Transpacific Refiners Pty Ltd
14-Jane-2015

Air Quality Impact Assessment

Transpacific Diversification Project 05_0037 Mod 5

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Client: Transpacific Refiners Pty Ltd

ABN: 74 101 155 220

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

14-Jane-2015

Job No.: 60430258

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Executive Summary

AECOM was commissioned by TPR to investigate the air quality and GHG emissions as part of the proposed TPR Diversification Project. TPR are currently seeking approval for the proposed modification of project approval 05_0037, under Section 75W (repealed) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an oil polishing plant and additional oil storage tanks at the facility. The modification involves the conversion of currently produced Group I oil to Group II oil.

As part of the Environmental Assessment, both an air quality impact assessment and greenhouse gas (GHG) assessment were required to assess the air quality, odour and greenhouse gas impacts associated with the proposed modification in accordance with the DP&Es Secretary's Environmental Assessment Requirements (SEARs). This report addresses the requirements listed under the SEARs with regards to air quality, odour and GHGs.

A Level 2 Air Quality Impact Assessment was conducted in accordance with the *NSW Approved Methods for Modelling and Assessment OF Air Pollutants in NSW* (DEC 2005). The report provides an assessment of the potential ground level air quality impacts from TSP, PM_{10}, NO_2, TVOCs, H_2SO_4, H_2S, SO_2 and odour. Odour emissions used in the assessment were derived from sample data at the Rutherford Facility and from TPR's plant in Narangba, Qld.

Two modelling scenarios were assessed as are described as follows:

Scenario 1 (EPL Limits): A theoretical modelling scenario whereby all point sources would operating at the maximum stack concentration for each pollutant set by the EPL, and all other emissions not mandated by the EPL where based on scaled maximum recorded emission concentrations.

Scenario 2 (Maximum Approved Production): A worst case modelling scenario based on standard operating conditions at a maximum operational capacity of 40,000tpa.

Results of the modelling showed no exceedances of the EPA criterion for the predicted cumulative impacts of TSP, PM_{10}, NO_2, TVOCs, H_2SO_4, H_2S and SO_2 over all averaging periods for both Scenarios. For all pollutants the predicted maximum concentration for Scenario 1 (EPL limits) were found to be higher than for Scenario 2 (Maximum Proposed Production). This is attributed to the lower emission rates used in Scenario 2 where emission concentrations under standard operating conditions at the maximum approved production rate are expected to be lower than the existing and proposed EPL limits. Furthermore under the proposed operating conditions of the Facility results are expected to be lower than predicted under Scenario 2 as TPR are likely to be operating under their approved production rate.

Results of the odour modelling showed the incremental ground level concentration impacts from the proposal under Scenario 1 and Scenario 2 both at the highest sensitive receptor and maximum offsite impacts were under the EPA 2 OU criterion. As shown in the predicted highest 99th percentile concentration at a sensitive receptor for Scenario 1 and Scenario 1 was found to be 0.57 OU and 0.54 OU respectively. The maximum offsite concentration for both Scenarios was also below the odour criterion with a predicted value of 1.54 OU, this occurred at the north-eastern boundary of the site and in each case the odour contour dissipates to less than 1 OU within 200 metres of the site. Some conservatism has been built into the results with odour emissions used from the Narangba Facility for Point 2 likely to contain a higher percentage of sulphurous compounds than the Rutherford plant, due to the higher sulphur content of the light fuel used at Narangba (0.5%S vs. 0.03%S). Also emission rates derived from sample data Point 5 are likely to be overestimated due to the redirection of tank vapours from this emission source to the proposed multi fuel boiler.

With regard to the assessment of cumulative odour impacts the predicted contributions from existing operations at TPR are very small compared to other facilities within the Rutherford Industrial Estate (RIE) which provide significant contributions to odour sensitivity of the Rutherford area. While still an area for concern, background odour concentrations in Rutherford have also likely reduced since 2014 with some facilities reducing odour emissions through routine maintenance, odour mitigation works and increased site presence by the EPA at some facilities. Future efforts are also being made at other odour generating facilities to reduce odour impacts in the RIE through odour mitigation. As such the proposed incremental impacts associated with the TPR facility are thought to have no significant impacts on odour within the Rutherford area.

While the results of the dispersion modelling indicate compliance with all relevant air quality and odour criteria, predicted stack conditions and emission rates have been extrapolated from existing sample data and sourced

from another facility where emission data was unavailable. It is therefore recommended that following approval and commissioning of the project a verification study be undertaken. Emissions testing on each modelled point source be undertaken following commissioning when the plant is operating under design loads and normal operating conditions. Following emissions testing a Level 2 air quality assessment should be carried out in accordance with the *Approved Methods* (DEC 2005). A validation report containing both the stack testing and dispersion modelling results should be prepared and submitted to the EPA for review.

A greenhouse gas assessment will be undertaken in accordance with the requirements outlined in the SEAR's and the *Australian National Greenhouse Accounts; National Greenhouse Accounts Factors, December 2014*. The assessment provides a qualitative assessment of GHG emissions during construction and an inventory of GHG emissions during operation of the Facility and a qualitative analysis of the Facilities relative contribution to national greenhouse emissions.

An assessment of operational GHG impacts was undertaken for the existing operations and proposed operations An increase in the GHG emissions from the existing to the proposed operations was observed, largely attributed to the increased production of base oils. The intensity of GHG emissions per unit of production was found to decrease however due to the use of the by-product light oil within the proposed mixed-fuel boiler. Predicted emissions for the Proposal provide only a relatively small contribution to the state and national greenhouse emissions.

1.0 Introduction

1.1 Background

AECOM Australia Pty Ltd (AECOM) was commissioned by Transpacific Refiners Pty Ltd (TPR), to prepare an Environmental Assessment (EA) for the proposed modification (MP 05_0037 ((MOD 5)) to the Transpacific Diversification Project previously approved by the NSW Department of Planning and Environment (DP&E) (Major Project Approval MP05_0037). The Transpacific Diversification Project involves construction and operation of an oil polishing system and additional oil storage tanks at TPRs Resource Recovery and Recycling Facility (the Facility) located within the Rutherford industrial area in the Maitland Local Government Area (LGA).

TPR are currently seeking approval for the proposed modification of project approval 05_0037, under Section 75W (repealed) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of an oil polishing system to further refine process oil and additional oil storage tanks at the facility. The modification involves the conversion of currently produced Group I oil to Group II oil and would comprise of the following changes:

- Installation of a new piece of plant (polishing system) to further refine Group I oils to the higher specification Group II oils;
- Replacement of the existing burner on the Low Pressure (LP) Steam Boiler with a multi-fuel burner;
- Reuse of process gases, tank vapours and low sulphur light oil as burner fuel in the new LP Steam Boiler; and
- Installation of additional storage tanks for Group II specification oils, equating to up to an additional 2.4 ML of storage;
- The proposal does not intend to alter production capacity or operating hours.

As part of the EA, both an air quality impact assessment and greenhouse gas assessment were required to assess the air quality, odour and greenhouse gas impacts associated with the proposed modification in accordance with the DP&Es Secretary's Environmental Assessment Requirements (SEARs). SEARs for the project concerning air quality, odour and greenhouse gas impacts are discussed in **Section 1.2**.

1.2 SEARs Requirements

The Project SEARs for the modification were issued by the Department of Planning and Environment on 10 August 2015. Under the SEAR's the impact assessment must take into account the air quality and greenhouse gas (GHG) assessment requirements provided by the NSW Environmental Protection Authority (EPA) and Maitland City Council (MCC).

A detailed list of the EPA's recommended SEAR's for Air Quality, Odour and GHGs and where they are addressed in this report is provided in **Appendix A**. Key issues raised by the EPA are stated as follows:

"The proposed reuse of process gases, tank vapours and low sulphur light oil in the new LP steam boiler burner is a change from existing operations and likely to change the nature of emission from the steam boiler emission point. The likely emissions, proposed emissions concentration limits and the significance for air quality and odour need to be assessed. The premises is located in an area of significant odour sensitivity"

Assessment requirements as stated by MCC are as follows:

"…The potential to impact sensitive receptors by way of … odour and air quality amenity should form a major component of the EA and should interpret and make contingency for future industrial and residential growth expected in the vicinity.

Assessment of Odour should be considered at the site boundary as well as the nearest sensitive receivers to ensure appropriate assessment of odour and its impact is assessed against where people are likely to work or reside"

1.3 Purpose of this Report

The Purpose of this report is to undertake an Air Quality Impact Assessment (AQIA) and GHG Assessment for the proposed modification to the TPR Product Diversification project for inclusion into the EA. This report aims to address the SEARs described in **Section 1.2** and **Appendix A** for MOD 5 of the TPR Product Diversification project and has been prepared in accordance with the following guidelines:

- Air quality and odour impact assessment guidelines:
  - *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005);
  - *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into Approved Methods for Modeling (sic) and Assessments of Air Pollutants in NSW, Australia* (TRC 2011);
  - *Technical Framework, Assessment and management of odour from stationary sources in NSW* (DEC 2006);
  - *Technical Notes, Assessment and management of odour from stationary sources in NSW* (DEC 2006); and
- GHG Assessment guidelines:
  - *National Greenhouse Accounts Factors, Australian National Greenhouse Accounts* (DoE 2014).

1.4 Project Scope

The air quality and greenhouse impact assessment includes air dispersion modelling using the Lagrangian puff model CALPUFF to assess the air quality and odour impacts from the project and qualitative and quantitative assessment of the construction and operational greenhouse impacts respectively.

In summary the scope of this report includes:

- Description of the proposed modification;
- Description of the existing environment including local meteorology, climatic conditions, terrain, land use and sensitive receptors;
- Preparation of an AQIA including:
  - Identification of relevant ambient air quality and odour criteria;
  - Description of methodology used to develop emissions inventory;
  - Description of modelling methodology;
  - Assessment of potential air quality and odour impacts; and
  - Discussion and recommendations.
- Preparation of a GHG Assessment including:
  - Description of methodology used to develop emissions inventory;
  - Assessment of potential GHG impacts; and
  - Discussion and recommendations.

2.0 Project Description

2.1 Location

The Facility is located at 11 Kyle Street, Rutherford, NSW within the Rutherford Industrial Estate (RIE) and is shown in **Figure 1**. The location of the Facility is marked in orange. The RIE consists of a number of small to medium scale industrial premises regulated by MCC and the EPA. The estate is largely bound by a mix of rural residential and native vegetation to the north, west and south; to the east are largely urban residential properties. The Maitland Airport is also situated approximately 1km north west of the Facility.

The closest residential receptors approximately 1.6km from the Facility, however due to the odour sensitivity of the area (see **Section 4.3.2**) discrete receptors for this project have been based on the location of odour complaints data attributed to a number of facilities within the Rutherford Industrial Area and is inclusive of industrial properties. The locations of discrete receptors are shown in red in **Figure 1** and are further discussed in **Section 4.4**.

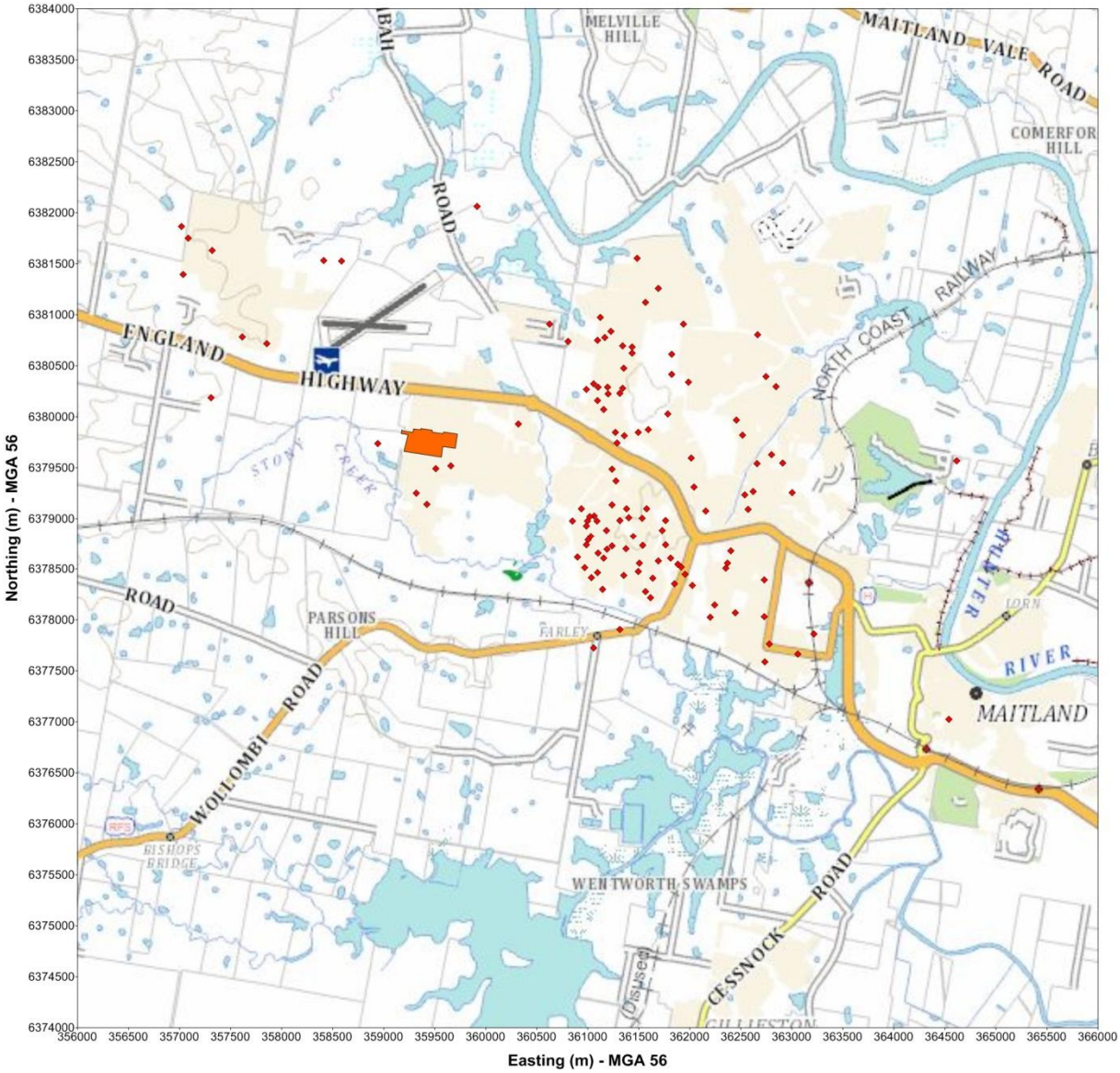

Figure 1 Location of Transpacific Refineries at Rutherford, NSW.

Note: Map imagery obtained from SIX Maps, NSW Land and Property Information (2015).

The property boundary is delineated by the black line in **Figure 2** and point sources as described in **Table 1** are shown in red. The proposed storage tanks for Group II base oils would be situated on vacant land south of the existing storage tank farm within the boundaries of the TPR facility.

Figure 2 Site Location of TPR at Rutherford.

2.2 Existing Operations

The TPR Facility at Rutherford currently operates as a process oil and lubricant recycling facility, converting process oil and lubricants from industrial facilities to base oil for purchase and reuse. The site has approval to process 43 mega litres per year (ML/y) of process oil, equating to the production of 40 ML/y of Group I base oil per annum. Currently TPR are operating under there approved rate processing approximately 24 ML/y of process oil; equating to 22ML/y of Group I base oil. The existing Facility consists of:

- A lube oil hydrogenation plant to process re-refined process oils to generate refinery grade Group I base lubricants oils;
- An on-site laboratory; and
- An industrial cleaning depot and environmental recovery services depot.

Air emissions from existing operations would largely be attributed to stack emissions and include the following pollutants:

- Total suspended particulates (TSP);
- Particulate matter less than or equal to 10 microns in diameter (PM_{10});
- Oxides of nitrogen (NO_x);
- Volatile organic compounds (VOCs);
- Sulphuric acid mist (H_2SO_4);
- Hydrogen Sulphide (H_2S);
- Sulphur dioxide (SO_2); and
- Odour.

A description of air emission point sources from the site as listed under the EPL (No. 12555) are presented in **Table 1** also describes the currently pollution control equipment employed on each emission point source **Figure 2** also shows the location of existing point sources described in **Table 1** as indicated in red.

Other minor sources of dust emissions from the site include dust emissions from traffic on sealed roads and fugitive odour emissions from the oil receiving facility and safe plant process area. These sources of air emissions are considered to be minor, and are unlikely to cause an impact offsite. As such only stack emission point sources have been identified as having the potential to cause off-site air quality impacts.

Table 1 Air Emission Point Sources at TPR Rutherford as Listed under EPL 12555 (EPA 2015)

Source ID	Description
Point 2	3.0 megawatt (MW) LP gas fired boiler stack.
Point 3	0.2 MW gas fired boiler stack.
Point 4	Emergency flare, to which any un-combusted gas is redirected in the event of process failure. The flare designed to destroy VOC emissions in the event of start-up, shut down and emergency process upset conditions. This source does not operate continuously.
Point 5	Emissions from the activated carbon drum system followed by the light ends scrubber (vapour recovery unit).
Point 19	Stack serving two gas fired heaters. A thermal oil heater operates on natural gas and a fired heater operating on both natural gas and fuel gas from the operating process. Exhaust from the oil heater is directed immediately through P19 while exhaust from the fired heater is exhausted to a SO_2 scrubber to control potential sulphur emissions.. After passing through the scrubber, emissions from the Fired Heater exhaust to P19.
Point 20	Hydrogen reformer burner.

2.3 Proposed Development

The modification involves the conversion of currently produced Group I oil to Group II oil and would comprise of the following changes:

- Installation of a new piece of plant (polishing system) to further refine Group I oils to the higher specification Group II oils;
- Replacement of the existing burner on the LP Steam Boiler with a multi-fuel burner;
- Extension of the multi-fuel burner stack (Point 2) from 8m to 14m above ground level (AGL) to reduce wake effects and increase plume dispersion;
- Reuse of process gases, tank vapours and low sulphur light oil as burner fuel in the new LP Steam Boiler;
- Installation additional storage tanks for Group II specification oils to accommodate up to an additional 2.4 ML of storage; and

- Expand existing firefighting capability as required, to accommodate the new tank farm and new Oil Polishing System.

The proposal does not intend to alter production capacity or approved operating hours. Under the proposed diversification project TPR are expected to process approximately 36 ML/y of process oil into 20 ML/y of Group I base oil and 14 ML/y of Group II base oil which equates to a total of 34 ML/y of base oil. This is under the current approved 43 ML/y of process oil.

As part of the proposal there would be some changes to air emissions from the site due to the new multi-fuel burner. Changes to air emissions would be observed from Point 2 with the use of process gas, use of low sulphur light oil fuel and redirection of tank vapours. A reduction in air emissions from Point 5 may be observed due to the redirection of tank vapours. As such TPR are proposing changes to the EPL air emission limits for Point 2 this is discussed in detail in **Section 2.4**.

2.4 Environment Protection Licence Limits

Under Section the *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act) TPR hold an EPL (No. 12555) administered by the NSW EPA. Section 3, Condition 3.3 of the EPL details the stack concentration limits for the existing plant for Point 2, Point 3, Point 5, Point 19 and Point 20. There are no concentration limits set for Point 4 (the flare) which is only used to destroy VOC emissions in the event of start-up, shut down and emergency process upset conditions. The existing EPL limits are presented in **Table 2**.

Table 2 also shows the proposed changes to the EPL limits for Point 2 whereby a new multi-fuel burner would be installed to the existing LP steam boiler. Proposed stack emission limits for the converted boiler have been proposed based on Schedule 4 standard concentrations for Group 6 under of the *Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW)* (POEO (Clear Air) Regulation 2010)). In exception to this is the proposed concentration limit for total *VOCs to which a* stack concentration of 10mg/m^3 (in line with the existing EPL limit for Point 19) has been recommended which is lower than the recommended value of 40mg/m^3 stated under Schedule 4 of the POEO (Clean Air) Regulation 2010. No changes to the EPL limits for all other point sources have been proposed as part of the Project.

Under Section 5 Condition M2.4 of the EPL Point 2, Point 3 and Point 19 have an oxygen correction factor of eight percent and Point 20 has an oxygen correction factor of four percent for all relevant pollutants listed in **Table 2**. No changes to the oxygen correction factor are proposed as part of the project.

It should be noted that under the existing EPL no stack odour concentration limit for the five point sources has been set by the EPA and no limit has been proposed. Odour would be assessed at ground level concentration in accordance with the criteria described in **Section 3.2**. Additionally no stack concentration limit for SO_2 has been proposed for Point 2 as part of the requested amendment to the existing EPL licence. Under Part 6 Clause 58(1) of the POEO (Clear Air) Regulation 2010 the operation of fuel burning equipment with liquid fuel is limited to a sulphur content of equal to or less than 0.5 percent by weight. TPR have indicated that four test results taken over an 18 month period on the light oil produced onsite has a sulphur content of approximately 0.05 percent by weight.

Table 2 Existing and Proposed EPL Stack Concentration Limits

Stack ID	TSP (mg/m^3)		NOx (mg/m^3)		TVOCs (mg/m^3)		H_2SO_4 (mg/m^3)		H_2S (mg/m^3)		SO_2 (mg/m^3)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Point 2	10	50	350	350	10	10	No limit	100	No limit	5	No limit -	No limit
Point 3	10	10	350	350	10	10	No limit	No limit	No limit	No limit	No limit	No limit
Point 5	No limit	No limit	No limit	No limit	20	20	No limit	No limit	No limit	No limit	No limit	No limit
Point 19	50	50	350	350	10	10	100	100	5	5	1360	1360
Point 20	10	10	350	350	10	10	No limit	No limit	No limit	No limit	No limit	No limit

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3.0 Assessment Criteria

3.1 Ambient Air Quality Criteria

As discussed in **Section 2.2** and **Section 2.4** major contributing air pollutants from the existing and proposed operations would include TSP, PM_{10}, VOCs, H_2SO_4, H_2S and SO_4. **Table 3** summarises the NSW EPA's impact assessment criteria as detailed in the *NSW Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005) for the pollutants included in the assessment. In general, these criteria relate to the total burden of air pollutants in the air and not just the air pollutants from project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess impacts. A discussion of background levels in the study area is provided in **Section 4.3.1**.

Table 3 NSW EPA Air Quality Impact Assessment Criteria (DEC 2005)

Pollutant	Averaging Period	EPA Criteria (µg/m^3)
TSP	Annual Average	90
PM_{10}	24 Hour Maximum	50
	Annual Average	30
NO_2	1 Hour Maximum	246
	Annual Average	62
TVOCs (as benzene)[1]	1 Hour (99.9th Percentile)	29
H_2SO_4	1 Hour (99.9th Percentile)	18
H_2S	1 Hour (99th Percentile)	1.38[2]
SO_2	1 Hour Maximum	570
	24 Hour Maximum	228
	Annual Average	60

[1] Under the Approved Methods (DEC 2005) there is no ambient air quality criteria for TVOCs as such the EPA criterion for benzene has been adopted for this assessment.

[2] Impact assessment criteria for H_2S as an individual odorous pollutant is based on a function of population density, given the odour sensitive nature of the study area (refer to **Section 4.3.2**) the most stringent assessment criterion of 1.38µg/m^3 has been adopted for the purpose of this assessment. This equates to a population density of ≥2000 urban residence. This criterion is more stringent that the criterion of 3.45 previously adopted for the PAE Holmes 2013 report for the facility.

3.2 Odour Criteria

The perception of odour is based on an individual's response to chemical exposure. The odour threshold is the theoretical minimum concentration of a chemical that produces an olfactory response, which, in practice, is used to indicate whether an odour is detectable; the odour threshold defines 1 odour unit (1 OU) for each chemical. The threshold relates to odour detection and does not consider the recognition of an odours character.

The EPA's impact assessment criteria for complex mixtures of odours (DEC, 2005) were designed to take into account the ranges of individual sensitivity to odours based on a statistical approach based on the size of the surrounding population. As population density increases, the proportion of sensitive individuals is also likely to increase; as such, areas with larger populations require more stringent criteria. The criteria are shown in **Table 4**.

Table 4 EPA Impact Assessment Criteria – Complex Odours

Population	Criteria (OU)*
Urban (≥ ~2000) and/or schools and hospitals	2
~ 500	3
~ 125	4
~ 30	5
~ 10	6
Single residence (≤ ~2)	7
*99th percentile nose response time	

The Facility is located within an industrial estate and is located approximately 1.6km the nearest residential receivers, however the site is located within an odour sensitive area due to the cumulative effects of odour generating processes at multiple industrial properties within the estate (refer to **Section 4.3.2**). As such an odour assessment criterion of 2 OU has been adopted for this assessment[3].

[3] This in more stringent than the most recent air quality assessment undertaken by PAE Holmes in 2010; which adopted an odour criterion of 4 OU.

4.0 Existing Environment

4.1 Dispersion Meteorology

4.1.1 Wind Speed and Direction

Meteorology in the area surrounding the resource recovery centre is affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography at the small scale, while factors such as synoptic scale winds affect wind speed and direction on the larger scale. Wind speed and direction are important variables in assessing potential air quality impacts, as they dictate the direction and distance air pollutant plumes travel.

The CALMET meteorological model has been used to generate meteorological data for the TPR Facility for the year 2008. The year 2008 was chosen to coincide with the year which received the largest number of odour complaints between 2008 and 2014 and for consistency with the dispersion modelling undertaken for the Rutherford Odour Investigation Project (refer to **Section 3.2**) This data utilised local observation data from the Bureau of Meteorology (BoM) Weather Stations at Paterson (Tocal) and Cessnock Airport[4] and the Commonwealth Scientific Industrial Research Organisation's (CSIRO) The Air Pollution Model (TAPM). This methodology is further detailed in **Section 5.1.2.1, Section 5.1.2.2** and **Section 5.1.4**

A wind speed frequency distribution table for the 2008 CALMET data is presented in **Table 5**; while annual and seasonal wind roses are presented in **Figure 3**. It can be seen from **Table 5** and **Figure 3** that on an annual basis the dominant wind direction is from the west northwest to northwest; occurring for 30 per cent of the time. The annual average wind speed was found to be 2.47 metres per second (m/s) a light to moderate wind speed. Calms (<0.5m/s) were found to occur for just over one percent of the year.

Seasonally, the highest average wind speed during 2008 was observed during the winter months (2.73 m/s) and the lowest average wind speed occurring in autumn (1.95 m/s). During autumn, winter and spring the dominant wind direction is similar to the annual trend with winds commonly occurring from the west northwest to northwest, winds are also frequent from the east to south east in autumn and spring. During summer the predominant winds are from the south to south east.

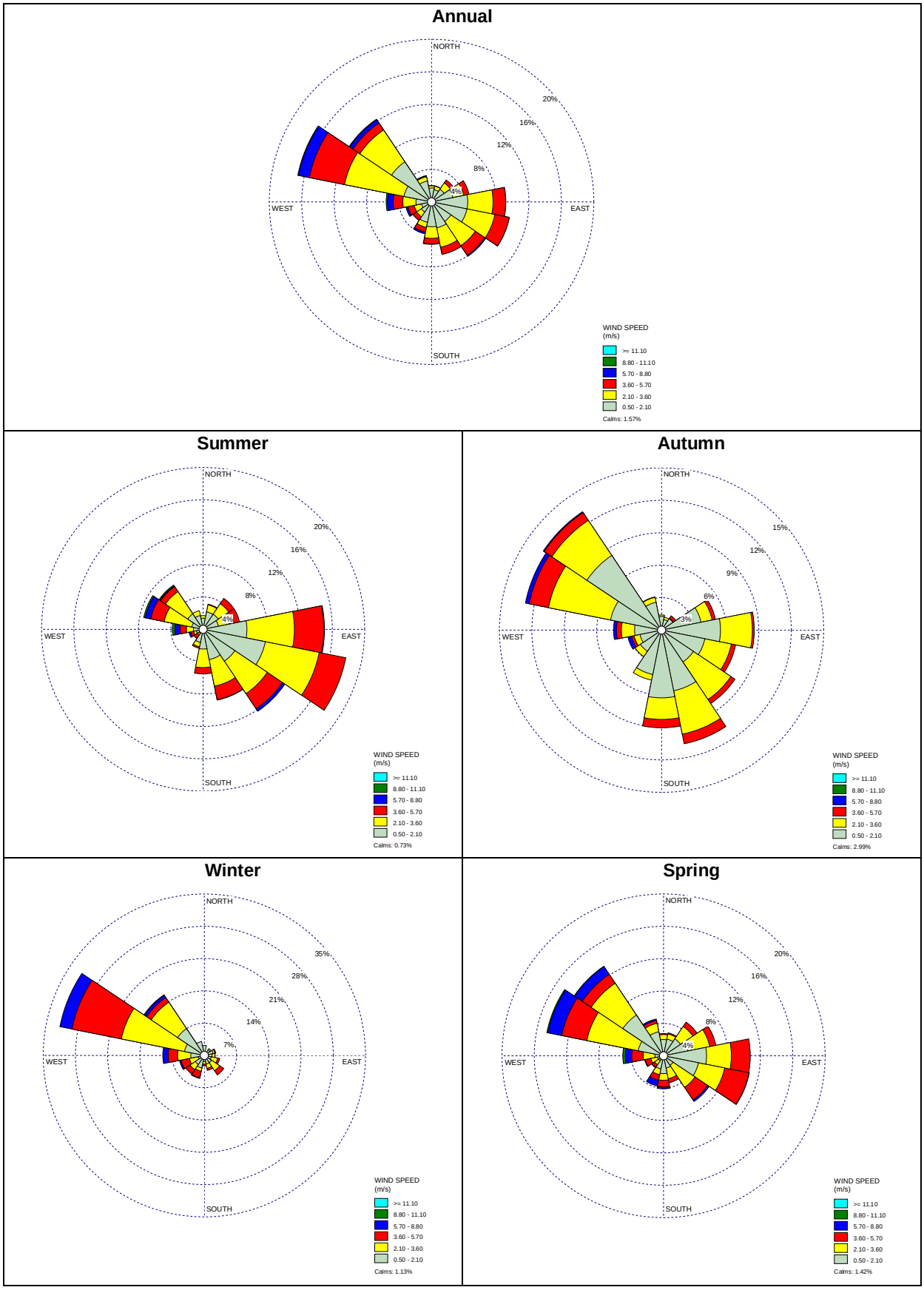
A comparison of the CALMET 2008 meteorological data with data collected from the BoM Weather Station at Paterson in **Appendix B**.

[4] The nearest BoM meteorological station to the TPR Facility is located at the Maitland Visitors Centre, however due to insufficient data frequency data from this site has been excluded. Thus Cessnock Airport and Paterson BoM station data have been used. This is consistent with the meteorological modelling undertaken for the Katestone Environmental 2014 report.

Table 5 Wind Speed Frequency Distribution of CALMET 2014 data (%)

Wind Direction	Wind Speed Class (m/s)						
	0.5-2.1	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	≥11.1	Total
N	1.7080	0.2619	0.0342	0.0000	0.0000	0.0000	2.0041
NNE	1.5259	0.4327	0.0569	0.0000	0.0000	0.0000	2.0155
NE	1.8675	0.9337	0.4213	0.0000	0.0000	0.0000	3.2225
ENE	2.6645	1.3664	0.6604	0.0000	0.0000	0.0000	4.6914
E	4.4523	3.1086	1.5486	0.0228	0.0000	0.0000	9.1323
ESE	4.4409	3.4958	1.8105	0.0114	0.0000	0.0000	9.7586
SE	2.8809	3.5869	1.4120	0.1480	0.0000	0.0000	8.0278
SSE	3.2453	2.4254	0.8882	0.0114	0.0000	0.0000	6.5703
S	3.0517	1.4234	0.6832	0.0569	0.0000	0.0000	5.2152
SSW	2.5621	0.6377	0.5807	0.2164	0.0000	0.0000	3.9968
SW	1.5145	0.6946	0.5238	0.0114	0.0000	0.0000	2.7443
WSW	1.2526	0.9223	0.7857	0.2505	0.0000	0.0000	3.2111
W	1.9244	1.6056	1.1729	0.7174	0.1594	0.0000	5.5796
WNW	3.4616	7.4471	4.4067	1.3664	0.0797	0.0000	16.7616
NW	5.9098	4.7028	1.0248	0.4896	0.0683	0.0000	12.1954
NNW	2.6190	0.5238	0.1025	0.0456	0.0000	0.0000	3.2908
Sub-Total	45.0808	33.5687	16.1125	3.3478	0.3075	0.0000	98.4172
Annual (Jan to Dec, 2008). Total periods = 8,782; Valid periods = 8,781; Calm wind periods = 138; Calm winds: 1.57%							

Figure 3 Annual and Seasonal Wind Roses at TPR, Rutherford Generated by CALMET 2008



4.1.2 Atmospheric Stability

In dispersion modelling, atmospheric stability describes the rate at which a plume will disperse, represented by typically six classes; A to F (that is, unstable through to very stable conditions). For the TPR site, stability class was calculated by CALMET for each hour in the 2008 calendar year. **Table 6** shows the frequency of occurrence of the stability categories expected in the area.

Table 6 Frequency of Occurrence of Stability Categories at Rutherford (2008)

Stability Class	Frequency of Occurrence (%)
A	2
B	7
C	12
D	40
E	7
F	32
Total	

The most common stability class was determined to be D class. This suggests that the dispersion conditions are such that air emissions will disperse rapidly for a significant proportion of the time. While the most common stability class was found to be D, stability class F was also found to occur 32 percent of the time, during these conditions pollutants would disperse slowly.

4.2 Local Climatic Conditions

The BoM meteorological station located at Paterson (Tocal) (Station Number 061250) approximately 12.5 km northeast of the site records climate data for a range of meteorological parameters including, temperature, humidity, rainfall, wind speed and wind direction. A summary of the long-term data recorded at this station between 1967 and 2015 is shown in **Table 7.** The data provides an indication of the regional climate of the area.

Long term data for the Cessnock Airport BoM monitoring station is also described in **Appendix B.**

Table 7 Climate Summary, BOM Monitoring Station at Paterson (Tocal AWS), 1967 to 2015 (BoM 2015)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	29.8	28.8	27.0	24.2	20.7	17.8	17.4	19.4	22.5	25.1	26.8	29.0	24.0
Mean minimum temperature (°C)	17.6	17.6	15.7	12.5	9.6	7.5	6.2	6.6	8.9	11.4	14.0	16.2	12.0
Mean rainfall (mm)	104	120	115	90	73	76	40	37	49	66	86	81	937
Decile 5 (median) rainfall (mm)	76	84	98	70	61	55	32	30	33	48	73	70	943
Mean number of days of rain ≥ 1 mm	9	9	9	8	7	8	6	5	6	7	9	8	90
Mean 9am temperature (°C)	22.7	22.0	20.6	18.0	14.6	11.9	11.0	12.6	16.2	19.1	20.1	22.2	17.6
Mean 9am relative humidity (%)	74	79	80	77	80	78	76	69	64	64	69	69	73
Mean 9am wind speed (km/h)	7.0	5.5	5.8	7.0	8.4	11.0	11.5	13.3	13.1	11.1	9.5	8.5	9.3
Mean 3pm temperature (°C)	28.3	27.4	25.7	23.0	19.7	16.8	16.4	18.3	20.9	23.3	25.1	27.5	22.7

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean 3pm relative humidity (%)	52	56	58	56	58	59	55	46	46	48	49	49	53
Mean 3pm wind speed (km/h)	14.6	12.3	11.6	11.3	11.4	13.8	15.0	17.9	17.8	16.5	16.5	16.1	14.6
Station Number: 061250, Latitude: 32.63 °S, **Longitude:** 151.59 °E, **Elevation**: 30 m, Latest available data**:** 14 October 2015													

As shown in **Table 7** the study area experiences a warm to moderate climate. The warmest temperatures occur during the summer months, with the highest average maximum temperature (29.8°C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 6.2°C.

The annual average rainfall for the area is 937 millimetres (mm) over 90 days a year. February is the wettest month, with an average rainfall of 120 mm, while August is driest month with an average rainfall of just 37mm. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon.

Daytime wind speeds were found to be moderate, with higher wind speeds occurring in the afternoon compared to the morning. The annual average 9am wind speed recorded is 9.3 kilometres per hour (km/h) and the annual average 3pm wind speed was14.6 km/h. Seasonally, wind speeds are higher during the warmer months with the highest average wind speed occurring in December at 28.3 km/h. A review of local wind distribution patterns for 9am and 3pm are presented in **Appendix B** These show that on an annual basis the dominant wind direction is from the west to north east during the mornings and from the southeast during the afternoons.

4.3 Existing Air Quality

4.3.1 Air Pollutants

The EPA operates a number of air quality monitoring stations in the Lower Hunter. The closest monitoring station sites to the proposed development are located at Beresfield (18km southeast of the site). This station records hourly PM_{10} concentrations using a Tapered Element Oscillating Microbalance (TEOM), NO_2 and SO_2. Ambient air quality monitoring data for 2014 at Beresfield is presented in **Table 8**.

The maximum PM_{10} 24-hour concentration measured at Beresfield in 2014 (the most recent year for which data are available) was 45.4 µg/m^3 which is just below the EPA 24 hour maximum criterion of 50 µg/m^3 (OEH 2015). The annual average PM_{10} concentration recorded at 19.3 µg/m^3 for 2012 which is just under two thirds the EPA annual average criterion of 30 µg/m^3 (OEH 2015) (refer to **Table 8**).

In 2014 the maximum 1 hour NO_2 concentration was 80µg/m^3 approximately one third of the EPA criterion, the annual average NO_2 concentration was also well below the criterion recorded at 18.5 µg/m^3. Similarly recorded background concentrations for SO_2 for all averaging periods were well below the relevant criteria (refer to **Table 8**).

No measurements of local TSP ambient air quality concentrations were available. In the absence of existing annual TSP concentration data, the annual PM_{10} concentration can be assumed to be 40% of the annual TSP concentration. This is a conservative approach as data reported by the NSW Minerals Council (2000). This equates to an annual TSP concentration of 48.3µg/m^3, which is below the NSW EPA criterion of 90 µg/m^3.

OEH do not currently undertaken ambient air quality monitoring for VOCs, H_2SO_4 and H_2S. Previous ambient air quality monitoring for air toxics undertaken between 1996 and 2001 indicated low levels of pollutants within the Greater Metropolitan Region (GMR) as such background concentrations of VOCs, H_2SO_4 and H_2S are not considered to be a primary issue of concern.

Table 8 Ambient Air Monitoring in Beresfield, NSW for 2014 (OEH 2015)

Pollutant	Averaging Period	2014	EPA Criteria (µg/m^3)
PM_{10}	24 Hour Maximum	45.4	50
	Annual Average	19.3	30
NO_2	1 Hour Maximum	80.0	246
	Annual Average	18.5	62
SO_2	1 Hour Maximum	88.7	570
	24 Hour Maximum	20.0	228
	Annual Average	2.9	60

4.3.2 Odour

Odour impacts from the Rutherford Industrial Estate have been of long standing concern from the surrounding community. Since 2008 the EPA has received over 700 odour complaints from residential areas surrounding the RIE, including Rutherford, Aberglasslyn, Farley, Windella and Telarah (EPA 2015b).

On 7 September 2011, the Minister for Environment established the Rutherford Air Quality Liaison Committee (RAQLC) to provide direct point of contact between the local community, industry and the EPA on matters specifically related to air quality at the Rutherford Industrial Estate, including odour and air quality monitoring. As part of the RAQLC the EPA have commissioned a number of odour assessment, sampling and dispersion modelling programs between 2012 and 2014[5].

[5] Studies undertaken between 2012 and 2014 by the RAQLC include the: Rutherford Odour Investigation Project (TAS 2012), Rutherford Odour Investigation Project: Part 1, Task A (TOU 2013a), Rutherford Odour Investigation Project: Part 1 Task B (TOU 2013b), Rutherford Odour Investigation Project Part 2 (Katestone Environmental 2014) and Rutherford Odour Investigation Project: Part 3 (TOU 2014a).

As part of the Rutherford Odour Investigation Project (ROIP) seven facilities in addition to TPR were identified within the REI as odour generating facilities including:

- Australian Waste Oil Refineries (AWOR);
- National Ceramic Industries Australia (NCIA);
- Biodiesel Industries Australia (BIA);
- Atlantic Pacific Foods (APF);
- Wax Converters Textiles (WCT);
- Treloar; and
- Fulton Hogan (FH).

The *Rutherford Odour Investigation; Part 2 Modelling Program* (Katestone Environmental 2014) provides an odour impact assessment of the above mentioned eight facilities under current operating conditions. Odour impacts were assessed at 142 discrete sensitive receivers based on the location complaints data records from 2008 to 2012. A summary of these results are presented in **Table 9**.

The ROIP (Katestone Environmental 2014) does not provide a cumulative odour impact assessment of the eight identified odour generating facilities in the project but provides an assessment of individual facility contributions. It can be seen from **Table 9** that the largest contributors of odour both inside and outside the RIE are APF and FH with the predicted maximum 99th percentile concentrations well above to EPA odour criterion of 2OU. WCT was also predicted to result in exceedances of the EPA criterion at sensitive receptors outside the RIE.

It can be seen from **Table 9** that predicted odour concentrations for TPR under current operating conditions were found to be well below the 2OU criterion with a maximum concentration of 0.7OU inside the RIE and 0.3OU outside the RIE. This is well below the incremental impacts predicted for the highest contributing facility Inside the RIE FH at 47 OU and outside the RIE, APF at 28.3 OU.

It should be noted that since the completion of the ROIP studies in May 2014 the EPA have carried out a number of regulatory actions to reduce odour impacts within the RIE (EPA 2015). These include implementation of odour mitigation measures at two premises and the issue of two prevention notices to other facilities requiring ongoing studies and monitoring programs to ensure odour mitigation measures meet performance rudiments. An increase to the frequency of inspections has also been implemented to identify operational improvements as where applicable negotiate pollution reduction programs (PRPs) (EPA 2015). Potential changes to odour emissions which may alter the predicted 2014 ground level odour concentrations are detailed in **Table 9**.

With regards to odour complaints within the region reports peaked in 2007 and 2008 with 246 and 236 reports received respectively. In 2009 following regulatory action by the EPA and improvements to capture and reduce odours from facilities in the RIE odour reports fell by half to 115, with similar complaints numbers observed in recent years up until 2014[6]. In 2015 from 1 January to 31 March the EPA received 18 odour reports for Rutherford. This was consistent with the number of reports received during the first quarter of 2014 (EPA 2015).

[6] With the exception of 2013, where odour reports fell to 45, this is likely attributed to community awareness of the RAQLC and the active investigations being carried out as part of the ROIP (EPA 2015).

Table 9 Odours Industries in at Rutherford Industrial Estate (EPA 2014, EPA 2015 and Katestone Environmental 2014)

Facility	Changes to Odour Generating Facility Operations 2014	Predicted Odour Concentration at Sensitive Receptors (OU) (99th Percentile)			
		Inside RIE		Outside RIE	
		Min	Max	Min	Max
TPR Process oil storage and processing facility	The EPA has increased site inspection frequency and TPR have demonstrated proper and efficient management of all processes during EPA inspections.	0.1	0.7	<0.1	0.3
AWOR Waste oil refinery	The EPA has increased site inspection frequency. A number of maintenance issues have been identified which when rectified should reduce fugitive odours from the site.	0.1	0.7	<0.1	0.2
NCIA Ceramic tile manufacturing plant	No changes to operations	0.2	0.6	<0.1	0.5
BIA Biodiesel refinery	No changes to operations	<0.1	0.1	<0.1	0.3
APF Vegetable oil refinery	No changes to operations	2.2	28.3	0.4	2.6
WCT Fabric Manufacturing Plant	Increased the stack velocity at the PVC plant to improve odour dispersion. An options assessment using dispersion modelling is currently being undertaken to assess further potential odour mitigation options.	0.1	0.2	1.1	9.5
Treloar Petroleum fluid and handling products manufacturing plant;	No changes to operations	<0.1	0.1	<0.1	<0.1
Fulton Hogan Asphalt plant	Implemented odour mitigation measures, in July 2014, in response to a Prevention Notice issued by the EPA. The measures included reducing temperature of the bitumen and installing a charcoal scrubber to reduce odour emissions from the premises.	0.5	47.0	0.0	2.3

4.4 Terrain and Land Use

Table 7 shows a three dimensional representation of the local terrain. Terrain data were captured from NASA's Shuttle Radar Topography Mission (SRTM), which produces terrain information for the entire globe. For Australia, terrain data are available at approximately 90 m resolution (3-arc seconds).

The site lies approximately 26m above MSL and the immediate terrain surrounding the area is relatively flat. In the wider context the study area lies approximately 32km to the northwest of East Australian coastline and terrain height within the study area range from between 0 and 110 metres with higher elevations to the southeast. North of the site the Hunter river runs west to east, before turning south at Oakhampton, and then east again at Maitland. At its closest point the Hunter River lies approximately 2.3km northeast of the facility.

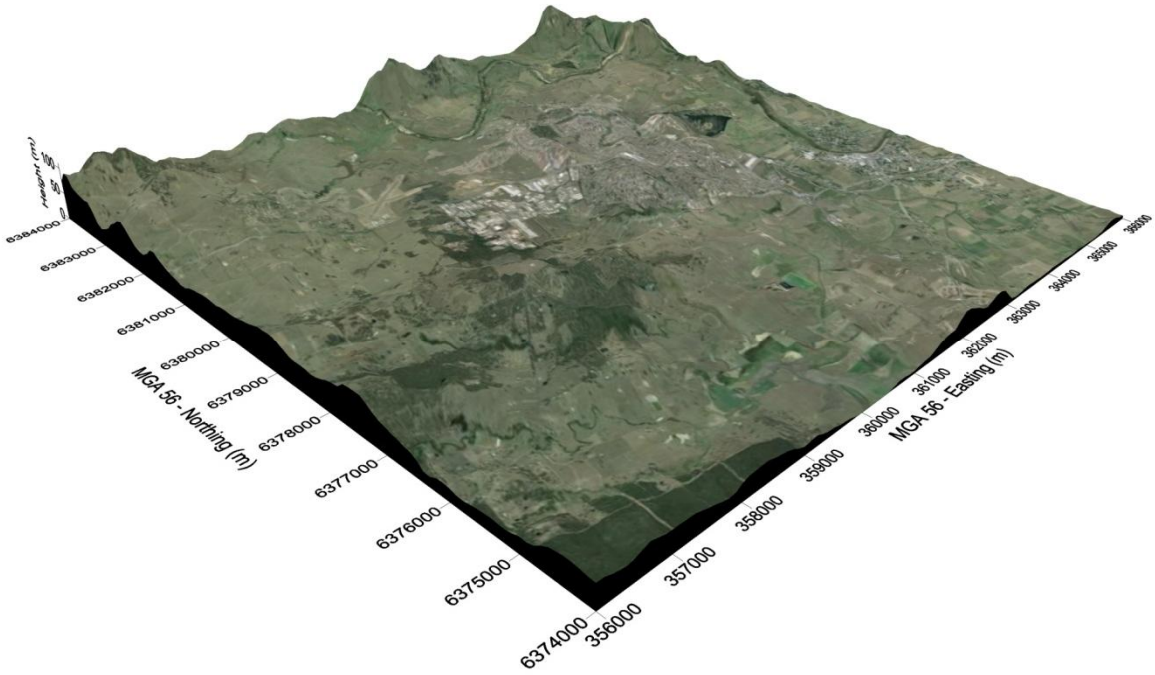


Figure 4 Terrain

The surrounding land use as previously discussed in **Section 2.1** is largely comprised of small to medium scale industrial premises within the confines of the RIE. The RIE is largely bound by a mix of rural residential and native vegetation to the north, west and south; to the east are largely urban residential properties. The Maitland Airport is also situated approximately 1km north west of the Facility.

The closest urban residential receptors approximately 1.6km from the Facility, however due to the odour sensitivity of the area (see **Section 4.3.2**) discrete receptors for this project have been based on the location of odour complaints data attributed to a number of facilities within the Rutherford Industrial Area and is inclusive of industrial properties. A total of 126 discrete receptors have been identified within the confines of the modelling domain and the locations[7] are shown in red in **Figure 1**.

Land use categories used in the CALMET meteorological model we assigned using satellite imagery in accordance with the U.S. Geological Survey Land Use and Land Classification System. Land Use categories for the entire modelling domain are shown in **Figure 5**.

In addition to existing land uses, other potential sensitive land uses in the future are outlined in the Maitland Urban Settlement Strategy: 2001-2020 (MSC 2008). This includes:

- Newly developed Heritage Parc Residential Estate, 1.3km south east of the Facility;

[7] Due to the absence of identification markers or coordinates in the Katestone Environmental 2012 report, the locations of discrete receptors have been approximated from figures in the 2012 report. Discrete receptors outside the model domain for this assessment have been excluded.

- Newly developed Signature Gardens Seniors Living Development, approximately 1.4km north northeast of the Facility;
- Future residential development of approximately 1500 lots at Farley, south of the Facility;
- Future rural residential development of six lots at Windella northwest of the Facility; and
- Future residential development within the Anambah Urban Release Area north of the Facility of approximately 3100 new lots.

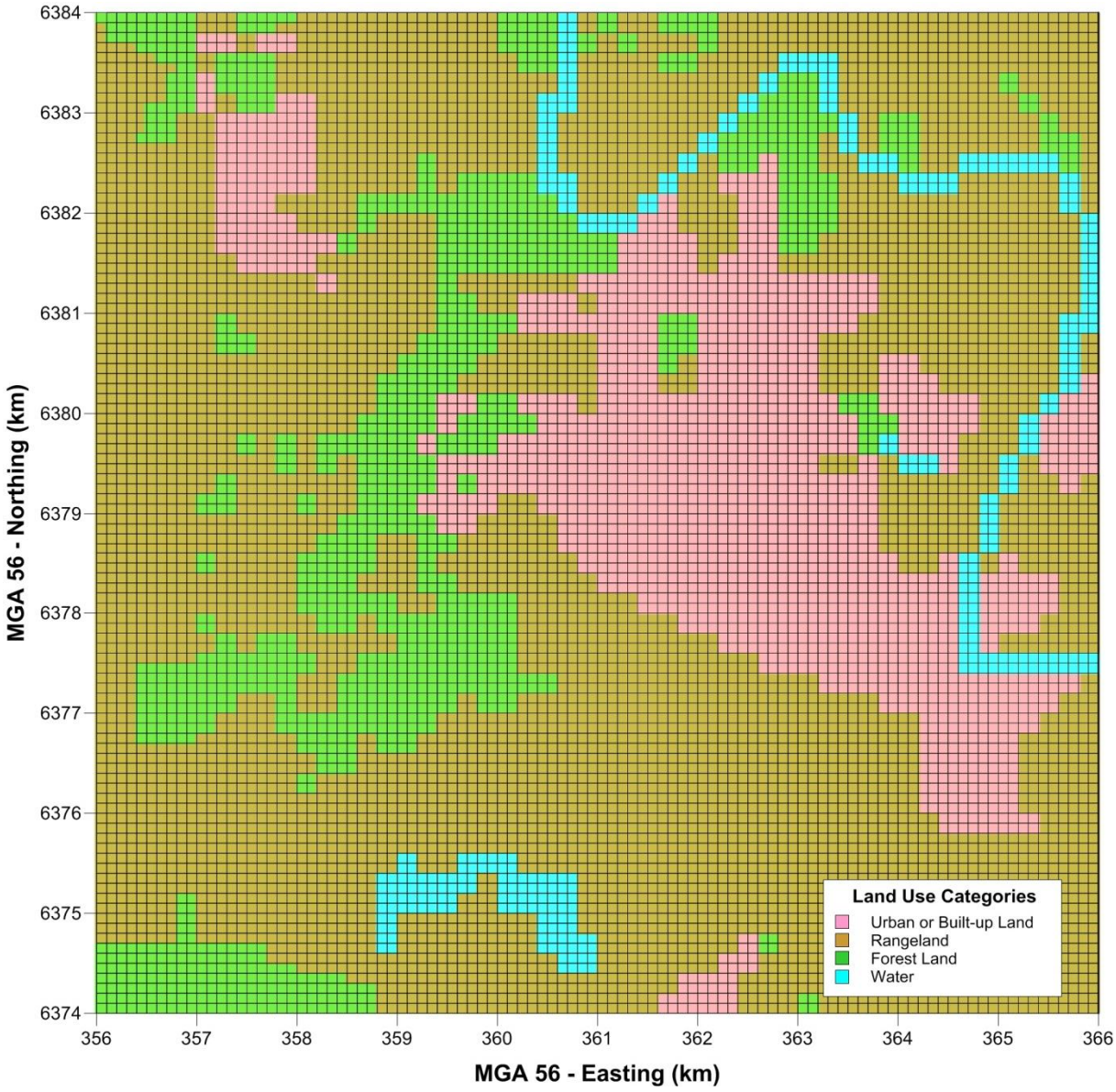


Figure 5 Land Use

5.0 Air Quality Impact Assessment

5.1 Modelling Methodology

5.1.1 Modelling Scenarios

In accordance with the SEAR's (Refer to **Appendix A)** two dispersion modelling scenarios have been undertaken for this assessment. These are described in **Table 10**. Scenario 1 is a theoretical modelling scenario whereby all point sources would operating at the maximum stack concentration for each pollutant set by the EPL, and all other emissions not mandated by the EPL where based on maximum recorded emission concentrations. Scenario 2 is a worst case modelling scenario based on standard operating conditions at a maximum operational capacity of 40,000tpa. Further detail surrounding the emission rates used for each scenario are described in **Section 5.1.3**.

Table 10 Modelling Scenarios

Scenario	Description
Scenario 1 (EPL Limits)	- All point sources modelled using proposed stack concentration EPL limits detailed in **Table 2**; and - Where EPL limits do not apply but source emission data is available the model scenario assumes the facility is operating with maximum pollutant emissions for each individual source scaled to approved maximum operational capacity of 40,000tpa.
Scenario 2 (Maximum Operational Capacity)	- Proposed plant operating at maximum operational capacity of 40,000tpa; and - All point sources modelled using average source emission data[1] scaled to maximum production rate.
[1]. Due to the absence of suitable H_2SO_4 emission data for Point 2 the proposed EPL limit of 100mg/m^3 has been adopted.	

5.1.2 Dispersion Models

This assessment made use of TAPM, the CALMET meteorological processor and the CALPUFF dispersion model. A brief description of each model is provided in **Section 5.1.2.1** to **Section 5.1.2.3**. A summary of the data and parameters used for both the meteorological and air dispersion modelling is described in **Table 14**.

5.1.2.1 TAPM

The Air Pollution Model (TAPM) is a prognostic meteorological and air pollution model developed by CSIRO. The model can be used to predict three-dimensional meteorology, including terrain-induced circulations and is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world.

TAPM was used in this assessment to generate gridded three dimensional meteorological file for input into the CALMET model. As described in **Table 14,** TAPM were runs with the assimilation of local surface meteorological data from BoM monitoring stations at Paterson and Cessnock Airport. Input parameters described in **Table 14** were replicated from the ROIP Stage 2 report for consistency.

5.1.2.2 CALMET

CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. CALMET produces a meteorological file that is used within the CALPUFF model to predict the movement of air pollution.

TAPM prognostic three-dimensional meteorological data, nudged with local BoM data were used to simulate the three-dimensional complex meteorological patterns that exist within the modelling domain, accounting for the effects of local topography and changes in land surface characteristics. Gridded three-dimensional TAPM data were input into the CALMET model to generate the initial guess wind field[8] in CALMET and to generate the final

[8] CALMET uses a two step procedure in developing final wind fields. The "initial guess" wind field is developed based on a domain-average wind profile, and this domain-average profile of winds is adjusted for terrain effects and divergence

three-dimensional wind fields for use in CALPUFF. The dispersion modelling was undertaken using one year of meteorological data (January 2008 – December 2008).

5.1.2.3 CALPUFF

CALPUFF is a non-steady state, three-dimensional Gaussian puff model developed for the US Environmental Protection Agency (USEPA) for use in situations where basic Gaussian plume models are not effective. These situations include areas where stagnation conditions occur, which are characterised by calm or very low wind speeds with variable wind direction. The CALPUFF modelling system (and associated CALMET program) has the ability to model spatially varying winds and turbulence fields that are important in complex terrain, long range transport and near calm conditions. As such, CALPUFF was selected as the appropriate dispersion model for this assessment.

A summary of the data and parameters used for both the meteorological and air dispersion modelling is described in **Table 14**, while additional information regarding meteorology, local terrain and land use and air and odour emissions are described in **Section 4.1, Section 4.4** and **Section 5.1.3** respectively.

The CALPUFF suite of programs, including meteorological (CALMET), dispersion (CALPUFF) and post processing modules (CALPOST), is an advanced non-steady state modelling system designed for meteorological and air quality modelling. CALPUFF is approved for use in NSW by the EPA, particularly in applications involving complex terrain, non-steady-state conditions, in areas where coastal effects may occur, and/ or when there are high frequencies of stable or calm meteorological conditions. CALPUFF was selected for use in this assessment based on the modelling systems ability to model low wind speeds and calm hours by simulating stagnant puffs and puff transport caused by divergence or slope flow. This was necessary due to the odour sensitivity of the area, where light wind and stable conditions are often worst case for many types of sources and calm hours are likely to result in the overall highest impacts.

5.1.3 Emissions Inventory

Stack parameters for each of the five modelled point sources are presented in **Table 11** and modelled emission rates for Scenario 1 and Scenario 2 as described in **Section 5.1.1** are presented in **Table 12** and **Table 13** respectively. The gas flare stack (Point 4) has been excluded from the assessment; as this source is only operational during start up, shutdown and in emergencies, and as such its contribution to local air emissions is limited.

Stack parameters in **Table 11** apply to both modelled scenarios. Stack temperature and velocity have been derived from stack testing reports obtained from sample data collected between 2013 and 2014 at the Rutherford Facility (TOU 2013c, PEL 2014a, PEL2014b and PEL 2015). For each scenario stack velocity has been scaled based on the approved capacity of the plant. Hourly production data at the time of testing and a maximum operational capacity of 5000kg/h were used to calculate the velocity. The plant production rate at the time of testing was found to vary between 2900kg/h and 3500kg/h. The method used to calculate the velocity for each plant source is further described in **Appendix C**.

Table 11 Stack Parameters

Stack ID	Height AGL (m)	Diameter (m)	Cross sectional area (m^2)	Temperature (K)	Velocity (m/s) (measured)	VFR (Nm^3/s) (measured)
Point 2	16	0.65	0.33	449	6.20	1.10
Point 3	10	0.29	0.07	522	16.47	0.47
Point 5	8	0.2	0.03	297	8.39	0.25
Point 19	26	0.4	0.13	372	6.77	0.56
Point 20	14	0.34	0.09	1050	17.06	0.31

For Scenario 1 emission rates in **Table 12** have been derived from the EPL limits described in in **Table 2**. All EPL emission limits were uncorrected to oxygen emissions for each individual source obtained from sample data collected between 2013 and 2014 at the Rutherford Facility. For Point 3, Point 5, Point 19 and Point 20 where

minimisation to produce a 'Step 1' wind field. The second step is the processing of the wind field is the introduction of observational data into the terrain adjusted Step 1 field.

EPL limits do not apply but source emission data is available emission rates in **Table 12** have been calculated from the maximum pollutant emissions obtained from the sample data collected at the Rutherford Facility. Similar to method described above for calculating velocity the emission rates were scaled to the maximum operational capacity based on production data (refer to **Appendix C**).

For Point 2 emission rates for SO_2 and odour shown in in **Table 12** were derived from TPRs process oil processing facility at Narangba, Queensland. Sample data taken from the boiler stack Narangba site on 25 October 2010 and the 25 September 2015 for SO_2 and Odour respectively (ALE 2014 and ALE 2015) were scaled from a production rate of 6000kg/h to 5000kg/h to calculate an emission rate for SO_2 and odour from Point 2 and Rutherford. The boiler at Narangba uses light oil as an additional fuel source similar the mixed fuel process described in **Section 2.3**. It should be noted that TPR have advised that the sulphur content of the light oil used at Narangba as advised by TPR is considerably higher (approximately ten times) than the sulphur content of the light oil produced at the Rutherford site. As such emission estimates in **Table 12** for SO_2 and odour (due to the presence of sulphurous compounds) are likely to be conservative.

For Scenario 2 emission rates in **Table 13** have been calculated from the average pollutant emissions obtained from the sample data collected at the Rutherford Facility between 2013 and 2014 for Point 3, Point 5, Point 19 and Point 20. These emission rates were then scaled to the maximum operational capacity based on production data (refer to **Appendix C**). Point 2 sources were also scaled to the maximum operational capacity but using data from the Narangba Facility. No data or H_2SO_4 was available from the Narangba plant as such as a conservative estimate the H_2 SO_4 emission rate for Point 2 under Scenario 2 was assumed to be equal to the stack concentration limit proposed in **Table 2**. Similarly as described above for Scenario 1 SO_2 and odour emission rates for Point 2 are likely to be conservative.

With the exception to H_2SO_4 for Point 2 in Scenario 2 where the EPL limit has been adopted it can be seen that for all pollutants with and EPL limit the estimated emission rates in **Table 13** are lower than the emission rates presented in **Table 12** for Scenario 2. This indicates that under normal operating conditions the Facility is expected to be operating under the EPL limits for each source when operating at the maximum approved production capacity of 40 ML/y of base oil per annum. Furthermore it should be noted that while the emission rates presented in **Table 13** are representative of the maximum approved production capacity of the facility under the current proposal the plant is expected to produce approximately 36 ML/y of base oil per.

It should be noted that emission rates derived from sample data in **Table 12** and **Table 13** for Point 5 are likely to be lower due that reported due to the redirection of tank vapours from this emission source, and as such are considered a conservative estimate.

Table 12 Scenario 1: Emission Rates

Stack ID	TSP (g/s)	NO_X (g/s)	TVOCs (g/s)	H_2SO_4 (g/s)	H_2S (g/s)	SO_2 (g/s)	OU* (OU/s)
Point 2	0.0602	0.4212	0.0120	0.1203	0.0060	0.2052	4868
Point 3	0.0049	0.1712	0.0049	N/A	0.00057	0.0018	1272
Point 5	0.0009	0.0004	0.0049	N/A	0.0009	0.0004	35
Point 19	0.0331	0.2315	0.0066	0.0662	0.0029	0.8997	2379
Point 20	0.0044	0.1545	0.0044	0.0016	0.0016	0.0012	1470
* A peak to mean ratio of 2.3 for wake-affected point sources was applied to all odour emission rates (DEC 2005)							

Table 13 Scenario 2: Maximum Approved Capacity (40,000tpa)

Stack ID	TSP (g/s)	NO_X (g/s)	TVOCs (g/s)	H_2SO_4 (g/s)	H_2S (g/s)	SO_2 (g/s)	OU* (OU/s)
Point 2	0.0342	0.2280	0.0052	0.1203	0.0060	0.2052	4868
Point 3	0.0029	0.1217	0.0008	N/A	0.0005	0.0015	1272
Point 5	0.0007	0.0004	0.0008	N/A	0.0005	0.0004	12
Point 19	0.0187	0.1960	0.0017	0.0281	0.0008	0.0262	1804
Point 20	0.0033	0.0729	0.0007	0.0009	0.0009	0.0011	1173

Stack ID	TSP (g/s)	NO_X (g/s)	TVOCs (g/s)	H_2SO_4 (g/s)	H_2S (g/s)	SO_2 (g/s)	OU* (OU/s)
* A peak to mean ratio of 2.3 for wake-affected point sources was applied to all odour emission rates (DEC 2005)							

5.1.4 Model Input Parameters

A summary of the data and parameters used as input parameters for CALMET, TAPM and CALPUFF is shown in **Table 14**.

Table 14 Summary of Meteorological and CALPUFF Input Parameters

Parameter	Input
CALMET (v6.42)	
Meteorological grid domain	10 kilometres x 10 kilometres
Meteorological grid resolution	100 metre resolution (100 x 100 grid cells)
Reference grid coordinate of southwest corner	356.000 E, 6374.000 S
Cell face heights in vertical grid	0, 40, 80, 125, 175, 225, 300, 425, 650, 1200, 2100 and 3600 m
Simulation length	1 year (2008)
Surface meteorological stations	CALMET No Obs Mode: Run using TAPM gridded numerological data nudged with data from the Paterson (Tocal) and Cessnock Airport surface meteorological stations operated BoM.
Upper air meteorological station	No upper air stations. The 3-dimensional gridded prognostic data from TAPM were used as the initial guess wind-field for CALMET.
Terrain data	Terrain elevations were extracted from the NASA Shuttle Radar Topography Mission data set (SRTM 90 metre, 3-arc sec).
Land use data	Land use information for CALMET was derived from the USGS one kilometre land use data set and satellite imagery.
TAPM	
TAPM Version	v4.04
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1km)
Number of grid points	35 x 35 x 30
Simulation period	2008
Terrain information	AUSLIG 9 second (horizontal resolution 9”)
Centre of analysis	32°43 S, 151°30 E
Local data assimilation	**Paterson (Tocal) BoM Monitoring Station (Station No. 061250)** *Hourly data:* Wind speed and wind direction. *MGA Coordinates (m)*: 367913E, 6,388,886 S *Radius of Influence*: 5000m *Levels Assimilated*: 3 *Anemometer Height:* 10m *Data Quality Indicator:* 1 (reliable)
	Cessnock Airport BoM Monitoring Station (Station No. 061260) *Hourly data:* Wind speed and wind direction. *MGA Coordinates (m)*: 344344E, 6,370,924 S *Radius of Influence:* 6,000m *Levels Assimilated*: 3 *Anemometer Height:* 10m *Data Quality Indicator:* 1 (reliable)
Mode	Meteorology mode only

Parameter	Input
CALPUFF (v6.42)	
Modelling domain	**Computation grid:** 10.00km x 10.00km **Sampling grid:** 9.00km x 9.00km *MGA SW Coordinates (km)*: 357.000 E, 6375.000 S *MGA NE Coordinates (km)*: 365.000 E, 6383.000 S
Modelling grid resolution	**Grid resolution:** 100m
Number of sensitive receivers	A total of 126 discrete receptors were added surrounding the plant. An additional 17 cartesian plant boundary receptors were also added to define the confines of the facility.
Dispersion algorithm	Turbulence-based coefficients
Hours modelled	8,784 hours
Meteorological modelling period	1 January 2008 – 31 December 2008

5.2 Limitations

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of different variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes based on our understanding of the processes involved and their interactions, available input data, and processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those wind speeds less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

While the models contain a large number of variables that can be modified to increase the accuracy of the predictions under any given circumstances, the constraints of model use in a commercial setting, as well as the lack of data against which to compare the results in most instances, typically precludes extensive testing of the impacts of modification of these variables. With this in mind, model developers typically specify a range of default values for model variables that are applicable under most modelling circumstances. These default values are recommended for use unless there is sufficient evidence to support their modification.

As a result, the results of dispersion modelling provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time. As stated above, however, the model predictions are typically conservative, and tend to over predict maximum pollutant concentrations at receiver locations.

This assessment was undertaken with the data available at the time of the assessment. Should changes to the project be made, further assessment may be required to determine if the findings of this assessment are still applicable.

5.3 Results and Discussion

The following subsections of the report provide a Level 2 quantitative assessment of the air pollutant (refer to **Section 5.3.1**) and odour (refer to **Section 5.3.2**) associated with the operation of the proposed Transpacific Diversification Project. The following points for each modelled scenario should be noted when reviewing the results:

5.3.1 Air Pollutants

Predicted pollutant concentrations including both incremental and cumulative impacts are shown in **Table 15** for both Scenario 1 and Scenario 2. It can be seen in **Table 15** that there are no exceedances of the EPA criterion for the predicted cumulative impacts of each examined pollutant for both Scenarios. For all pollutants the predicted maximum concentration for Scenario 1 (EPL limits) were found to be higher than for Scenario 2 (Maximum Proposed Production). This is attributed to the lower emission rates (refer to **Section 5.1.3**) used in Scenario 2 where emission concentrations under standard operating conditions at the maximum approved production rate are expected to be lower than the existing and proposed EPL limits (see **Section 2.4**) as described in **Section 5.1.1** and **Section 5.1.3**.

Predicted concentrations reported in **Table 15** are at the highest sensitive receptor, with the exception of Total VOCs (as benzene) and H_2SO_4 which under Section 7.2.2 of the Approved Methods (DEC 2005) are assessed at the highest offsite concentration. A summary of the results in **Table 15** is as follows:

- Annual average TSP results for the project were found to be 0.5µg/m^3 and 0.1 µg/m^3 for Scenario 1 and Scenario 2 respectively. When accounting for background TSP concentrations the predicted cumulative results were approximately 48 µg/m^3, just over half the EPA criterion of 90 µg/m^3;
- A conservative estimate of PM_{10} ground level concentrations was made assuming all TSP was equal to PM_{10}. Results of then modelling indicate:
  - Predicted 24 hour cumulative concentrations for PM_{10} were 98 and 93 percent of the EPA criterion of 50µg/m^3 for Scenario 1 and Scenario 2 respectively, this is attributed largely to the maximum 24-hour background concentration of 45.4µg/m^3. The maximum predicted project contribution was found to be 3.4µg/m^3 for Scenario 1 and 1.2µg/m^3 for Scenario 2; and
  - Predicted cumulative annual average PM_{10} concentrations for Scenario 1 and Scenario 2 less than two thirds of EPA criterion of 30 µg/m^3.
- Predicted NO_2 ground level concentrations were considered conservative assuming 100 percent conversion of NO_x to NO_2. Results of the modelling show:
  - A predicted 1 hour maximum cumulative impact of 192.4µg/m^3 (70 percent of the criterion) for Scenario 1, dropping to 142.5µg/m^3 (58 percent of the criterion) for Scenario 2; and
  - Maximum annual average cumulative concentration was approximately one third of the background criterion for both scenarios.
- The 1 hour 99.9th percentile concentration for TVOCs was found to be 48 percent of the EPA criterion under using EPL limits (Scenario 1) dropping to 5 percent under the maximum production scenario (Scenario 2);
- The predicted 1 hour 99.9th percentile concentration for H_2SO_4 for Scenario 1 was predicted to be 15.95µg/m^3 equating to 89 percent of the EPA criterion of 18 µg/m^3. For Scenario 2 this dropped to 11.06 µg/m^3 (61 percent of the criterion), however this value is considered conservative as the emission rate of Point 2 was assumed to be equal to the EPL (see **Section 5.1.3**);
- The 1 hour 99.9th percentile concentration for TVOCs was found to be 48 percent of the EPA criterion under using EPL limits (Scenario 1) dropping to 5 percent under the maximum production scenario (Scenario 2);
- The predicted 99th percentile concentration for H_2S was found to be 0.68 µg/m^3 for Scenario 1 and 0.37 µg/m^3 which is well below the criterion of 1.38µg/m^3; and
- Predicted 1 hour, 24 hour and annual average cumulative SO_2 impacts were found to be well below the relevant EPA criteria for both modelled scenarios.

Table 15 Predicted Pollutant Concentrations for Scenario1 and Scenario 2 (µg/m^3)

Pollutant	Averaging Period	Scenario 1				Scenario 2				EPA Criteria
		Increment	Background	Cumulative	Percentage of Criteria	Increment	Background	Cumulative	Percentage of Criteria	
TSP	Annual Average	0.5	48.3	48.8	54	0.1	48.3	48.4	54	90
PM_{10}	24 Hour Maximum	3.4	45.4	48.8	98	1.2	45.4	46.6	93	50
	Annual Average	0.5	19.3	19.8	66	0.1	19.3	19.4	65	30
NO_2	1 Hour Maximum	112.4	80	192.4	78	62.5	80	142.5	58	246
	Annual Average	4.8	18.5	23.3	38	2	18.5	20.5	33	62
TVOCs (as C_6H_{12})	1 Hour (99.9th Percentile)	13.9	NA	NA	48	1.35	NA	NA	5	29
H_2SO_4	1 Hour (99.9th Percentile)	15.95	NA	NA	89	11.06	NA	NA	61	18
H_2S	1 Hour (99th Percentile)	0.68	NA	NA	49	0.37	NA	NA	27	1.38
SO_2	1 Hour Maximum	128.8	88.7	217.5	38	20.4	88.7	109.1	19	570
	24 Hour Maximum	39	20	59	26	4.5	20	24.5	11	228
	Annual Average	5.5	2.9	8.4	14	0.6	2.9	3.5	6	60

5.3.2 Odour

The predicted highest 1 hour 99th percentile odour concentration at nearby sensitive receptors for Scenario 1 and Scenario 2 are shown in **Table 16**. As requested by MCC (refer to **Section 1.2**) the maximum offsite concentration has also been reported in **Table 16**. No EPL limits apply for stack odour concentration, but where available odour concentrations in Scenario 1 are based on maximum stack concentrations from sample data, while Scenario 2 is based on average stack concentrations.

As shown in **Table 16** the predicted highest 99th percentile concentration at a sensitive receptor for Scenario 1 was found to be 0.57 OU which equates to 29 percent of the 2OU criterion. The maximum offsite concentration was also below the odour criterion with a predicted value of 1.54 OU, this occurred at the north-eastern boundary of the site. The predicted results for Scenario 2 were lower than Scenario 1. The highest 99th percentile concentration at a sensitive receptor was found to be 0.54 OU which equates to 27 percent of the 2OU criterion. The maximum offsite concentration was also below the odour criterion with a predicted value of 1.54 OU, and also occurred at the north-eastern boundary of the site.

Figure 6 and **Figure 7** show the predicted 1 hour 99th percentile concentration contour plots for Scenario 1 and Scenario 2 respectively. The TPR lot is marked in white with the site boundary delineated by a red line. It can be seen from **Figure 6** and **Figure 7** that the plume is oriented in a northwest south east direction towards Maitland Airport and the south-eastern portion of the RIE. There is no exceedance of the OU criterion beyond the boundary of the site and in each case the odour contour dissipates to less than 1 OU within 200 metres of the site.

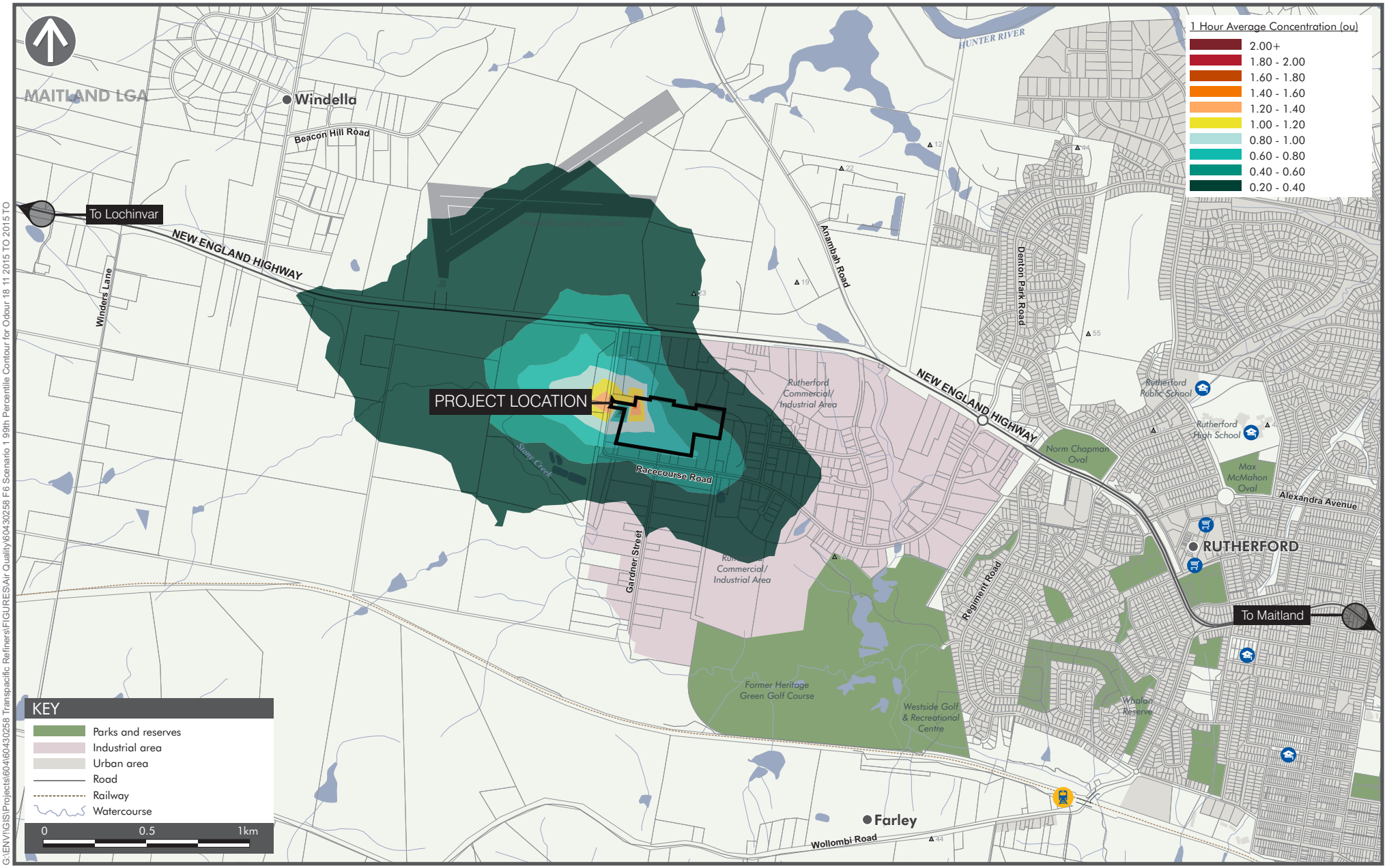
With regard to the assessment of cumulative odour impacts it is difficult to determine an appropriate background odour concentration as previous modelling undertaken as part of the ROIP does not provide a cumulative odour impact assessment of the eight identified odour generating facilities in the project but provides an assessment of individual facility contributions. As discussed in **Section 4.3.2** the contributions from existing operations at TPR are very small compared to other facilities within the REI, including APF, FH and WCT with a maximum concentration of 0.7OU inside the RIE and 0.3OU outside the RIE. The incremental impacts of the proposed development also remain very small when compared to the major contributors of odour within the REI. Additionally background odour concentrations modelled in the Katestone Environmental 2014 report are likely to no longer be representative of the incremental impacts of some facilities with the reduction of fugitive odour emissions at AWOR through maintenance works and odour mitigation measures taken at FH and WC (refer to **Table 9**). Future odour mitigation measures are also likely to be implemented at other sites including WC which would further reduce the background odour concentration.

It should be noted that some conservativeness has been built into the results with odour emissions used from the Narangba Facility for Point 2 likely to contain a higher percentage of sulphurous compounds due to the higher sulphur content of the light fuel. Also emission rates derived from sample data Point 5 are likely to be overestimated due to the redirection of tank vapours from this emission source to the multi fuel boiler.

Furthermore the predicted results shown in **Table 16** and **Figure 6** and **Figure 7**have been based on the plant operating at production capacity of 40ML of base oil per year. Based on the proposal TPR would be operating at a lower capacity producing 36ML of base oil per year, which would result in lower ground level concentrations.

Table 16 Predicted 1 Hour Odour Concentrations (99th percentile) at for Scenario1 and Scenario 2 (OU)

Scenario	Maximum Concentration at Receptors		Maximum Offsite Concentration		EPA Criterion (OU)
	Increment (OU)	Percentage of Criteria (%)	Increment (OU)	Percentage of Criteria (%)	
Scenario 1	0.57	29	1.54	77	2.0
Scenario 2	0.54	27	1.54	77	2.0



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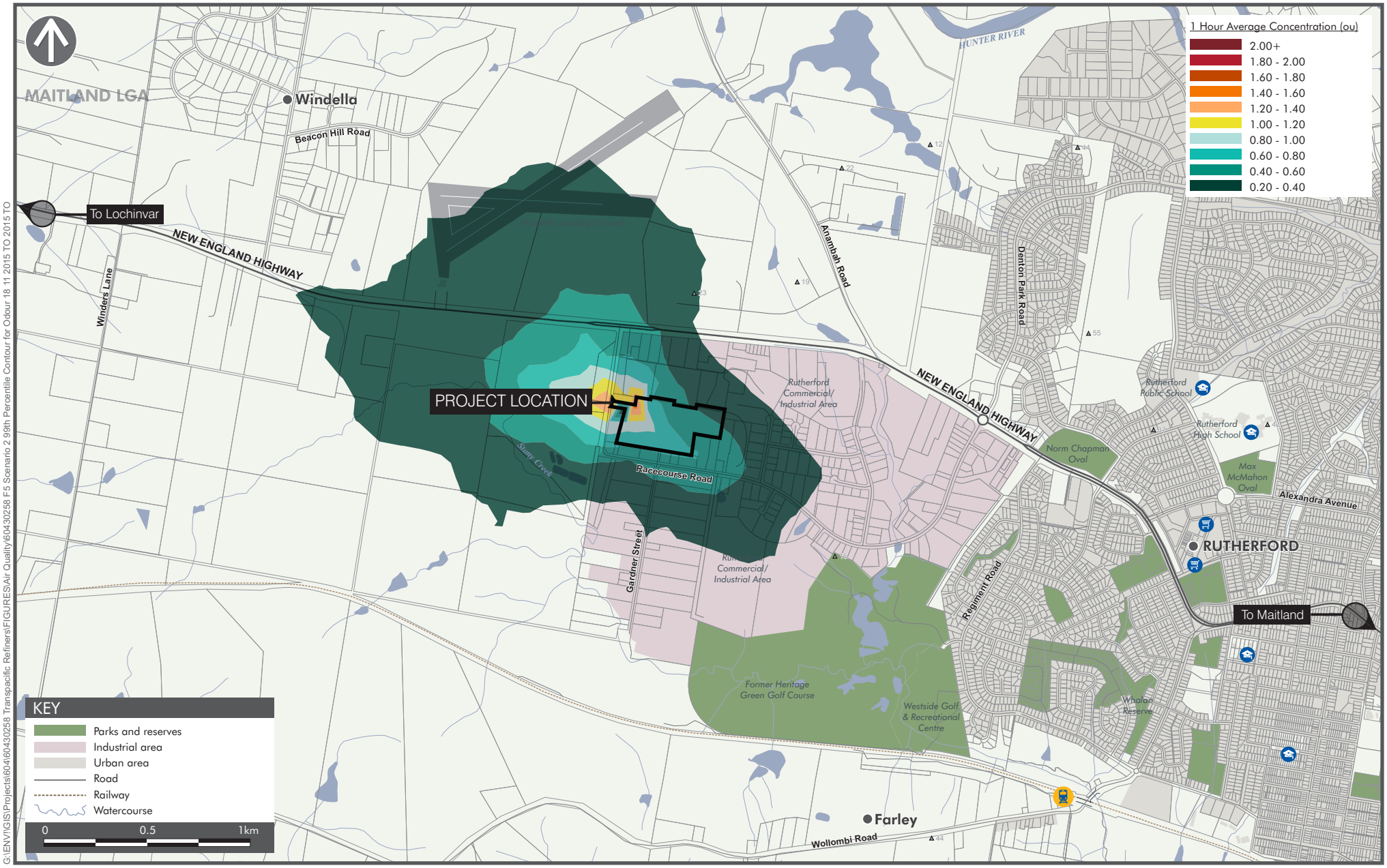
AECOM

SCENARIO 1: 99TH PERCENTILE CONTOUR FOR ODOUR

Transpacific Refiners Diversification Project
MOD 3 s75W Environmental Assessment

FIGURE 6



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SCENARIO 2: 99TH PERCENTILE CONTOUR FOR ODOUR

Transpacific Refiners Diversification Project
MOD 3 s75W Environmental Assessment

FIGURE 7

5.4 Recommendations

Results of the dispersion modelling as discussed in **Section 4.3.1** and **Section 4.3.2** indicate compliance with all relevant air quality and odour criteria. It should be noted that, as discussed in **Section 5.1.3** predicted stack conditions and emission rates have been extrapolated from existing sample data to account differences in existing and approved production rates and sourced from another facility where emission data was unavailable. It is therefore recommended that following approval and commissioning of the project a verification study be undertaken.

It is recommended that emissions testing on each stack listed in **Table 1** (with the exception to Point 4) be undertaken following commissioning when the plant is operating under design loads and normal operating conditions[9]. Following emissions testing a Level air quality assessment should be carried out in accordance with the *Approved Methods* (DEC 2005). A validation report containing both the stack testing and dispersion modelling results should be prepared and submitted to the EPA for review.

[9] One round of testing for each of the assessed point sources (five in total) should provide sufficient evidence for the validation study.

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6.0 Greenhouse Gas Assessment

6.1 Methodology

A greenhouse gas assessment was undertaken in accordance with the requirements outlined in the SEAR's and the *Australian National Greenhouse Accounts; National Greenhouse Accounts Factors, December 2014*. The assessment provides a qualitative assessment of GHG emissions during construction and an inventory of GHG emissions during operation of the Facility and a qualitative analysis of the Facilities relative contribution to national greenhouse emissions.

6.2 Key Definitions and Terms

6.2.1 Greenhouse Gases Global Warming Potentials

The Global Warming Potential (GWP) is an index used to convert relevant non-carbon dioxide gases to a carbon dioxide equivalent (CO_2^{-e}) by multiplying the quantity of the gas by its GWP. GWPs for common greenhouse gases are presented in **Table 17**.

Table 17 Global Warming Potentials (Australian Government 2014)

GHG Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	21
Nitrous Oxide (N2O)	310
Hydrofluorocarbons (HFCs)	140-11,700
Perfluorocarbons (PFCs)	6,500-9,200
Sulphur hexafluoride (SF_6)	23,900

6.2.2 Direct and Indirect Emissions

Direct emissions are produced from sources within the boundary of an organisation and as a result of the organisations activities. These include generation of energy or electricity, manufacturing processes that produce emissions, transportation of materials, fugitive emissions and onsite waste management (Australian Government 2014).

Indirect emissions are emissions generated in the wider economy as a consequence of organisations activities that are physically produced by the activities of another organisation. This includes consumption of electricity, upstream emissions generated in the extraction and production of fossil fuels, downstream emissions from transport of an organisations product to customers and emissions from contracted and outsourced activities (Australian Government 2014).

6.2.3 Types of Emission Factors

Emission factors are activity specific and the activity being undertaken defines the emission factor used. The scope that emission factors are reported under is determined by whether the activity is within the organisations boundary or outside it and is defined as follows:

- **Scope 1:** All direct GHG emissions;
- **Scope 2:** Indirect GHG emissions from the consumption of purchased electricity; and
- **Scope 3:** Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport related activities in vehicles not owned or controlled by the reporting entity, outsourced activities and waste disposal.

6.3 Impact Assessment

6.3.1 Construction Impacts

Greenhouse gas emissions from construction would be temporary in nature and would include fuel consumption from the transport of construction equipment and mobile and equipment onsite and embodied energy for construction equipment such as concrete and steel.

6.3.2 Operational Impacts

6.3.2.1 Emissions Estimation

Table 18 provides a breakdown of the Scope 1, Scope 2 and Scope 3 emissions during operation of the existing and proposed augmentation of the Facility. Due to both the wide distribution of upstream and downstream users and cyclic nature of the process oil and lubricant recycling facility Scope 3 have been limited to end product users for Group I and Group II base oils. Vehicle movements to and from the site have been excluded from the assessment. However vehicle movements are not expected to exceed truck numbers assessed under the original project approval as such no changes to GHG emissions are anticipated.

It can be seen from **Table 18** there would be an increase in the GHG emissions from the existing to the proposed operations with estimated total GHG emissions changing from 9,952 CO_2^{-e}t/y to 15,901 CO_2^{-e} t/y. This is largely attributed to the increased production of base oils from 24ML/y to 36ML/y[10].

When predicted GHG emissions from the proposal are compared to state and national GHG emissions foe 2013, the Facilities contribution is relatively small, contributing 0.11% of NSW, GHG emissions and 0.0029% of national emissions accounting for Scope 1, Scope 2 and Scope 3 emissions.

Table 18 Existing and Proposed GHG Emissions (CO_2^{-e}t/y)

Source	Type	Current Production (24ML/y)		Proposed Production (36ML/y)	
		Quantity	Emissions (CO_2-e t)	Quantity	Emissions (CO_2-e t)
Natural gas consumption	Scope 1	72,000 GJ/y	3,696	96,333 GJ/y	4,945
Light oil consumption	Scope 1	0 kL/y	0	600 kL/y	1,429
Electricity consumption	Scope 2	1,536,000 kWh/y	1,321	2,469,760 kWh/y	2,124
Base oil end users	Scope 3	24,000kL/y	4,935	36,000kL/y	6,992
Total			**9,952**		**15,901**

6.3.2.2 GHG Emission Intensity

The intensity of greenhouse emissions from the project (per unit of production) has been estimated from the total GHG emissions under existing and proposed operations as discussed in **Section 6.3.1**. These results are shown in **Table 19**. It can be seen from **Table 19** that the under the proposal the GHG emission intensity is predicted to decrease by 0.01 CO_2^{e-}t/L of base oil from 0.45 CO_2^{e-}t/L to 0.44 CO_2^{e-}t/L. This decrease is likely attributed to the use of the by-product light oil within the proposed mixed-fuel boiler, this would reduce the amount of natural gas required per unit of production.

Table 19 Emission Intensity per Unit of Production

Operation	Production Rate (ML/y)	GHG Emissions (CO2e- t/y)	CO2e- t/L
Existing (24 ML/y)	24	9,952	0.45
Proposed (36/ML/y)	36	15,901	0.44

[10] GHG emissions have been based on long term proposed production rates and a thus considered conservative. In the medium term production is forecast to stay at around 26 ML/year for the next five years.

6.4 Proposed Safeguards

Where possible, GHG emissions should be reduced during the construction and operational phases of the project. During construction potential measures to reduce GHG emissions would include sourcing construction materials wherever possible from local supplies to reduce haulage routes, ensuring all mobile and plant equipment used during construction is well maintained and scheduling activities so that equipment and vehicle operation is optimised. During operations safeguard measures would include ensuring all mobile and plant equipment is well maintained, limiting haul routes, wherever possible using light oil produced onsite to reduce the consumption of natural gas and undertaking an energy audit for the site to identify energy efficiency opportunities.

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7.0 Conclusion

AECOM was commissioned by TPR to investigate the air quality and GHG emissions as part of the proposed TPR Diversification Project. TPR are currently seeking approval for the proposed modification of project approval 05_0037, under Section 75W (repealed) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of additional oil storage tanks at the facility. The modification involves the conversion of currently produced Group I oil to Group II oil.

A Level 2 Air Quality Impact Assessment was conducted in accordance with the *NSW Approved Methods for Modelling and Assessment OF Air Pollutants in NSW* (DEC 2005). The report provides an assessment of the potential ground level air quality impacts from TSP, PM_{10}, NO_2, TVOCs, H_2SO_4, H_2S, SO_2 and odour. Odour emissions used in the assessment were derived from sample data at the Rutherford Facility and from TPR's plant in Narangba, Qld.

Dispersion modelling was undertaken for the AQIA using the Lagrangian model CALPUFF. Two modelling scenarios were assessed and are described as follows:

Scenario 1 (EPL Limits): A theoretical modelling scenario whereby all point sources would operating at the maximum stack concentration for each pollutant set by the EPL, and all other emissions not mandated by the EPL where based on scaled maximum recorded emission concentrations.

Scenario 2 (Maximum Approved Production): A worst case modelling scenario based on standard operating conditions at a maximum operational capacity of 40,000tpa.

Results of the modelling showed no exceedances of the EPA criterion for the predicted cumulative impacts of TSP, PM_{10}, NO_2, TVOCs, H_2SO_4, H_2S and SO_2 over all averaging periods for both Scenarios. For all pollutants the predicted maximum concentration for Scenario 1 (EPL limits) were found to be higher than for Scenario 2 (Maximum Proposed Production). This is attributed to the lower emission rates used in Scenario 2 where emission concentrations under standard operating conditions at the maximum approved production rate are expected to be lower than the existing and proposed EPL limits. Furthermore under the proposed operating conditions of the Facility results are expected to be lower than predicted under Scenario 2 as TPR are likely to be operating under the approved production rate.

Results of the odour modelling showed the incremental ground level concentration impacts from the proposal under Scenario 1 and Scenario 2 both at the highest sensitive receptor and maximum offsite impacts were under the EPA 2 OU criterion. As shown in the predicted highest 99th percentile concentration at a sensitive receptor for Scenario 1 and Scenario 1 was found to be 0.57 OU and 0.54 OU respectively. The maximum offsite concentration for both Scenarios was also below the odour criterion with a predicted value of 1.54 OU, this occurred at the north-eastern boundary of the site and in each case the odour contour dissipates to less than 1 OU within 200 metres of the site. Some conservative has been built into the results with odour emissions used from the Narangba Facility for Point 2 likely to contain a higher percentage of sulphurous compounds due to the higher sulphur content of the light fuel. Also emission rates derived from sample data Point 5 are likely to be overestimated due to the redirection of tank vapours from this emission source to the multi fuel boiler.

With regard to the assessment of cumulative odour impacts the predicted contributions from existing operations at TPR are very small compared to other facilities within the RIE which provide significant contributions to odour sensitivity of the Rutherford area. While still an area for concern, background odour concentrations in Rutherford have also likely reduced since 2014 with some facility reducing odour emissions through routine maintenance, odour mitigation works and increased site presence by the EPA at some facilities. Future efforts are also being made at other odour generating facilities to reduce odour impacts in the RIE through odour mitigation. As such the proposed incremental impacts associated with the TPR facility are thought to have no significant impacts on odour within the Rutherford area.

While the results of the dispersion modelling indicate compliance with all relevant air quality and odour criteria, predicted stack conditions and emission rates have been extrapolated from existing sample data and sourced from another facility where emission data was unavailable. It is therefore recommended that following approval and commissioning of the project a verification study be undertaken.

A greenhouse gas assessment will be undertaken in accordance with the requirements outlined in the SEAR's and the *Australian National Greenhouse Accounts; National Greenhouse Accounts Factors, December 2014*. The assessment provides a qualitative assessment of GHG emissions during construction and an inventory of GHG emissions during operation of the Facility and a qualitative analysis of the Facilities relative contribution to national greenhouse emissions.

An assessment of operational GHG impacts was undertaken for the existing operations (production of 24 ML/y of base oil) and proposed operations (production of 36 ML/y of base oil). An increase in the GHG emissions from the existing to the proposed operations was observed, largely attributed to the increased production of base oils. The intensity of GHG emissions per unit of production was found to decrease however due to the use of the by-product light oil within the proposed mixed-fuel boiler. Predicted emissions for the Proposal provide only a relatively small contribution to the state and national greenhouse emissions.

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Appendix A

EPA's Recommended Secretary's Environmental Assessment Requirements (SEARs)

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The Project SEARs for the modification were issued by the Department of Planning and Environment on 10 August 2015. Under the SEAR's the impact assessment must take into account the air quality and greenhouse gas (GHG) assessment requirements provided by the NSW Environmental Protection Authority (EPA).

A detailed list of the EPA's recommended SEAR's for Air Quality, Odour and GHGs and where they are addressed in this report is provided in the table below.

EPA Requirement	Section in Report and/or Comments
Air Quality	
1) Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity.	**Section 5.1**
2) Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: a) Proposal location; b) Characteristics of receiving environment; and c) Type and quantity of pollutants emitted.	**Section 3.0**, **Section 5.1.3** and
3) Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and interregional as appropriate). The description must include but not me limited to; a) Meteorology and climate; b) Topography; c) Surrounding land use and receptors; d) Location of all sensitive receptors; and e) Ambient air quality.	**Section 2.1**, **Section 4.0** and **Section 5.1**.
4) Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.	**Section 2.3** and **Section 5.1.3**
5) Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.	**Section 5.1.1** and **Section5.1.4**
6) Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.	**Section 5.1.4**
7) Include an air dispersion model in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2005).	**Section 1.3** and **Section 5.1**
8) Demonstrate the proposals ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2010).	**Section 2.4** and **Section 5.1.3**
9) Detail emission control techniques and management practices that will be employed by the proposal to address point and fugitive emissions.	**Section 2.3** and **Section 2.2**
10) Detailed proposed emission limits.	**Section 2.4**
11) Detailed monitoring that will be conducted to assess the impacts of the proposal.	**Section 5.4**
12) Provide an assessment of the project in terms of the priorities	Project aligns with the socioeconomic

EPA Requirement	Section in Report and/or Comments
Air Quality	
and targets adopted under the NSW State Plan 2010 and its implementation plan Action for Air.	goals of the NSW government in unlocking the Hunter Valleys productive potential as a key contributor to the state's economy. The predicted impacts from the project meet the Actions for Air goal to maintain national air quality standards identified in the Air NEPM.
Odour	
1) The EA should include a detailed odour impact assessment. The odour impact assessment should be completed in accordance with: a) Approved Methods for the Modelling and Assessment of Pollutants in NSW (DECC 2006); b) Approved Methods for Sampling and Analysis of Air Pollutants in NSW (DECC 2007); c) Technical framework: Assessment and management of odour from stationary sources in NSW (DECO 2006); and d) Technical notes: Assessment and management of odour from stationary sources in NSW (DECO 2006); Demonstrate the ability to comply with relevant regulatory and assessment criteria.	**Section 1.3** and **Section 5.1**
2) The assessment must include identification of all potentially odorous pollutants from emission points, including but not limited to the proposed Low Pressure Stem boiler multi fuel burner.	**Section 2.3** and **Section 5.1.3**
3) If the air quality assessment indicates that any odour criteria or regulatory limit specified in the documents above, or the POEO (Clean Air) Regulation, is exceeded, the report must include details of what action will be taken to achieve compliance with the criteria and a timetable for completion of these actions.	Not applicable, see **Section 5.1.3** for comparison of emission rates based on sample data to emission rates calculated from EPL limits.
Greenhouse Gas	
1) The EA should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO_2e). Emissions should be reported broken down by: a) direct emissions (scope 1 as defined by the Greenhouse Gas Protocol — see reference below); b) indirect emissions from electricity (scope 2); and c) upstream and downstream emissions (scope 3); before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).	**Section 6.3**
2) The EA should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.	**Section 6.3.2.2**
3) The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines.	**Section 6.1**
4) The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.	**Section 6.4**

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Appendix B

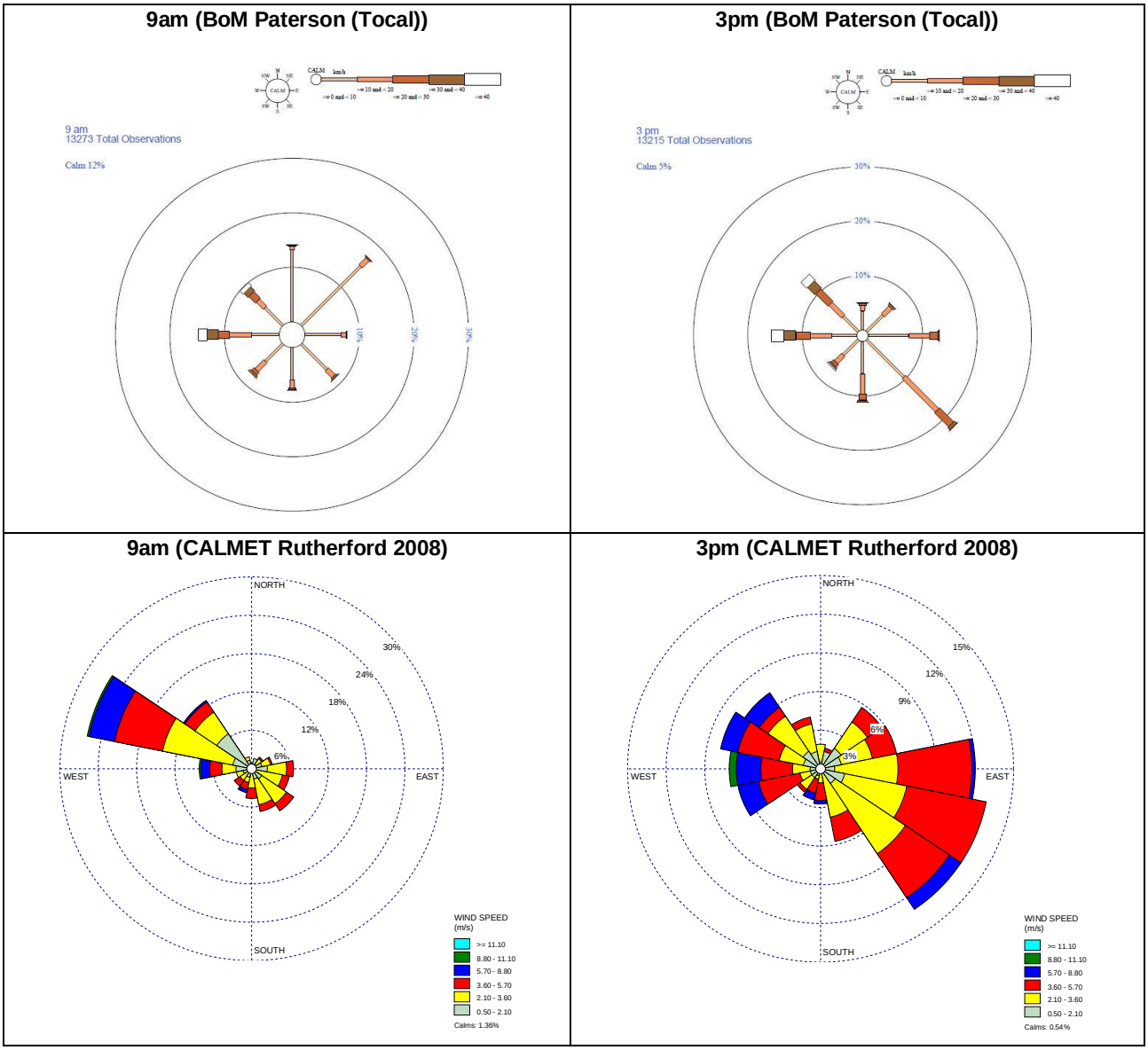
BoM Meteorological Data

Appendix B BoM Meteorological Data

Comparison of BoM and CALMET Data

Figure 8 shows a comparison of the 9am and 3pm long term BoM data collected the Paterson (Tocal) BoM site with 9am and 3pm data for 2008 at Rutherford generated by CALMET. It can be seen from **Figure 8** that there is more variation in 9am wind direction at Paterson than at Rutherford; which shows the dominant winds range from west to north east. The annual average 9am wind speed at Rutherford is slightly higher (2.9 m/s) than the long term average at Paterson (2.6 m/s). At 3pm wind speed and wind direction was also different with a lower afternoon wind speed of 3.5 m/s compared to 4.0 m/s, the predominant south easterly winds were also present at Paterson however. These differences in short term dispersion meteorology predicted at Rutherford and long term trends recorded at Paterson are likely attributed the difference in location with an approximate distance of 12.5km between sites.

Figure 8 Annual 9am and 3pm Wind Roses at Rutherford (CALMET 2008) Paterson (BoM 1967-2010)



Climate Statistics for Cessnock

The BoM meteorological station located at Cessnock Airport (Station Number 061260) approximately 17.5 km northeast of the site records climate data for a range of meteorological parameters including, temperature, humidity, rainfall, wind speed and wind direction. A summary of the long-term data recorded at this station between 1967 and 2015 is shown in Table 20. The data provide an indication of the regional climate of the area.

Table 20 Climate Summary, BOM Monitoring Station at Cessnock Airport AWS, 1968 to 2015 (BoM 2015)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	30.1	29.0	27.2	24.1	20.6	17.8	17.3	19.4	22.6	25.2	26.8	28.8	24.1
Mean minimum temperature (°C)	16.8	16.8	14.5	10.5	7.5	5.7	4.0	4.5	7.0	9.6	13.0	14.9	10.4
Mean rainfall (mm)	72.9	102.9	72.1	59.6	42.9	57.4	28.7	34.6	44.4	51.3	74.3	77.2	714.5
Decile 5 (median) rainfall (mm)	55.4	107.9	59.6	45.2	43.0	35.7	19.4	24.4	32.0	42.4	62.6	73.2	747.2
Mean number of days of rain ≥ 1 mm	6.2	7.9	7.1	5.8	5.4	5.4	4.1	4.4	5.5	6.5	7.3	7.0	72.6
Mean 9am temperature (°C)	23.2	22.2	20.2	17.8	14.1	11.0	10.1	12.2	16.2	19.1	20.2	22.2	17.4
Mean 9am relative humidity (%)	68	76	80	76	79	80	76	69	63	60	65	65	71
Mean 9am wind speed (km/h)	11.5	10.2	8.7	10.1	10.4	11.5	11.5	13.0	14.0	13.7	12.7	11.8	11.6
Mean 3pm temperature (°C)	28.7	27.3	25.7	23.0	19.6	16.8	16.4	18.6	21.2	23.4	25.0	27.3	22.8
Mean 3pm relative humidity (%)	46	53	53	52	54	55	49	42	42	44	47	46	49
Mean 3pm wind speed (km/h)	18.5	17.3	15.7	14.6	14.2	15.1	15.3	17.3	19.1	18.7	18.6	18.3	16.9
Station Number: 061260, **Latitude:** 32.79 °S, **Longitude:** 151.34 °E, **Elevation**: 61 m, **Latest available data:** 14 Oct 2015													

As shown in **Table 7** the study area experiences a warm to moderate climate. The warmest temperatures occur during the summer months, with the highest average maximum temperature (30.1°C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 4.0°C.

The annual average rainfall for the area is 715 millimetres (mm) over 73 days a year. February is the wettest month, with an average rainfall of 108 mm, while July is driest month with an average rainfall of just 19.4mm. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon.

Daytime wind speeds were found to be moderate, with higher wind speeds occurring in the afternoon compared to the morning. The annual average 9am wind speed recorded is 11.6 kilometres per hour (km/h) and the annual average 3pm wind speed was14.6 km/h. Seasonally, wind speeds are higher during the warmer months with the highest average wind speed occurring in December at 16.9 km/h.

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Appendix C

Emission Calculations

Appendix C Emission Calculations

Scaling Stack Velocity and Emission Concentrations

Stack velocity for both modelling scenarios was scaled to represent the maximum approved production rate of the facility from sample data (average stack velocity) and hourly production rate data collected from the Rutherford Facility between 2013 to 2014. The formula used is as follows:

Formula 1: $$V_m = V_a \times \frac{P_M}{P_A}$$

Where:

P_m = Maximum production rate; where P_m = 5000kg/h

P_a = Actual production rate at time of emissions testing (kg/h)

V_m = Maximum velocity (m/s)

V_a = Actual velocity (m/s)

For Scenario 1 emission concentrations were scaled from to represent the maximum approved production rate of the facility from the sample data (maximum emission concentration) and hourly production rate data collected from the Rutherford and Narangba facilities between 2013 and 2015. The formula used is as follows:

Formula 2: $$EC_m = EC_a \times \frac{P_M}{P_A}$$

Where:

EC_m = Maximum emission concentration (mg/m^3)

EC_a = Actual emission concentration (mg/m^3)

P_m = Maximum production rate; where P_m = 5000kg/h

P_a = Actual production rate at time of emissions testing (kg/h)

For Scenario 2 emission concentrations were scaled from to represent the maximum approved production rate of the facility from the sample data (average emission concentration) and hourly production rate data collected from the Rutherford and Narangba facilities between 2013 and 2015. Formula 2 was also used to calculate the maximum emission rate, whereby the EC_a equals the average actual emission concentration.

EPL Oxygen Correction Factors

The emission rates presented in **Section 5.1.3** of this report for the exiting EPL limits for Point 3, Point 19 and Point 20 and for the proposed EPL limits for Point 2 were uncorrected for oxygen for the purpose of dispersion modelling. The actual average oxygen content was calculated for each point source based on available stack testing data at the Rutherford facility between 2013 and 2014. This average was then used to determine the uncorrected (O_2) EPL limit for each pollutant. Oxygen correction factors and average measured data for each point source presented in the table below.

Stack ID	Oxygen Reference Condition (%)	Average Actual Oxygen (%)
Point 2	8.00	8.50
Point 3	8.00	9.84
Point 19	8.00	7.23
Point 20	4.00	2.38