possibly occur at once every ten paint day cycle (based on advice from experienced shipbuilders), it is adopted as a continuous rate throughout the year.
- An hourly emission rate for all modelled pollutants from the boilers and CEPS has been conservatively adopted and while this emission rate would only be expected to occur infrequently (e,g, under maintenance or emergency conditions), it is adopted as a continuous rate throughout the year.
- VOC emission rates for paint and blast facilities have been based upon the previous Vipac assessment (Vipac Ref. 70B-23-0233-TRP-60733-2) including paint usage (see Table 5-1).
- The majority of potential emissions are expected to occur from paint and blast activities, fuel/oil power boilers and fuel/oil power CEPS. In the absence of detailed site information, all emission sources and their relevant parameters have been assumed. Eighteen potential new sources of emissions to air have been identified as follows:
    - One stack source for Fabrication Workshop (East).
    - One stack source for Fabrication Workshop (West).
    - One stack source for Fabrication Workshop Annex – A.
    - One stack source for Fabrication Workshop Annex – B.
    - Three stack sources for Blast, Paint and Tile Workshop.
    - Emissions from the Outfitting Workshop from painting on board the vessels. These emissions are treated as a volume source ventilated via natural ventilation.
    - Emissions from the Main Workshop Complex from painting on board the vessels. These emissions are treated as a volume source ventilated via natural ventilation.
    - One stack source for the Specialised Manufacturing Facility.
    - Two stack sources for the Boiler House.
    - Emissions from the Launch Facility from surface treatment maintenance of hulls painting on board the vessels. These emissions are treated as an area source ventilated via natural ventilation.
    - Two stack sources for the Boiler Room.
    - 12 diesel engine stack sources for the CEPS (Central Emergency Power Station).
    - Two stack sources for a third Boiler facility.
- Emission rates of individual VOC species were estimated based on the maximum % by weight specified in the MSDS of the relevant paint product.
- Emission rates for the boiler stacks were derived from the NPI EET Manual for Combustion in Boilers based upon an assumed maximum fuel oil demand of 1.04 kg/s as specified in the Master Plan.
- Emission rates for the CEPS were derived from manufacturer specified data for 12 x 1.5MW diesel engines required for a maximum demand of 20MVA for the emergency power station.

5.4.1.4 Model Input Data

5.4.1.4.1 Emissions Input Data

Table 5-2 provides the model input parameters for the SCY main blasting and painting halls and Table 5-3 for the remaining facilities. Table 5-4 and Table 5-5 provide the model input parameters for the existing and proposed ONS sources. Building dimensions were also modelled for wake effects.

Table 5-2: SCY Blast and Paint Hall Model Inputs – Scenarios Normal and Maximum

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (^0C)	Total VOC[1] Emission Rate (g/s)
Normal Operating Scenario					
B18a Stack 1 SCY	20	27	1.2	20	1.11
B18a Stack 2 SCY	20	27	1.2	20	1.11
B18a Stack 3 SCY	20	27	1.2	20	1.11
Maximum Operating Scenario					
B18a Stack 1 SCY	20	27	1.2	20	1.67
B18a Stack 2 SCY	20	27	1.2	20	1.67
B18a Stack 3 SCY	20	27	1.2	20	1.67

1. VOC emissions from paint application activities. Emission rates for individual VOC species are derived from paint VOC content fractions specified in their MSDS.

Table 5-3: SCY Model Inputs – Both Scenarios

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (^0C)	Emission Rate (g/s)									
					Total VOC[1]	Total VOC[2]	CO	SO_2	NOx	PAH	Total Metals[3]	TSP	PM10	PM2.5
Fabrication Workshop (East)	10	27	0.25	20	0.29	0	0	0	0	0	0	0	0	0
Fabrication Workshop (West)	10	27	0.25	20	0.29	0	0	0	0	0	0	0	0	0
Fabrication Workshop Annex A	10	27	0.25	20	0.29	0	0	0	0	0	0	0	0	0
Fabrication Workshop Annex B	10	27	0.25	20	0.29	0	0	0	0	0	0	0	0	0
Outfitting Workshop	n/a	27	n/a	n/a	0.02	0	0	0	0	0	0	0	0	0
Main Workshop Complex	n/a	27	n/a	n/a	0.02	0	0	0	0	0	0	0	0	0
Specialised Manufacturing Facility	10	33	1	20	0.04	0	0	0	0	0	0	0	0	0
Boiler Room stack 1	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
Boiler Room stack 2	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
Launch Facility, hardstand	n/a	15	n/a	n/a	0.00003	0	0	0	0	0	0	0	0	0

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (°C)	Emission Rate (g/s)									
					Total VOC[1]	Total VOC[2]	CO	SO_2	NOx	PAH	Total Metals[3]	TSP	PM10	PM2.5
Boiler House stack 1	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
Boiler House stack 2	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
Boilers, 3rd facility stack 1	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
Boilers, 3rd facility stack 2	10	33	2	400	0	0.01	0.35	0.01	1.41	0.0001	0.0006	0.07	0.07	0.02
CEPS	34	27	7.6	500	0	1.55	20.94	0.02	159.33	0	0	0.55	0.55	0.55

1. Total VOC emissions from paint application activities. Emission rates for individual VOC species are derived from paint VOC content fractions specified in their MSDS.

2. Total VOC emissions from boiler and CEPS combustion sources. Emission rates for individual VOC species are derived from the emission factors provided in the NPI EET Manual for Combustion in Boilers and manufacturer specification data.

2. Total metal emissions from boiler combustion sources. Emission rates for individual metal species are derived from the emission factors provided in the NPI EET Manual for Combustion in Boilers and manufacturer specification data.

Table 5-4: Model Inputs – ONSP and CUF

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (°C)	Total VOC[1] Emission Rate (g/s)
Steel treatment line	10	20	0.25	20	0.29
Small part paint shop	10	20	1.00	20	0.04
Hardstand	n/a	15	n/a	n/a	0.25
Erection hall	n/a	15	n/a	n/a	0.07

1. Total VOC emissions from paint application activities. Emission rates for individual VOC species are derived from paint VOC content fractions specified in their MSDS.

Table 5-5: B18 and B18a Model Inputs – Scenarios Normal and Maximum[1]

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (°C)	Total VOC[1] Emission Rate (g/s)
Normal Operating Scenario					
B18 Stack 1	11	27	1.6	20	1.67
B18 Stack 2	11	27	1.6	20	1.67
B18a Stack 1	20	27	1.2	20	1.11
B18a Stack 2	20	27	1.2	20	1.11
B18a Stack 3	20	27	1.2	20	1.11

Source	Velocity (m/s)	Height (m)	Diameter (m)	Temperature (^{0}C)	Total VOC[1] Emission Rate (g/s)
Maximum Operating Scenario					
B18 Stack 1	11	27	1.6	20	2.5
B18 Stack 2	11	27	1.6	20	2.5
B18a Stack 1	20	27	1.2	20	1.67
B18a Stack 2	20	27	1.2	20	1.67
B18a Stack 3	20	27	1.2	20	1.67

1. Total VOC emissions from paint application activities. Emission rates for individual VOC species are derived from paint VOC content fractions specified in their MSDS.

5.4.2 Transport Emissions

5.4.2.1 Traffic Data

Modelling of emissions from vehicles was performed using the CALPUFF model as detailed in Section 5. Forecast peak vehicle volumes were derived for vehicles projected to be travelling on Victoria Road, Veitch Road, Pelican Point Road and access routes based on forecast vehicle volumes for 2034 obtained from the Traffic Planning Assessment Report[4]. It is noted that the vehicle volumes are inclusive of forecast traffic demand to support the expanded development and non-ANI growth (i.e. local traffic not associated with ANI).

The approach adopted as presented in the Traffic Planning Assessment is reported as deliberately tailored to be appropriate for the current stage of planning and approvals, and as such is set at a strategic / high level to give an early assessment of possible traffic demand. Assumptions adopted in the derivation of the future traffic flows therefore apply to their use for the emissions modelling assessment which is also considered high level but conservative. The key traffic data parameters adopted for the assessment are provided in Table 5-6. Where relevant, maximum forecast peak hour vehicle volumes have been applied for these times (i.e. from 6 till 9am and 3 till 6pm) and constant hourly vehicle volumes accounting for approximately 80% of the AEDT at other times. Furthermore, the maximum projected percentage of heavy vehicles for each road was conservatively applied for the estimation of the emission factors.

Table 5-6 - Traffic Data

Road	Year	Hourly Traffic Volume (veh/hr)		Heavy Vehicles (%)
		Peak	Non-peak	
Victoria Road - Northbound	2034	2,140	428	19
Victoria Road - Southbound		2,142	428	19
Veitch Road - Eastbound		589	118	43
Veitch Road - Westbound		462	92	43
Pelican Point Road		1,654	331	43
Internal access routes		811	162	43

5.4.3 Emission Factors

The National Pollution Inventory Emission Estimation Technique for Motor Vehicles was withdrawn in 2014 and replaced with the Australian Motor Vehicle Emission Inventory for the National Pollution Inventory (NPI). This NPI document has developed a nationally consistent Motor Vehicle Emission Inventory (MVEI) for each state and territory, using COPERT Australia.

The COPERT Australia software calculates emissions from 226 vehicle classes and different types of emissions (hot running, cold start, evaporative) from motor vehicles. The emission factors within this software are developed for the vehicle fleet composition and age of the fleet vehicles in the base year 2010 and future year (2025) scenario. As a conservative approach, this assessment is based on emission factors derived for age of the fleet vehicles in the base year 2025 which do not account for any anticipated improvements in vehicle emissions technology or increased electric vehicle usage on Australian roads.

Vehicle emission rates are substantially affected by local driving conditions, vehicle fleet composition, weather conditions and traffic volume. Composite emission factors adopted for 2034 were derived using the Composite Motor Vehicle Emission Factors for Air Quality Modelling using COPERT Australia, data tool. The emissions factors are based upon COPERT Australia emission factor calculations. Available inputs for calculation of the composite emission factors include:

- Percentage of heavy vehicles
- Season of year
- Traffic situation (urban, congested, and freeway)
- Road gradient

These inputs provide emission factors light-duty and heavy vehicles as well as a composite emission factor based on proportion of heavy vehicles. Emission factors for target road traffic related pollutants are then calculated. Vehicle emission rates are substantially affected by local driving conditions, vehicle fleet composition, weather conditions and traffic volume. The emission factors used in this assessment are presented in Table 5-7. The composite emission factors for the Winter

[4] SMEC, ANI Link Road Traffic Planning Assessment Report, 5/4/2024

season and urban flow are higher than Spring, Summer or Autumn and therefore the Winter and urban flow emission factors have been used to present a conservative assessment.

For further conservatism, the composite EF for 2025 were adopted for 2034, which does not account for any improvement in vehicle exhaust emissions technology or increased demand for electric vehicles that is likely to occur by 2034.

A NOx to NO_2 composite conversion factor of 13% is applied based on the Composite Motor Vehicle Emission Factors for Air Quality Modelling using COPERT Australia, data tool.

Table 5-7: Composite vehicle emission factors modelled

Road	Modelled Emission Factors (g/VKT)			
	NOx	PM_{10}	$PM_{2.5}$	Benzene
Victoria Road (both directions)	0.7	0.061	0.036	0.052
All other roads	1.2	0.082	0.047	0.037

5.5 Modelling

5.5.1 TAPM

To generate the meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO. TAPM was configured as outlined in Table 5-8.

Table 5-8: TAPM Set Up Data

Parameter	Setting
Centre Coordinates	34.783 S; 138.508 E
Dates Modelled	30 December 2008 to 1 January 2010 (2 start-up days)
Grid Domains	Four nested grid domains of 30 km, 10 km, 3 km and 1 km;
Vertical Levels	25 vertical levels from 10 m to an altitude of 8000 m above sea level
Data assimilation	Bureau of Meteorology Parafield Airport Weather Station for 2009

5.5.2 CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system.

The CALMET simulation was run as No-Obs simulation with the gridded TAPM three-dimensional wind field data from the innermost grid. CALMET then adjusts the prognostic data for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation.

Vipac adopted the no observation approach for this site which uses prognostic data generated using TAPM nudged with observational data for the assessment. The CALMET modelling setup is presented in Table 5-9.

Table 5-9: CALMET setup parameters

Parameter	Setting
Meteorological grid domain	10km x 10km (100 x 100 x 10 grid dimensions)
Meteorological grid resolution	0.1km
Surface meteorological stations	None

Upper air meteorological station	None
3D Wind field	3D wind fields from TAPM (1km resolution) input as an initial guess to CALMET

5.5.3 CALPUFF

CALPUFF is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

The emissions have been modelled using CALPUFF using the following key inputs at both sites:

- meteorological dataset for 1/1/2009 to 31/12/2009 generated in CALMET.
- 50 x 50 grid with a grid spacing 100m.
- terrain data from Geoscience Australia Digital Elevation Model.
- emission rates and source configurations as presented in Section 5.4.1.4.1.
- partial plume adjustment for terrain influences.
- a radius of terrain feature set to 5km and minimum radius of influence to 0.1km.

5.6 Other Parameters

5.6.1 Conversion of Oxides of Nitrogen to Nitrogen Dioxide

Oxides of nitrogen are formed during high-temperature combustion processes from the oxidation of nitrogen in the air or fuel. NOx from combustion consists largely of nitrogen oxide (NO) and partly of nitrogen dioxide (NO_2). After emission from the stack, NO is transformed to NO_2 through oxidation with atmospheric ozone (O_3).

As a worst case scenario, 100% of the oxides of nitrogen released by the boiler and CEPS stacks were assumed to be converted to nitrogen dioxide.

5.6.2 Derivation of 3 Minute Average Concentrations

Three-minute average concentrations were derived from the Power Law as follows:

$$c(t) = c(t_0)\ (t_0/t)^{0.2},$$

where (t) is the averaging time (minutes) of interest (3 minutes in this case), and (t_0) is the averaging time consistent with the dispersion rates (1 hour in this case).

5.6.3 Derivation of Odour Concentrations

Odour classification criteria specified in the Air Quality EPP are adopted for the conservative assessment of impacts at the residential receivers for individual pollutants. Impacts from complex mixtures of odours are assessed by comparison of predicted odour concentrations with the odour impact assessment criteria outlined in Section 3.2. The predicted odour concentrations are derived using the following formula (Equation 1)[5] :

$$OAV = \sum_{i=1}^{n} \frac{Ci}{OTi}$$

Where:

OAV = Odour Activity Value (OU/m^3)

C*i* = Concentration of compound *I* (mg/m^3)

OT = Odour threshold of compound (mg/OU)

[5] Capelli, L, Sironi, S, Del Rosso, R, Guillot J-M. Measuring odours in the environment vs dispersion modelling: A review. *Atmospheric Environment. 79 (2013) 731-743*

6 Results

6.1 Construction Impact Assessment

6.1.1 Step 1 – Screening

The results of the screening assessment is summarised in Table 6-1, it should also be noted that the boundary of the site was estimated from the Master Plan, as provided in Figure 2-2 . The outcome of the screening assessment indicates that a detailed assessment is required.

Table 6-1: Results of Screening Step

Receptor Type	Criteria	Outcome
Human Receptors	Within 350m of site boundary	Yes
	Within 50m of route used by construction vehicles up to 500m from a site entrance*	Yes
Ecological/Environmental receptors	Within 50m of site boundary	Yes
	Within 50m of route used by construction vehicles up to 500m from a site entrance*	Yes

*Haul routes and construction vehicle routes are not yet defined; given the location and access, it is possible that they will be within 50m of human and ecological receptors and have been assessed as such, conservatively.

6.1.2 Step 2 – Assessment of Risk of Construction Dust Impacts

6.1.2.1 Step 2A – Potential Construction Dust Emission Magnitude

The potential dust emission magnitude prescribed by IAQM classifies each activity as large, medium, or small and provides example assessments for each of the four construction activity types. The example criteria given in the guidance document have been used to assess the magnitude of potential emissions. The classification outcomes for potential emissions and any associated comments are provided in Table 6-2.

Table 6-2: Dust Emission Potential

Activity	Potential Dust Emission Magnitude	Comments
Demolition	Small	As outlined in the Master Plan, existing structures at the site will be incorporated into the design plan, and in some cases, building slabs will require demolition. Therefore, demolition is expected to be minimal.
Earthworks	Medium	As previously noted, much of the land-based portion of the proposed subject site has been cleared in the past 10 years[6]. Therefore, the main impacts from earthworks are expected to be generated mostly by soil preloading in Area 3.
Construction	Large	Proposed building dimensions are not yet available. However, it is expected a large volume of building constructions will be required.
Track-out	Large	Due to uncertainty around construction phasing, expected construction vehicle volumes are unknown. Therefore, this activity has been conservatively assessed as a large potential dust emission magnitude.

[6] Impact Assessed Development Application ANI NPSCY, URPS

6.1.2.2 Step 2B – Sensitivity of Area

This approach is based on distance from the footprint of the construction works and the receptor sensitivity. Residential receptors are considered as a high sensitivity receptor and the surrounding commercial and ecological receptors are considered a medium sensitivity. Given the distance to the footprint of works and following the guidance from IAQM, it has been determined that the surrounding human (residential) receptors are considered to be 'Low Sensitivity' as they are greater than 100m away from the source. The ecological receptors have been determined to be 'Medium Sensitivity' due to the proximity of conservation areas and waterways. The assessment matrix used to determine receptor sensitivity is provided in Table 6-3.

Table 6-3: Sensitivity of the Area and Dust Effects on Receptors

Receptor Sensitivity	Distance from the Source (m)		
	<20m	<50m	<100m
High	High	Medium	Low
Medium	Medium	Low	Low
Low	Low	Low	Negligible

6.1.2.3 Step 2C – Definition of Risk of Impacts

Using the assessments outlined above for defining the risk level of receptors and the risk level of uncontrolled potential construction-related activities, an overall risk assessment has been determined. Table 6-4 details the assessment matrix of receptor sensitivity and potential dust emissions magnitude and is used to determine the overall risk of potential dust impacts from the four categories of construction activities, as provided in Table 6-5.

Table 6-4: Receptor Sensitivity and Emission Magnitude Matrix

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Low Risk
Low	Low Risk	Low Risk	Negligible Risk

Table 6-5: Dust Impact Risk Assessment of Uncontrolled Activity

Activity	Dust Emission Magnitude	Sensitivity of the Receptor		
		High (<20m)	Medium (<50m)	Low (<100m)
Demolition	Small	Medium Risk	Low Risk	Negligible Risk
Earthworks	Medium	Medium Risk	Low Risk	Negligible Risk
Construction	Large	High Risk	Medium Risk	Low Risk
Track-out	Large	High Risk	Medium Risk	Low Risk

The results of the risk assessment matrix are summarised as follows:

- The closest residential dwellings are approximately 250m to the west of the footprint of works. A low to negligible risk rating is determined for all activities without control measures in place.
- The closest commercial receptors are approximately 35m to the west of the footprint of works. A low to medium risk rating is determined for all activities without control measures in place.
- Ecological receptors have been considered as medium risk level as there are water ways and conservation areas adjacent to the site. An overall low to medium risk to ecological receptors is determined for all activities without control measures in place.

It is noted that this construction dust risk assessment to human and ecological receptors is based upon potential construction activities without control measures. With control measures in place, potential dust emissions can be effectively mitigated using the recommended site-specific control measures for the construction phase of the project as provided in Section 7.1.

6.2 Distance Evaluation Assessment

As discussed in Section 3.3, the "Evaluation distances for effective air quality and noise management" document provides proposed evaluation distances beyond which the EPA is unlikely to request specific evaluation of impacts predicated on typical activities, except where there is a potential for ground level concentrations of pollutants to exceed criteria. Table 6-6 presents a comparison of the estimated distances of the sensitive receptors from activities to the relevant evaluation distances stipulated by the EPA. For the purposes of assessing air quality, the EPA considers sensitive land uses to include house, building, other premises or open area where health, property or amenity is affected by emissions that increase the concentration of the emitted parameter above background levels.

As shown in Table 6-6, whilst evaluation distances are met for some activities (e.g. transport and surface coating) further assessment of air quality impacts from these sources is still provided because of their potential for cumulative impacts. This approach aligns with the purpose of the evaluation distances which are predicated on the potential for low risks from cumulative impacts.

Furthermore, those activities with the potential to generate air pollutants that are assessed (and meet) by the EPA recommended evaluation distances only are proposed to be either infrequent (i.e. outdoor washing) and/or appropriately controlled (i.e. blasting and dry dock construction and fabrication). For example, fumes and smoke from welding and cutting are normally diluted sufficiently via the workshops' natural ventilation. All places where a concentration of automatic welding and cutting takes place, a fume extraction installation would typically be installed. All fume and smoke extraction ventilators will have particle filters, such that exhausts are sufficiently diluted and not regarded harmful.

Table 6-6: EPA Recommended Evaluation Distances

Activity	Evaluation Distance (m)	Evaluation and Distance to the Closest Sensitive Receptors (m)
Abrasive blasting	Blasting in the open Dry abrasive cleaning – 500 Wet abrasive cleaning – 300 Blast cleaning cabinets Greater than 5 m^3 in volume – 100 Not exceeding 5 m^3 in volume or totally enclosed automatic blast cleaning units – 50	No dry abrasive blasting is proposed in the open. Some outdoor washing of steel (wet) may occur in Area 1, which is approx. 450m from the nearest residential receptors and at a greater distance from the nearest industrial receptors (Figure 4-1). Enclosed blasting activities are proposed in the paint and blast workshop at approx. 750m to the nearest residential receptors and 700m to the Port Adelaide River receptors at a greater distance from the nearest industrial receptors (Figure 4-1).
Surface Coating	Spray painting and powder coating with a capacity to use more than 100 litres/day of paint or 10 kg/day of dry powder – 300 Spray painting and powder coating with a capacity to use up to but not exceeding 100 litres/day of paint or 10 kg/day of dry powder – 100	As described above, the primary paint application activities are proposed in the paint and blast workshop at approx. 750m to the nearest residential receptors and 700m to the Port Adelaide River receptors at a greater distance from the nearest industrial receptors (Figure 4-1). Some additional painting sources may be within the proposed fabrication workshop at approx. 400m to the nearest residential receptors at a greater distance from the nearest industrial receptors (Figure 4-1). Individual assessment of the potential impacts from spray painting, however, has been provided despite the distance to the nearest sensitive receptors. Please see Note 1.
Fuel burning	Individual assessment	Individual assessment is provided
Major roads	Roads with an estimated traffic volume greater than 20,000 vehicles per day– 100	A worst-case future vehicle traffic flow for 2034 is estimated as ~ 10,500 veh/day based upon a maximum peak hour flowrate of 2,500 veh/day for AM (6AM- 7AM) and PM (3PM-4PM) peaks as detailed in the Traffic Assessment Report[7]. An individual assessment is also provided for a worst-case future vehicle traffic flow forecast for 2041.
Maritime construction works	300	It is anticipated that the dry dock construction and fabrication activities will occur in the proposed fabrication workshop at approx. 400m to the nearest residential receptors at a greater distance from the nearest industrial receptors (Figure 4-1).

[7] ANI Link Road Traffic Planning Assessment Report, SMEC

		It is further noted that fumes and smoke from welding and cutting are normally diluted sufficiently via the workshops' natural ventilation. All places where a concentration of automatic welding and cutting takes place, a fume extraction installation would typically be installed. All fume and smoke extraction ventilators will have particle filters, such that exhausts are sufficiently diluted and not regarded harmful[8].

1. As the nearest sensitive residential properties are just outside the evaluation zone (i.e. 400m compared with 300m) and the potential for cumulative impacts from painting activities from the existing ONS sources, further assessment including pollutant dispersion modelling has been conservatively undertaken of the surface coating (primer and painting) operations to assess impact on the residential properties. In addition, as outlined in Table 6-6, individual assessment is also incorporated into the modelling for the fuel burning sources.

6.3 Operational Impact Assessment

6.3.1 Overview

Sections 6.3.2 and 6.3.3 provide the results of the modelling assessments for the ONS facilities and transport emissions separately. Cumulative impacts associated with normal and maximum operations of the ONS facilities including background emissions) are presented in section 6.3.2. Whilst section 6.3.3 presents a very high level prediction of impacts from vehicle emissions forecast for the year 2034 in isolation but inclusive of non-ANI associated traffic which would contribute to background levels of air pollutants.

6.3.2 ONS Facilities

Table 6-7 provides the maximum three-minute average VOC concentrations at the sensitive receptors (residential and industrial) for the maximum operating scenario and compares with the relevant criteria. The 3 minute average VOC concentrations at the sensitive receptors for the normal operating scenario are provided in Appendix C.

The maximum predicted metal and combustion gas and particulate ground level concentrations (inclusive of background, where applicable) and dust deposition rates are provided in Table 6-8 and Table 6-9, respectively. It is noted that these predictions are considered consistent for normal and maximum operations whereby the modelling is representative of a worst-case scenario accounting for the simultaneous operation of the boiler and CEPS operations.

Table 6-10 outlines the 99.9th percentile 3 minute average model predictions for odour concentrations under the normal and maximum operating scenario.

Contour plots showing the spatial distribution of the predicted pollutant concentrations from the proposed development in isolation for display purposes but inclusive of the other ONS operations are provided in Appendix D, where relevant. The plots provided include Xylenes as demonstrative of impacts upon VOCs and Selenium for the metals.

The results of the modelling may be summarised as follows:

- The results show that the highest concentration of the VOCs is 294 µg/m^3 for Xylenes predicted to occur during maximum activities at the industrial receptor immediately southwest of the boundary of the Precinct (R5).
- The predicted concentrations are well below the relevant toxicity-based criteria for all individual VOCs modelled for both scenarios. Furthermore, the model predictions are below the odour criteria for all individual VOCs modelled at the residential receptors.
- The results show that the cumulative odour predictions are below the criteria of 2 OU at all residential receptors modelled and above 2 OU (i.e. 2.41 OU) at the industrial receptor (R1) for the maximum emissions scenario. However, given the conservatism of the modelling this is not considered likely. For example, the modelling has adopted continuous hourly emission rates for potential odour generating events while this emission rate could only possibly occur at once every ten paint day cycle (based on advice from experienced shipbuilders).
- The predicted concentrations of metals are negligible (i.e. near 0 µg/m^3) and are well below criteria at all receptors modelled.

[8] Background for and emission volumes from SASIU shipyard' document, Odense Maritime Technology A/S

- The maximum predicted metal and combustion gas and particulate ground level concentrations (inclusive of background, where applicable) and dust deposition rates are also well below relevant criteria at all receptors modelled.

Based upon the modelling assumptions and methodology adopted for this assessment, Vipac concludes that air quality should not be a constraint to the proposed development.

Table 6-7: Maximum Predicted VOC Concentrations (µg/m³) - Maximum Operations

		Maximum Predicted 3- Minute Average Ground Level VOC and PAH Concentrations (µg/m³)							
ID	Type	Xylene	Butan-1-ol	Ethyl-benzene	Acetaldehyde	Benzene	Formaldehyde	Toluene	PAH
R1	Ind	257	18	58	0.0003	0.0099	0.0010	0.0035	0.004
R2	Ind	224	15	51	0.0003	0.0092	0.0009	0.0033	0.003
R3	Ind	192	13	44	0.0003	0.0093	0.0009	0.0033	0.004
R4	Ind	125	9	28	0.0003	0.0094	0.0009	0.0033	0.003
R5	Ind	294	20	67	0.0003	0.0101	0.0010	0.0036	0.004
Industrial Criteria		1240	5570	15800	6440	58	44	13400	0.8
R6	Res	183	13	42	0.0004	0.0126	0.0013	0.0045	0.004
R7	Res	192	13	44	0.0004	0.0124	0.0012	0.0044	0.005
R8	Res	230	16	52	0.0004	0.0126	0.0013	0.0045	0.005
R9	Res	235	16	53	0.0004	0.0129	0.0013	0.0046	0.005
R10	Res	211	14	48	0.0004	0.0132	0.0013	0.0047	0.004
R11	Res	204	14	46	0.0004	0.0134	0.0013	0.0047	0.004
R12	Res	152	10	35	0.0004	0.0137	0.0014	0.0048	0.004
R13	Res	206	14	47	0.0004	0.0138	0.0014	0.0049	0.004
R14	Res	244	17	55	0.0004	0.0138	0.0014	0.0049	0.004
R15	Res	209	14	48	0.0004	0.0139	0.0014	0.0049	0.003
R16	Res	202	14	46	0.0004	0.0141	0.0014	0.0050	0.003
R17	Res	187	13	43	0.0004	0.0139	0.0014	0.0049	0.004
R18	Res	205	14	47	0.0004	0.0129	0.0013	0.0046	0.004
R19	Res	229	16	52	0.0004	0.0116	0.0012	0.0041	0.003
R20	Res	170	12	39	0.0004	0.0116	0.0012	0.0041	0.003
R21	Res	175	12	40	0.0004	0.0113	0.0011	0.0040	0.003
R22	Res	199	14	45	0.0003	0.0109	0.0011	0.0039	0.003
R23	Res	179	12	41	0.0004	0.0117	0.0012	0.0041	0.003
R24	Res	146	10	33	0.0004	0.0126	0.0013	0.0045	0.003
R25	Res	141	10	32	0.0004	0.0133	0.0013	0.0047	0.003
R26	Res	146	10	33	0.0004	0.0142	0.0014	0.0050	0.004
R27	Res	149	10	34	0.0005	0.0148	0.0015	0.0052	0.004
R28	Res	145	10	33	0.0005	0.0157	0.0016	0.0055	0.004
R29	Res	142	10	32	0.0005	0.0164	0.0016	0.0058	0.004
R30	Res	136	9	31	0.0006	0.0175	0.0017	0.0062	0.004
R31	Res	130	9	30	0.0006	0.0184	0.0018	0.0065	0.004
R32	Res	127	9	29	0.0006	0.0190	0.0019	0.0067	0.004
R33	Res	124	8	28	0.0006	0.0194	0.0019	0.0068	0.004
R34	Res	119	8	27	0.0006	0.0196	0.0020	0.0069	0.005
R35	Res	117	8	27	0.0006	0.0192	0.0019	0.0068	0.005

R36	Res	103	7	23	0.0005	0.0174	0.0017	0.0062	0.005
R37	Res	90	6	20	0.0005	0.0145	0.0014	0.0051	0.004
R38	Env	36	2	8	0.0001	0.0035	0.0004	0.0013	0.002
R39	Env	154	10	35	0.0002	0.0072	0.0007	0.0026	0.003
R40	Env	71	5	16	0.0003	0.0106	0.0011	0.0037	0.002
R41	Env	73	5	17	0.0003	0.0101	0.0010	0.0036	0.002
R42	Env	78	5	18	0.0003	0.0089	0.0009	0.0032	0.002
R43	Env	205	14	47	0.0003	0.0099	0.0010	0.0035	0.003
R44	Env	122	8	28	0.0006	0.0200	0.0020	0.0071	0.006
R45	Env	63	4	14	0.0005	0.0166	0.0017	0.0059	0.003
R46	Env	78	5	18	0.0003	0.0096	0.0010	0.0034	0.004
R47	Env	49	3	11	0.0004	0.0127	0.0013	0.0045	0.006
R48	Env	58	4	13	0.0003	0.0105	0.0011	0.0037	0.004
R49	Env	60	4	14	0.0004	0.0139	0.0014	0.0049	0.003
R50	Env	30	2	7	0.0004	0.0129	0.0013	0.0046	0.003
R51	Env	43	3	10	0.0003	0.0098	0.0010	0.0035	0.003
R52	Env	46	3	11	0.0003	0.0080	0.0008	0.0028	0.003
R53	Env	32	2	7	0.0001	0.0045	0.0004	0.0016	0.001
R54	Res	78	5	18	0.0003	0.0096	0.0010	0.0034	0.004
Residential /Environmental Criteria		380	980	15800	83	58	44	710	0.8

Table 6-8: Maximum Predicted Metal Concentrations ($\mu g/m^3$)

		Maximum Predicted 3-Minute Average[1] Ground Level Metal Concentrations ($\mu g/m^3$)										
ID	Type	As	Be	Cd	Cr	Cu	Pb	Hg	Ni	Mn	Se[4]	Zn[5]
R1	Ind	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R2	Ind	0.0011	0.0004	0.0001	0	0	0	0	0	0	0.001	0.0002
R3	Ind	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R4	Ind	0.0011	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R5	Ind	0.0013	0.0006	0.0001	0	0	0	0	0	0	0.001	0.0003
Industrial Criteria		0.19	0.008	0.036	19	36	0.5	0.36	0.36	36	10	20
R6	Res	0.0015	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R7	Res	0.0016	0.0007	0.0001	0	0	0	0	0	0	0.002	0.0003
R8	Res	0.0016	0.0007	0.0001	0	0	0	0	0	0	0.002	0.0003
R9	Res	0.0016	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R10	Res	0.0015	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R11	Res	0.0015	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R12	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R13	Res	0.0013	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0003
R14	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R15	Res	0.0011	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R16	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R17	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R18	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002

R19	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R20	Res	0.0011	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R21	Res	0.0011	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R22	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R23	Res	0.0011	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R24	Res	0.0010	0.0004	0.0001	0	0	0	0	0	0	0.001	0.0002
R25	Res	0.0011	0.0004	0.0001	0	0	0	0	0	0	0.001	0.0002
R26	Res	0.0013	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R27	Res	0.0013	0.0006	0.0001	0	0	0	0	0	0	0.001	0.0003
R28	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R29	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R30	Res	0.0013	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0003
R31	Res	0.0015	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R32	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R33	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R34	Res	0.0017	0.0007	0.0001	0	0	0	0	0	0	0.002	0.0003
R35	Res	0.0018	0.0007	0.0001	0	0	0	0	0	0	0.002	0.0004
R36	Res	0.0016	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R37	Res	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R38	Env	0.0007	0.0003	0.0000	0	0	0	0	0	0	0.001	0.0001
R39	Env	0.0009	0.0004	0.0000	0	0	0	0	0	0	0.001	0.0002
R40	Env	0.0008	0.0003	0.0000	0	0	0	0	0	0	0.001	0.0001
R41	Env	0.0008	0.0003	0.0000	0	0	0	0	0	0	0.001	0.0001
R42	Env	0.0006	0.0003	0.0000	0	0	0	0	0	0	0.001	0.0001
R43	Env	0.0010	0.0004	0.0001	0	0	0	0	0	0	0.001	0.0002
R44	Env	0.0021	0.0008	0.0001	0	0	0	0	0	0	0.002	0.0004
R45	Env	0.0009	0.0004	0.0000	0	0	0	0	0	0	0.001	0.0002
R46	Env	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.001	0.0003
R47	Env	0.0021	0.0009	0.0001	0	0	0	0	0	0	0.002	0.0004
R48	Env	0.0015	0.0006	0.0001	0	0	0	0	0	0	0.002	0.0003
R49	Env	0.0009	0.0004	0.0000	0	0	0	0	0	0	0.001	0.0002
R50	Env	0.0009	0.0004	0.0000	0	0	0	0	0	0	0.001	0.0002
R51	Env	0.0012	0.0005	0.0001	0	0	0	0	0	0	0.001	0.0002
R52	Env	0.0010	0.0004	0.0001	0	0	0	0	0	0	0.001	0.0002
R53	Env	0.0005	0.0002	0.0000	0	0	0	0	0	0	0.001	0.0001
R54	Res	0.0014	0.0006	0.0001	0	0	0	0	0	0	0.001	0.0003
Residential /Environmental Criteria		0.19	0.008	0.036	19	36	0.5	0.36	0.36	36	10	20

Table 6-9: Maximum Predicted Ground Level Concentrations (including background)

		Maximum Predicted Ground Level Concentrations (µg/m³ including background)[1]									
		PM2.5		PM10	Dust Deposition[2]	CO		NO_2		SO_2	
ID	Type	24 hr	Ann	24 hr	Month	1 hr	8 hr	1 hr	Ann	1 hr	24 hr
R1	Ind	4.75	3.80	15.52	0.003	318	316	68.35	10.77	3.08	1.23

R2	Ind	4.75	3.80	15.52	0.002	317	316	64.35	10.75	3.05	1.23
R3	Ind	4.75	3.80	15.53	0.002	318	316	64.88	10.75	3.07	1.23
R4	Ind	4.75	3.80	15.53	0.001	320	317	65.33	10.50	3.05	1.22
R5	Ind	4.75	3.80	15.54	0.003	321	318	69.16	10.77	3.08	1.24
Industrial Criteria		25	8	50	2	31,240	11,250	164	n/a	290	n/a
R6	Res	4.76	3.80	15.55	0.002	321	318	83.55	10.74	3.11	1.23
R7	Res	4.76	3.81	15.56	0.002	321	318	82.05	10.74	3.12	1.23
R8	Res	4.76	3.81	15.57	0.002	321	318	83.63	10.75	3.12	1.23
R9	Res	4.77	3.81	15.58	0.002	321	318	85.18	10.74	3.11	1.23
R10	Res	4.77	3.81	15.60	0.002	321	318	86.72	10.74	3.10	1.23
R11	Res	4.77	3.81	15.62	0.002	321	319	87.68	10.74	3.10	1.23
R12	Res	4.78	3.81	15.65	0.002	321	319	89.33	10.74	3.09	1.24
R13	Res	4.79	3.81	15.67	0.002	322	319	90.33	10.74	3.08	1.24
R14	Res	4.79	3.81	15.69	0.003	322	319	90.37	10.74	3.07	1.24
R15	Res	4.79	3.81	15.70	0.003	322	319	90.72	10.74	3.05	1.24
R16	Res	4.79	3.81	15.69	0.003	322	319	91.98	10.74	3.06	1.24
R17	Res	4.79	3.81	15.68	0.003	322	319	90.56	10.74	3.07	1.24
R18	Res	4.79	3.81	15.69	0.003	322	319	84.96	10.74	3.07	1.25
R19	Res	4.79	3.81	15.71	0.003	321	318	77.59	10.73	3.06	1.25
R20	Res	4.79	3.81	15.73	0.003	321	318	77.39	10.71	3.05	1.25
R21	Res	4.79	3.81	15.73	0.003	320	318	76.16	10.71	3.05	1.26
R22	Res	4.79	3.81	15.72	0.003	320	318	75.13	10.71	3.06	1.25
R23	Res	4.79	3.81	15.70	0.003	319	317	79.50	10.69	3.05	1.25
R24	Res	4.78	3.81	15.67	0.003	318	317	84.80	10.68	3.04	1.25
R25	Res	4.79	3.81	15.70	0.003	318	316	88.75	10.67	3.05	1.26
R26	Res	4.79	3.81	15.73	0.003	318	316	93.49	10.67	3.07	1.26
R27	Res	4.80	3.81	15.74	0.003	317	316	96.97	10.66	3.08	1.26
R28	Res	4.78	3.81	15.69	0.003	317	316	101.86	10.65	3.09	1.26
R29	Res	4.77	3.81	15.64	0.003	317	316	106.35	10.65	3.09	1.26
R30	Res	4.75	3.80	15.54	0.003	317	316	112.13	10.65	3.08	1.25
R31	Res	4.75	3.80	15.54	0.002	317	315	117.77	10.64	3.10	1.26
R32	Res	4.72	3.80	15.36	0.002	317	315	120.72	10.63	3.10	1.26
R33	Res	4.73	3.80	15.41	0.002	317	316	123.02	10.62	3.09	1.26
R34	Res	4.74	3.80	15.41	0.002	317	316	124.37	10.59	3.13	1.25
R35	Res	4.75	3.80	15.47	0.002	317	315	122.11	10.57	3.14	1.25
R36	Res	4.76	3.80	15.51	0.001	317	316	112.33	10.52	3.11	1.23
R37	Res	4.80	3.80	15.61	0.000	318	316	95.46	10.49	3.07	1.23
R38	Env	4.76	3.80	15.60	0.001	314	314	32.42	10.11	2.99	1.21
R39	Env	4.83	3.81	15.92	0.001	316	315	55.87	10.26	3.02	1.22
R40	Env	4.81	3.81	15.81	0.001	317	316	72.09	10.38	3.00	1.21
R41	Env	4.78	3.81	15.66	0.001	317	316	69.31	10.47	3.00	1.22
R42	Env	4.76	3.81	15.58	0.001	318	316	62.70	10.63	2.99	1.23
R43	Env	4.76	3.80	15.58	0.001	322	319	68.00	10.71	3.04	1.24
R44	Env	4.73	3.80	15.45	0.000	318	316	125.91	10.38	3.18	1.24

R45	Env	4.75	3.80	15.52	0.002	319	317	106.08	10.68	3.03	1.29
R46	Env	4.75	3.80	15.51	0.002	318	316	66.69	10.86	3.09	1.27
R47	Env	4.73	3.80	15.37	0.001	319	317	84.15	10.84	3.19	1.25
R48	Env	4.75	3.80	15.52	0.001	317	316	71.86	10.63	3.05	1.24
R49	Env	4.75	3.80	15.52	0.000	318	317	91.57	10.47	3.03	1.24
R50	Env	4.75	3.80	15.53	0.001	316	315	86.50	10.31	3.02	1.22
R51	Env	4.75	3.80	15.53	0.000	317	316	74.25	10.50	3.06	1.23
R52	Env	4.75	3.80	15.54	0.000	318	316	58.18	10.49	3.04	1.23
R53	Env	4.75	3.80	15.54	0.003	315	314	37.44	10.34	2.96	1.21
R54	Res	4.75	3.81	15.58	0.002	321	318	66.69	10.86	3.099	1.27
Residential /Environmental Criteria		25	8	50	2	31,240	11,250	164	30	290	60

1. except as noted

2. g/m^2/month, excluding background

Table 6-10: 99.9th Percentile Predicted Ground Level Odour Concentrations (OU)

		99.9th Percentile Predicted 3 Minute Average Ground Level Odour Concentrations (OU)	
ID	Type	Normal	Maximum
R1	Ind	1.60	2.41
R2	Ind	1.19	1.79
R3	Ind	1.07	1.62
R4	Ind	0.24	0.37
R5	Ind	1.24	1.87
R6	Res	0.76	1.15
R7	Res	0.78	1.17
R8	Res	0.82	1.24
R9	Res	0.86	1.29
R10	Res	0.89	1.34
R11	Res	0.90	1.35
R12	Res	0.95	1.42
R13	Res	0.99	1.49
R14	Res	1.06	1.59
R15	Res	1.08	1.62
R16	Res	0.90	1.36
R17	Res	1.06	1.59
R18	Res	0.97	1.47
R19	Res	0.88	1.32
R20	Res	0.82	1.24
R21	Res	0.96	1.45
R22	Res	1.09	1.64
R23	Res	1.05	1.57
R24	Res	1.01	1.52
R25	Res	0.99	1.50
R26	Res	0.98	1.47

R27	Res	0.96	1.45
R28	Res	0.91	1.37
R29	Res	0.91	1.37
R30	Res	0.87	1.30
R31	Res	0.82	1.24
R32	Res	0.79	1.19
R33	Res	0.77	1.16
R34	Res	0.72	1.08
R35	Res	0.71	1.06
R36	Res	0.61	0.91
R37	Res	0.54	0.82
R38	Env	0.17	0.26
R39	Env	0.32	0.47
R40	Env	0.12	0.17
R41	Env	0.33	0.50
R42	Env	0.51	0.76
R43	Env	0.77	1.16
R44	Env	0.75	1.13
R45	Env	0.38	0.56
R46	Env	0.38	0.57
R47	Env	0.30	0.45
R48	Env	0.30	0.45
R49	Env	0.37	0.55
R50	Env	0.16	0.24
R51	Env	0.24	0.36
R52	Env	0.19	0.28
R53	Env	0.10	0.15
R54	Res	0.38	0.57
Residential Criteria		2	2

6.3.3 Transport Emissions

The model predictions for each pollutant generated by the vehicle emissions are provided in Table 6-11 for the sensitive receptors and are compared with the adopted ambient air quality criteria.

As shown in Table 6-11, with the exception of 1 hour average NO_2, the predicted maximum predictions for all pollutants modelled are well below the relevant ambient air quality criteria. The predicted maximum predictions of 1 hour average NO_2 are just below the criteria of 164 µg/m^3 at several of the sensitive receptors modelled. However, as discuss in section 5.4.2, the adopted modelling approach is high level and extremely conservative including, for example, non-ANI associated traffic estimates. The model predictions of impacts from vehicle exhaust emissions may therefore be considered an over estimation.

Table 6-11: Maximum Predicted Ground Level Concentrations

		Maximum Predicted Ground Level Concentrations (µg/m^3)			
		PM2.5	PM10	NO_2	Benzene

ID	Type	24 hr	Ann	24 hr	1 hr	Ann	3 mins
R1	Ind	0.89	0.03	1.53	28.54	0.08	2.75
R2	Ind	0.78	0.02	1.34	23.05	0.06	2.37
R3	Ind	0.61	0.01	1.05	18.64	0.04	1.80
R4	Ind	0.03	0.00	0.05	1.14	0.01	0.09
R5	Ind	1.56	0.22	2.66	53.17	0.42	5.10
Industrial Criteria		25	8	50	164	n/a	58
R6	Res	1.97	0.20	3.36	85.34	0.74	7.06
R7	Res	2.56	0.31	4.35	109.22	1.15	8.96
R8	Res	2.84	0.36	4.84	118.57	1.34	9.75
R9	Res	2.79	0.34	4.75	115.26	1.22	9.55
R10	Res	3.02	0.35	5.14	116.57	1.27	9.75
R11	Res	3.87	0.40	6.62	130.99	1.42	12.19
R12	Res	3.31	0.37	5.65	134.06	1.34	12.22
R13	Res	3.11	0.36	5.30	132.39	1.30	11.64
R14	Res	2.92	0.32	4.96	128.55	1.16	11.02
R15	Res	3.16	0.37	5.37	137.25	1.41	11.55
R16	Res	2.92	0.32	4.96	130.79	1.21	10.83
R17	Res	3.11	0.37	5.28	138.16	1.41	11.26
R18	Res	3.40	0.43	5.77	146.87	1.72	11.71
R19	Res	3.42	0.48	5.81	129.55	1.86	10.37
R20	Res	3.45	0.54	5.86	121.10	2.03	9.62
R21	Res	3.59	0.62	6.09	142.66	2.39	11.25
R22	Res	3.25	0.43	5.53	131.31	1.64	10.30
R23	Res	3.73	0.53	6.35	138.29	1.97	10.76
R24	Res	4.83	0.67	8.22	161.99	2.51	11.63
R25	Res	5.33	0.66	9.10	161.25	2.41	12.01
R26	Res	4.76	0.50	8.12	152.56	1.80	11.32
R27	Res	6.05	0.72	10.31	165.65	2.69	12.23
R28	Res	5.27	0.63	8.99	141.14	2.36	10.51
R29	Res	4.91	0.55	8.37	138.58	2.07	10.30
R30	Res	3.93	0.45	6.71	112.17	1.65	8.16
R31	Res	4.70	0.57	8.00	81.52	2.12	5.94
R32	Res	4.42	0.57	7.52	71.53	2.11	5.19
R33	Res	4.14	0.56	7.04	68.74	2.10	4.91
R34	Res	4.03	0.47	6.86	72.93	1.78	4.95
R35	Res	5.09	0.62	8.65	97.61	2.41	7.38
R36	Res	4.83	0.50	8.19	118.87	1.87	9.36
R37	Res	3.82	0.43	6.48	76.60	1.58	6.23
R38	Env	0.02	0.00	0.03	0.77	0.00	0.06
R39	Env	0.04	0.00	0.06	0.96	0.00	0.06
R40	Env	0.02	0.00	0.03	0.50	0.00	0.04
R41	Env	0.02	0.00	0.04	1.04	0.00	0.08
R42	Env	0.07	0.00	0.11	2.64	0.01	0.23

R43	Env	0.18	0.01	0.31	5.73	0.02	0.47
R44	Env	0.17	0.01	0.29	6.36	0.03	0.42
R45	Env	0.14	0.01	0.24	4.35	0.03	0.29
R46	Env	0.12	0.01	0.21	4.14	0.02	0.27
R47	Env	0.07	0.01	0.11	1.76	0.02	0.12
R48	Env	0.10	0.01	0.17	3.21	0.03	0.25
R49	Env	0.24	0.02	0.41	8.50	0.06	0.67
R50	Env	0.09	0.01	0.16	1.77	0.02	0.14
R51	Env	0.06	0.01	0.10	1.60	0.02	0.09
R52	Env	0.04	0.00	0.06	1.01	0.01	0.06
R53	Env	0.02	0.00	0.04	0.67	0.01	0.04
R54	Res	1.97	0.20	3.36	85.34	0.74	7.06
Residential /Environmental Criteria		25	8	50	164	30	58

7 Recommendations

7.1 Construction Dust

A qualitative construction dust assessment on the impacts upon human and ecological receptors is detailed in Section 6.1. It has been determined that, due to the proximity of receptors, uncontrolled potential dust emissions caused by construction related activities pose a low risk to human receptors and a low to medium risk to ecological receptors.

Details for the construction phase of the project, including construction schedule and associated equipment are not yet available. However, it is anticipated that a Construction Air Quality Management Plan, as part of the Construction Environment Management Plan (CEMP) will be developed and implemented prior to construction activities commencing.

The main air pollution and amenity impacts from construction activities are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust;
- elevated concentrations of airborne particulate matter less than 10µm (PM10) due to dust-generating activities; and
- exhaust emissions from construction equipment.

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

The construction activities are inherently temporary and potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan. Furthermore, much of the land-based portion of the proposed subject site has been cleared in the past 10 years such that dust emissions from these activities are expected to be minimal.

In addition, distances of the sensitive (e.g. residential and ecological) receptors from the construction activities are anticipated to be large enough such that impacts on air quality from them are expected to be meet relevant criteria at the receptors, when managed appropriately.

Whilst impacts from construction activities are expected to meet criteria, given the size and sensitivity of the project, the proposed mitigation measures include a range of best practice measures specific to the site (e.g. monitoring) which are provided below.

7.1.1 General

Preparation of a *Air Quality Management Plan (AQMP)* or consideration of these measures within a broader CEMP that considers the adopted assessment criteria, sensitive receptors and the following:

- Detailed construction methodology, including timing and scheduling of relevant work packages.
- Adopted mitigation and management measures specific to each work package.
- Consideration of the nearest receptors during planning/timing of construction works.
- Prior to commencement of construction activities, develop appropriate communications to notify the potentially impacted residences of the project (duration, types of works, etc), relevant contact details for environmental complaints reporting;
- A complaints logbook will be maintained throughout the construction phase which should include any complaints related to dust; where a dust complaint is received, the response actions should be detailed in the logbook;
- Record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the logbook;
- Carry out daily site inspections, including local meteorological forecast. Record inspection results in a logbook;
- Ensure proper maintenance of all equipment engines; and
- Avoid leaving engines running at idle where possible.

Establish a real time particulate monitoring location within the site boundary and in the direction of the most likely affected residential receptor to monitor Total Suspended Particulates and PM_{10} during primary dust generating activities (e.g. earthworks), where applicable. Monitored real time concentrations should be compared to documented trigger levels and actioned (e.g. for further control) when breached.

In addition, sampling by dust deposition gauge is recommended, with its results and the results of the particulate monitoring (described above) to be compared to the adopted criteria. If concentrations/deposition rates are above the limit an investigation should be performed to determine:

- whether the concentrations were impacted by other events, i.e. bushfires, dust storms.
- from normal or abnormal operations or
- from operations which require more controls.

7.1.2 Demolition

- Erect shade cloth barriers to site fences around potentially dusty activities where practicable.
- Keep site fencing and barriers clean using wet methods.

7.1.3 Earthworks

- Erect shade cloth barriers to site fences around potentially dusty activities such as clearing and material stockpiles where practicable;
- Keep site fencing and barriers clean using wet methods;
- Deploy a water cart to ensure that exposed areas and topsoils/subsoil are kept moist, where necessary;
- Modify working practices by limiting activity during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site;
- Limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing; and
- Minimise drop heights from loading or handling equipment.
- Revegetate (e.g. landscaping) or seal exposed areas where practicable
- Regular cleaning of work areas and maintain a high level of housekeeping to – especially when waste/spoil is temporarily being stockpiled on site, to minimize the likelihood of windborne dust.

7.1.4 Meteorology and Receptor Location

Consideration should be made in regard to receptor locations and meteorological conditions. It is noted that the residential receptors are situated to the west and south west of the project site and are at an approximate distance of 250m at the closest point. Ecological/environmental receptors are situated directly adjacent to the site boundary, in particular the waterway surrounding the site to the north and east as well as the designated conservation zone directly adjacent to the site.

The predominant annual wind direction is from the south west and stronger winds (over 5.4 m/s) with the potential to disturb dust are infrequent. However, during the morning period, the dominant wind direction is from the north and north east and blows towards the residential receptors. Additionally, winds occurring in winter are more frequent from the west, blowing towards environmental receptors and stronger winds are more frequent.

Stronger winds have a higher potential to generate wind borne dust, particularly during construction processes and material stockpiling. Construction dust emission controls should consider these factors and should be implemented accordingly to ensure protection of the receptors.

7.2 Operational

The primary impacts upon air quality from the operation of the SCY are potentially generated by paint and blasting activities, manufacturing and fuel combustion sources. The main air pollutants with the potential to be generated by these activities include:

- Volatile organic compounds
- Particulate matter (as TSP, dust, PM10 an PM2.5)
- Combustion gases (e.g. SO_2, CO and NO_2)
- Metals
- PAHS
- Odour

The modelling assessment of air quality impacts from the operational sources has predicted no exceedances of the relevant criteria for these pollutants at the sensitive receptors.

It is noted, however, that the assessment has been based upon a variety of informed assumptions and the site plan provided. In the event that these assumptions or the site plan are required to differ from those used, then further assessment should be undertaken.

Whilst impacts from operational activities are predicted to meet criteria, given the size and sensitivity of the project, the proposed mitigation measures include a range of best practice measures (e.g. monitoring) which are provided below.

7.2.1 Painting Activities

- The major paint operations should be undertaken in an enclosed environment with stacks for the discharge of emissions into the atmosphere. No major paint application should be done outdoors.
- Physical parameters for the painting activity sources (e.g. stack height, diameter, velocity) should align with the values modelled in the air quality assessment, where practical.
- Align the locations of the painting activities with the site plan locations (i.e. at a sufficient distance from sensitive receptors), where practical.
- Consideration should be given to the VOC content of the individual species of the paints proposed for the SCY operations and, where possible, align with those adopted for the air quality assessment.

7.2.2 Blasting Activities

- No major blasting activities should be undertaken outdoors.
- Locate blasting operations indoors and align with the site plan locations (i.e. at a sufficient distance from sensitive receptors), where practical.

7.2.3 Manufacturing

- Undertake major manufacturing activities indoors and align locations with the site plan locations (i.e. at a sufficient distance from sensitive receptors), where practical.
- Incorporate particle filters in exhaust systems where major manufacturing activities are undertaken.

7.2.4 Fuel Combustion

- Physical parameters for the fuel combustion sources (e.g. stack height, diameter, velocity, location) should align with the values modelled in the air quality assessment, where practical.
- Consideration also should be given to avoiding the use of diesel generators and rely on mains power, where possible.
- Where possible adopt a modern equipment fleet.
- Avoid idling vehicles especially when located near sensitive receptors.

7.2.5 General

- Establish a stack emissions testing program of stack sources upon commissioning and at regular intervals (i.e. annually) for verification of modelled parameters.

8 Conclusions

An Air Quality Impact Assessment has been undertaken for the paint, blasting and associated operations proposed for the proposed SCY at the ANI Osborne Naval Shipyard Precinct at Osborne, South Australia. In addition, to the proposed SCY, the Air Quality Impact Assessment accounts for existing ONS operations including the ONSP; CUF; and the proposed Blast and Paint Hall B18a within the ONSP sub-precinct.

The results of the modelling assessment for scenarios representative of normal and maximum operations may be summarised as follows:

- The results show that the highest concentration of the VOCs is 294 µg/m^3 Xylenes predicted to occur during maximum activities at the industrial receptor immediately southwest of the boundary of the Precinct (R5).
- The predicted concentrations are well below the relevant toxicity-based criteria for all individual VOCs modelled for both scenarios. Furthermore, the model predictions are below the odour criteria for all individual VOCs modelled at the residential receptors.
- The results show that the cumulative odour predictions are below the criteria of 2 OU at all residential receptors modelled and above 2 OU (i.e. 2.41 OU) at the industrial receptor (R1) for the maximum emissions scenario. However, given the conservatism of the modelling this is not considered likely. For example, the modelling has adopted continuous hourly emission rates for potential odour generating events while this emission rate could only possibly occur at once every ten paint day cycle (based on advice from experienced shipbuilders).
- The predicted concentrations of metals are negligible (i.e. near 0 µg/m^3) and are well below criteria at all receptors modelled.
- The maximum predicted metal and combustion gas and particulate ground level concentrations (inclusive of background, where applicable) and dust deposition rates are also well below relevant criteria at all receptors modelled.
- The maximum predicted concentrations of the primary air pollutants associated with vehicles projected to be travelling on Victoria Road, Veitch Road, Pelican Point Road and access routes in 2034 are below relevant criteria at all receptors modelled.

In addition, potential impacts from the construction of the SCY have been assessed following the guidance from IAQM. It has been determined that the surrounding human (residential) receptors are considered to be 'Low Sensitivity' and ecological receptors to be 'Medium Sensitivity' due to the proximity of conservation areas and waterways. With control measures in place, potential dust emissions can be effectively mitigated such that the risks to these receptors is assessed to be minimal.

Based upon the modelling assumptions and methodology adopted for this assessment, Vipac therefore concludes that air quality should not be a constraint to the proposed development.

Appendix A Sensitive Receptor Locations

Sensitive Receptor ID	UTM Coordinates (zone 54S)		Description
	East (km)	South (km)	
R1	271.89	6147.583	Industrial
R2	271.969	6147.434	Industrial
R3	272.144	6147.488	Industrial
R4	272.995	6145.809	Industrial
R5	271.596	6147.501	Industrial
R6	271.339	6147.242	residential
R7	271.363	6147.258	residential
R8	271.368	6147.302	residential
R9	271.363	6147.338	residential
R10	271.363	6147.392	residential
R11	271.367	6147.432	residential
R12	271.373	6147.497	residential
R13	271.369	6147.564	residential
R14	271.371	6147.627	residential
R15	271.37	6147.675	residential
R16	271.377	6147.756	residential
R17	271.373	6147.821	residential
R18	271.364	6147.899	residential
R19	271.341	6147.957	residential
R20	271.322	6148.019	residential
R21	271.317	6148.063	residential
R22	271.302	6148.109	residential
R23	271.277	6148.145	residential
R24	271.246	6148.181	residential
R25	271.225	6148.212	residential
R26	271.197	6148.242	residential
R27	271.178	6148.271	residential
R28	271.143	6148.289	residential
R29	271.111	6148.312	residential
R30	271.064	6148.34	residential
R31	271.007	6148.376	residential
R32	270.967	6148.395	residential
R33	270.923	6148.417	residential
R34	270.824	6148.47	residential

R35	270.764	6148.512	residential
R36	270.617	6148.585	residential
R37	270.453	6148.684	residential
R38	274.917	6146.092	Environmental (dolphin sanctuary)
R39	274.017	6145.947	environmental
R40	273.436	6145.303	environmental
R41	272.695	6145.357	environmental
R42	272.439	6146.389	environmental
R43	272.484	6147.403	environmental
R44	272.682	6148.517	environmental
R45	272.865	6149.581	environmental
R46	272.228	6150.456	environmental
R47	271.077	6150.478	environmental
R48	270.248	6150.017	environmental
R49	269.599	6149.158	environmental
R50	269.07	6148.287	environmental
R51	269.726	6146.77	environmental
R52	269.785	6145.699	environmental
R53	269.949	6145.083	environmental
R54	274.411	6153.021	residential

Appendix B Model Predictions at the Sensitive Receptors – Normal Operations

		Maximum Predicted 3- Minute Average Ground Level VOC Concentrations (µg/m³)						
ID	Type	Xylene	Butan-1-ol	Ethyl-benzene	Acetaldehyde	Benzene	Formaldehyde	Toluene
R1	Ind	136	9	31	0.0003	0.0099	0.0010	0.0035
R2	Ind	101	7	23	0.0003	0.0092	0.0009	0.0033
R3	Ind	91	6	21	0.0003	0.0093	0.0009	0.0033
R4	Ind	21	1	5	0.0003	0.0094	0.0009	0.0033
R5	Ind	105	7	24	0.0003	0.0101	0.0010	0.0036
Industrial Criteria		1240	5570	15800				
R6	Res	65	4	15	0.0004	0.0126	0.0013	0.0045
R7	Res	66	4	15	0.0004	0.0124	0.0012	0.0044
R8	Res	70	5	16	0.0004	0.0126	0.0013	0.0045
R9	Res	73	5	16	0.0004	0.0129	0.0013	0.0046
R10	Res	75	5	17	0.0004	0.0132	0.0013	0.0047
R11	Res	76	5	17	0.0004	0.0134	0.0013	0.0047
R12	Res	80	5	18	0.0004	0.0137	0.0014	0.0048
R13	Res	84	6	19	0.0004	0.0138	0.0014	0.0049
R14	Res	90	6	20	0.0004	0.0138	0.0014	0.0049
R15	Res	91	6	21	0.0004	0.0139	0.0014	0.0049
R16	Res	76	5	17	0.0004	0.0141	0.0014	0.0050
R17	Res	90	6	20	0.0004	0.0139	0.0014	0.0049
R18	Res	83	6	19	0.0004	0.0129	0.0013	0.0046
R19	Res	75	5	17	0.0004	0.0116	0.0012	0.0041
R20	Res	70	5	16	0.0004	0.0116	0.0012	0.0041
R21	Res	82	6	19	0.0004	0.0113	0.0011	0.0040
R22	Res	93	6	21	0.0003	0.0109	0.0011	0.0039
R23	Res	89	6	20	0.0004	0.0117	0.0012	0.0041
R24	Res	86	6	20	0.0004	0.0126	0.0013	0.0045
R25	Res	84	6	19	0.0004	0.0133	0.0013	0.0047
R26	Res	83	6	19	0.0004	0.0142	0.0014	0.0050
R27	Res	81	6	19	0.0005	0.0148	0.0015	0.0052
R28	Res	77	5	18	0.0005	0.0157	0.0016	0.0055
R29	Res	77	5	17	0.0005	0.0164	0.0016	0.0058
R30	Res	73	5	17	0.0006	0.0175	0.0017	0.0062
R31	Res	70	5	16	0.0006	0.0184	0.0018	0.0065
R32	Res	67	5	15	0.0006	0.0190	0.0019	0.0067
R33	Res	65	4	15	0.0006	0.0194	0.0019	0.0068
R34	Res	61	4	14	0.0006	0.0196	0.0020	0.0069
R35	Res	60	4	14	0.0006	0.0192	0.0019	0.0068
R36	Res	51	4	12	0.0005	0.0174	0.0017	0.0062
R37	Res	46	3	10	0.0005	0.0145	0.0014	0.0051
R38	Env	14	1	3	0.0001	0.0035	0.0004	0.0013
R39	Env	27	2	6	0.0002	0.0072	0.0007	0.0026
R40	Env	10	1	2	0.0003	0.0106	0.0011	0.0037

R41	Env	28	2	6	0.0003	0.0101	0.0010	0.0036
R42	Env	43	3	10	0.0003	0.0089	0.0009	0.0032
R43	Env	66	4	15	0.0003	0.0099	0.0010	0.0035
R44	Env	63	4	14	0.0006	0.0200	0.0020	0.0071
R45	Env	32	2	7	0.0005	0.0166	0.0017	0.0059
R46	Env	32	2	7	0.0003	0.0096	0.0010	0.0034
R47	Env	26	2	6	0.0004	0.0127	0.0013	0.0045
R48	Env	25	2	6	0.0003	0.0105	0.0011	0.0037
R49	Env	31	2	7	0.0004	0.0139	0.0014	0.0049
R50	Env	14	1	3	0.0004	0.0129	0.0013	0.0046
R51	Env	20	1	5	0.0003	0.0098	0.0010	0.0035
R52	Env	16	1	4	0.0003	0.0080	0.0008	0.0028
R53	Env	9	1	2	0.0001	0.0045	0.0004	0.0016
R54	Res	32	2	7	0.0003	0.0096	0.0010	0.0034
Residential /Environmental Criteria		380	980	15800				

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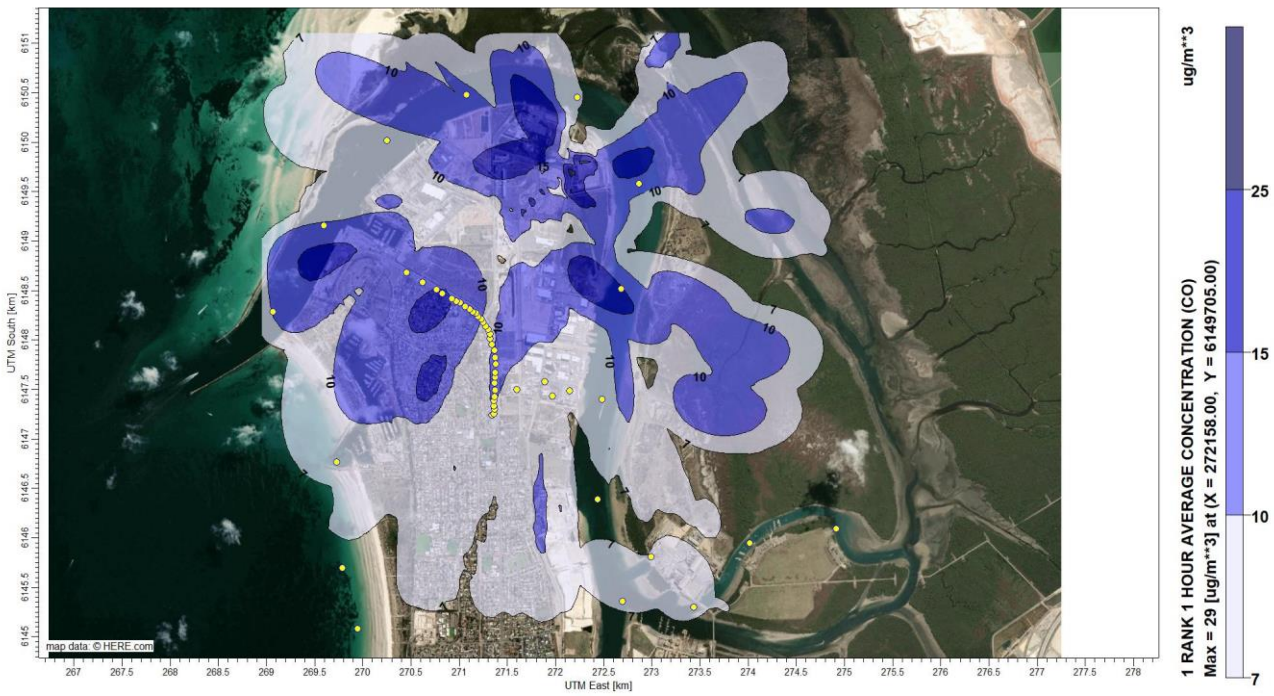
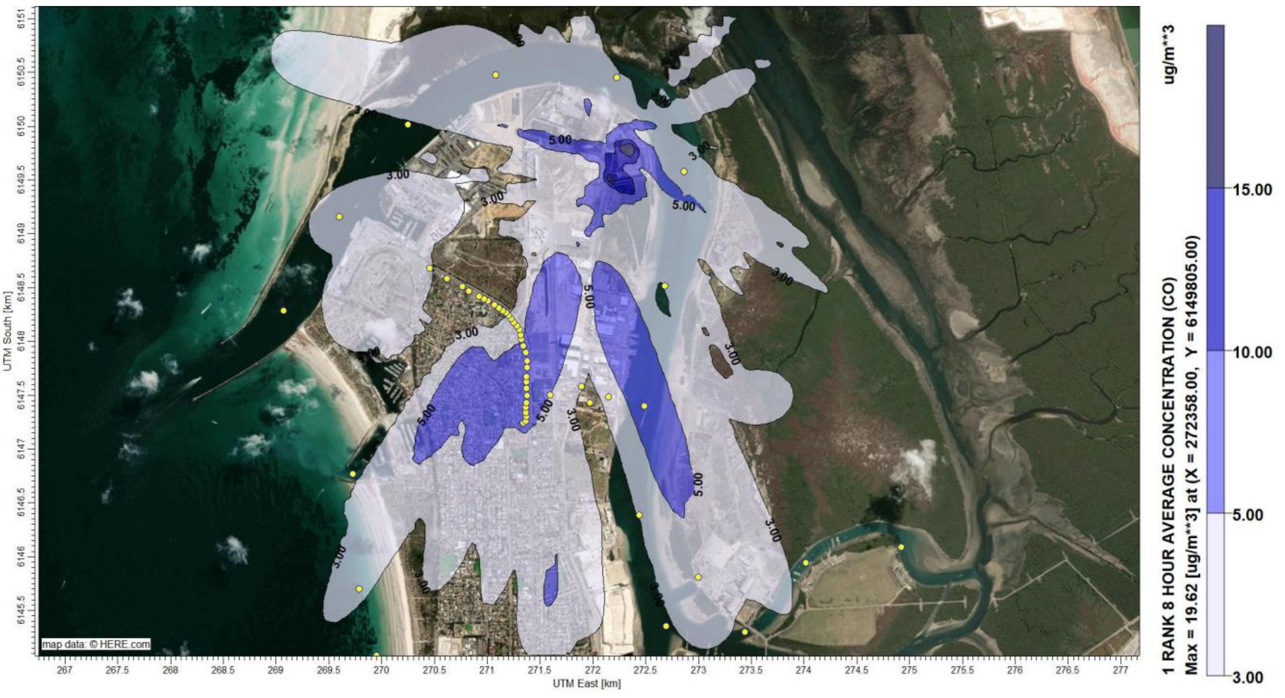
Appendix C Contour Plots – Maximum Activities



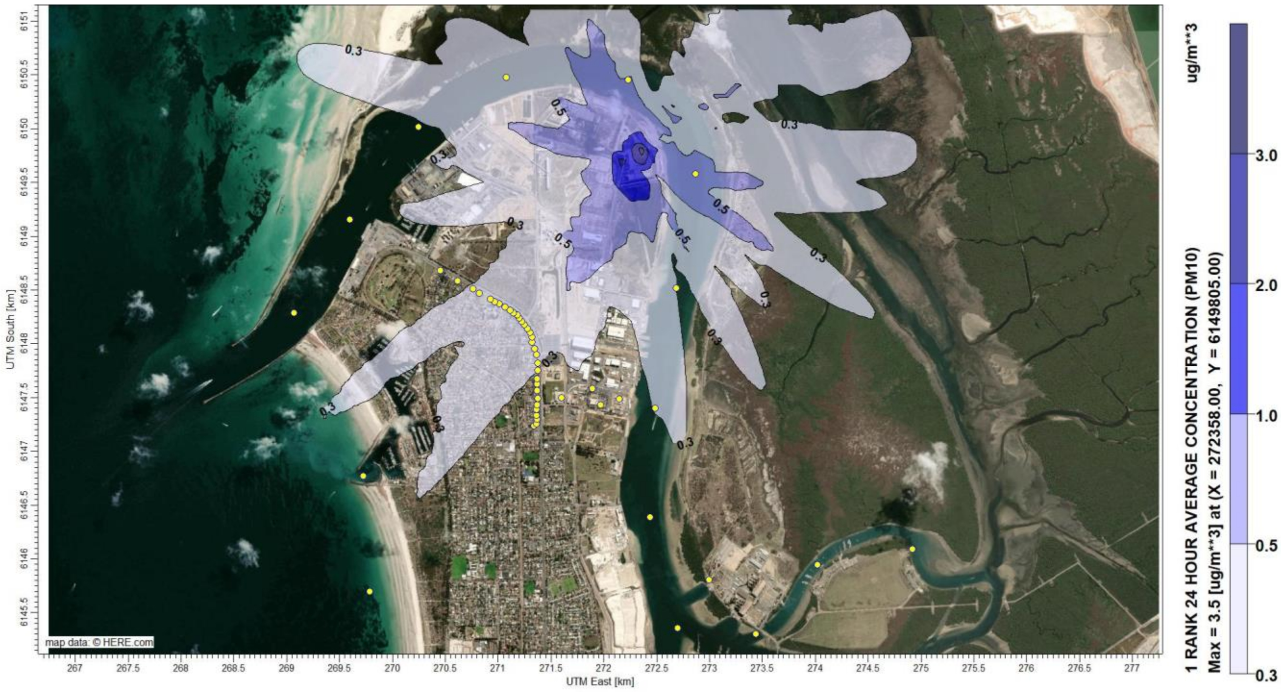
Location:	Pollutant:	Averaging Period:	Percentile:	Criteria:
Osborne (in isolation)	Carbon Monoxide	1 hour	100th	31,240 µg/m^3



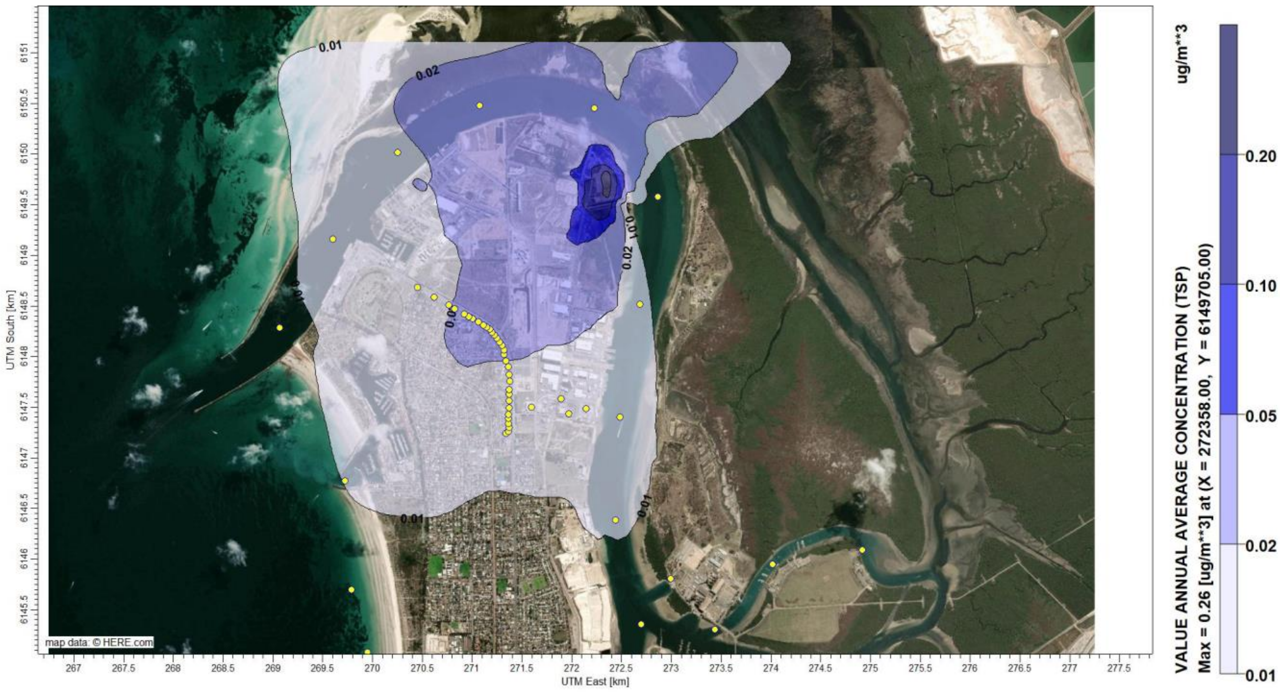
Location:	Pollutant:	Averaging Period:	Percentile:	Criteria:
Osborne (in isolation)	Carbon Monoxide	8 hours	100^{th}	11,250 µg/m^3

Location: Osborne (in isolation)	**Pollutant:** $PM_{2.5}$	**Averaging Period:** 24 hours	**Percentile:** 100^{th}	**Criteria:** 25 $\mu g/m^3$

Location: Osborne (in isolation)	Pollutant: $PM_{2.5}$	Averaging Period: 12 months	Percentile: 100^{th}	Criteria: 8 µg/m^3



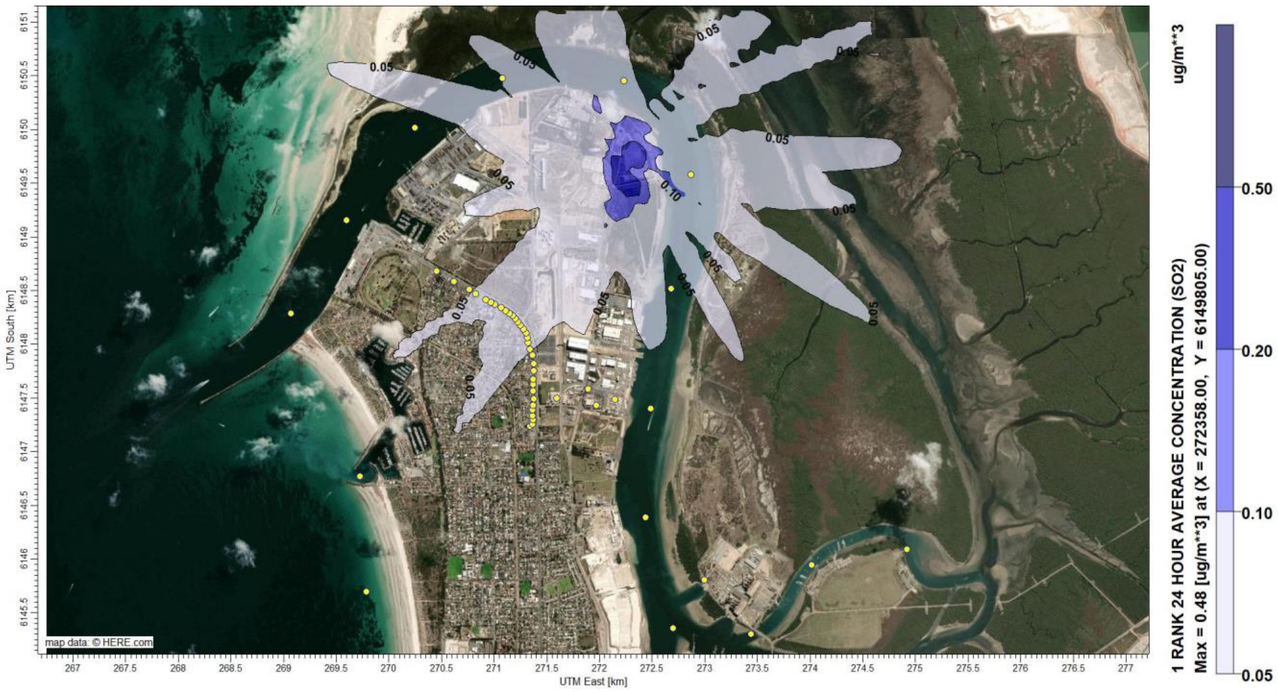
Location: Osborne (in isolation)	Pollutant: PM_{10}	Averaging Period: 24 hours	Percentile: 100^{th}	Criteria: 50 µg/m^3



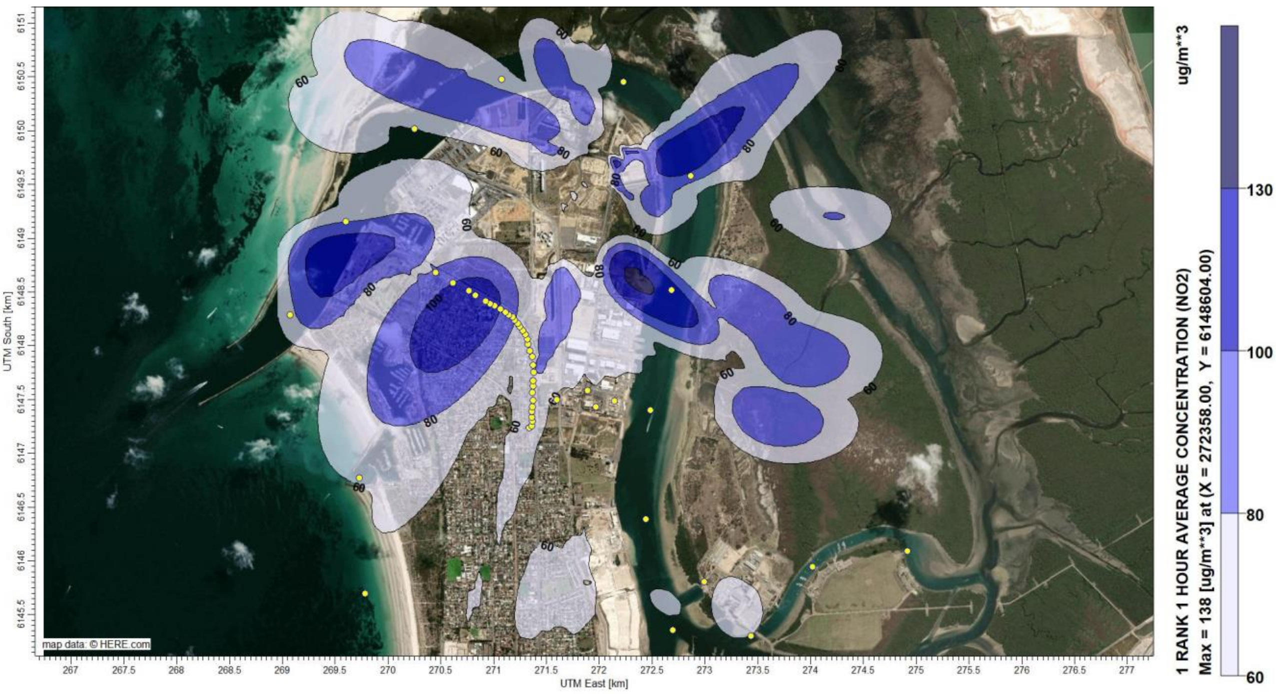
Location: Osborne (in isolation)	Pollutant: Total Suspended Particulates	Averaging Period: 12 months	Percentile: 100th	Criteria: 90 µg/m^3

Location: Osborne (in isolation)	Pollutant: Deposited dust	Averaging Period: 12 months	Percentile: 100th	Criteria: 2g/m²/month in isolation 4 g/m²/month cumulative

Location: Osborne (in isolation)	Pollutant: Sulphur Dioxide	Averaging Period: 1 hour	Percentile: 100th	Criteria: 290 µg/m^3



Location: Osborne (in isolation)	Pollutant: Sulphur Dioxide	Averaging Period: 24 hours	Percentile: 100th	Criteria: 60 µg/m³



Location: Osborne (in isolation)	**Pollutant:** Nitrogen Dioxide	**Averaging Period:** 1 hour	**Percentile:** 100th	**Criteria:** 164 µg/m³

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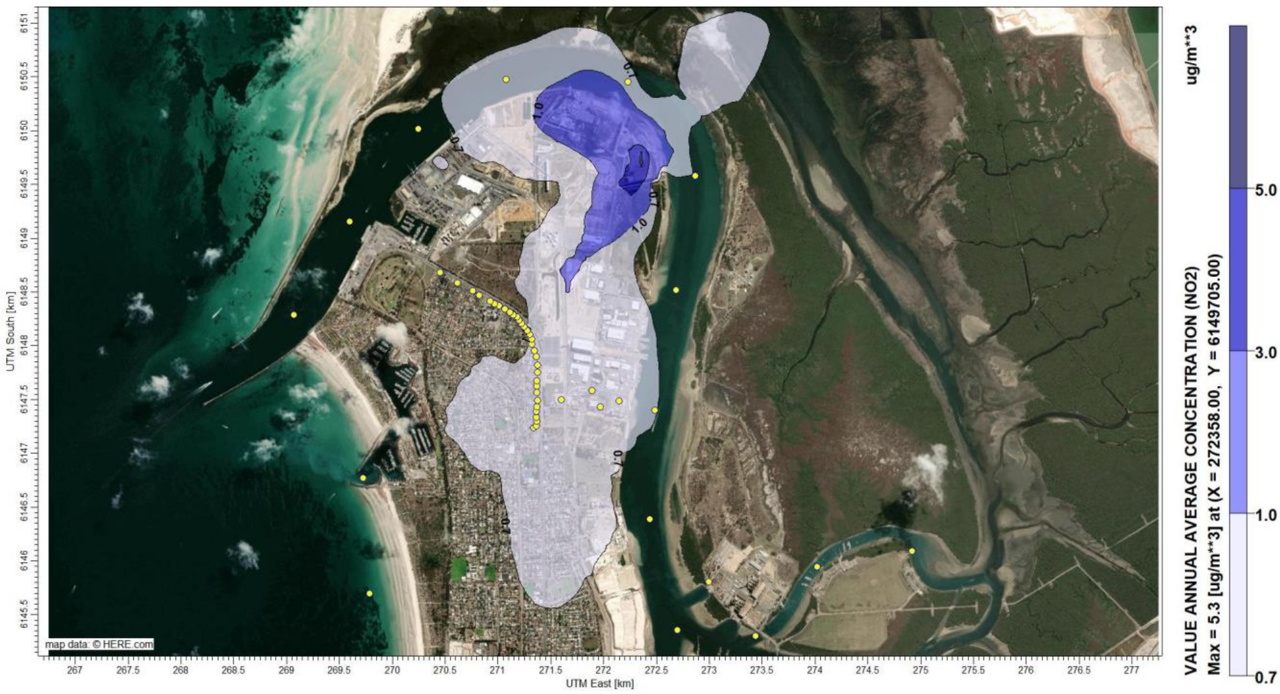
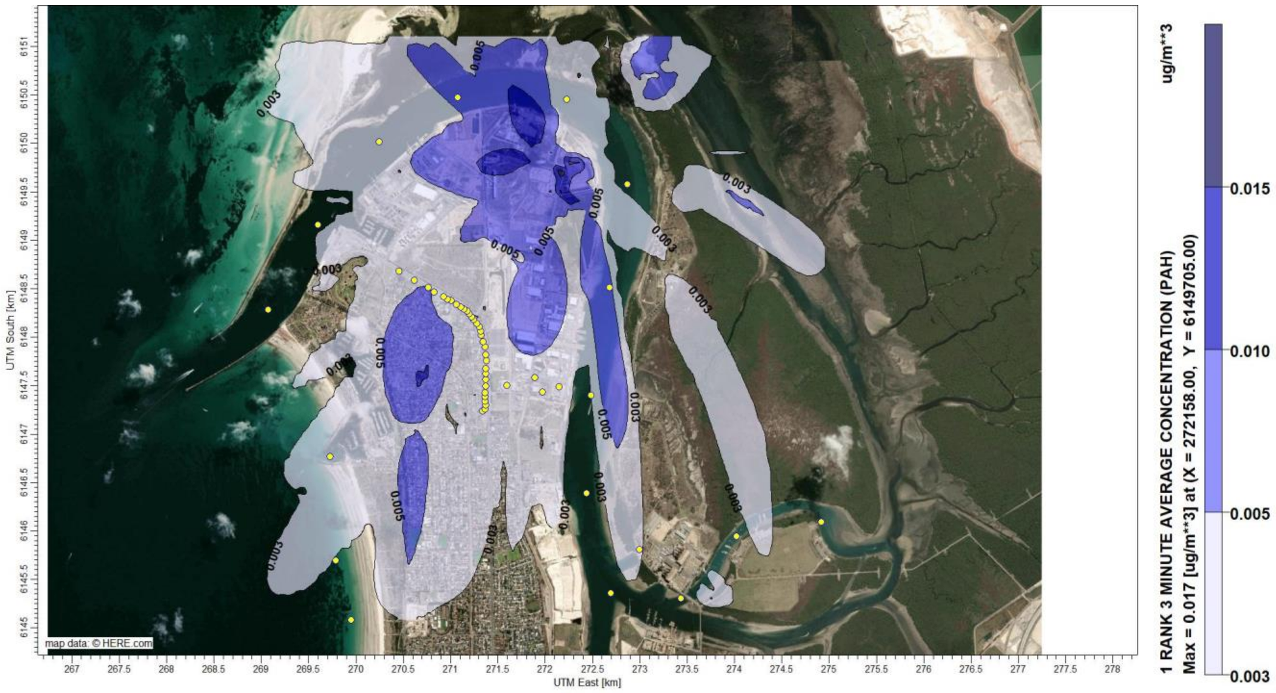
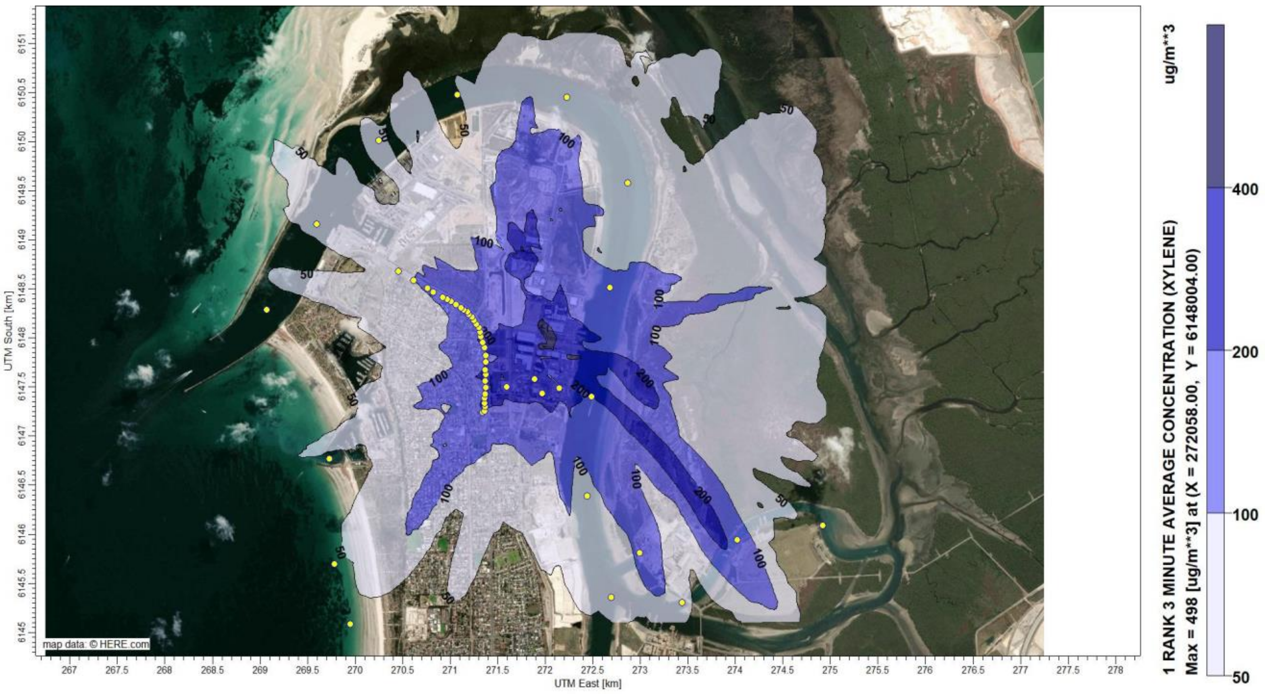


Location: Osborne (in isolation)	Pollutant: Nitrogen Dioxide	Averaging Period: 12 months	Percentile: 100th	Criteria: 15 µg/m³



Location: Osborne (in isolation)	**Pollutant:** PAHs	**Averaging Period:** 3 minutes	**Percentile:** 100^{th}	**Criteria:** IARC 0.8 $\mu g/m^3$



Location:	Pollutant:	Averaging Period:	Percentile:	Criteria:
Osborne (in isolation)	Xylenes	3 minutes	100^{th}	Odour - 380 µg/m^3 Toxicity – 1,240 µg/m^3