PSA CONSULTING

Baiada Poultry Pty Ltd –

Proposed Poultry Processing Facility Odour Impact Assessment

Oakburn, NSW

Final Report

Version 2 - July 2020

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EXECUTIVE SUMMARY

The Odour Unit Pty Ltd (**TOU**) was commissioned by PSA Consulting (Australia) Pty Ltd (**PSA**) on behalf of Baiada Poultry Pty Ltd (**Baiada**) to carry out an odour impact assessment (**OIA**) for the proposed integrated Poultry Processing Facility (**PPF**) to be sited adjacent to the Oakburn Protein Recovery Plant (**PRP**) near Oxley Highway, Westdale, New South Wales (Lot 100 on DP1097471). The proposed PPF is to replace the existing abattoir located at Out Street, Tamworth, New South Wales.

Odour Dispersion Modelling Approach

The OIA assessment was carried out using the CALPUFF Modelling System with use of odour emissions estimates based upon measurements collected by TOU at Oakburn PRP, Baiada Hanwood Processing Plant and at the Out Street, Tamworth abattoir. All Oakburn odour sources have been assessed as a combined impact and separately grouped by origin: PRP, PPF and wastewater treatment plant (**WWTP**) (i.e. inclusive of the advanced wastewater treatment plant (**AWTP**)). The odour impact from the PRP biofilters was included for conservatism despite being a treated emission source. All modelling was undertaken in accordance with the New South Wales Environment Protection Authority guidelines (**NSW EPA**).

It should be noted that the meteorology developed for the modelling overpredicted calm and light wind conditions, particularly from the south-south-westerly direction. This would have a conservative effect on the results, that is overpredicting the extent and magnitude of odour concentration projections, especially north-north-westwards from the site.

Odour Dispersion Modelling Findings

The OIA modelling findings indicating the following:

- The addition of the proposed PPF modelled alone shows predicted odour impact does not largely exceed the NSW EPA odour IAC of 5 ou beyond the Oakburn site boundary;

- The results show that the predicted odour impact for PRP and PPF WWTPs is below the NSW EPA odour IAC under the assumption that SBR night-time filling would be avoided and the PTB is mechanically ventilated by roof fans;

- Overall, the results are below the odour IAC at the nearest sensitive receptor. The cumulative 5 ou contour encroaches beyond the site boundary marginally to the north and marginally to the south. Therefore, it has been found that the proposed PPF is unlikely to cause adverse odour impacts under normal conditions; and

- The results for the proposed childcare centre show that for both a 24 hour per day operation and a long-day operation, the odour IAC is predicted to be exceeded. The perceived sensitivity of the ancillary childcare centre to odour from the proposed PPF is debateable. Based upon the context and function of the proposal (i.e. employee family welfare), community expectations and recommended odour risk reduction measures for the ancillary childcare centre as part of an Odour Management Plan (**OMP**), the residual odour annoyance risk at this location could be reduced significantly compared with a nearby stand-alone childcare facility without the recommended odour risk reduction measures implemented and having no commercial or functional relationship with Baiada. With due consideration to the information provided associated OMP, the residual odour impact risk rating for the ancillary childcare is considered to be low.

<u>Sensitive Analysis Findings</u>

A sensitivity modelling analysis for the proposed PPF indicated the following:

- Cumulative odour effects from the proposed PPF with three poultry farms located to the northwest demonstrates that there the model is sensitive to the presence of these sources; and

- However, prediction of cumulative effects is almost certainly overstated as it considers all Oakburn sources including treated odours (e.g. biofilter, etc) and odours of different characters (e.g. rendering, wastewater, etc) that do not combine in the atmosphere and tend to be observed as individually identifiable odour characters in the field.

<u>Other Air Quality Impact Findings</u>

For the proposed PPF, other air quality impact findings are as follows:

- The composition of the natural gas to be used by the boilers will contain negligible levels of sulphur and other contaminants that may affect efficient combustion performance and emissions discharge to air from the boiler stacks. As such, air quality impact from the boiler operations at the proposed PPF are assessed to be negligible; and

- With due consideration to the operational analysis for the proposed PPF, it is TOU's assessment that the risk level of adverse dust impact is of very low potential; and that a refined quantitative assessment is not required.

<u>Concluding Remarks</u>

Given the complexity and scale of the proposed PPF operations, a modelling based OIA is not an ideal tool to help form a contingency plan for unpredicted operational odour impacts or adequately predict the real-world impacts from measures designed to avoid, mitigate, manage and/or offset impacts (typical examples that support this position are the characteristics associated with treated quality emissions from a biofilter or aerobic wastewater treatment source, which in the OIA have been modelled and contributed to the cumulative odour impact prediction profile). These matters are best addressed by sufficient odour separation distances (i.e. odour buffers, when possible) and a site-specific OMP. A site-specific OMP is an important tool that facilitates in contextualising the modelling findings and give due consideration to the residual odour risk rating from the proposed engineered controls, monitoring and management protocols, and standard operating procedures that will support the proposed PPF operations. As such, on the basis that the proposed management practices and controls are implemented to that documented in the associated OMP, the residual odour impact risks for the proposed PPF operations will be significantly minimised to the degree that odour impacts in practice are unlikely.

CONTENTS

FIGURES AND TABLES

FIGURES

TABLES

LIST OF ABBREVIATIONS & DEFINITIONS

AWTP	Advanced Water Treatment Plant
Baiada	Baiada Poultry Pty Ltd
BOM	Bureau of Meteorology
BPIP	Building Profile Input Program
CAL	covered anaerobic lagoon
CW	clear wells
DAF	dissolved air flotation
DEM	digital elevation model
DPE	Department of Planning & Environment
HTR	High-Temperature Rendering
Hydroflux	Hydroflux Industrial Pty Ltd
IAC	impact assessment criteria
LBR	live bird reception
LTR	Low-Temperature Rendering
MBR	membrane bioreactor
NSW EPA	New South Wales Environment Protection Authority
OER	odour emission rate
OIA	Odour Impact Assessment
OMP	Odour Management Plan
P/M	peak-to-mean ratio
POEO Act	Protection of the Environment Operations Act 1997
PPF	Poultry Processing Facility
PRP	Protein Recovery Plant
PSA	PSA Consulting (Australia) Pty Ltd
PTB	Primary Treatment Building
RDC	Research and Development Corporation

SBR	sequencing batch reactor
SCADA	supervisory control and data acquisition
SEARs	Secretary's Environmental Assessment Requirements
SOER	specific odour emission rate
SRTM	Shuttle Radar Topography Mission
TAPM	The Air Pollution Model
TOU	The Odour Unit Pty Ltd
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant
YSTW	Tamworth Airport AWS

UNITS OF MEASUREMENTS

km	Kilometres
m	metres
m/s	metres per second
m^3/h	cubic metres per hour
m^3/s	cubic metres per second
ML	megalitres
MW	megawatts
^oC	degrees Celsius
ou	odour units
ou.m^3/m^2.s	odour units by cubic metre per square metre by second
ou.m^3/s	odour units cubic metre per second
Pa	Pascals
ppm	parts per million, by volume

AIR POLLUTANTS AND CHEMICAL NOMENCLATURE

CO	carbon monoxide

CO_2	carbon dioxide
NO_X	oxides of nitrogen
SO_2	sulphur dioxide

1 INTRODUCTION

1.1 BACKGROUND

The Odour Unit Pty Ltd (**TOU**) was commissioned by PSA Consulting (Australia) Pty Ltd (**PSA**) on behalf of Baiada Poultry Pty Ltd (**Baiada**) to carry out an odour impact assessment (**OIA**) for the proposed integrated Poultry Processing Facility (**PPF**) to be sited adjacent to the existing Oakburn Protein Recovery Plant (**PRP**) near Oxley Highway, Westdale, New South Wales (Lot 100 on DP1097471), as shown in **Figure 2.1**. The proposed PPF is to replace the existing abattoir located at Out Street, Tamworth, New South Wales.

1.2 PURPOSE OF OIA

The aim of OIA for the proposed PPF is to address key issues raised in the Department of Planning & Environment (**DPE**) Secretary's Environmental Assessment Requirements (**SEARs**) Baiada Oakburn Poultry Processing Facility (SSD 9394) document. The key issues in the SEARs were related to potential impacts of the proposed PPF and measures to avoid, mitigate, manage and/or offset impacts.

The matters to be addressed specific to odour impacts in the SEARs include:

- *"a quantitative odour and air quality impact assessment in accordance with the relevant Environment Protection Authority (EPA) guidelines. This assessment must include:*
  - *an investigation and assessment of odour impacts on all identified and potential receivers including, but not limited to, the adjacent rural residences and the Tamworth Regional Airport;*
  - *an assessment of the cumulative air quality and odour impacts of the development, taking into account existing and proposed livestock intensive industries in the surrounding area;*
  - *evidence of appropriate meteorological data for use in air dispersion modelling, using real meteorological data where possible;*
  - *inclusion of 'worst case' emission scenarios and sensitivity analyses;*
  - *a contingency plan to address unpredicted operational odour impacts;*
  - *a description and appraisal of air quality and odour impact monitoring, emission control techniques and mitigation measures."*

It is proposed to operate a childcare centre on-site. Odour impacts have been considered as recommended by *Child Care Planning Guideline – Delivering quality child care for NSW, 2017*. As such, the OIA has given due consideration to C28 of this guideline document, which states that:

> *"A suitably qualified air quality professional should prepare an air quality assessment report to demonstrate that proposed child care facilities close to*

> *major roads or industrial developments can meet air quality standards in accordance with relevant legislation and guidelines".*

Furthermore, the New South Wales Environment Protection Authority (**NSW EPA**) key information requirements (notice number 1566238) also include:

> *"an adequate assessment of dust generated and management of potential impacts on adjacent rural residences during the construction and operational phases"*

The dust impact potential is addressed in **Section 2.4**. The boiler air quality impact is addressed in **Section 2.5**.

In September 2019, TOU was provided with comments and feedback on the first version of the OIA report dated 6 June 2019, which was received during the notification period of the PPF for response and addressed in this second version of the OIA report.

The OIA report contains the methodology, results and findings for the proposed PPF as conducted by TOU.

1.3 RELEVANT DOCUMENTATION

A site-specific Odour Management Plan (**OMP**) has been prepared TOU to supplement the OIA conducted for the proposed PPF. An OMP is a documented operational management system and a 'live' manual that is changed as required, to reflect the current practices and odour controls prevalent at a facility. The sole purpose of an OMP is to eliminate, prevent or minimise the potential for odour generation through a hierarchy of controls, in the form of, but not limited to, engineered, administration and/or management practices. An OMP seeks to find a reasonably practical balance between maintaining the quality of process operations designed to yield a high-quality end-product and the ability to control odour emission generation. Put simply, the OMP describes the measures that will facilitate in preventing, mitigating, managing and/or offsetting odour impacts risks from the proposed PPF. As such, the OMP should be read in conjunction with the OIA report prepared for the proposed PPF.

2 SITE DESCRIPTION

2.1 SITE SURROUNDS

An aerial map of the PPF and its surroundings is shown in **Figure 2.1**.

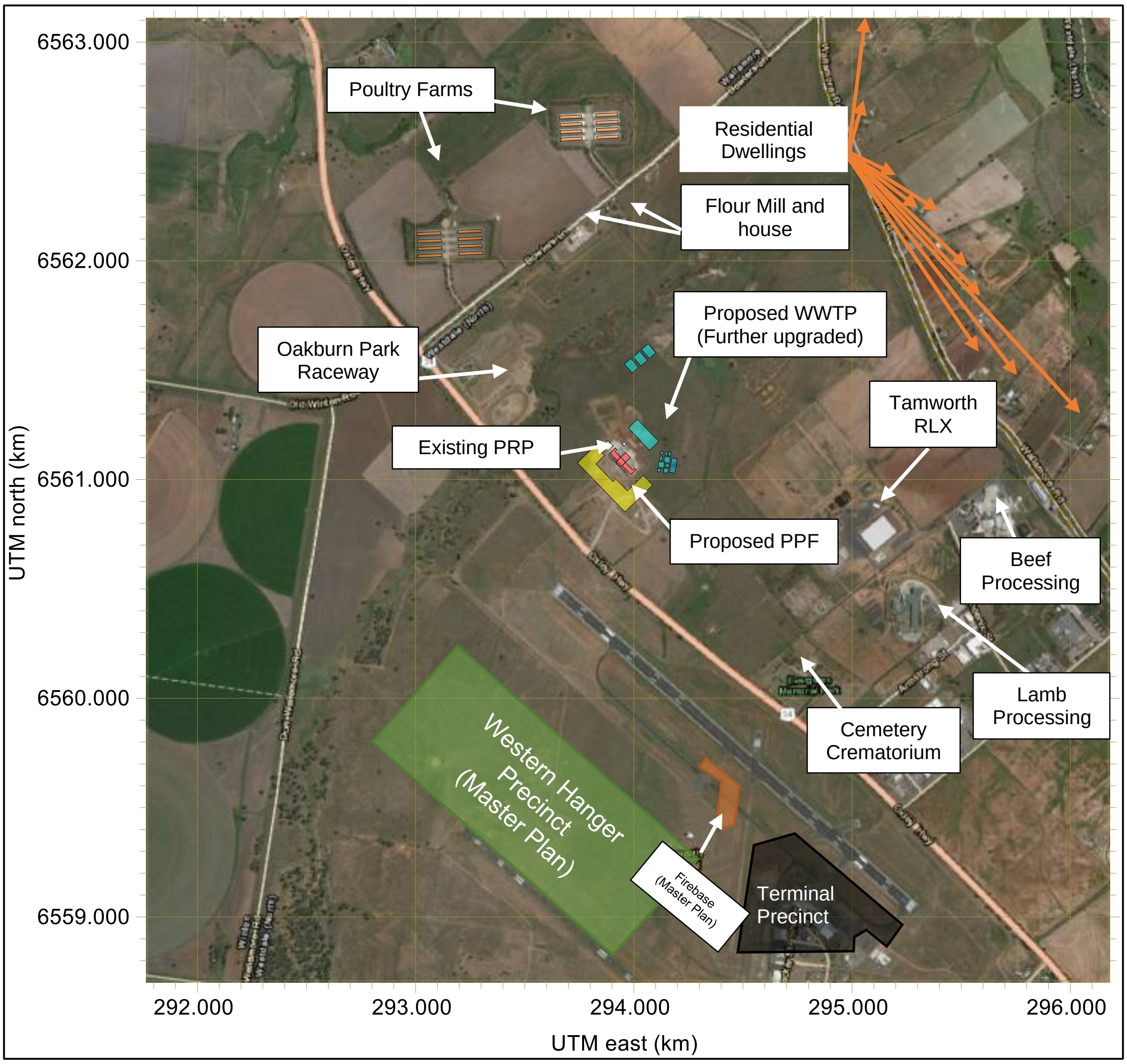


Figure 2.1 – Site location and surrounds

From an odour viewpoint, the surrounding features of interest to the proposed PPF include:

- Oakburn Park Raceway;
- Tamworth Regional Livestock Exchange;
- Tamworth Regional Airport;
- Sensitive places including eleven dwellings along Wallamore Road and Bowlers Lane;

- The dwelling on Bowlers Lane is understood to be owned by Tamworth Regional Council and will be removed as part of the proposed PPF; and
- The other land uses include beef processing, lamb processing, poultry farming, flour milling and a cemetery-crematorium.

The near-field topography surrounding the proposed PPF could be described as a flat rural floodplain. Further afield there is a slightly elevated ridgeline that runs along Bowlers Lane from the north to the southwest. The Peel River valley is to the northeast.

2.2 OAKBURN PROPOSED POULTRY PROCESSING FACILITY DESCRIPTION

The proposed PPF has been described by Baiada in their request for SEARs (Boulton & Ireland, 2018):

> *"Baiada is proposing a new, integrated poultry processing plant on the site consisting of the following items:*
>
> - *Construction of an integrated poultry processing plant consisting of:*
>   - *36,000 m² of Gross Floor Area providing for live bird storage, processing, chilling, cold store and distribution facilities;*
>   - *1,600 m² workshop and store building;*
>   - *4,100 m² of ancillary administration, staff amenities and childcare space;*
>   - *Wastewater Treatment Plant (**WWTP**) and Advanced Water Treatment Plant (**AWTP**); and*
>   - *Installation of ancillary infrastructure, landscaping and services.*
> - *Increase the approved level of poultry processing on the site to a maximum of 3 million birds per week;*
> - *Increase production at the existing rendering plant to a maximum of 1,680 tonnes of finished product per week (240 tonnes / day 7 days a week); and*
> - *Operation of all aspects of the site facility up to 24 hours per day, 7 days a week with no restrictions."*

Since lodgement of the OIA and Environmental Impact Statement, and receipt of submissions, Baiada proceeded with further detailed design and planning of the proposed PPF, which has resulted in an amended development layout, as follows:

- Total ground floor area: 39,810 m²;
- Processing area: 30,273 m²;
- Office area: 4,848 m²;

- Child care area: 346 m^2;
- Maintenance 1,118 m^2; and
- Wastewater Treatment area: 3,225 m^2.

While the design of the facility has been amended, the operational aspects of the proposed PPF operations (i.e. production volumes and processes, etc.) generally remain consistent with the previously submitted OIA and Environmental Impact Statement.

The potential key odour emission sources from the proposed PPF and an on-site sensitive receiver have been described in **Section 2.3**.

2.3 PROPOSED PPF ODOUR SOURCES

Based on the ground floor plan shown in **Figure 2.3**, the key odour sources derived for the proposed PPF are as follows:

- Receival of live birds into the reception hall ventilation comprising of five roof fans; and
- Processing Lines 1 & 2, which consist of seventeen roof fans, ventilating process areas including but not limited to:
    - Receival of live birds into the reception hall via trucks;
    - Livestock preparation including stunning, shackling and kill;
    - Scalding and de-feathering;
    - Evisceration and inspection;
    - Removal and transport of offal, co-products and by-products to the PRP; and
    - Primary treatment, processing pumps, waste staging and crate wash.

2.3.1 Ancillary Childcare Centre

It is proposed to operate a childcare centre on-site at the location indicated in **Figure 2.2.**

2.3.2 WWTP Odour Sources

A WWTP and AWTP concept process design for the PPF was completed by Hydroflux Industrial Pty Ltd (**Hydroflux**) that proposed to treat up to 8 million litres (**ML**) of wastewater from the PPF and allow recovery for up to 7.2 ML for reuse as potable water per day. All wastewater from the PRP will be treated separately by the operational WWTP, which is designed to accommodate up to 3 million birds per week with a contingency buffer (Hydroflux Industrial, 2020).

The PRP wastewater would continue to be screened within the PRP where it is sent to be treated in a 25 ML Covered Anaerobic Lagoon (**CAL**) before being polished in a 5 ML Sequencing Batch Reactor (**SBR**). The liquid is discharged into two 5 ML Clear Wells (**CW**) before discharge to sewer. All wastewater from the PRP is currently operational and has been designed to accommodate additional volumes associated with the PPF. The treated wastewater from the PRP based operations will continue to be discharged to the sewer. An odour impact assessment for the PRP WWTP upgrade was completed by TOU in March 2018 (Hayes & Munro, 2018) and have been included as odour sources in this OIA report.

The wastewater from the proposed PPF will be treated with primary and secondary treatment processes by the WWTP involving dissolved air floatation (**DAF**) and a membrane bioreactor (**MBR**). The 8 ML/day design is expected to contain five membrane train. The effluent from the MBR is then further treated by the AWTP for reuse at the PPF by reverse osmosis, chlorination, ultraviolet light and remineralisation processes designed to exceed reuse water quality standards set out by various authorities (Hydroflux Industrial, 2020). The layout of the WWTP and AWTP is illustrated in **Figure 2.3**, and process flow diagram is available in **Figure 2.4**.

For this OIA report, the primary and secondary treatment stages of the WWTP process are considered to contribute significantly to the odour emission profile for the proposed PPF. The tertiary treatment process, including the AWTP process units, will be negligible odour emission contributors and have not been given any further consideration. The key odour sources from the WWTP include:

- Primary Treatment Building (**PTB**) comprising of grit removal, screening, DAF and sludge treatment;
- A balance tank;
- Two pre-anoxic tanks;
- Two aerobic tanks;
- Two post-anoxic tanks; and
- Two MBR trains.

Figure 2.2 – Site plan for the proposed PPF

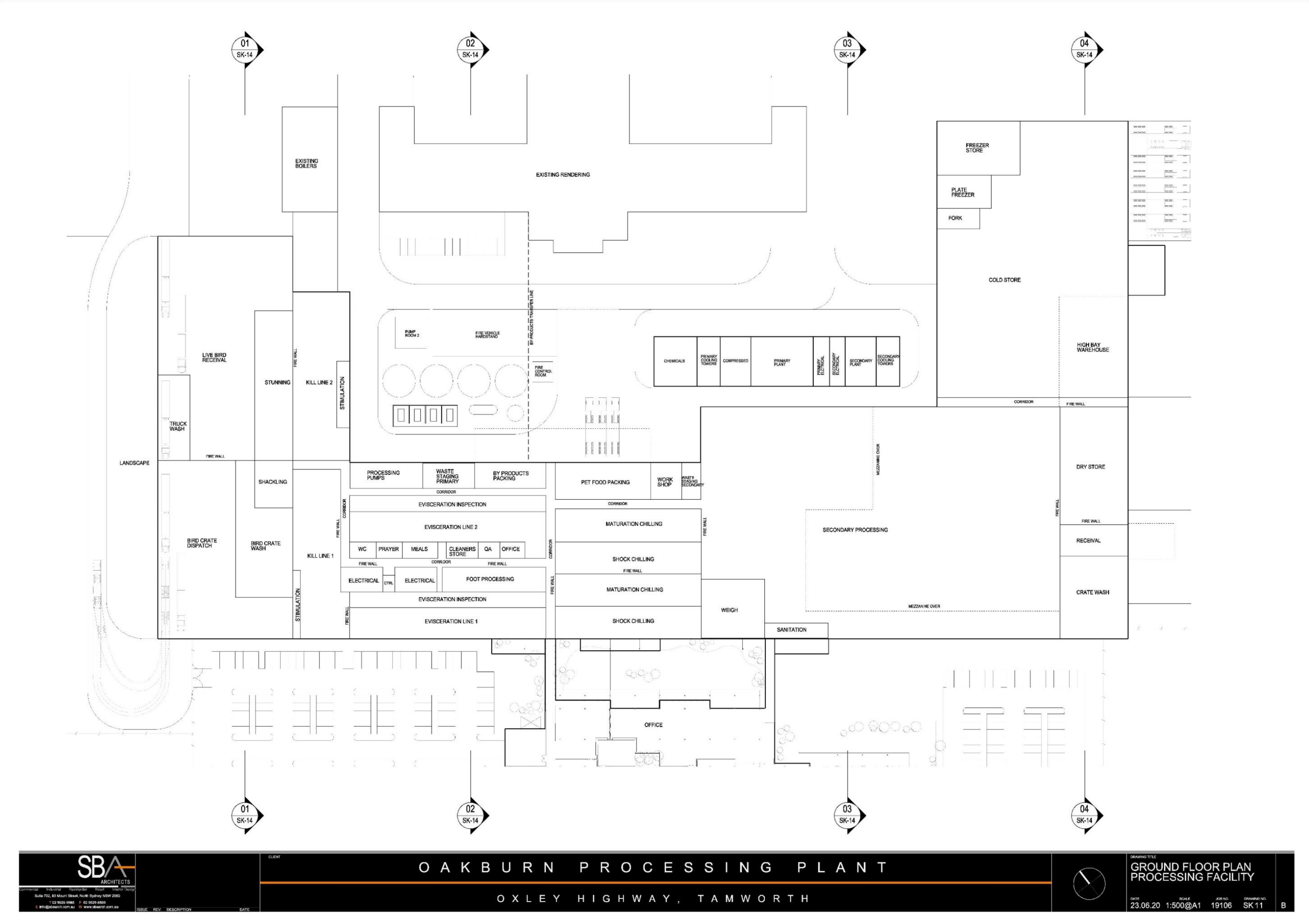
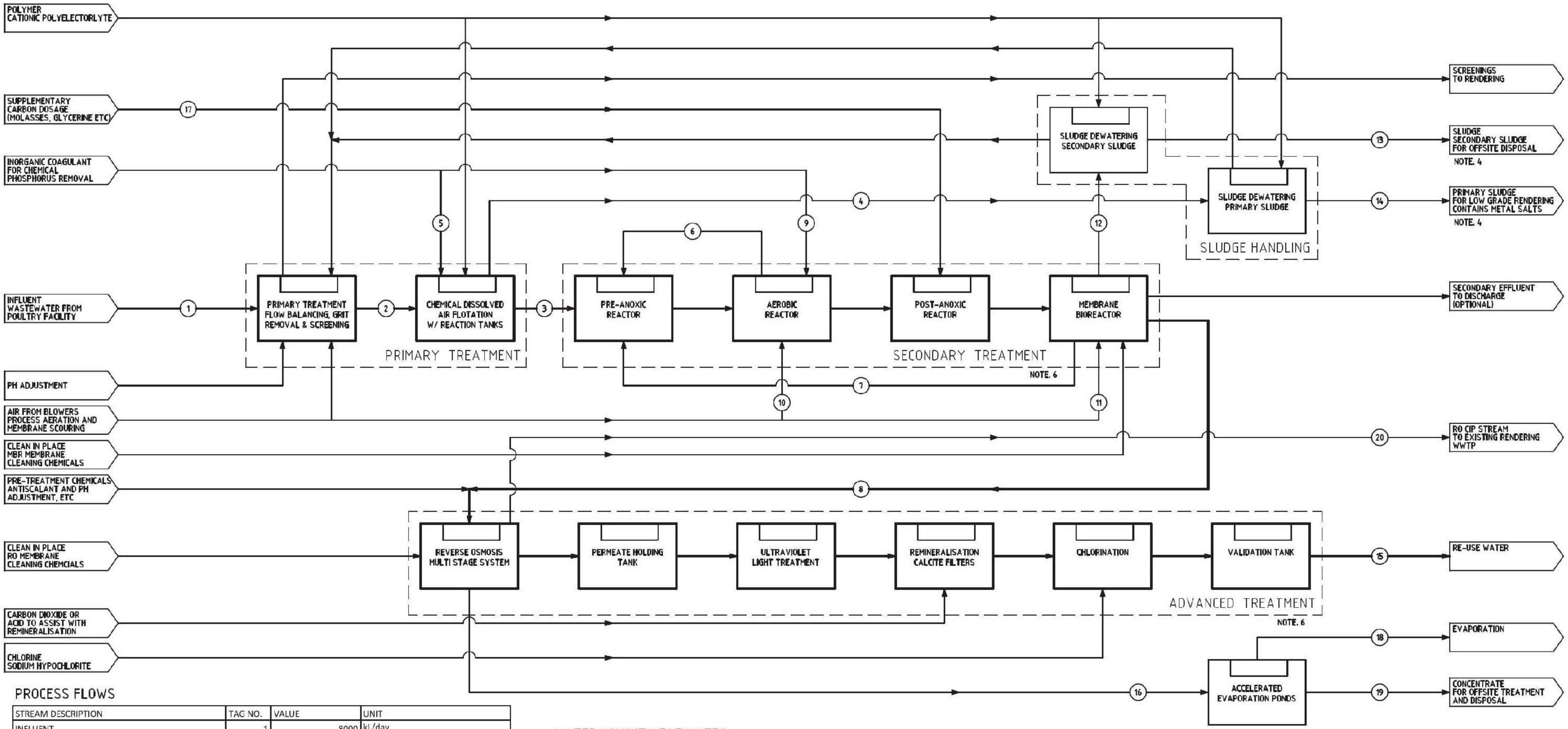


Figure 2.3 – Ground floor layout of the integrated PPF operations



PROCESS FLOWS

STREAM DESCRIPTION	TAG NO.	VALUE	UNIT
INFLUENT	1	8000	kL/day
BALANCED FEED TO DAF	2	8000	kL/day
FEED TO SECONDARY TREATMENT	3	8000	kL/day
PRIMARY SLUDGE TO DEWATERING - NOTE 1	4	10502.4	kg TSS/day
COAGULANT TO DAF - NOTE. 2	5	4998.2	kg/day Ferric Chloride 42%
MIXED LIQUOR RETURN	6	32,000 - 64,000	kL/day
RETURN ACTIVATED SLUDGE	7	8000	kL/day
MEMBRANE BIOREACTOR EFFLUENT	8	7943.2	kL/day
COAGULANT TO SECONDARY TREATMENT - NOTE. 2	9	1249.6	kg/day Ferric Chloride 42%
AERATION FOR AEROBIC REACTOR	10	31960	Nm3/hr @ 620 mBar.g
AERATION FOR MEMBRANE SCOUR	11	13000	Nm3/hr @ 570 mBar.g
WASTE ACTIVATED SLUDGE - NOTE. 1	12	3077.6	kg TSS/day
DEWATERED SECONDARY SLUDGE	13	2923.7	kg TSS/day
DEWATED PRIMARY SLUDGE	14	9977.3	kg TSS/day
TREATED WATER FOR RECYCLING	15	7200	kL/day
RESERVE OSMOSIS CONCENTRATE	16	800	kL/day
SUPPLEMENTARY CARBON - NOTE 3.	17	AS REQUIRED FOR DENITRIFICATION PERFORMANCE.	
EVAPORATION OF CONCENTRATE	18	720	kL/day
CONCENTRATE POST EVAPORATION	19	80	kL/day
REVERSE OSMOSIS CIP STREAM TO EXISTING WWTP	20	40	kL/month

WATER QUALITY ESTIMATES

STREAM DESCRIPTION	TAG NO.	VOLUMETRIC FLOW	COD	BOD	TN	TKN	TP	PO4-P	TS	TSS	TDS
-	#	kL/day	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
INFLUENT	1	8000	3970	2380	210	210	40	36	2700	1300	1400
FEED TO SECONDARY TREATMENT	3	8000	1500	899	210	210	10	10	1600	200	1400
MEMBRANE BIOREACTOR EFFLUENT	8	8000	50	20	21	15	1	1	1405	5	1400
TREATED WATER FOR RECYCLING	15	7200	-	-	-	-	-	-	50 - 200	-	50 - 200
RESERVE OSMOSIS CONCENTRATE	16	800	250	200	210	150	312	272	13600	50	13550
CONCENTRATE POST EVAPORATION	19	80	2500	2000	2100	1500	3120	2720	136000	500	135500

NOTE. 5

NOTES:

1. PRELIMINARY CALCULATIONS SUGGEST 1,041 KG TSS IS PRECIPITATED DUE TO CHEMICAL P REMOVAL. FOR DESIGN PURPOSES IT HAS BEEN ASSUMED THAT 80% OF THIS SLUDGE IS PRODUCED DURING PRIMARY TREATMENT, WITH THE RESIDUAL PRODUCED IN THE SECONDARY TREATMENT PROCESS.
2. ESTIMATED FERRIC CHLORIDE DOSAGE IS 3,123.9 KG/DAY AS 42% SOLUTION. ASSUMPTION HAS BEEN MADE THAT THIS IS DOSED 4:1 INTO PRIMARY AND SECONDARY TREATMENT STAGES. MOLAR RATIO OF 2:1 [METAL]:[PHOSPHATE] USED FOR CALCULATIONS.
3. SUPPLEMENTARY CARBON DOSAGE MAY BE REQUIRED TO ACHIEVE TARGET TOTAL NITROGEN VALUES IN THE EFFLUENT.
4. WATER CONTENT OF DEWATERED SLUDGE HAS NOT BEEN CONSIDERED IN THE MASS BALANCE.
5. IMPACT OF CHEMICAL DOSING FOR PH CORRECTION, DISINFECTION AND CLEANING HAS NOT BEEN CONSIDERED IN THIS MASS BALANCE.
6. SECONDARY AND ADVANCED TREATMENT SPLIT INTO TWO PARALLEL TREATMENT TRAINS

Figure 2.4 – Process flow diagram of PPF WWTP and AWTP

2.3.3 Existing Protein Recovery Plant Odour Sources

The odour sources assumed for the existing PRP are the same as those used for the previous TOU odour impact assessment report for the Stage One WWTP upgrade (Hayes & Munro, 2018). The PRP odour sources assessed were:

- High-Temperature Rendering (**HTR**), namely:
  - Processing, and
  - Storage/dispatch;
- Low-Temperature Rendering (LTR), namely:
  - Processing; and
  - Storage/dispatch;
- Raw materials receival area/loading bay;
- HTR processing biofilter system; and
- LTR processing biofilter system.

The fugitive (non-biofilter) odour emissions from the PRP building were updated from measurements taken by TOU on 8 August 2018.

2.4 POTENTIAL FOR DUST IMPACTS

Based on TOU's experience with poultry processing facilities across Australia, processing, rendering and wastewater sources are high in moisture and low in particulate emissions. Moreover, it is inferred from the low odour concentrations measured from live bird storage at the Out Street facility that the particulate levels will be correspondingly low given the accepted nexus between odour and dust across many industries. Consequently, TOU's analysis of dust impacts is as follows:

- the nature of all processing, rendering and wastewater sources of the proposed facility is not high risk (compared with, for example, feed mills);
- the site car-parks and roadways will be sealed; and
- there is a large separation distance to the nearest residential dwellings;

With due consideration to the above operational analysis for the proposed PPF, it is TOU's assessment that the risk level of adverse dust impact is of very low potential; and that a refined quantitative assessment is not required.

2.5 POTENTIAL FOR AIR QUALITY IMPACT FROM BOILERS

To satisfy the process demands of the operations for the proposed PPF, two existing 10 megawatts (**MW**) and one existing 15 MW natural gas-fired boilers will be employed. It is well established that the combustion of fuels in equipment such as boilers results in atmospheric emissions of substances. The volume and nature of emissions depend on several factors including fuel composition and consumption, boiler design and operation, as well as pollution control devices. It is understood that all previous tests and results commissioned by Baiada to date are well under the POEO (Clean Air) Regulation 2010, Group 6 emission standards for the three existing boilers. If required, any new boiler acquired for the new processing will also be natural gas-fired, sized similarly and with an equivalent emission performance specification.

It should be noted that emission factor for sulphur dioxide (**SO_2**) is dependent on the amount of sulphur in the fuel gases. For the proposed PPF, it is understood that the composition of the natural gas to be used by the boilers will contain negligible levels of sulphur and other contaminants that may affect efficient combustion performance and emissions discharge to air from the boiler stacks. This is supported by results of previous testing of the boilers completed in February 2016, shown in **Table 2.1**.

Table 2.1 – Boiler testing results: February 2016

Analyte	Boiler 1 Low fire	Boiler 1 High fire	Boiler 2 Low fire	Boiler 2 High fire	Boiler 3 Low Fire	Boiler 3 High fire
CO_2%	5.9	9.5	7.5	9.2	6.3	9.5
O_2	10.6	4.1	7.7	4.6	9.8	4.1
CO (ppm)	166	30	52	35	264	23
Temp (°C)	109	134	105	126	96	133
NO_x (ppm)	2	34	17	37	1	17

If secondary fuel such as biogas from the CAL (or an alternative energy source other than natural gas) is to be used, an on-site assessment will need to be conducted upon commissioning to validate the air emissions performance from the boiler stacks are complaint with under POEO (Clean Air) Regulation 2010, Group 6 emission standards. However, with regards to the large separation distances to nearest sensitive residences the boiler emissions are unlikely to cause adverse effects.

3 ODOUR SOURCES AND EMISSIONS INVENTORY

The odour emission rates (**OER**) used in the modelling scenarios are shown in the following sections. The odour concentration measurement reports upon which these OERs are derived can be provided upon request.

3.1 POINT SOURCES

The odour emission inventory for point sources was developed with a set of design parameters provided by Baiada and as outlined in **Table 3.1**.

Table 3.1 – Design parameters used for the calculation of OER

Parameter	Units	Value
LBR capacity	birds	90,000
Ventilation rate	m^3/h.bird	10
Total flow discharged from LBR	m^3/h	900,000
Roof vent discharge velocity	m/s	15
Processing room air exchange rate	/h	15
Line 1 Scaling and Defeathering Room	m^3	4,929
Line 2 Scaling and Defeathering Room	m^3	4,929
Line 1 Evisceration Room	m^3	3,738
Line 2 Evisceration Room	m^3	3,738
Line 1 Offal Processing Room	m^3	1,122
Line 2 Offal Processing Room	m^3	1,122
Line 1 Foot Processing Room	m^3	781
Line 2 Foot Processing Room	m^3	781
By-products Prep & Pack Room	m^3	1,080
Pet Food Prep & Pack Room	m^3	2,080
Primary Plant Room	m^3	1,128
Primary Waste Staging Room	m^3	768
Secondary Waste Staging Room	m^3	720
Crate Washroom	m^3	3,270
Live bird odour emissions factor	ou.m^3/s.bird	0.35
Hanwood PP vents mean measured odour concentration	ou	240
Biofilter surface area	m^2	160
Biofilter design flowrate	m^3/h	30,000
Biofilter surface area per cell	m^2	53
Biofilter design flowrate per cell	m^3/h	10,000
Biofilter discharge odour concentration	ou	500
PTB	m^3	10,062
PTB air exchange rate	/h	15

3.1.1 PRP Biofilters

The biofilter cells were modelled as individual low exit velocity, wide diameter and wake-affected point sources. The locations of the point sources representing the biofilter cells are shown in **Figure 3.1**. The point source release parameters and OERs are given in **Table 3.2**.

The treated odour level exiting the PRP biofilters is expected to range from a mean of 200 odour units (**ou**) upon commissioning to a concentration discharge mean of 500 ou to a maximum of 500 ou as the medium degrades. The PRP biofilters were modelled based upon the concentration discharge mean of 500 ou for biofilters with medium near its end-of-life.

3.1.2 Live Bird Reception Ventilation

The live bird reception (**LBR**) point sources were modelled using an odour emission factor of 0.35 ou.m^3/s.bird. This factor is based on TOU's odour emissions database, compiled over many years of measurement and confirmed again on 8 August 2018 from the Baiada Out St live bird storage area. The ventilation rate used was 900,000 m^3/h, based upon a design factor of 10 m^3/h per bird and a maximum capacity of 90,000 birds per hour. The actual numbers are likely to be lower and fluctuate as trucks arrive and birds are processed over time. Birds were assumed to be present between 1 am and 9 pm. Three million birds a week equates to approximately 21,500 birds per hour over 20 hours per day, 7 days per week. Therefore, a ventilation rate based upon a peak capacity of 90,000 birds is considered conservative and worst-case under normal operations. The locations of the point sources representing the LBR ventilation are shown in **Figure 3.1**. The point source release parameters and OERs are given in **Table 3.2**.

3.1.3 PPF ventilation

The PPF processing line roof vents were modelled using OER data collected by TOU on 16 November 2011 from Baiada's Hanwood poultry processing facility (Munro & Hayes, 2018). The ventilation rates were estimated by multiplying the volume of each process room by a nominal 15 air changes per hour. The discharge odour concentration used was the mean measured value of 220 ou based upon measurements from the Hanwood Processing Plant roof vents. For the modelling, each processing line was assumed to be under constant 24 hour per day operation. The locations of the point sources representing the PPF ventilation shown in **Figure 3.1**. The point source release parameters and OERs are given in **Table 3.2**.

3.1.4 PTB ventilation

The PTB ventilation point sources were modelled using OER data. TOU has assumed that the total OER discharged from the building is the same as that reported from the old PRP DAF building and reported in 2016 (Boddy, 2016).

3.2 AREA SOURCES

3.2.1 Wastewater Treatment Plants

The operational PRP WWTP area sources, except for the CAL, have been modelled using data collected from the Baiada Hanwood WWTP.

For the CAL, an OER was derived from TOU's database. In the absence of relevant data from a poultry processing plant, a maximum emission rate from an uncovered anaerobic pond servicing a red meat abattoir was used for this application. The red meat abattoir utilised a similar wastewater process with an SBR and settling ponds downstream of the uncovered anaerobic pond. The biogas capture rate from the proposed CALs was assumed to be 99.9%.

The proposed phasing of the SBR cycles was modelled under the assumption that filling during night-time hours should be avoided. However, this practice can be reassessed following commissioning of the proposed PPF with the OMP updated to reflect the revised operating protocol. As a worst-case scenario, the SBR was set at the fill emission rate for day-time hours between 8 am and 5 pm with the aeration and settling emission rates set overnight. It is understood in practice that the fill phase should only take approximately one hour, followed by the aeration and settling phases.

The proposed PPF WWTP area sources, except for the balance tank has been modelled under a conservative assumption that SOERs through the treatment train would be similar to what was from the Baiada Hanwood SBR-based WWTP system. This is despite the advanced MBR technology that is proposed to be deployed that will most likely result in lower odour emissions.

For the balance tank, TOU has assumed that the SOER is the same as that reported from the old PRP WWTP measured and reported in 2016 (Boddy, 2016).

The locations of the point sources representing the PRP and PPF WWTP odour sources are shown in **Figure 3.2**. The area source OERs are shown in **Table 3.3**.

3.3 VOLUME SOURCES

3.3.1 Protein Recovery Plant

Fugitive odour emissions from the PRP have been calculated from actual measurements collected from the PRP building by TOU on 8 August 2018. It has been estimated that there were approximately three air changes per hour of room air ventilation occurring at the time of measurement.

Five volume sources were input into the model to represent each major section of the structure with OERs proportionally assigned by the estimated volume of each section. The volume source settings within the model have considered that fugitive process emissions are released at a high level via vents that are either naturally or mechanically aided by roof fans. The theoretical maximum production rates have been used for 24 hours, 7 days per week. The locations of the volume sources representing the PRP fugitive emissions are shown in **Figure 3.1**. The volume source release parameters are available in **Table 3.4**.

The relatively low OER values for the Low-Temperature and High-Temperature Processing and Storage areas reflect the excellent odour capture experienced during the August 2018 testing, arising from the fully enclosed nature of the rendering processes. Consistent with measurement and observations made by TOU at the PRP, the raw material loading bay OER was estimated by multiplying the mean measured odour concentration from the Low-Temperature and High-Temperature Processing and Storage areas by a ventilation rate of three air changes per hour.

Figure 3.1 – Point and volume source locations

Figure 3.2 – Area source locations

Table 3.2 – Point source odour emissions inventory

Description	Source ID	UTM east (km)	UTM north (km)	Height (m)	Elevation (m)	Diameter (m)	Velocity (m/s)	Temperature (K)	Flowrate (m^3/h)	OER ($ou.m^3/s$)	OER P/M60 (2.3) ($ou.m^3/s$)
Live Bird Reception Roof Vent 1	LB01	293.8332	6561.1371	13.0	388.0	2.06	15.0	293.15	180,000	6,300	14,490
Live Bird Reception Roof Vent 2	LB02	293.8213	6561.1249	13.0	388.0	2.06	15.0	293.15	180,000	6,300	14,490
Live Bird Reception Roof Vent 3	LB03	293.8090	6561.1118	13.0	388.0	2.06	15.0	293.15	180,000	6,300	14,490
Live Bird Reception Roof Vent 4	LB04	293.7831	6561.0935	13.0	388.0	2.06	15.0	293.15	180,000	6,300	14,490
Live Bird Reception Roof Vent 5	LB05	293.7666	6561.0759	13.0	388.0	2.06	15.0	293.15	180,000	6,300	14,490
Scalding and Defeather Roof Vent 1	DF01	293.8466	6561.1074	13.0	388.0	0.93	15.0	293.15	36,968	2,465	5,668
Scalding and Defeather Roof Vent 2	DF02	293.8249	6561.0866	13.0	388.0	0.93	15.0	293.15	36,968	2,465	5,668
Scalding and Defeather Roof Vent 3	DF03	293.8058	6561.0685	13.0	388.0	0.93	15.0	293.15	36,968	2,465	5,668
Scalding and Defeather Roof Vent 4	DF04	293.7845	6561.0476	13.0	388.0	0.93	15.0	293.15	36,968	2,465	5,668
Evisceration Roof Vent 1	EV01	293.8236	6561.0378	13.0	388.0	1.15	15.0	293.15	56,070	3,738	8,597
Evisceration Roof Vent 2	EV02	293.8074	6561.0189	13.0	388.0	1.15	15.0	293.15	56,070	3,738	8,597
Offal Processing Roof Vent 1	OF01	293.8455	6561.0141	13.0	388.0	0.63	15.0	293.15	16,830	1,122	2,581
Offal Processing Roof Vent 2	OF02	293.8301	6560.9976	13.0	388.0	0.63	15.0	293.15	16,830	1,122	2,581
Foot Processing Roof Vent 1	FT01	293.8414	6561.0096	13.0	388.0	0.53	15.0	293.15	11,715	781	1,796
Foot Processing Roof Vent 2	FT02	293.8363	6561.0038	13.0	388.0	0.53	15.0	293.15	11,715	781	1,796
By-products Roof Vent 1	BP01	293.8615	6561.0279	13.0	388.0	0.62	15.0	293.15	16,200	1,080	2,484
Pet Food Roof Vent 1	PF01	293.8816	6561.0054	13.0	388.0	0.86	15.0	293.15	31,200	2,080	4,784
Primary Plant Roof Vent 1	PP01	293.8324	6561.0580	13.0	388.0	0.63	15.0	293.15	16,920	1,128	2,594
Primary Waste Staging Roof Vent 1	PW01	293.8403	6561.0487	13.0	388.0	0.52	15.0	293.15	11,520	768	1,766
Secondary Waste Staging Roof Vent 1	SW01	293.8949	6560.9846	13.0	388.0	0.50	15.0	293.15	10,800	720	1,656
Crate Wash Roof Vent 1	CR01	293.9677	6560.8752	13.0	388.0	0.76	15.0	293.15	24,525	1,635	3,761
Crate Wash Roof Vent 2	CR02	293.9546	6560.8624	13.0	388.0	0.76	15.0	293.15	24,525	1,635	3,761
HTR Biofilter Cell 1	BF1C1	293.9443	6561.1196	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
HTR Biofilter Cell 2	BF1C2	293.9372	6561.1254	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
HTR Biofilter Cell 3	BF1C3	293.9322	6561.1313	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
LTR Biofilter Cell 1	BF2C1	293.9752	6561.0864	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
LTR Biofilter Cell 2	BF2C2	293.9802	6561.0805	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
LTR Biofilter Cell 3	BF2C3	293.9852	6561.0756	2.0	385.0	8.24	0.052	313.15	10,000	1,389	3,194
Primary Building (Screen Section)	SCR	294.1772	6561.0418	6.0	384.3	1.09	15.0	273.15	50,310	2,960	6,808
Primary Building (DAF Section)	DAF	294.1808	6561.0639	6.0	384.3	1.09	15.0	273.15	50,310	2,970	6,831
Primary Building (Sludge Section)	SLG	294.1844	6561.0860	6.0	384.3	1.09	15.0	273.15	50,310	2,960	6,808

Table 3.3 – Area source odour emissions inventory

Description	Source ID	Elevation (m)	Area (m^2)	UTM east (km)	UTM north (km)	SOER ($ou.m^3/m^2.s$)	SOER P/M60 (2.3) ($ou.m^3/m^2.s$)	SOER P/M60 (1.9) ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	OER P/M60 (2.3) ($ou.m^3/s$)	OER P/M60 (1.9) ($ou.m^3/s$)
Clear Well #1	CW1	380.8	2,167	294.0274 294.0624 294.0324 293.9964	6561.586 6561.544 6561.519 6561.56	0.141	0.324	0.268	306	703	581
Covered Anaerobic Lagoon	CAL1	385	8,242	294.0162 294.1141 294.0723 293.9744	6561.275 6561.174 6561.133 6561.234	0.0518	0.119	0.098	427	982	811
Clear Well #2	CW2	380.8	2,167	293.9868 294.0218 293.9918 293.9558	6561.554 6561.512 6561.487 6561.528	0.141	0.324	0.268	306	703	581
Sequential Batch Reactor (Fill)	SBR1	380.8	2,167	294.0657 294.1007 294.0707 294.0347	6561.62 6561.578 6561.553 6561.594	3.89	8.95	7.39	8,430	19,388	16,016
Sequential Batch Reactor (Start cycle)	SBR1	380.8	2,167	294.0657 294.1007 294.0707 294.0347	6561.62 6561.578 6561.553 6561.594	0.224	0.52	0.43	485	1,116	922
Sequential Batch Reactor (Mid cycle)	SBR1	380.8	2,167	294.0657 294.1007 294.0707 294.0347	6561.62 6561.578 6561.553 6561.594	0.082	0.19	0.16	178	409	338
Sequential Batch Reactor (End cycle)	SBR1	380.8	2,167	294.0657 294.1007 294.0707 294.0347	6561.62 6561.578 6561.553 6561.594	0.03	0.069	0.057	65	150	124
Sequential Batch Reactor (Settling/Decant)	SBR1	380.8	2,167	294.0657 294.1007 294.0707 294.0347	6561.62 6561.578 6561.553 6561.594	0.018	0.041	0.034	39	90	74
Balance Tank	BAL1	384.3	416	294.1366 294.157 294.157 294.1366	6561.05 6561.05 6561.03 6561.03	0.3	0.69	0.57	125	287	237
Pre-anoxic Tank #1	PRAX1	384.3	213	294.1464 294.161 294.161 294.1464	6561.071 6561.071 6561.056 6561.056	0.224	0.515	0.426	48	110	91

Table 3.3 (continued) – Area source odour emissions inventory

Description	Source ID	Elevation (m)	Area (m^2)	UTM east (km)	UTM north (km)	SOER ($ou.m^3/m^2.s$)	SOER P/M60 (2.3) ($ou.m^3/m^2.s$)	SOER P/M60 (1.9) ($ou.m^3/m^2.s$)	OER ($ou.m^3/s$)	OER P/M60 (2.3) ($ou.m^3/s$)	OER P/M60 (1.9) ($ou.m^3/s$)
Pre-anoxic Tank #2	PRAX2	384.3	213	294.1083	6561.049	0.224	0.515	0.426	48	110	91
				294.1229	6561.049						
				294.1229	6561.035						
				294.1083	6561.035						
Aerobic Tank #1	AER1	384.3	676	294.1394	6561.103	0.082	0.189	0.156	55	127	105
				294.1654	6561.103						
				294.1654	6561.077						
				294.1394	6561.077						
Aerobic Tank #2	AER2	384.3	676	294.1128	6561.08	0.082	0.189	0.156	55	127	105
				294.1388	6561.08						
				294.1388	6561.054						
				294.1128	6561.054						
Post-anoxic Tank #1	POAX1	384.3	161	294.1425	6561.124	0.03	0.069	0.057	5	11	9
				294.1552	6561.124						
				294.1552	6561.111						
				294.1425	6561.111						
Post-anoxic Tank #2	POAX2	384.3	161	294.1216	6561.127	0.03	0.069	0.057	5	11	
				294.1343	6561.127						
				294.1343	6561.115						
				294.1216	6561.115						
Membrane Bioreactor #1	MBR1	384.3	210	294.1603	6561.128	0.018	0.0414	0.0342	4	9	7
				294.1706	6561.126						
				294.1674	6561.107						
				294.157	6561.108						
Membrane Bioreactor #2	MBR2	384.3	210	294.1211	6561.107	0.018	0.0414	0.0342	4	9	7
				294.1314	6561.106						
				294.1282	6561.086						
				294.1178	6561.088						

Table 3.4 – Volume source odour emissions inventory

Description	Source ID	UTM east (km)	UTM north (km)	Height (m)	Elevation (m)	Sigma Y (m)	Sigma Z (m)	OER ($ou.m^3/s$)	OER P/M60 (2.3) ($ou.m^3/s$)
HTR Storage	HST	293.905	6561.11	6.4	385	12.06	5.95	84	193
HTR Processing	HPR	293.922	6561.1	6.4	385	12.06	5.95	390	897
LTR Processing	LPR	293.96	6561.06	6.4	385	12.06	5.95	540	1,242
LTR Storage	LST	293.976	6561.04	6.4	385	12.06	5.95	100	230
Loading Bay	LOAD	293.959	6561.1	7.2	385	12.06	6.7	334	769
Primary Building (Screen Section)	SCR	294.177	6561.04	3	384.3	10.37	2.79	2,960	6,808
Primary Building (DAF Section)	DAF	294.181	6561.06	3	384.3	10.37	2.79	2,970	6,831
Primary Building (Sludge Section)	SLG	294.184	6561.09	3	384.3	10.37	2.79	2,960	6,808

3.4 CUMULATIVE ODOUR EFFECTS

The cumulative odour effects from the proposed PPF have been assessed by combining all Oakburn odour sources into a single grouped impact and separately grouped by origin, namely: PRP, PPF and WWTP (i.e. inclusive of the AWTP). In TOU's experience, multiple odour plumes of distinctly different odour characters do not combine in the atmosphere and tend to be observed as individually identifiable odour characters in the field, even well downwind of the sources. Furthermore, treated odour emissions from an effective biofilter remove almost all process odour, having an 'earthy, musty' odour character. Moreover, in TOU's opinion, odour impacts from biofilters and other proven odour control systems should be modelled as a non-cumulative impact (or completely removed from the dispersion modelling process).

The cumulative odour effects from the proposed PPF with three poultry farms located to the northwest have been considered in the form of a sensitivity analysis. This is in response to comments received from NSW EPA during the notification phase of the proposed PPF development.

3.4.1 Bowlers Lane Poultry Farms

There are three poultry farms located along Bowlers Lane to the northwest of the proposed PPF development, as indicated in **Figure 2.1**. Each farm comprises of eight tunnel-ventilated, climate-controlled, metal structure sheds with side curtains. The key farm operational parameters are given in **Table 3.5**. The hourly varying odour emissions from the farms were estimated with the use of the 'K-factor' poultry farm odour emissions model (Ormerod & Holmes, 2005) based upon:

- Bird population;
- Stocking density as a function of the bird population, age and shed size;
- Ventilation rate as a function of bird age and ambient temperature; and
- Farm operational parameters.

Table 3.5 – Operational parameters of Bowlers Lane poultry farms			
Parameter	**BOWLERS 1**	**BOWLERS 2**	**BOWLERS 3**
No batches litter used	1	1	1
Drinking system	Nipple	Nipple	Nipple
Automated shed environmental control with alarm	Yes	Yes	Yes
Inspect and replace wet litter daily	Yes	Yes	Yes
Max shed WS > 2.5m/s	No	No	No
Externally accredited management system	Yes	Yes	Yes
Litter type	Shavings	Shavings	Shavings
Floor-type	Earth	Earth	Earth
Foggers installed	No	No	No
Sheds dimensions	Sheds 1,2,3 & 8: 105 m long, 14 m wide, 3m high, 4.8 apex. Sheds 4,5,6 & 7: 107 m long, 12.6 m wide, 3 m high, 3.8 m apex	100 m long, 13.85 m wide, 2.8 high. 4.5 m apex	110 m long, 13.5 m wide, 2.1 m high, 4.2 apex
Specifications of fans	4 Tunnel Fans / Shed (Running at ~22,000 CFM)	8 Tunnel Fans / Shed (Running at ~22,000 CFM)	6 Tunnel Fans / Shed (Running at ~27,000 CFM)
Number of birds placed per batch	171,000 birds	220,000 birds	220,000 birds
Typical annual batch cycle regime	52 days cycle with 8-10 days farm empty	52 days cycle with 8-10 days farm empty	52 days cycle with 8-10 days farm empty
Thin-out/ pick up regime	3 thin outs then empty days 31, 38, 44-49	3 thin outs then empty days 31, 38, 44-49	3 thin outs then empty days 31, 38, 44-49

3.4.2 Odour Emissions Estimation

Standardised hourly varying OERs were predicted by use of the following equation:

$$OERs = 0.025\, K\, V^{0.5}$$ **Equation 3.1**

where:

OER_S = standardised OER (ou.m³/s) per unit shed area (m²) per unit of bird density (in kg/m²);

V = ventilation rate (m^3/s); and

K = scaling factor between 1 and 5.

Based upon the operational parameters of the farms in **Table 3.5**, a scaling factor of 2 was selected plus an additional 10% (i.e. K = 2.2) to account for inherent uncertainties in the odour emission model predictions (PAEHolmes, 2011).

The hourly varying ventilation rates were estimated by *Fan Activity Prediction Model 2* with *Farm C* coefficients and Cobb500 chicken breed described in the Rural Industries Research and Development Corporation (**RIRDC**) report: *Monitoring mechanical ventilation rates in poultry buildings* (Dunlop & Duperouzel, 2014).

To complete the process, the standardised OER is multiplied by the shed live bird weight to produce a shed OER for every hour of the batch cycle. The performance objectives supplied by Baiada for the Cobb500 breed of chicken that is grown at the farms are shown in **Figure 3.3**. These were used to estimate the total shed live bird weight based on operational parameters described in **Table 3.5**. For conservatism, TOU has assumed that the batch cycle for each shed begins on the same day.

The locations of the points sources representing the tunnel fan discharges for each shed are shown in **Figure 3.1**. The point source release parameters are available in **Table 3.6**. Each point source was placed approximately 30 meters downstream of the tunnel fans, the diameter was set to represent the vertical cross-sectional area of each shed discharge end, and vertical momentum was set to zero to represent the horizontal discharge from the end of the sheds.

An example of hourly varying shed OER over the course of 2017 has been shown below in **Figure 3.5**. This shows the OER variation based on day-to-day conditions, bird age, thin-outs, clean-outs and between batches across different seasons of the year.

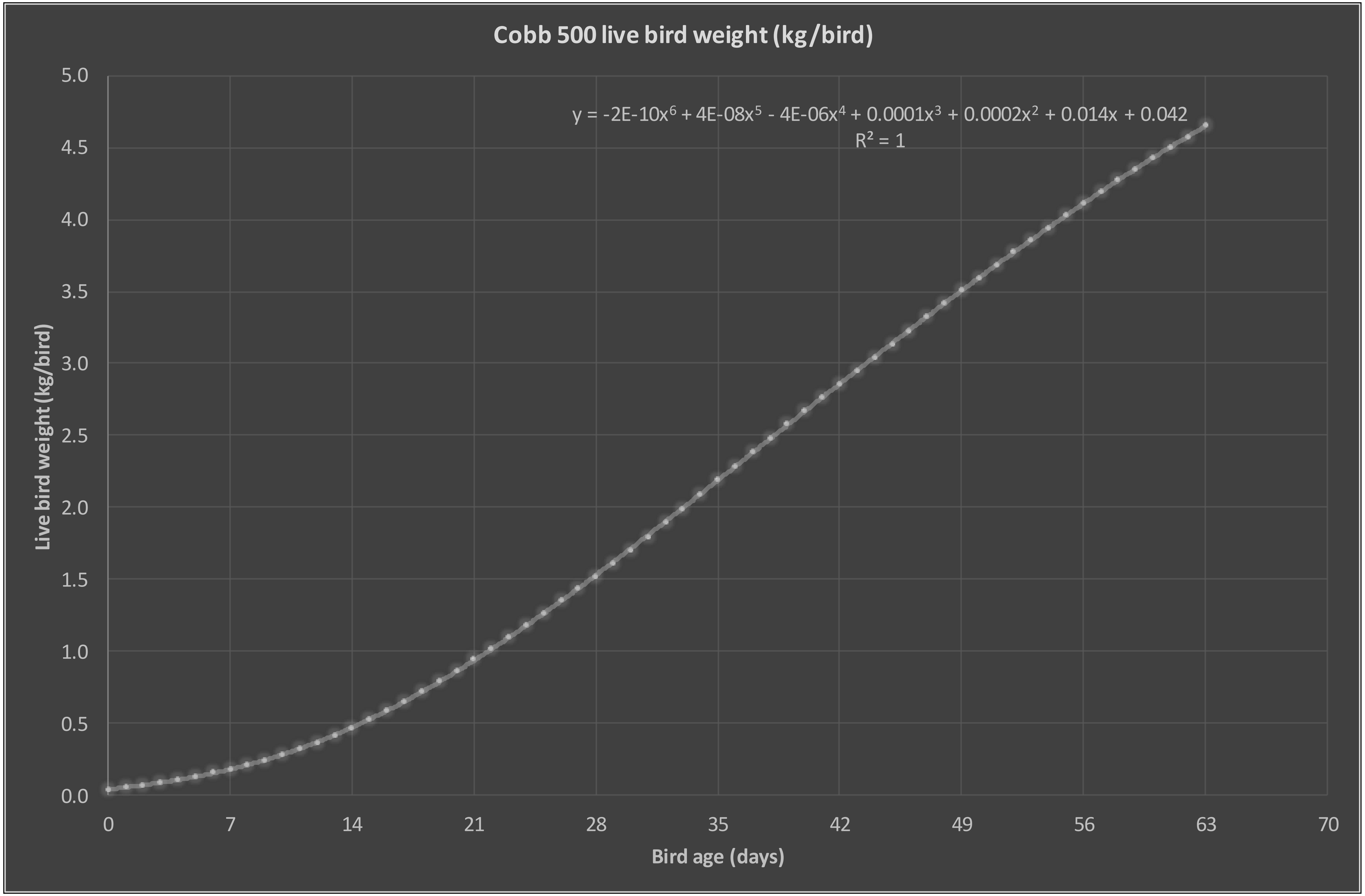


Figure 3.3 – Cobb 500 live bird weight performance objective (Source: supplied)

Figure 3.4 – Bowlers Lane poultry farms point source locations

Table 3.6 – Bowlers Lane poultry farm point source release parameters						
Description	**Source ID**	**UTM east (km)**	**UTM north (km)**	**Height (m)**	**Elevation (m)**	**Diameter (m)**
Bowlers Lane 1 Shed 1	F1S1	294.7517	6563.42	1	379	8.20
Bowlers Lane 1 Shed 2	F1S2	294.7145	6563.384	1	377.8	8.20
Bowlers Lane 1 Shed 3	F1S3	294.6755	6563.348	1	377.8	8.20
Bowlers Lane 1 Shed 4	F1S4	294.6329	6563.314	1	382.1	7.89
Bowlers Lane 1 Shed 5	F1S5	294.5943	6563.277	1	382.1	7.89
Bowlers Lane 1 Shed 6	F1S6	294.5453	6563.229	1	382.1	7.89
Bowlers Lane 1 Shed 7	F1S7	294.5063	6563.193	1	381.5	7.89
Bowlers Lane 1 Shed 8	F1S8	294.4728	6563.159	1	384.1	8.20
Bowlers Lane 2 Shed 1	F2S1	293.9604	6562.57	1	394.8	7.93
Bowlers Lane 2 Shed 2	F2S2	293.9577	6562.604	1	394.8	7.93
Bowlers Lane 2 Shed 3	F2S3	293.9567	6562.638	1	394.9	7.93
Bowlers Lane 2 Shed 4	F2S4	293.9547	6562.67	1	394.9	7.93
Bowlers Lane 2 Shed 5	F2S5	293.6332	6562.553	1	397.3	7.93
Bowlers Lane 2 Shed 6	F2S6	293.6322	6562.586	1	397.3	7.93
Bowlers Lane 2 Shed 7	F2S7	293.6322	6562.619	1	393	7.93
Bowlers Lane 2 Shed 8	F2S8	293.6307	6562.653	1	393	7.93
Bowlers Lane 3 Shed 1	F3S1	293.3382	6562.038	1	397.8	7.93
Bowlers Lane 3 Shed 2	F3S2	293.3355	6562.071	1	397.8	7.93
Bowlers Lane 3 Shed 3	F3S3	293.3345	6562.105	1	397.8	7.93
Bowlers Lane 3 Shed 4	F3S4	293.3318	6562.138	1	397.8	7.93
Bowlers Lane 3 Shed 5	F3S5	292.9815	6562.019	1	392.7	7.93
Bowlers Lane 3 Shed 6	F3S6	292.9799	6562.053	1	392.7	7.93
Bowlers Lane 3 Shed 7	F3S7	292.9783	6562.087	1	392.7	7.93
Bowlers Lane 3 Shed 8	F3S8	292.9762	6562.121	1	392.7	7.93

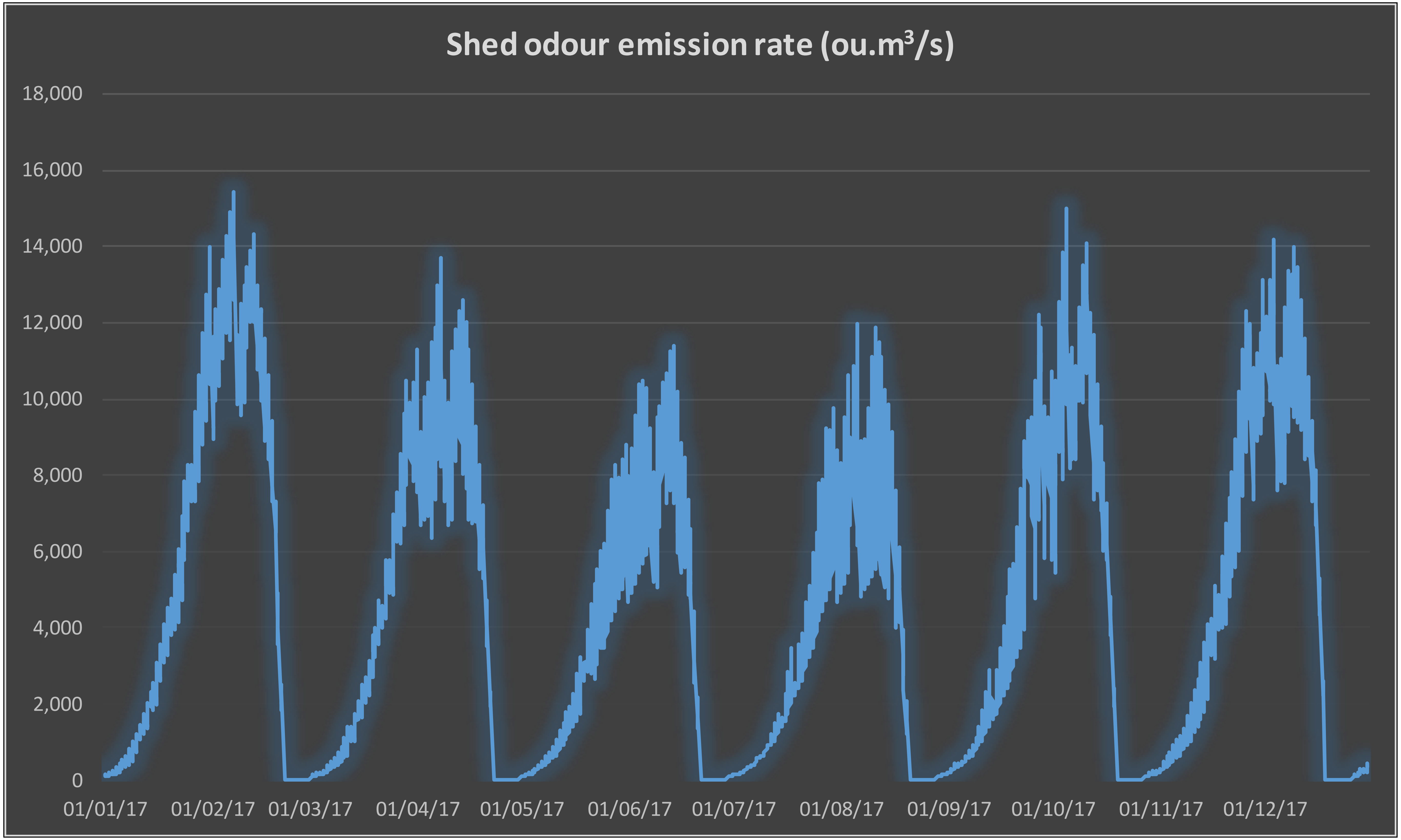


Figure 3.5 – Example of hourly varying shed OER for 2017

4 ODOUR DISPERSION MODELLING APPROACH

4.1 NSW ODOUR CRITERIA AND DISPERSION MODEL GUIDELINES

The applicable guidelines for the OIA report conducted for the proposed PPF operations include:

- NSW EPA, 2016, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Environment Protection Authority, 2017);
- NSW EPA, 2006, *Technical framework (and notes): assessment and management of odour from stationary sources in NSW* (Environment Protection Authority, 2006a & b); and
- Barclay and Scire, 2011, Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia' (Barclay & Scire, 2011)

The documents specify that the odour modelling for Level 3 impact assessments upon which this study has been conducted be based on the use of:

- 99.0^{th} percentile dispersion model predictions;
- 1-hour averaging times with built-in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time;
- The peak-to-mean ratios in the far-field for wake-affected point sources is 2.3;
- The peak-to-mean ratios in the far-field for volume sources is 2.3;
- The peak-to-mean ratios in the far-field for area sources is 2.3 for stability classes A to D and 1.9 for stability classes E and F; and
- The appropriate odour unit performance criterion based on the population of the affected community in the vicinity of the development.

The impact assessment criteria (**IAC**) for complex mixtures of odours are designed to include receptors with a range of sensitivities. Therefore, a statistical approach is used to determine the acceptable ground level concentration of odour at the nearest sensitive receptor. This criterion is determined by the following equation outlined on page 35 of NSW EPA Modelling Methods (Environment Protection Authority, 2017):

$$IAC = \frac{log_{10}(p) - 4.5}{-0.6}$$ **Equation 4.1**

where:

IAC **=** Impact Assessment Criterion (ou); and p = population.

Based on **Equation 4.1**, **Table 4.1** outlines the odour performance criteria for six different affected population density categories and is reproduced from NSW EPA Modelling Methods (Environment Protection Authority, 2017). It states that higher odour concentrations are permitted in lower population density applications.

Table 4.1 – Impact assessment criteria for complex mixtures of odorous air pollutants (nose response-time average, 99^{th} percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban Area (≥ ~2000) and/or schools or hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤ ~2)	7.0

Source: *Table 7.5* of the NSW EPA 2016 Methods

It is understood that there are up to 11 sensitive residences present along Wallamore Road, based upon Census 2016 (SA2) household size of 2.7 this equates to an approximate population of 30. Therefore, the preliminary IAC adopted for this odour impact assessment study is **5.0 ou** and is consistent with a long-standing criterion that has been successfully applied for the Westdale region. This will be discussed further from the population predicted to be affected by the results of the modelling.

4.2 DISPERSION MODELLING

4.2.1 The Odour Dispersion Model

The odour dispersion modelling assessment was carried out using the CALPUFF Modelling System. The main system programs used were:

- CALPUFF - Version 7.2.1 (Level 150618);
- CALMET - Version 6.5.0 (Level 150223); and
- CALPOST - Version 7.1.0 (Level 141010).

CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport (Environment Protection Authority, 2017). CALMET is a meteorological model that produces three-dimensional gridded wind and temperature fields to be fed into CALPUFF. The primary output from CALPUFF is hourly pollutant concentrations evaluated at gridded and/or discrete receptor locations. CALPOST processes the hourly pollutant concentration output to produce tables at each receptor and contour plots across the modelling domain. The result is a summary of pollutant concentrations at various time averages and percentiles or a tally of hours where a pollutant has exceeded a pre-determined concentration. For further technical information about the CALPUFF modelling system refer to the document *CALPUFF Modeling System Version 6 User Instructions* (Atmospheric Studies Group, 2011).

The CALPUFF system can account for a variety of effects such as non-steady-state meteorological conditions, complex terrain, varying land uses, plume fumigation and low wind speed dispersion (Environment Protection Authority, 2017). CALPUFF is considered an appropriate dispersion model for air impact assessments, as outlined in the NSW EPA modelling methods, in one or more of the following applications:

- complex terrain, non-steady-state conditions,
- buoyant line plumes,
- coastal effects such as fumigation,
- high frequency of stable calm night-time conditions,
- high frequency of calm conditions, and
- inversion break-up fumigation conditions.

In the case of this assessment, CALPUFF was required in order to handle the moderate complexity of terrain surrounding Oakburn PRP. The terrain may induce deflection or channelling of odour plumes. Also, the high incidence of calm and very light winds (modelled 40.2% annual frequency < 2.0 m/s) and very stable night-time conditions (modelled 35.9% modelled F-class) were likely to induce non-steady-state conditions such as accumulation of odour and/or downslope movement with drainage airflow.

For the OIA for the proposed PPF, the air contaminant was **odour** and ground-level concentrations in ou have been projected.

4.2.2 Geophysical and Meteorological Configuration

A CALMET hybrid three-dimensional meteorological data file for Oakburn PRP was produced that incorporated gridded numerical meteorological data supplemented with surface observation data, topography and land use over the domain area.

4.2.3 Terrain Configuration

Terrain elevations were sourced from 1 Second Shuttle Radar Topography Mission (**SRTM**) Derived Smoothed Digital Elevation Model (DEM-S). The SRTM data has been treated with several processes including but not limited to removal of stripes, void filling, tree offset removal and adaptive smoothing (Gallant, et al., 2011). The DEM-S was used as input into TERREL processor to produce a 30 km by 30 km grid at 0.20 km resolution. A map of the terrain, including site and the meteorological station is shown in **Figure 4.1**.

4.2.4 Land Use Configuration

Land use was sourced from the United States Geological Survey (**USGS**) Global Land Cover Characteristics Data Base for the Australia-Pacific Region (United States

Geological Survey, 1997). The data was used as input into CTGPROC processor to produce a 30 km by 30 km grid at 0.20 km resolution. A map of the land, including the Oakburn site and the meteorological station, is shown in **Figure 4.2**.

4.2.5 Geophysical Configuration

The geophysical data file was created using the MAKEGEO processor. Land use data from CTGPROC and terrain data from TERREL was used as input to produce a 30 km by 30 km geophysical grid at 0.20 km resolution.

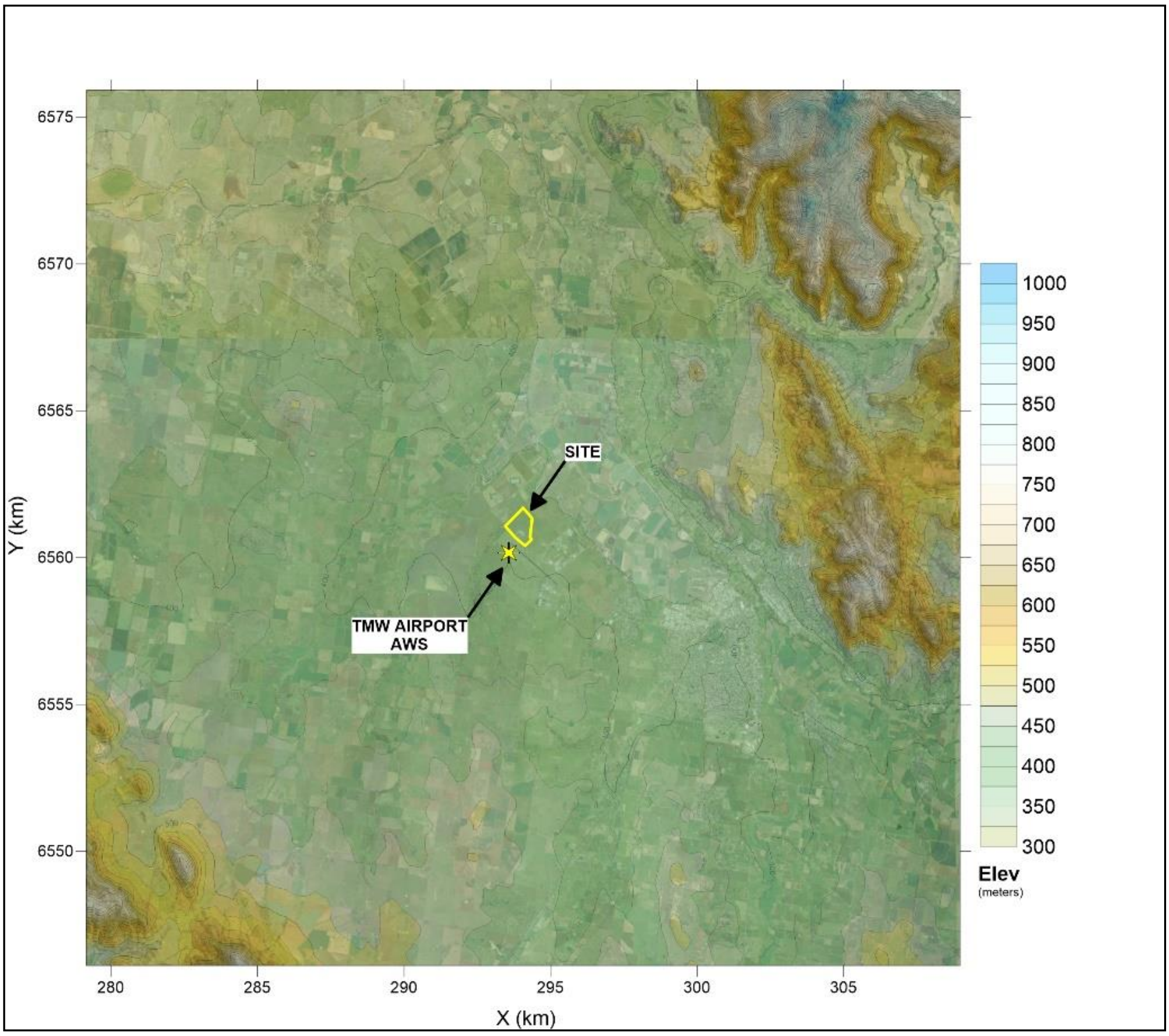


Figure 4.1 – Terrain dataset of Oakburn PRP and surrounds

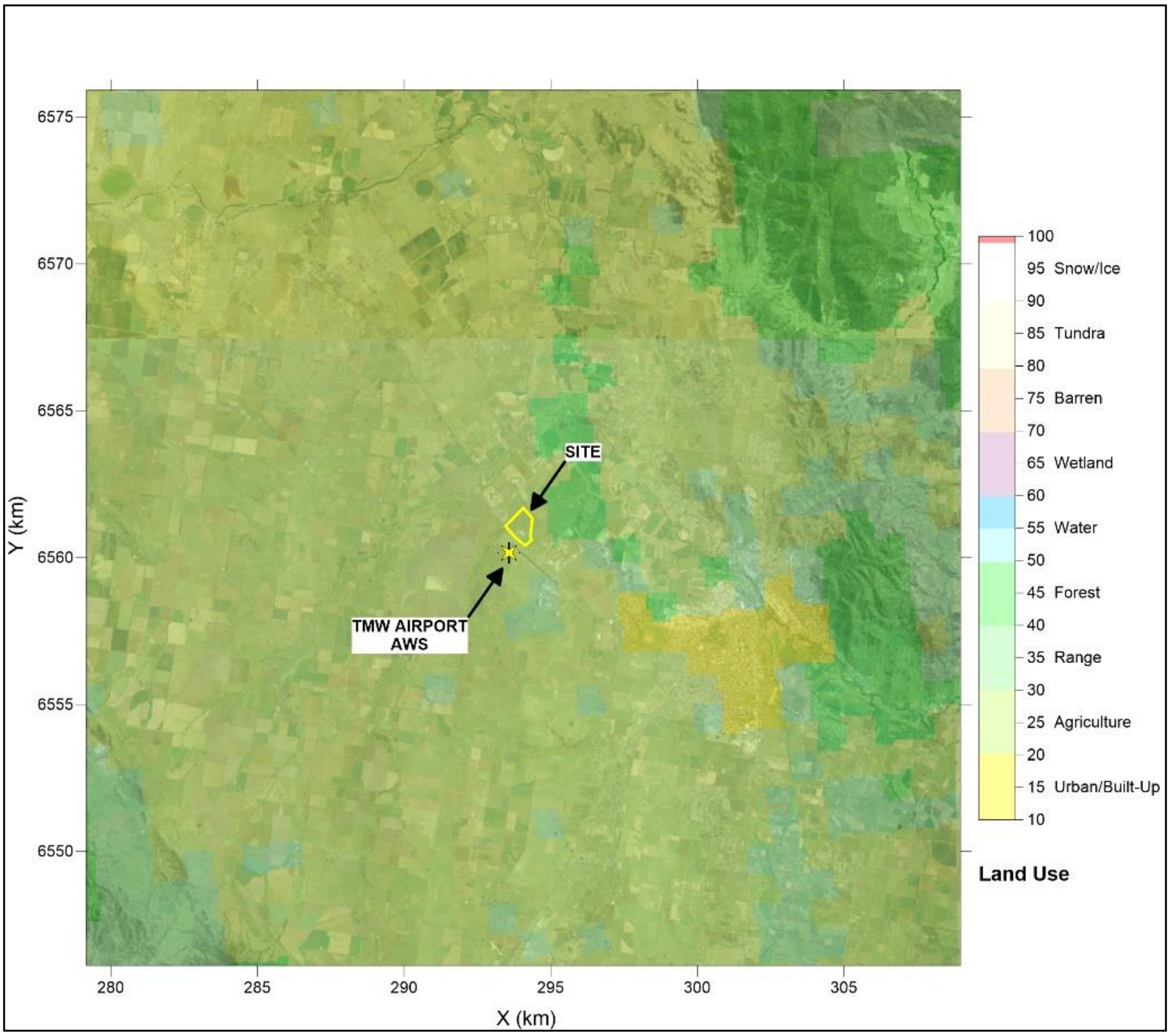


Figure 4.2 – Land use dataset of Oakburn PRP and surrounds

4.2.6 Meteorological Input Data

One-hour average observed meteorological surface data for 2017 was sourced from Tamworth Airport AWS (**YSTW**) maintained by the Bureau of Meteorology (**BOM**). The BOM data was formatted into a generic format and was processed with SMERGE to produce a surface meteorological data file. A small number of single hour gap-fills were carried out by interpolation.

Numerical meteorological data was produced as a 3D data tile from The Air Pollution Model (v4.0.5) and processed it with CALTAPM (v7.0.0) into a suitable format. TAPM was run using multiple nested grids—at least three nests and 35 vertical levels. The nested grid resolutions were close to a ratio of three as possible. The innermost nest was 33 km by 33 km at 1 km resolution.

4.2.7 Meteorological Model Configuration

CALMET was run with the hybrid option that uses geophysical data, surface station data and upper-air data. The data was used to initialise the diagnostic functions of the CALMET module to produce a full 3D meteorology data for input into CALPUFF. **Table 4.2** shows the key variables selected.

Table 4.2 – CALMET key variable fields

Grid Configuration (WGS-84 UTM Zone 56S)		
150		**NX Cells**
150		**NY Cells**
0.20		**Cell Size (km)**
279.073	6546.008	**SW Corner (km)**
11		**Vertical Layers**

ZFACE (m)	0	20	40	80	160	320	640	1000	1500	2000	2500	3000
LAYER	1	2	3	4	5	6	7	8	9	10	11	
MID-PT (m)	10	30	60	120	240	480	820	1250	1750	2250	2750	

Critical Wind Field Settings			
Value	**Found**	**Typical**	**Values**
TERRAD	2	None	Terrain scale (km) for terrain effects
IEXTRP	-4	4, -4	Similarity extrap. of wind (-4 ignore upper stn sfc)
ICALM	0	0	Do Not extrapolate calm winds
RMAX1	6	None	MAX radius of influence over land in layer 1 (km)
RMAX2	7	None	MAX radius of influence over land aloft (km)
R1	0.1	None	Distance (km) where OBS wt = IGF wt in layer 1
R2	0.1	None	Distance (km) where OBS wt = IGF wt aloft

4.2.8 Meteorological Data Analysis

Observed 2017 BOM surface data was compared with longer-term climate (2013 – 2017) from YSTW to gauge how representative and suitable the year is for air quality dispersion modelling. The annual wind roses (**Figure 4.3** and **Figure 4.4**) show very good agreement. The reported annual frequency of calms (< 0.5 m/s) was at 3.5% and 3.2% respectively and very light winds (0.5 – 2 m/s) occurred 22.1% and 22.8% of the time – a total frequency of 25.6% and 26.0% respectively.

The modelled meteorological surface data (**Figure 4.5**) was extracted from the nearest grid point to the YSTW location for comparison with the observed readings. The annual wind roses show acceptable correlations except for overprediction of winds from the south-south-easterly direction (20.6% compared with 15.6% recent climate) and underpredicted south-easterly direction (9.1% versus 15.5%). There was an overprediction of modelled annual frequency of calms at 4.4% and very light winds at 35.8% - a total of 40.2% (over predicted by 11 percentage points). This would have a conservative effect on the modelling, that is a positive bias towards the extent and magnitude of odour concentration projections, especially north-north-westwards from Oakburn PRP.

The monthly average (**Figure 4.6**) show that January and February were warmer in 2017 than usual, and April, July and November were cooler than the longer-term climate. The diurnal temperature (**Figure 4.7**) profile showed good agreement, but there are slightly warmer daytime temperatures indicated for 2017 than the longer-term climate. Diurnal mixing heights and stability class frequencies are shown in **Figure 4.8** and **Figure 4.9,** respectively. Poor for odour dispersion is stable calm night-time conditions, represented within the F-class, occurring 35.9% of the hours during 2017.

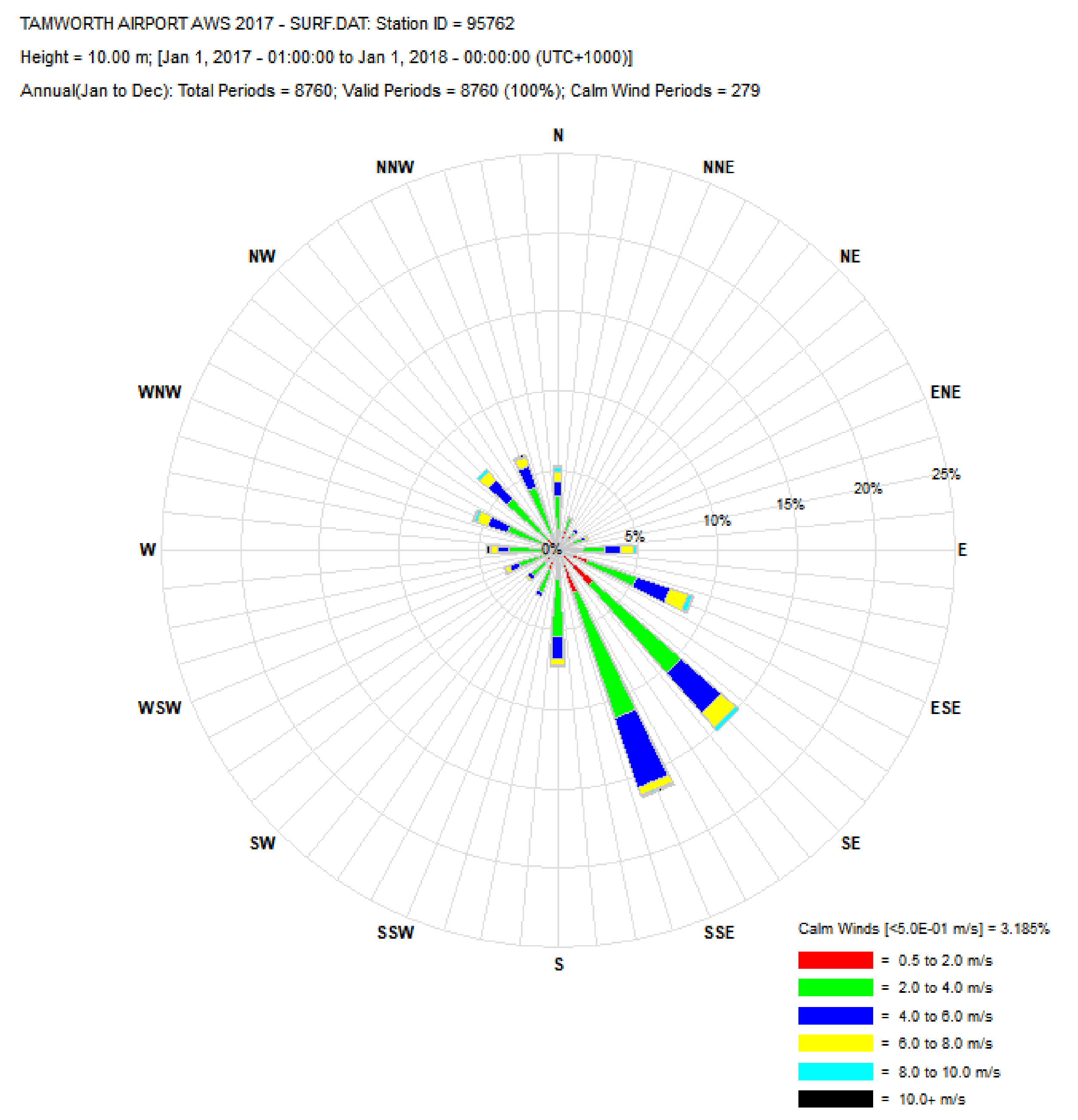


Figure 4.3 – Annual wind rose for YSTW 2017

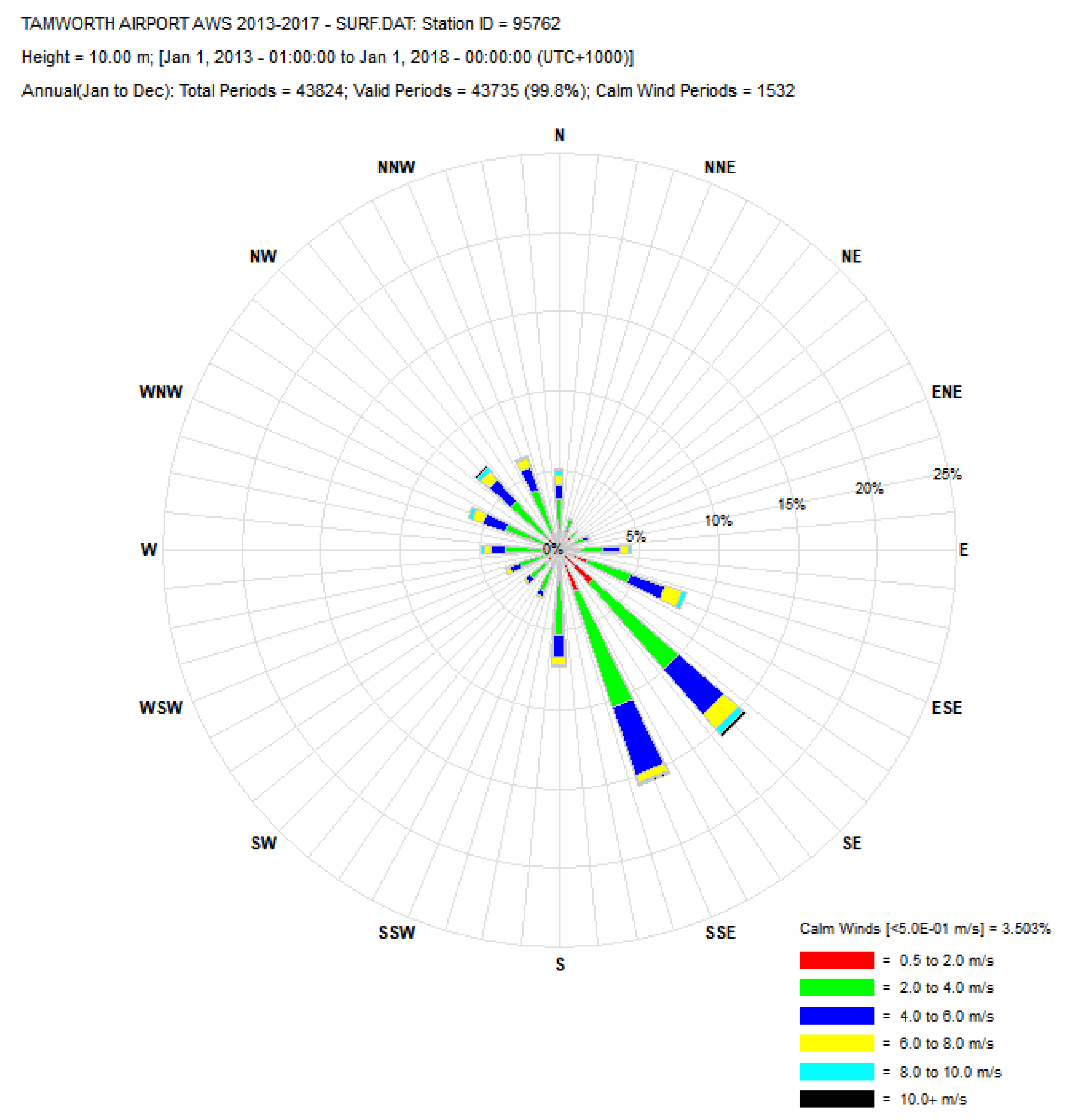


Figure 4.4 – Annual wind rose for YSTW 2013-2017

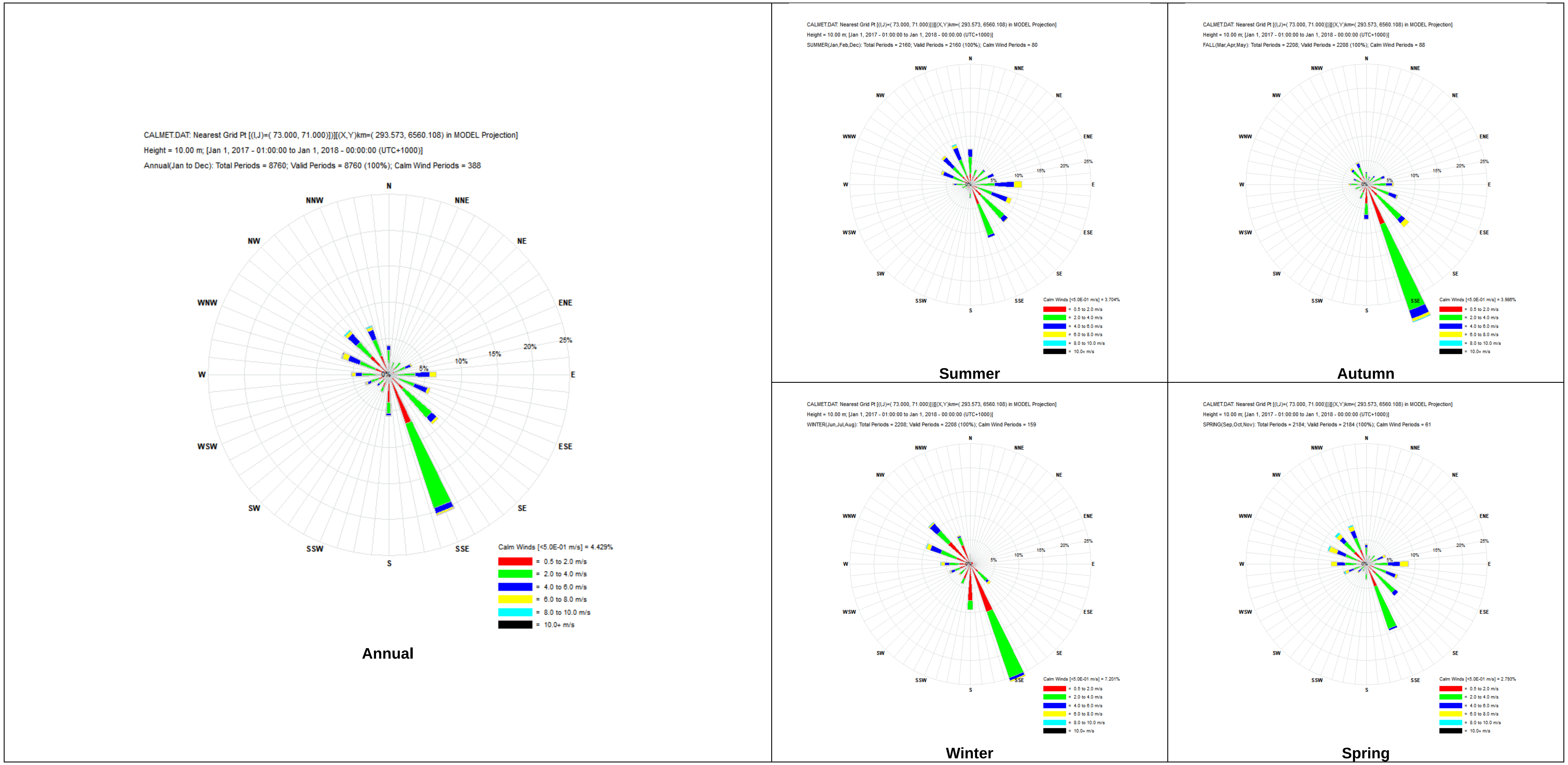


Figure 4.5 – Annual wind rose for nearest CALMET grid point to YSTW

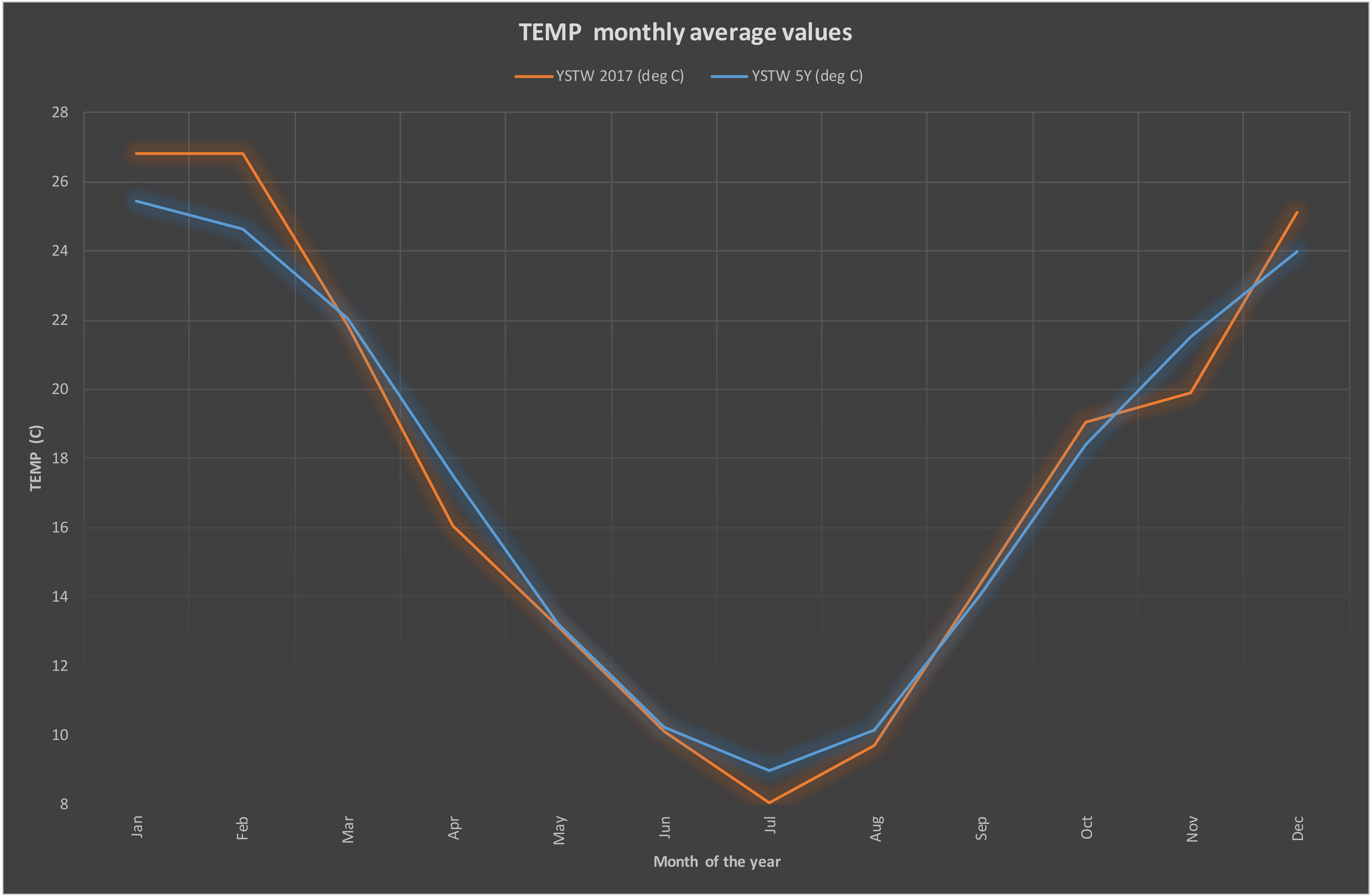


Figure 4.6 – Monthly average temperatures for YSTW 2017 and recent 5-years

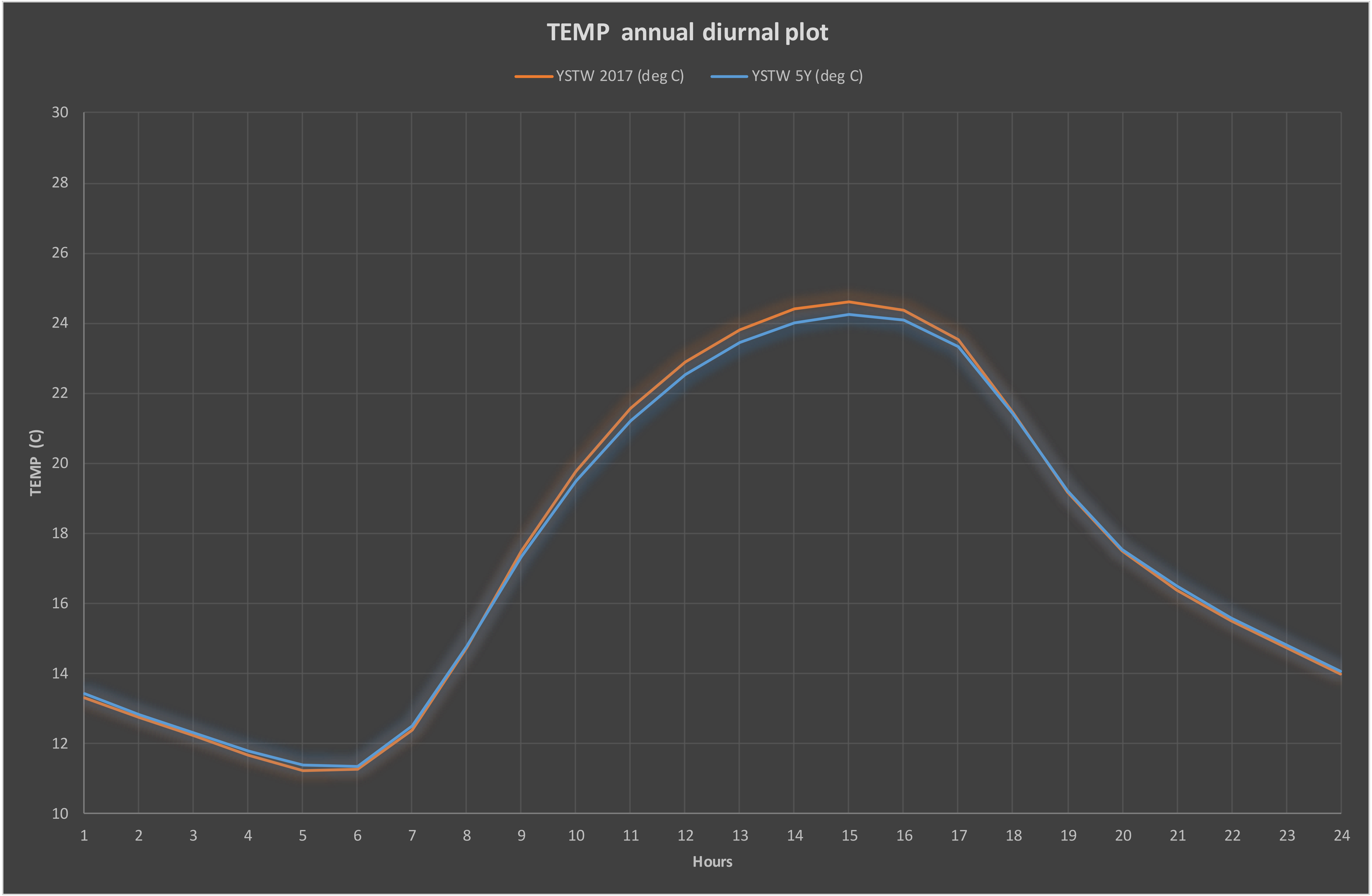


Figure 4.7 – Annual diurnal temperature for YSTW 2017 and 5-years

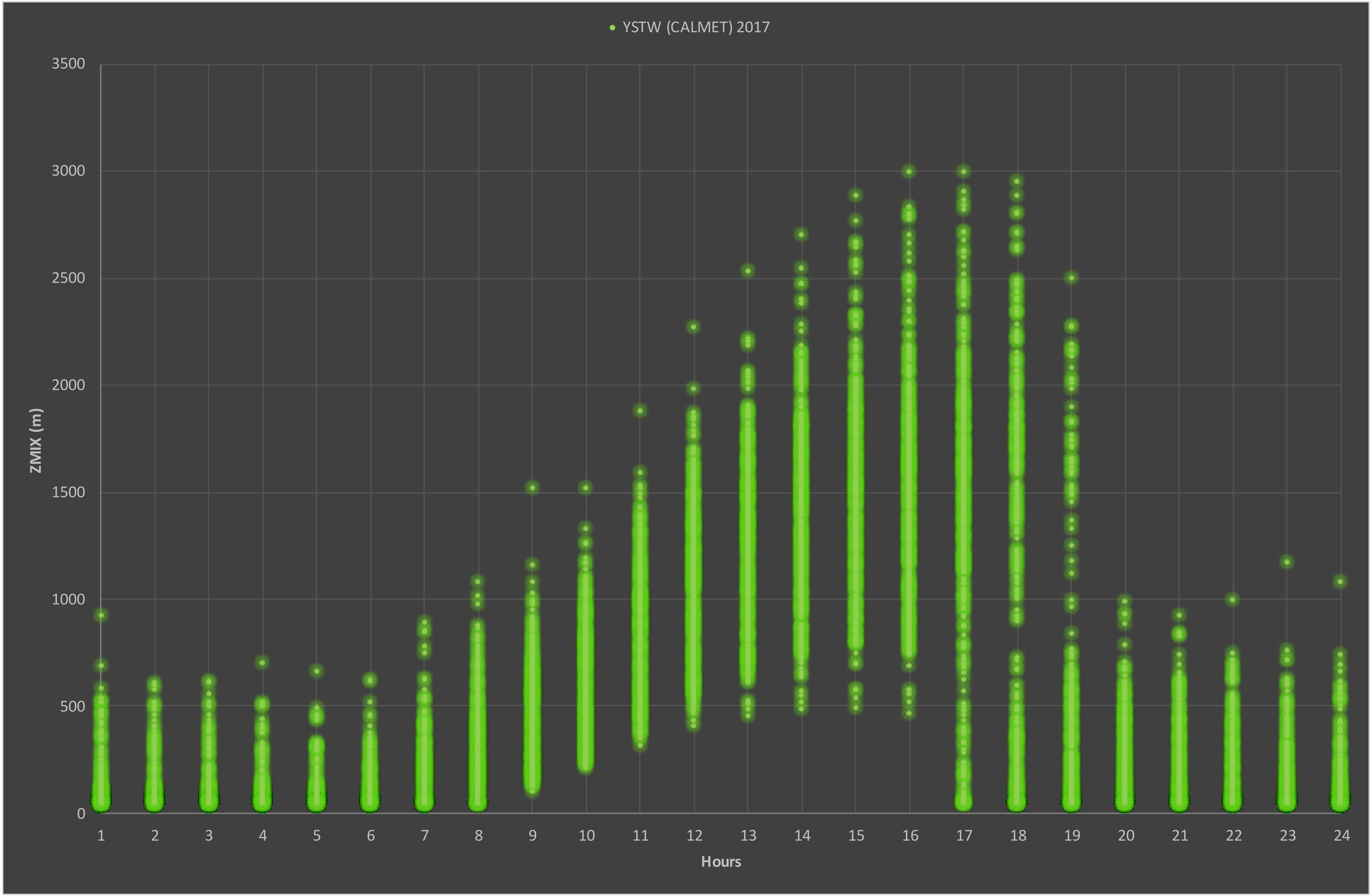


Figure 4.8 – Annual X-Y scatter plot diurnal mixing height for YSTW (CALMET) 2017

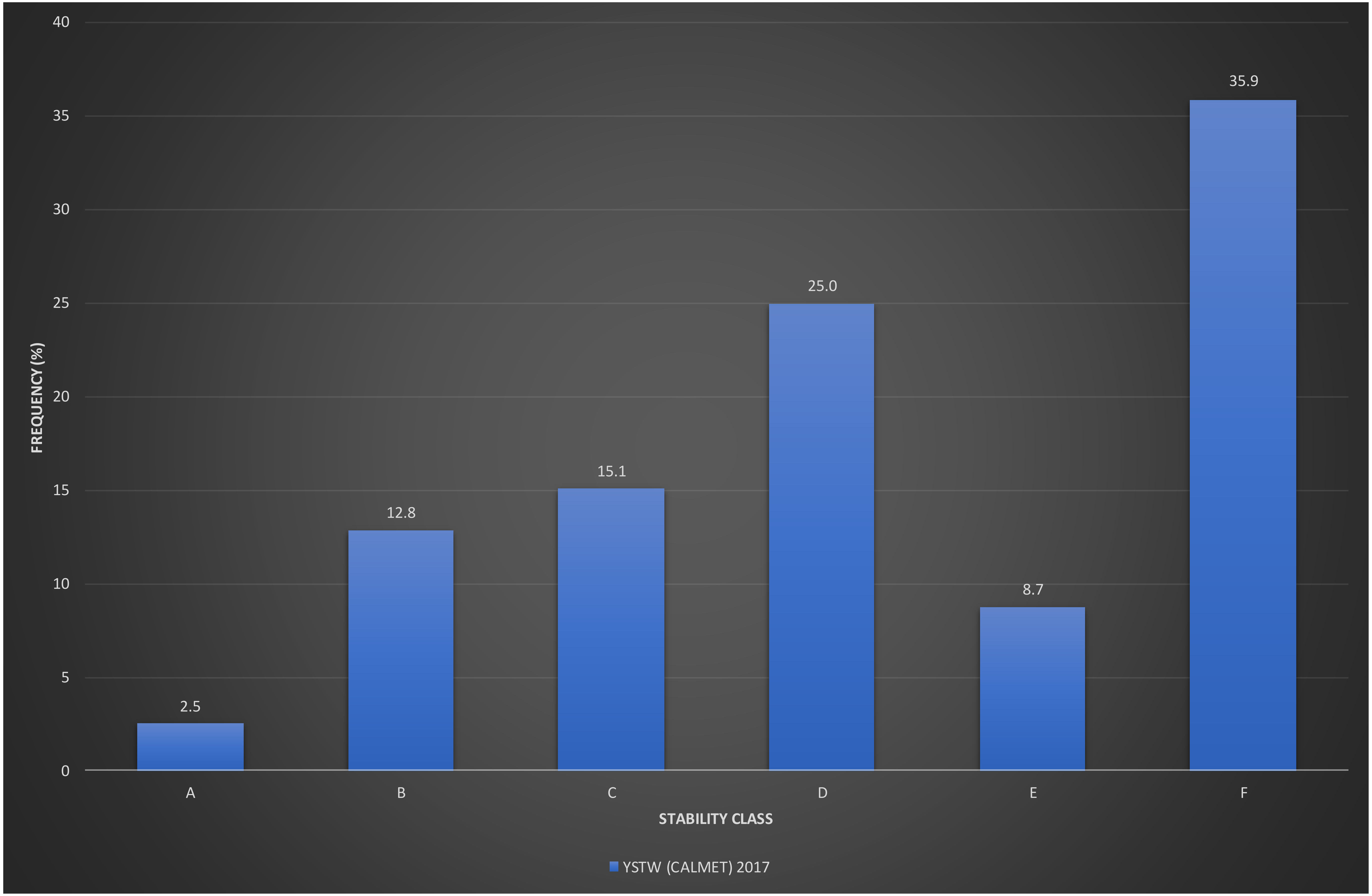


Figure 4.9 – Annual stability class frequency for YSTW (CALMET) 2017

4.2.9 CALPUFF Computational Domain and Receptor Configuration

The computational domain was set at 10 km by 10 km centred over Oakburn PRP. A receptor grid was created with a 4.4 km by 4.4 km by 0.05 km spacing centred over Oakburn PRP.

For the ancillary childcare centre, the 99th percentile odour concentrations were obtained from its location for both 24 hours per day operation and 14 hours per day operation (nominally from 5 am to 7 pm).

4.2.10 CALPUFF Source and Emission Configuration

Full odour source and emission configurations are available upon request.

4.2.11 CALPUFF Model Options

CALPUFF default model options were set except for the following as recommended in *Table A*-4 contained and explained within *Barclay & Scire, 2011*:

- Dispersion coefficients (MDISP) = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (2);
- Probability Density Function used for dispersion under convective conditions (MPDF) = Yes (1); and
- Minimum turbulence velocities sigma v for each stability class over land and water (SVMIN) = 0.2 m/s for A, B, C, D, E, F (0.200, 0.200, …, 0.200).

Further model configurations are available upon request.

4.3 ODOUR DISPERSION MODELLING SCENARIOS

The odour dispersion modelling scenario undertaken in the OIA are as follows:

- **Scenario 1** – Projected 5 ou (99%, 1-second) impact from all existing and proposed sources; and
- **Scenario 2** – Sensitivity Analysis: Cumulative odour effects from Oakburn and Bowlers Lane poultry farms.

5 ODOUR DISPERSION MODELLING RESULTS

5.1 ODOUR IAC

The procedure prescribed by NSW EPA during the notification phase of the proposed PPF to calculate the Odour IAC has been considered, namely:

> *"The AQR needs to be revised to include a 2 OU contour. The odour assessment criteria must then be based on the population within that 2 OU contour, including maximum capacity of the childcare centre. The maximum capacity of the Tamworth Regional Airport should be considered if it falls within the 2 OU contour."*

The predicted 2.0 ou (99%, P/M60) contour for the has been plotted in **Figure 5.1** It can be seen that the sensitive residences along Wallamore Road there were identified in the preliminary stages are not within the 2.0 ou contour and therefore unaffected according to NSW EPA procedure. The single rural residence to the north along Bowlers Lane is understood to be owned by TRC and will be removed and redeveloped into a compatible land use for the Westdale primary industry precinct. The remainder of the affected land uses intended for primary industry (i.e. agricultural/industrial) or non-passenger aviation, which are considered compatible.

The perceived sensitivity of the ancillary childcare centre to odour from the proposed PPF is debateable. Based upon the context and function of the proposal (i.e. employee family welfare), community expectations and recommended odour risk reduction measures for the ancillary childcare centre as part of an OMP, the residual odour annoyance risk at this location could be reduced significantly compared with a nearby stand-alone childcare facility without the recommended odour risk reduction measures implemented and having no commercial or functional relationship with Baiada.

Therefore, with all things considered including the history of IACs used for previous odour assessments for industries around the Westdale primary industry precinct, TOU considers that maintaining an odour IAC 5.0 ou (99%, P/M60) is the most appropriate and reasonable approach for this OIA and the proposed PPF.

5.2 RESULTS

The results in **Figure 5.1** reflect all sources at the 5.0 ou contour (99%, P/M60), specifically:

- Yellow contour – Proposed PPF including LBR and processing lines ventilation;
- Blue contour – Operational PRP WWTP and Proposed PPF WWTP sources;
- Red contour – Existing PRP fugitive and biofilter sources;
- White contour – All Oakburn (PRP, PPF and WWTP sources) combined;
- Dashed white contour – All PRP, PPF and WWTP sources combined (2 ou contour); and

- The results for the ancillary childcare centre location are shown in **Table 5.1** below. It should be noted the results do not consider the recommended odour risk reduction measures documented as part of the OMP for the proposed PPF, which is not quantifiable by odour dispersion modelling.

Table 5.1 – Projected ground level concentration at onsite childcare centre

UTM east coordinate (km)	UTM north coordinate (km)	24 hours operation (ou, 99%, P/M60)	5am to 7pm operation (ou, 99%, P/M60)
293.873	6560.858	9.2	7.0

The results in **Figure 3.2** reflects a sensitivity analysis for the 5.0 ou contour (99%, P/M60), where the cumulative odour effects are considered from Bowlers Lane poultry farms, namely:

- Solid white contour – All Oakburn site sources combined;
- Dashed yellow contour – Contribution from the LBR;
- Solid orange contour – Bowlers Lane Poultry Farms;
- Dashed contour – Cumulative effect of Oakburn site sources and poultry farms;
- It should be noted that the prediction of cumulative effects shown is almost certainly overstated as it considers all Oakburn sources including treated odours (e.g. biofilter, etc.) and odours of different characters (e.g. rendering, wastewater, etc.) that do not combine in the atmosphere and tend to be observed as individually identifiable odour characters in the field (as previously outlined in **Section 3.4**); and
- A more realistic analysis consistent with TOU's expectations of odour impact risk would consider the cumulative effect of the poultry farm (orange) contour with the LBR (dashed yellow) contour that has a similar live bird odour character.

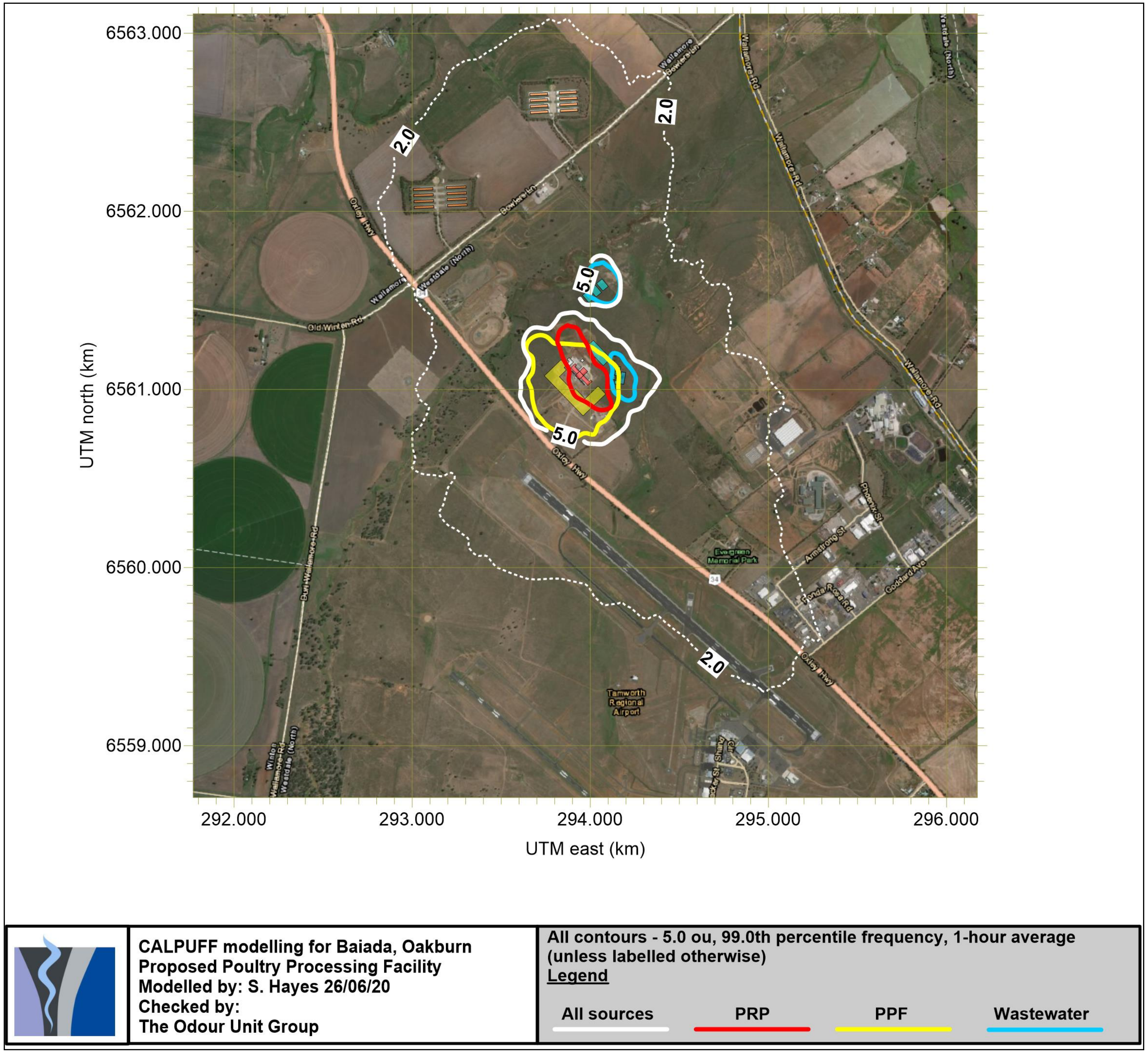
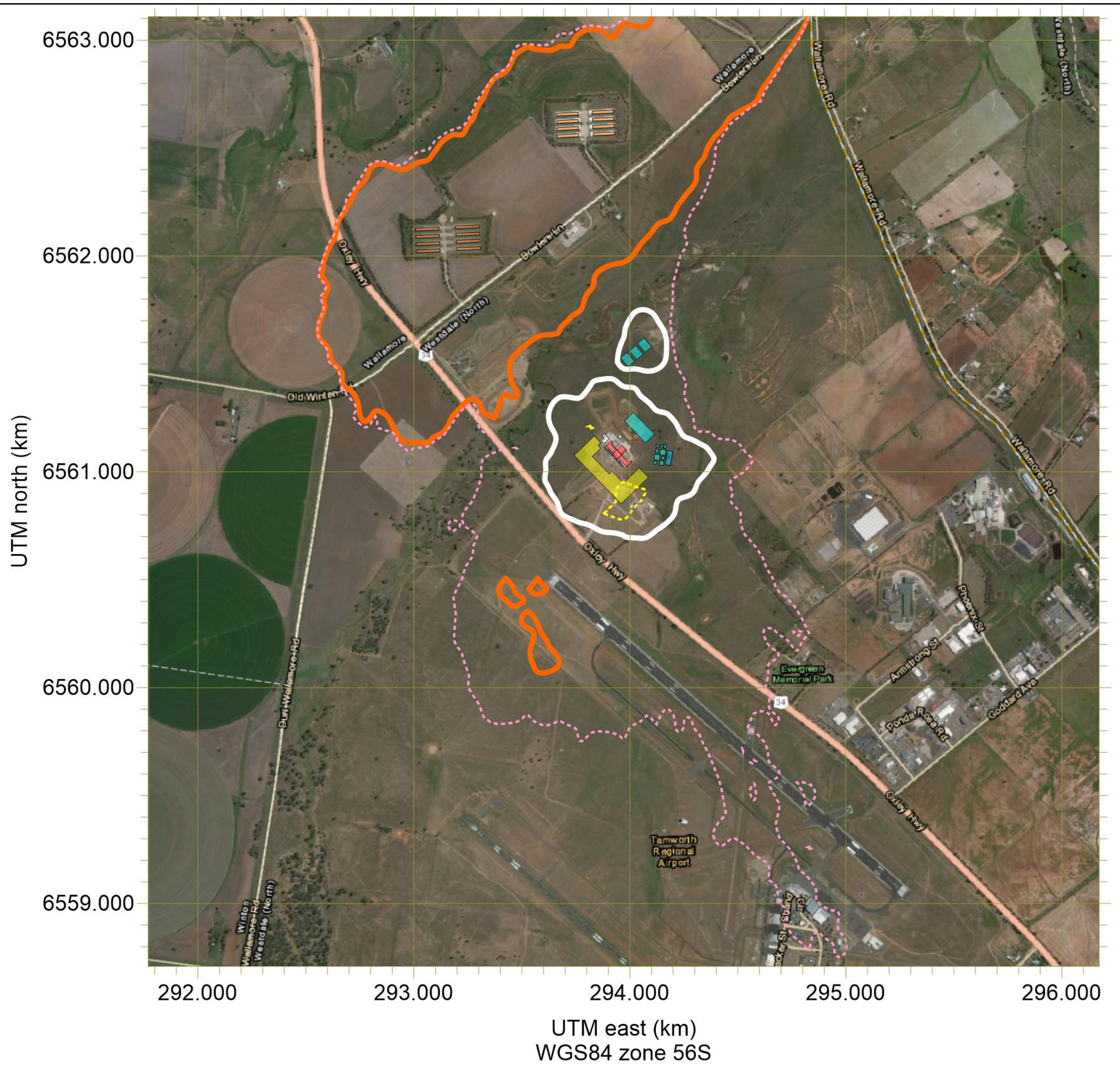


Figure 5.1 – Predicted ground level odour concentration – All sources



CALPUFF modelling for Baiada, Oakburn
Proposed Poultry Processing Facility
Modelled by: S. Hayes 26/06/20
Checked by:
The Odour Unit Group

All contours - 5.0 ou, 99.0th percentile frequency, 1-hour average

Legend

All Sources | **Live Bird Reception** | **Poultry Farms** | **Cumulative**

Figure 5.2 – Predicted ground level odour concentration – Sensitivity Analysis

6 FINDINGS AND CONCLUSIONS

The following section documents the findings and conclusions from the odour modelling process undertaken in the OIA for the proposed PPF. It should be read in conjunction with the modelling results provided in **Section 5**.

6.1 ODOUR MODELLING FINDINGS

The odour dispersion modelling assessment was carried out using the CALPUFF Modelling System with use of odour emissions estimates based upon measurements collected by TOU at Oakburn PRP, Baiada Hanwood Processing Plant and at the Out Street, Tamworth abattoir. All Oakburn odour sources have been assessed as a combined impact and separately grouped by origin: PRP, PPF and WWTP (i.e. inclusive of the AWTP). The odour impact from the PRP biofilters was included for conservatism despite being a treated emission.

It should be noted that the meteorology developed for the modelling overpredicted calm and light wind conditions, particularly from the south-south-westerly direction. This would have a conservative effect on the results, that is overpredicting the extent and magnitude of odour concentration projections, especially north-north-westwards from the site.

It is found that the addition of the proposed PPF modelled alone shows that the predicted odour impact does not largely exceed the NSW EPA odour IAC of 5 ou beyond the Oakburn site boundary as shown in **Figure 5.1**. The results show that the predicted odour impact for PRP and PPF WWTPs is below the NSW EPA odour IAC under the assumption that SBR night-time filling would be avoided and the PTB is mechanically ventilated by roof fans.

Overall, the results are below the odour IAC at the nearest sensitive receptor. The cumulative 5 ou contour encroaches beyond the site boundary marginally to the north and marginally to the south. Therefore, it has been found that the proposed PPF is unlikely to cause adverse odour impacts under normal conditions within the assumptions made for this assessment.

6.1.1 Childcare Findings

The results for the proposed childcare centre show that for both a 24 hour per day operation and a long-day operation, the odour IAC is predicted to be exceeded. The perceived sensitivity of the ancillary childcare centre to odour from the proposed PPF is debateable. Based upon the context and function of the proposal (i.e. employee family welfare), community expectations and recommended odour risk reduction measures for the ancillary childcare centre as part of an OMP, the residual odour annoyance risk at this location could be reduced significantly compared with a nearby stand-alone childcare facility without the recommended odour risk reduction measures implemented and having no commercial or functional relationship with Baiada. With due consideration to the information provided associated OMP, the residual odour impact risk rating for the ancillary childcare is considered to be low.

6.1.2 Sensitivity Analysis

The sensitivity analysis scenario, which assessed the cumulative odour effects from the proposed PPF with three poultry farms located to the northwest, demonstrates that there the model is sensitive to the presence of these sources. However, prediction of cumulative effects shown in **Figure 5.2** is almost certainly overstated as it considers all Oakburn sources including treated odours (e.g. biofilter, etc.) and odours of different characters (e.g. rendering, wastewater, etc.) that do not combine in the atmosphere and tend to be observed as individually identifiable odour characters in the field (as previously outlined in **Section 3.4**).

6.2 CONCLUDING REMARKS

Given the complexity and scale of the proposed PPF operations, a modelling based OIA is not an ideal tool to help form a contingency plan for unpredicted operational odour impacts or adequately predict the real-world impacts from measures designed to avoid, mitigate, manage and/or offset impacts (typical examples that support this position are the characteristics associated with treated quality emissions from a biofilter or aerobic wastewater treatment source, which in the OIA have been modelled and contributed to the cumulative odour impact prediction profile). These matters are best addressed by sufficient odour separation distances (i.e. odour buffers, when possible) and a site-specific OMP. A site-specific OMP is an important tool that facilitates in contextualising the modelling findings and give due consideration to the residual odour risk rating from the proposed engineered controls, monitoring and management protocols, and standard operating procedures that will support the proposed PPF operations. As such, on the basis that the proposed management practices and controls are implemented to that documented in the associated OMP, the residual odour impact risks for the proposed PPF operations will be significantly minimised to the degree that odour impacts in practice are unlikely.

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