Dunsandel Chicken Farm – Air Quality Assessment

Prepared for

Lifestyle Chickens Limited

May 2024

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Lifestyle Chickens Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Lifestyle Chickens Limited for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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1.0 Introduction

Lifestyle Chickens Limited (LCL) has engaged Pattle Delamore Partners Limited (PDP) to assess the potential air quality effects associated with its proposed chicken breeder farm at 227 Hunters Road, Dunsandel, Canterbury.

No chicken farming currently occurs on the site. LCL is proposing to construct eight sheds, with each shed housing up to 10,000 chickens.

PDP has been engaged to prepare an assessment of the potential air quality effects to accompany an application to Environment Canterbury for the appropriate resource consents. The odour assessment is based on the FIDOL assessment method and incorporates field odour assessments at a similar site as well as air dispersion modelling of the proposed operation.

Air quality effects of combustion emissions have also been considered, and the site's greenhouse gas emissions have been assessed against the National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat[1].

2.0 Background Information

2.1 Description of Proposed Chicken Farm

The proposed chicken farm is located at 227 Hunters Road, Dunsandel, Canterbury. The site is 8 km west of the town of Dunsandel, and 10 km north-east of the town of Rakaia. The location of the site is shown in Figure 1.

[1] Resource Management (National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat) Regulations 2023. New Zealand Government, June 2023.

Figure 1: Site Location

The proposed farm consists of the following:

- Eight enclosed sheds, each being approximately 126 m in length, 15 m in width, and 3 m in height. The maximum stocking density will be 5.5 birds/m².
- Egg conveying, fumigation, and holding rooms for each set of four sheds.
- Two 200 kVA diesel-fired generators.
- Eight ATLX 85 Indirect Gas Heaters, which will run on LPG.
- Staff facilities.

2.2 Local Meteorology

The topography of the surrounding area can influence wind speed and direction and can significantly affect how odour gets dispersed. The site is on a slight slope, with the elevation decreasing gradually to the east and south. Therefore, in this case, the topography is not likely to greatly affect odour dispersion.

The nearest publicly available meteorological data, from a station with a 10 m mast, is from the Darfield electronic weather station (EWS). Due to Darfield being located 20 km north of the farm, it is not considered representative of the winds experienced at the farm.

The distribution of hourly average wind speeds and direction has been extracted from a CALMET dataset[2] for the farm and is shown in Figure 2. The windrose shows that the predominant winds are from the northwest and northeast.

The frequency distribution of wind speeds has been provided in Table 1.

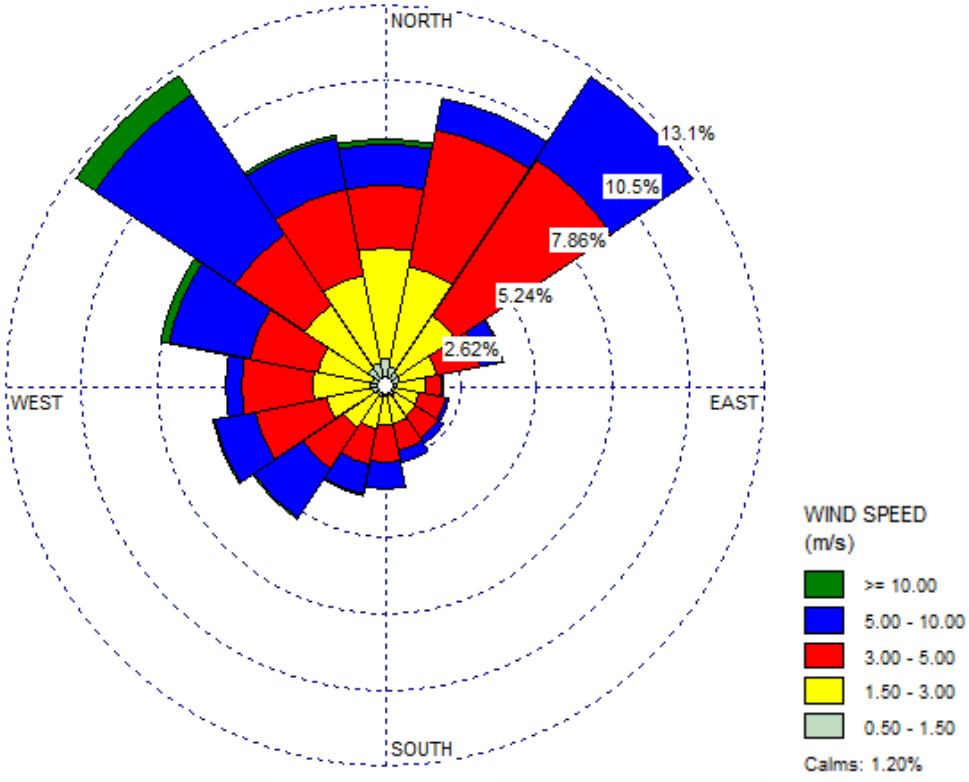

Figure 2: Windrose for the Site (CALMET)

[2] The development of this data set is described in Section 5.0

Table 1: Wind Speed Frequency Distribution			
Direction	Wind Speed Frequency (%)		Total (%)
	0-3 m/s	>3 m/s	
North	4.8	3.7	8.5
North northeast	4.3	5.9	10.2
Northeast	3.0	9.8	12.8
East northeast	1.9	2.3	4.2
East	1.4	0.6	2.1
East southeast	1.3	1.0	2.3
Southeast	1.3	1.2	2.5
South southeast	1.4	1.3	2.7
South	1.5	2.2	3.7
South southwest	1.7	2.3	4.0
Southwest	1.9	3.8	5.6
West southwest	2.1	4.0	6.2
West	2.5	3.0	5.6
West northwest	2.4	5.5	8.0
Northwest	3.5	9.5	12.9
North northwest	4.0	4.9	8.9
Total	**38.9**	**61.1**	**100**

3.0 Nature of the Discharges

3.1 Sources of Odour

The main potential sources of odour from the farm are:

- Litter;
- Chickens; and
- Litter and bird removal operations.

Other potential minor sources include:

- Decomposition of mortalities;

- Storage/treatment/disposal of other waste; and
- Feed decomposition.

3.1.1 Operational Measures

The following points outline the operational measures that will be used to control odour emissions.

- Ventilation will be managed through the use of an advanced computer control system. This ensures that humidity levels are controlled, which leads to better litter quality and reduced odour. If the chicken litter becomes too wet, odour can occur, but if the litter is too dry, dust issues could arise. Therefore, the computer system in each shed will monitor the humidity levels and air temperatures both inside and outside the building to manage ventilation. This system will be able to adjust the venting of the sheds accordingly for optimum conditions.
- The sheds are cleaned after each batch of birds and the litter is removed from site.
- Food (dry pellet feed) is conveyed from enclosed storage silos to feed pans within the sheds. Water is provided via nipple and cup drinks. This system reduces spillage which could contribute to damp litter and result in higher odour intensity.
- Mortalities are removed daily and stored frozen until off-site disposal.

3.2 Shed Design

The sheds will be 126 metres long and 14.8 m wide, with a ridge height of approximately 4.3 m. Each shed will have one horizontal fan at each end (BF 55 LPC model) and four horizontal fans along one side. The outer two side fans will be the BF 50 LPC-3 model, and the central two side fans will be the BF 50 LPC EL model.

3.3 Batch Cycles

Each cycle will take approximately 40 weeks. At the start of the cycle, dry, untreated wood shavings will be delivered and evenly distributed through the sheds. 20-week-old point of lay (POL) chickens will then be placed into the sheds and remain there for approximately 40 weeks. During this time the birds will be given access to food and water and will start the egg production cycle around 24 weeks of age. The birds will continue to produce eggs for the remainder of the 40-week cycle. During this period, the wood shavings will be combined with the chicken manure and break down into dry and friable litter. At approximately 60 weeks of age, the birds will be caught and processed offsite. Once the sheds are empty, the litter will be removed, and the sheds will be washed, cleaned, and sanitised. The cycle will then restart.

3.4 Combustion Emissions

The site will have a 200 kVA diesel-fired back-up generator for each set of four sheds, to provide electricity to the site in the event of a network supply outage.

LPG-fired heaters will be used to provide heat to the sheds when needed. The emission rates from the heaters will fluctuate as a result of temperature changes. However, the assessment of combustion emissions assumes that assesses the heating system running at full capacity 24/7.

4.0 Regulatory Compliance

The assessment contained in this report has considered the matters outlined in the following statutory documents:

- Resource Management Act 1991 (RMA);
- National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat (NES-IPH); and
- Canterbury Air Regional Plan (CARP).

4.1 Resource Management Act

Section 5(1) sets out the purpose of the RMA, which is '*to promote the sustainable management of natural and physical resources'.*

Section 5(2)(c) provides for this to occur while '*avoiding, remedying, or mitigating any adverse effects of activities on the environment'.*

Section 2 of the RMA defines '*environment'* and *'amenity values'* as follows:

"Environment"

Includes –

(a) Ecosystems and their constituent parts, including people and communities; and

(b) All natural and physical resources; and

(c) Amenity values; and

(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.

"Amenity Values"

those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreation attributes."

As odours can be considered to cause effects on amenity values, people, and communities, they need to be managed under the RMA. Since the compounds that cause odour effects are air contaminants, their discharge is therefore controlled under s.15 of the RMA. Under s.15(1) of the RMA, discharges from industrial or trade premises are only allowed if they are authorised by a rule in the regional plan, a resource consent, or regulation. If the activity is prohibited under a regional plan, then no resource consent can be obtained.

4.2 Regional Assessment Criteria

For the purposes of s.15 discharges, the site falls under the jurisdiction of Environment Canterbury.

The discharge to air from the site activities is covered under the restricted discretionary activity rule 7.67 of the CARP; as follows:

"7.67 The discharge of contaminants into air from intensive poultry farming, established on or after 1 June 2002 where the discharge is located at least 200m from a sensitive activity is a restricted discretionary activity provided the following condition is met:

1. *The discharge of odour does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2.*

The exercise of discretion is restricted to the following matters:

1. *The quantity, quality and type of discharge and any effects arising from that discharge, including cumulative effects; and*
2. *The methods to control the discharge and avoid, remedy or mitigate any adverse effects, including the odour and/or dust management plan; and*
3. *The location of the discharge, including proximity to sensitive activities, wāhi tapu, wāhi taonga or places of significance to Ngāi Tahu; and*
4. *The matters set out in Rule 7.2; and*
5. *Any effect on the environment of not meeting the condition or conditions of the particular rule contravened; and*
6. *Whether the conditions of the rule, when considered as a package, remain effective; and*
7. *Mitigation methods available to minimise any actual or potential environmental effects on the efficacy of the package of conditions."*

Under the CARP, the definition of intensive poultry farming *"means the keeping, rearing or breeding of 10,000 or more birds, whether for the purpose of the production of poultry for human consumption or for the purpose of egg production, where the predominant productive processes are carried out*

primarily within buildings, and includes (but is not limited to) intensive breeder poultry farming, intensive rearer poultry farming, intensive broiler poultry farming and intensive layer poultry farming, but excludes free range poultry farming and hatcheries."

As a breeder farm, the site meets the above definition.

Schedule 2 of the CARP is related to the assessment of offensive and objectionable effects and states the following matters are to be considered to determine "*whether or not a discharge of odour from an activity is likely to, or has caused "offensive or objectionable" effects beyond the property boundary:*

1. *The frequency of odour events; and*
2. *The intensity of events, as indicated by the degree of strength, but taking account of character or quality; and*
3. *The duration of each odour event; and*
4. *The offensiveness of the discharge, having regard to the character of the odour; including reference to the "hedonic tone"; and*
5. *The location of the odour, having regard to the sensitivity of the receiving environment, including taking into account the relevant zone(s) and provisions in the relevant District Plan"*

Schedule 2 also provides a list of tools that can be used, when determining whether odour emissions are offensive or objectionable beyond the property boundary. This includes:

- *"Complaint records;*
- *Community consultation;*
- *Odour annoyance surveys, and other surveying tools such as field investigations;*
- *Odour diary programmes;*
- *Review of process controls and design, including consideration of the best practicable option;*
- *Review of site management and contingency plans;*
- *Odour emissions measurement and dispersion modelling;*
- *Analysis of site specific wind and topographical features; and*
- *Experience and information from other sites where the discharge is of a similar nature and scale."*

4.2.1 Combustion Emissions

The relevant regional rules related to the combustion emissions from the chicken farm are also found in the CARP, with the specific rules for these activities presented in the AEE. However, in summary:

- The discharges from the LPG heaters do not comply with conditions 1 or 3 of Rule 7.20 and are therefore classed as a discretionary activity under Rule 7.24.
- The discharges from the emergency generators are classified as a discretionary activity under Rule 7.30.

4.3 Combustion Emissions Guidelines

The GPG ID[3] recommends an order of priority when reviewing air quality assessment criteria. The documents outlined below set out the minimum requirements that ambient air quality should meet in order to protect human health and the environment. This order of priority is as follows:

- MfE, Resource Management (National Environmental Standards for Air Quality) Regulations, 2004 (MfE, 2004);
- MfE Ambient Air Quality Guidelines (2002 update) (NZAAQG) (MfE, 2002);
- Canterbury Air Regional Plan, 2017 (CARP);
- World Health Organisation Air Quality Guideline (WHO AQG) Global Update 2005 (WHO, 2006);
- California Office of Environmental Health Hazard Assessment Reference Exposure Limits (OEHHA REL) www.oehha.ca.gov/air.html;
- US Environmental Protection Agency's Inhalation Reference Concentrations (US EPA RfC) www.epa.gov/iris/limits.htm;
- Texas effects screening levels (providing that these have been derived from toxicological data in a transparent manner) (Texas ESL) http://tceq.texas.gov/toxicology/esl; and
- Worksafe New Zealand Workplace Exposure Standards WES TWA divided by 50 for low and moderately toxic hazardous air contaminants or divided by 100 for highly toxic bio-accumulative or carcinogenic hazardous air contaminants.

[3] Ministry for the Environment, *Good Practice Guide for Assessing Discharges to Air from Industry*, November 2016.

Based on the order of priority recommended by GPG ID[4], the air quality assessment criteria are presented in Table 2. These standards and guidelines have been specifically developed to protect the health of the most sensitive individuals; therefore, if off-site concentrations are below them, there is no potential for adverse human health effects.

It should be noted that MfE has proposed a review of the NESAQ including adopting a $PM_{2.5}$ standard, although it is unclear when this will be progressed. For the purpose of this assessment, the values in MfE's discussion document[5] have been adopted.

The WHO has recently released updated AQGs, which are more stringent than those in its previous advice. The AQGs are presented as interim targets and final AQGs for each pollutant. The contaminants covered by these updated AQGs are $PM_{2.5}$, PM_{10}, ozone (O_3), NO_2, SO_2 and CO. The 24-hour $PM_{2.5}$, PM_{10}, NO_2, SO_2 and CO guidelines are the 99th percentile value (i.e. 3-4 exceedance days per year). At this stage these AQGs have not been adopted in New Zealand, therefore, PDP has used the current NESAQ and NZAAQG in preference.

Table 2: Relevant Assessment Criteria

Contaminant	Maximum Concentration (µg/m^3)	Averaging Period	Source
Carbon Monoxide	30,000	1-hour	NESAQ / NZAAQG
	10,000	8-hour	NESAQ
NO_2	200	1-hour	NESAQ
	100	24-hour	NZAAQG
	40	Annual	WHO AQG
PM_{10}	50	24-hour	NESAQ
	20	Annual	NZAAQG
$PM_{2.5}$	25	24-hour	Proposed NESAQ / CARP
	10	Annual	Proposed NESAQ / CARP
SO_2	350	1-hour	NESAQ
	570	1-hour	NESAQ
	120	24-hour	NZAAQG

[4] Ministry for the Environment, *Good Practice Guide for Assessing Discharges to Air From Industry*, November 2016.

[5] Ministry for the Environment, *Proposed amendments to the National Environmental Standards for Air Quality: particulate matter and mercury emissions – consultation document.* February 2020

4.4 Good Practice Guide Odour

The GPG Odour[6] provides guidance (but is not a statutory document) on the management of odour emissions from industrial facilities and the methods for assessing the likelihood these emissions could cause objectionable or offensive effects on an ordinary person.

The GPG Odour states that whether an odour has an offensive or objectionable effect requires "an overall judgement and considers the frequency, intensity, duration, offensiveness/character, and location of the odour event" (FIDOL factors). Table 5 of the GPG odour recommends a number of assessment tools that can be used for existing facilities, which are the same as those identified in Schedule 2 of the CARP.

The GPG Odour also sets out atmospheric dispersion modelling guidance, as it is not possible to directly compare atmospheric dispersion modelling results against the FIDOL factors. The values contained in the MfE GPG Odour are provided in Table 3.

Table 3: GPG Odour - Modelling Guidelines

Sensitivity of the Receiving Environment	Concentration	Percentile
High (worst-case impacts during unstable to semi-unstable conditions)	1 OU/m^3	0.1 and 0.5%
High (worst-case impacts during neutral to stable conditions)	2 OU/m^3	0.1 and 0.5%
Moderate (all conditions)	5 OU/m^3	0.1 and 0.5%
Low (all conditions)	5-10 OU/m^3	0.5%

Odour concentration percentiles were developed from dose/effect-based research, correlating modelled concentrations with population annoyance. It is MfE's guidance that the concentrations in Table 2 include the peak-to-mean ratio adjustment for all source types. MfE provides the following guidelines regarding Table 2, "*guidelines values should be used when considering the sensitivity of the receiving environment to assess modelling results and to determine whether the odour is likely to cause an adverse effect.*"

The chicken farm is located on land zoned rural, which allows for a range of normal rural activities to occur, and the odour that might be associated with them. Therefore, it would be likely to experience odours from silage, dairy effluent, or chicken litter as permitted activities in the immediate vicinity of the chicken farm.

[6] Ministry for the Environment, *Good Practice Guide for Assessing and Managing odour,* November 2016.

Therefore the sensitivity of the receiving environment is considered moderate, and the odour modelling results have been compared to the 5 OU guideline.

4.5 National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat

As a result of the 30 November 2022 amendments to the RMA, if a site discharges greenhouse gases (GHG), councils are required to assess these emissions when considering a resource consent application.

Following this amendment to the RMA, MfE has issued a National Policy Statement (NPS) and promulgated a Resource Management (National Environmental Standards) for GHG emissions from Industrial Process Heat Regulation (NES IPH)[7].

An assessment is required to be undertaken to determine whether LCL's site meets Regulation 10 of the NES IPH. This is:

"10 Restricted discretionary activity: device burns fossil fuel (not coal), etc

(1) The discharge of any greenhouse gas from a heating device is a restricted discretionary activity if the device –

(a) Burns any fossil fuel other than coal; and

(b) Is not a backup device; and

(c) Is not on a low-emission site.

(2) The discretion of a consent authority is restricted to the matters specified in –

(a) Regulation 16 and 17, if the device is new; or

(b) Regulation 17, the device is existing.

(3) A resource consent granted for the activity must –

(a) Last for the term specified in regulation 18; and

(b) Impose the conditions specified in Regulation 19."

Under the NES IPH, a low-emission site is one that, each year, emits less than 500 tonnes of carbon dioxide equivalent (CO_2-e) of greenhouse gases from heat devices that –

a) Burn any fossil fuel, and

b) Are not backup devices.

A GHG assessment for the site is provided in Appendix A. However, in summary, the site is considered to be a low-emission site and is predicted to emit

[7] Resource Management (National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat) Regulations 2023, *26 June 2023.*

approximately 60 tonnes of CO_2-e emissions per year. As a result of this, LCL does not require a consent under the NES IPH.

5.0 Assessment Methodology

5.1 Sensitive Receptors

A desktop study was undertaken to identify discrete receptors deemed sensitive to changes in air quality resulting from discharges to air from the site.

In the context of this report, the term 'sensitive receptor' is defined as locations where people or surroundings may be particularly sensitive to the effects of air pollution. This type of receptor is defined in the CARP as dwellings, schools, meeting places and retail premises.

The nearest potentially sensitive receptors are summarised in Table 4, and Figure 3 shows them graphically. PDP has identified all residences within 1 km of the sheds as sensitive receptors.

Table 4: Locations of Sensitive Receptors within 1 km of the Sheds

Receptor name	Address	Distance from the nearest shed (m)	Direction relative to the site
R1	319 Sharlands Road	220	East
R2	282 Sharlands Road	700	East
R3	269 Parkins Road	695	South
R4	179 Hunters Road	255	South
R5	375 Sharlands Road	245	North
R6	391 Sharlands Road	385	North
R7	394 Sharlands Road	295	North
R8	394 Sharlands Road[1]	790	North

Notes:

1. *R7 and R8 are on the same property.*

Figure 3: Map of Sensitive Receptors

5.2 Atmospheric Dispersion Modelling

The atmospheric dispersion modelling assessment was conducted using CALPUFF (Version 7), which has been extensively used in New Zealand and Australia and is a recommended model in MfE's Good Practice Guide for Atmospheric Dispersion Modelling (GPG ADM), particularly for sites surrounded by complex terrain and/or in complex settings. The CALPUFF model was set up in accordance with the guidance contained in the GPG ADM.

A two-year dataset running from 6 January 2019 to 10 January 2021 was developed in line with good practice.

5.2.1 Meteorological Data

A three-dimensional meteorological dataset was developed by the University of Canterbury using the Weather Research and Forecasting Model (WRF[8]). The WRF dataset covered the Canterbury Region at a 1 km resolution for the years 2019-2020. The WRF dataset was then used to provide inputs to the CALMET meteorological model which covered a 40 km x 40 km domain with a 1 km grid spacing. No surface observations were incorporated into the CALMET model.

The default terrain file (SRTM1), and the default land use (GLCC Australia Pacific ~1 km) were used to generate the CALMET model. The default values were

[8]https://www.mmm.ucar.edu/weather-research-and-forecasting-model

deemed suitable because the surrounding area has no significant land use factors that would impact dispersion.

5.3 Model Configuration

The CALPUFF model was configured to predict contaminant ground-level concentrations (GLCs) at a grid of receptor locations (Section 5.1). The sensitive receptors identified in Section 5.1 were included in the model as discrete receptors.

The presence of buildings and other structures close to stacks can result in building downwash effects on plumes, where the wind in the wake of the building can pull a plume towards the ground. The effect of building downwash was accounted for using the Building Profile Input Program (BPIP) building downwash algorithm.

5.4 Determination of Odour Emission Rates

There are two generally accepted methods used for calculating odour emission rates on chicken farms: mass-based and ventilation-based. In this assessment the ventilation-based method has been used as it is considered to provide a more realistic representation of the emissions.

5.4.1 Ventilation-based Emissions

An odour emission methodology for chicken farms based on ventilation rates has been developed for the Queensland Department of Employment, Economic Development and Innovation (DEEDI)[9]. This method uses the following equation:

$$OER = 0.025\, K\, A\, D\, V^{0.5}$$

Where:

- OER is the odour emission rate (OU.m^3/s).
- K is a scaling factor relating to the design and management of the sheds – recent data[10] recommends using a K-factor of no less than 1.9 as it represents the most recent test data from new farms. Therefore a K-factor of 1.9 has been applied to all sheds.
- A is the total shed floor area (m^2).
- D is the shed bird mass density (kg/m^2).
- V is the ventilation rate (m^3/s).

[9] PAEHolmes. 2011. "*Best Practice Guidance for the Queensland Poultry Industry – Plume Dispersion Modelling and Meteorological Processing".* Report prepared for Queensland Department of Employment, Economic Development and Innovation (DEEDI).
[10] AgriFutures Chicken Meat, *Planning and environment guideline for establishing meat chicken farms. Guide 1 Assessment Guide,* November 2021.

Ventilation rates are determined as a percentage of the maximum ventilation rate. This is based on the difference between the internal target temperature and ambient temperature (Rural industries guidance document[11]). The CALMET dataset has been used to determine the ambient temperature at the farm.

The Queensland DEEDI guidance document recommends a fixed mass density number. As the birds will be 20 weeks old and considered mature on arrival, PDP has modelled a constant weight of 5 kg per bird, with 10,000 birds being present in each shed year-round.

The total odour emission rate predicted from the site over the 2-year modelling period is provided in Figure 4.

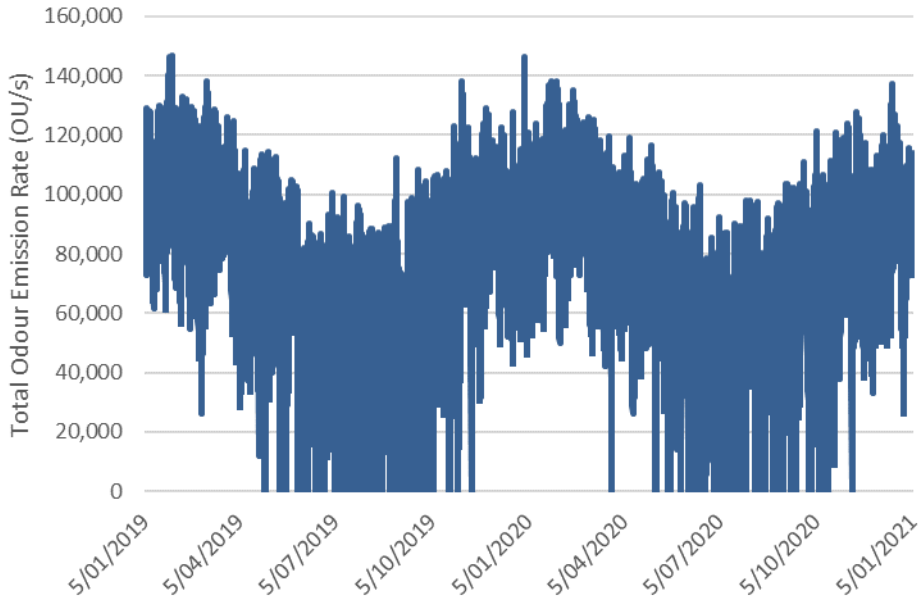

Figure 4: Predicted total chicken farm odour emission rate over a 2-year period

5.5 Determination of Combustion Emission Rates

The site will have eight 78.5 kW ATLX85 LPG-fired heaters (one per shed). For the purposes of this assessment, PDP has conservatively assumed that the heaters will operate 24 hours per day, seven days per week.

NO_X, CO, and PM concentrations in the discharge were determined using US EPA AP-42 emission factors and SO_2 concentrations were determined using the maximum sulphur content allowed in LPG in New Zealand. The following emission rates have been determined:

[11] Rural Industries Research & Development Corporation, *Odour Dispersion Modelling of Meat Chicken Farms Comparison of AERMOD, AUSPLUME and CALPUFF models,* October 2014.

- NOx – 0.0064 g/s
- CO – 0.0037 g/s
- PM – 0.00035 g/s
- SO_2 – 0.00058 g/s

For further conservatism, all NOx has been modelled as NO_2 and all PM has been modelled as PM_{10} and $PM_{2.5}$.

As the emergency generators are only used as a result of a power outage or for testing, the potential emissions have not been modelled.

6.0 Odour Assessment

6.1 Air Dispersion Modelling Results

The 99.5th percentile predicted 1-hour average odour concentrations from the farm are provided in Table 5 for each year of the model. The results vary between years due to the different meteorological conditions.

Table 5: Odour Dispersion Modelling Results

Receptor	99.5%ile 1-Hour Average Odour Concentration (Odour Units)	
	2019	2020
R1	4.6	4.9
R2	1.7	1.8
R3	3.0	2.7
R4	5.7	5.0
R5	6.3	7.2
R6	4.4	5.0
R7	4.7	5.2
R8	1.6	1.5

6.2 Model Validation

In order to validate the odour modelling, PDP has compared odour observations taken at a similar breeder farm with the modelling results. The observations were taken at the Tegel Foods Limited chicken breeder farm at 736 Tramway Road, Darfield. That farm is expected to have similar odour emissions to the

proposed farm as it also has eight sheds, arranged in two sets of four, and uses the same fans for ventilation.

Odour observations were taken on two occasions, 18th April 2024 and 24thApril 2024. The ambient temperature was approximately 17°C at the time of the first visit, and 16 °C during the second visit. Both days were sunny, with light winds from the northwest.

On the 18th of April, two sets of 10-minute observations were taken. The first was taken approximately 50 m downwind of the sheds. The second was taken across the road, approximately 60 m downwind of the sheds.

On the 24th of April, two sets of 10-minute observations were taken. The first was taken approximately 60 m downwind of the sheds. The second was taken approximately 50 m downwind of the sheds.

The odour observation locations are shown in Figure 5, numbered chronologically.

Figure 5: Odour observation locations

Table 6 summarises the strength and frequency of odours observed. All odours observed had a chicken litter character.

Table 6: Odour Observation Results				
Sample Number	Distance from the nearest shed (m)	Odour Strength		
		No Odour	Very Weak	Weak
1	50	48%	33%	18%
2	60	80%	18%	2%
3	60	68%	20%	12%
4	50	60%	23%	17%

Figure 1 shows that odours were detected less frequently further from the sheds.

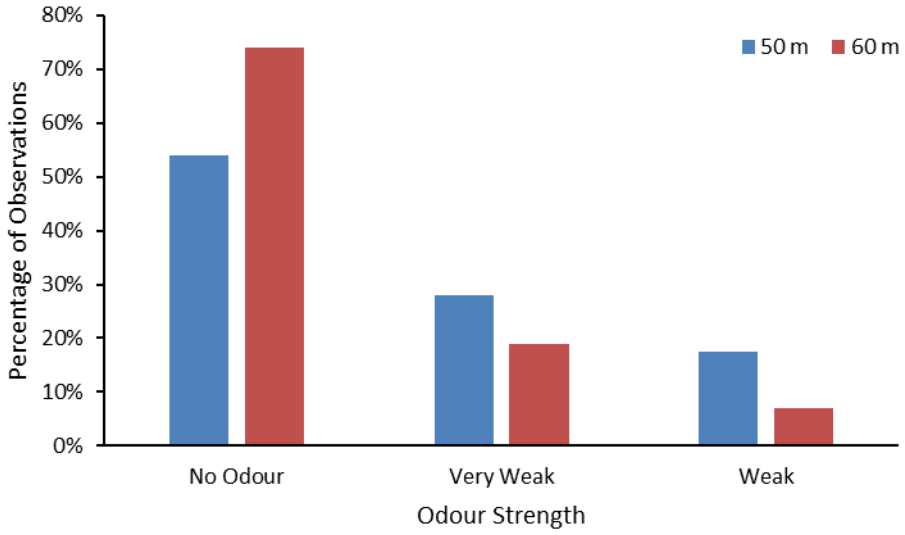

Figure 6: Summary of odour observations

The odour observations were compared to odour modelling results extracted from CALPUFF for a period with a similar wind speed, wind direction relative to the sheds, temperature, and time of year. These results predicted an odour concentration of 13 to 16 OU 50-60 m downwind of the sheds.

It is not possible to directly compare the observed odour strength to modelled odour concentration. However, the Department of Environmental Protection, Western Australia[12] has undertaken work that provides estimates of the relationship (Table 8) which PDP has used to convert the predicted concentrations to intensity.

[12] Department of Environmental Protection Perth, Western Australia, *Odour Methodology Guideline,* March 2002.

Table 7: Odour Strength to Odour Unit Comparison			
Odour Strength	**Intensity Level**	**Concentration using Web-Fechner (OU)**	**Concentration using Stevens Law (OU)**
Extremely Strong	6	144	79
Very Strong	5	52	42
Strong	4	19	20
Distinct	3	7	7.8
Weak	2	2.5	2.6
Very Weak	1	0.92	1.1
Not perceptible	0	0.34	-

The model predicts that the odour observed would have been distinct to strong, whereas the actual odour observed was very weak to weak, and was only observed intermittently. Therefore, the model appears to over-predict odour concentrations.

PDP has also undertaken odour observations at other chicken farms in Canterbury, and observed the same trend that the air dispersion model over-predicts the observed odour concentrations.

6.3 Shed Clean-out

The modelling assessment does not take into account shed clean-out and has assumed that the birds will be presented in the sheds year-round. However, after each cycle is completed there will be a shed clean-out period.

PDP has previously undertaken odour observations at another eight-shed chicken farm in Canterbury while the sheds were being cleared of litter. This farm was a broiler farm, with about three times the stocking density of the proposed Dunsandel breeder farm, so stronger odours would be expected. These observations showed:

- Once the chickens had been removed but the sheds were yet to be cleaned odour was only observed very close to the sheds (40 m).
- During removal of the litter from the sheds, odour fluctuated ranging from very weak to distinct and that odour decreased with distance, with distinct odours being observed less frequently 210 m from the sheds.

6.4 FIDOL Assessment

The FIDOL assessment tool is used to determine whether odours have the potential to be offensive or objectionable.

6.4.1 Frequency

Frequency relates to how often odours will be experienced at an off-site receptor. In terms of odour from the proposed operation, odour concentrations will be variable, as the air extraction rate depends on the ambient temperature. Therefore, the frequency at which odour could be detected at the neighbouring property will be a combination of the odour emissions from the farm and the meteorological conditions.

For odours to be experienced off-site, peak odour events have to occur during periods of poor dispersion, typically when wind speeds are below 3 m/s. Based on the meteorological data presented in Section 2.2, the predominant winds below 3 m/s occur from the north.

The modelling results in Table 8 indicate that the receptors will experience odour less than 5 OU 98.9% of the time. This indicates a low frequency of conditions with the potential to cause off-site odour nuisance effects. Given the infrequency of shed clean-out (which is not included in the model) it is unlikely to have any impact on the frequencies.

Table 8: Percentage of time above 5 OU for each receptor

Receptor	Hours above 5 OU per year		% of time	
	2019	2020	2019	2020
R1	37	42	0.4%	0.5%
R2	0	1	0%	0.01%
R3	8	4	0.1%	0.05%
R4	59	44	0.7%	0.5%
R5	81	111	0.9%	1.3%
R6	33	45	0.4%	0.5%
R7	39	46	0.4%	0.5%
R8	1	0	0.01%	0%

6.4.2 Intensity

Odour associated with chicken farming can have a strong intensity and can be considered offensive and objectionable. However, based on PDP's experience and field observations, this is usually only within 10 to 20 m of the sheds, with little odour detected beyond 300 m (broiler farms). When odour is detected off-site, it is usually weak in intensity, and intermittent. This is backed up by the odour observations undertaken, where only weak and very weak odours were

detected at 50 m, with no odour being detected approximately 50% of the time. Given the relatively low intensity and the intermittent nature of the odour, it is unlikely to be considered offensive or objectionable.

Intensity is also related to wind conditions as this determines the level of dilution that occurs between the source and the receptor. In essence, the stronger the wind, the more dilution of odour will occur. Considering the distance from the site to the receptors and the height of the discharge, odour from the farm should generally be well diluted before it reaches residential properties the majority of the time.

Based on the modelling results presented in Section 6.1, there is potential that some off-site receptors could experience an odour concentrations above the guidance criteria of 5 OU, however based on the odour observations this would correlate to weak to very weak odour.

6.4.3 Duration

As discussed previously, there will likely be some level of odour associated with the chicken farm, however, odours will generally be of a low intensity and only detectable onsite or very close to the sheds.

As with frequency, the duration someone could be exposed to odour will depend on the amount of time the wind is blowing in a specific direction along with the activities occurring. Overall odour emissions during the cycle are highly variable and dependent on the following factors:

- Ambient temperature;
- Humidity; and
- Litter control.

Typically, the duration of odour experienced off-site under normal day-to-day operations is short and intermittent. This is due to the exhaust fans constantly turning on and off to maintain a suitable environment for the birds. Fan operations are also further influenced by ambient temperature. In winter when the ambient temperatures are low, there would only be sufficient ventilation occurring to maintain a healthy environment.

Catching and clean-out are onsite activities that can occur for extended periods of time, as catching normally occurs in the early morning and the clean-out could be completed by mid-morning. The potential for odour from the clean-out is described in Section 6.3.

6.4.4 Offensiveness

If undiluted odours associated with chicken farming were experienced off-site, they would generally be considered offensive. However, the site is surrounded by rural activities with the closest receptor being 220 m away from the nearest shed.

The odour modelling results and observations at a similar site indicate that, for the majority of the time, the intensity of the odour will be weak, and would not be considered offensive. However, there will be occasions when some receptors will experience an elevated level of odour which might on occasions be considered offensive. However, this is likely to be less than that which might be experienced when chicken manure is spread.

6.4.5 Location

The location of the source in proximity to sensitive receptors is possibly the most important of the FIDOL factors. In general, the site is located in a rural setting and the pastoral areas will have a low sensitivity to odour given the infrequent and transient human occupation and the potential background agricultural odours.

The activities of the highest sensitivity to poultry farm odours in the area are isolated rural dwellings. However, these dwellings are already exposed to a range of odours, including from the application of chicken manure to land as a soil supplement which is a permitted activity.

Consequently, PDP does not consider that this area is particularly sensitive to odours.

6.4.6 FIDOL Assessment Conclusion

Taking all of the FIDOL factors into account, PDP does not consider that the proposed farm will have any significant impact on off-site odour or result in off-site odour nuisance effects.

7.0 Combustion Emissions Assessment

The predicted maximum off-site concentrations for the combustion emissions from the heaters are presented in Table 9 and are compared to the relevant assessment criteria (provided in Table 2). Given the low predicted off-site concentrations, only the maximum off-site concentrations have been provided.

Even with background values added, the predicted concentrations would not result in any exceedances of the NESAQ.

Table 9: Summary of maximum off-site concentrations

Contaminant	Averaging Period	Maximum Off-site Concentration ($\mu g/m^3$)	Assessment Criteria ($\mu g/m^3$)	Percentage of Criteria (%)
CO	1-hour	20.7	30,000	0.1%
	8-hour	7.92	10,000	0.1%
NO_2	1-hour	35.8	200	18%
	24-hour	14.0	100	14%
	Annual	0.91	40	2%
PM_{10}	24-hour	0.76	50	2%
	Annual	0.05	20	0.3%
$PM_{2.5}$	24-hour	0.76	25	3%
	Annual	0.05	10	1%
SO_2	1-hour	3.25	350	1%
	1-hour	3.25	570	1%
	24-hour	1.26	120	1%

8.0 Conclusions

Having assessed the air discharges from the proposed expansion, PDP concludes that off-site odours are predicted to be below the 5 OU MfE Guideline value for more than 98.9% of the time.

Given the nature of the area, PDP considers it unlikely that the proposed farm will result in odours that are considered offensive or objectionable.

The pollutant concentrations from the LPG-fired heaters are well below the health guideline values for all contaminants assessed.

The site is considered a low-emissions site under the NES-IPH and therefore does not require a resource consent for discharges of greenhouse gasses.

Overall, PDP considers it unlikely that the site will result in off-site air quality effects.

Appendix A: Greenhouse Gas Assessment

LCL is proposing to install eight 85 kW LPG heaters at the farm. As chicken sheds do not require continuous heating, LCL has provided PDP with the estimated fuel usage for a farm of the same size in Canterbury (20,300 kg/year).

Based on the calculations provided in the MfE guidance[13], the GHG emissions calculated using the LPG emission factors are provided in Table A1. The emission factor uncertainty of 0.5% provided by MfE has been used. The uncertainty in the annual LPG usage has not been quantified.

Table A1: Greenhouse Gas Emissions

LPG Usage (kg/year)	GHG Emissions (t CO_2-e/year)	CO_2	CH_4	N_2O	Emission Factor Uncertainty
		(t CO_2-e/year)			(t CO_2-e/year)
20,300	60.4	60.2	0.00002	0.00008	± 0.3

Overall LCL is estimated to produce 60.2 ± 0.3 tonnes of carbon dioxide equivalent per year. This means that LCL is considered a low-emission site under the NES IPH and does not require consent for discharges of greenhouse gases.

[13] Ministry for the Environment, *Te ine tukunga: He tohutohu pakihi Measuring Emissions: A guide for organisations 2023 detailed guide, July 2023.*