Decision Report

Application for Licence

Part V Division 3 of the *Environmental Protection Act 1986*

Licence Number	L9350/2022/1
Applicant	Christopher George David Vogel
File number	DER2022/000437
Premises	Dellendale Creamery 308 Churchill Road, SCOTSDALE, WA 6333 Legal description Lot 2091 on Plan 130312 As defined by the premises map attached to the issued licence
Date of report	03/02/2023
Decision	Licence granted

Table of Contents

1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from emissions and discharges during the operation of a cheese manufacturing facility at Dellendale Creamery, 308 Churchill Road, Scotsdale, WA (premises, Dellendale Creamery). As a result of this assessment, licence L9350/2022/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary and overview of premises

On 31 August 2022, Christopher George David Vogel (the applicant) submitted an application for a licence to the department under section 57 of the *Environmental Protection Act 1986* (EP Act).

The application is to seek a licence relating to the processing of milk to manufacture cheese and irrigate wastewater to land at the premises. The premises is approximately 6.4 km north of Denmark.

The premises relates to the category 17: milk processing and a design capacity of 400,000 litres (L) per year and an assessed cheese production of 265,000 L per year under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in licence L9350/2022/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in licence L9350/2022/1.

2.2.1 Background

The premises was issued with a works approval W4142/2005/1 on the 6 July 2005 which expired on 4 July 2008. The applicant did not submit compliance documentation on completion of the construction nor apply for a licence and has been operating and discharging waste to the environment not in accordance with a licence or works approval since~2005.

Dellendale Creamery processes milk to manufacture cheese and discharges untreated liquid waste and whey to land via irrigation.

The applicant uses the wastewater irrigation paddocks (approximately 40 ha) to raise cattle for a nearby milking dairy The remainder 20 ha is used to support a small herd of beef cattle. Cattle are rotated on the pasture paddocks for most of the year, with hay and silage cut from the property and fed out as grass growth slows and feed diminishes in the dry part of summer and exported from the property. Occasionally additional hay is imported to the property for feed. No other imported feed supplements are currently provided to livestock. Until recently whey-based wastewater was directed to paddocks from twin pipes rotated through the paddocks.

2.3 Infrastructure and operational aspects

Infrastructure

The existing milk processing facility infrastructure, as it relates to Category 17 activities are:

- Enclosed cheese production building including cellar 1, cellar 2, laboratory, cool room, packaging storage area, 500L batch pasteurizer, press ultrasonic cleaner.

- Volumetric flow meter on the potable water intake.
- Roofed, two side open milk van bay with open drains.
- Roofed two sided washdown area with open drains.
- Enclosed cheese storage cellar 3
- 1,300 L below ground wastewater sump, fitted with a sump pump
- 10,000 L wastewater holding tank fitted with a holding tank pump
- Overflow drain/pipe connected to sump and holding tank directed to pasture.
- 3,500 L wastewater truck for paddock irrigation
- 55 ha paddocks comprised of kikuyu, ryegrass, and clover

Operations (from application)

Dellendale Creamery operates 5 days a week from 6 am to 6 pm, the equivalent of 260 days a year. Cheese is produced from milk, bacterial cultures, rennet (enzyme Chymosin) and salt. Milk is received and transferred into the production shed where it undergoes manufacturing. Bacteria is added to the milk to start the production of milk sugar lactose into lactic acid in the curd and whey The rennet is added to the milk and coagulation occurs. The coagulated mass is cut into cubes allowing the separation of whey and curds. The curd is sometimes pressed to drain further, and bacteria added and to ripen cheese. The whey is collected and drains to a 1,300 L wastewater sump.

On average the cheese yield from milk is 10% for every 10 L of milk, this is 9 L of whey and 1 kg of cheese. Potable water is used to wash the curd during production and cleaning. The flow meter on the potable water intake indicated that a factor of 1.23 to the input of milk is used. This results in a liquid discharge of whey, water, and diluted cleaning products (household grade) at a volume 2.13 (0.9 +1.23) times the input of milk addition. The applicant provided the following milk to wastewater data.

- Current milk processing for 2021 and 2022 is 170,000 L/yr producing 362,100 L/yr (1,392.7 L/day) of wastewater.
- Long term milk processing 400,000 L/yr producing 852,000 L/year (3,276.9 L/day) of wastewater.

Any solid wastes from the manufacturing of cheese are stored within enclosed bins and taken off-site to landfill.

Wastewater Irrigation

Wastewater is irrigated onto pasture (kikuyu, ryegrass, and clover) via a spray behind a 3,500 L tank operating with a valve and through gravity pressure, pulled by vehicle. Target application rate is approximately 1mm. This is calculated with the width of the spray, rate of output, and vehicle speed. The paddocks are irrigated daily unless conditions require storage in the 10,000 L storage tank when soil is saturated and surface runoff conditions likely.

The irrigation area is a total of 55 ha divided into 18 summer irrigated paddocks and 15 winter irrigated paddocks. Paddock sizes range between 1.2 to 3.5 ha. The applicant has estimated that 1,500 L milk processed per day produces 3,195 L wastewater and this wastewater applied at 1mm would cover 0.32 ha/day, with a return interval of greater than 150 days.

The irrigated pasture is harvested for hay and silage and / or grazed for dairy / beef cattle at approximately 1 cow and calf per hectare. The pastures are dominated with ryegrass and annual clovers May to November and dominated by kikuyu between December and April when pastures have low soil moisture.

The applicant undertook an analysis of a wastewater sample taken in November 2020 and provided the following water quality results:

Table 1: Wastewater quality (from applicant)

Parameter	Applicant wastewater result	ANZECC 2000 – Primary Industries[2]
Total suspended solids (TSS)	2,200 mg/L	-
Total dissolved solids (TDS)	18,000 mg/L	3,000 mg/L
Oil and Grease	43 mg/L	-
BOD	20,000 mg/L	<15 mg/L
Electrical conductivity	3,500 µS/cm, 1,925 mg/L	-
Total nitrogen (TN)	400 mg/L	25 -125[3]
Total phosphorus (TP)	230 mg/L	0.8 -12[3]
Sodium	200 mg/L	-
Magnesium	35 mg/L	-
Calcium	170 mg/L	-
pH	6.2	6 - 9
SAR	3.7	-
Bacteria - *E.coli*	<10 cfu/100ml	-
Bacteria – Thermotolerant coliforms[1]	>1500 cfu/100ml	-

Note 1: Thermotolerant coliforms are fecal coliforms from fermenting lactose to acid and gas in the cheese manufacturing.

Note 2: National Water Quality Management Strategy Paper No. 4 – Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3 Primary Industries, 2000, ANZECC and ARMCANZ (ANZECC 2000).

Note 3: ANZECC 2000, requires site specific assessment to determine actual value

The applicant undertook soil analysis of 28 paddocks over 64 ha in January 2021 at a depth of 0 – 10 cm and provided the following soil analysis summary, however details of where samples were taken were not disclosed. The Phosphorus Environmental Risk Index (PERI) is a ratio of Cowells phosphorus to the phosphorus buffer index (PBI). This ratio provides an indication of the risk of soluble phosphorus loss. It is noted that most paddocks contain high levels of phosphorus and that paddocks have medium to very high capacity to bind phosphorus to the soil. The PERI indicates that there is a high to very high ability of the soil to leaching soluble phosphorus in the long term.

Table 2: Soil analysis results (from applicant)

	Phosphorus Buffer index (PBI)	pH	Phosphorus	PERI Phosphorus Environmental Risk Index
Category range	Hectares			
Very Low		6		

Low		41	8	4
Marginal / medium	26	17	5	17
High	23		51	23
Very high	17			17
Extreme				4

The applicant submitted a farm gate nutrient budget based on 187,000 L milk input, a water balance based on a 400,000 L of milk input, and screening criteria for land suitability, the following summarises their assumptions and outcomes.

Assumptions

- Rainfall 955 mm/year.
- Irrigation 52 weeks per year, 5 days per week, 260 day a year.
- Irrigation rate of 1mm per day, irrigating 12 months a year.
- Water balance considered pasture grazing with a stocking rate 1 cow and calf/ha
- Irrigation area was 55 ha
- Grazing area of 60 ha.
- 750 kg x 200 silage bales removed per annum (remove TN -3176kg, TP -486kg) for nutrient budget
- Forage redistribution – silage/hay cut on premises is recycled back out to cattle on irrigated pasture, recycling nutrients
- Additional fertiliser on harvest paddocks including:
    - 20 ha of silage/hay dressing in July (N - 214 kg, P – 47 kg)
    - 25 ha of silage/hay dressing in September (N – 335 kg, P - 74 kg)
    - 60 ha of fertiliser on all paddocks in May (N – 237 kg, P – 268 kg)
- Irrigated wastewater 168,300 (187,000 L milk *0.9), consisting of N – 237 kg and P – 74 kg
- Nutrient balance calculated animal grazing liveweight gain of 300 kg * 100 head (100/60 = ratio of 1.67 head/ha) for dairy heifers.
- Reduced rotational area in winter / spring when paddocks locked up for harvest
- Irrigation area was 55 ha area with winter irrigation keep to paddocks further away from river and irrigate lower paddocks in summer closest to river.
- Storage of wastewater in 3,500 L cartage vehicle and 10, 000 L tank

Outcomes

- Phosphorus saturation/leaching 0.3 m every 10 years.
- The water balance indicated that storage of wastewater is required in July and August as water balance inputs exceed outputs (excess of 31.2 mm/month and 37.2 mm/month respectively).
- Nitrogen and phosphorus loadings (fertiliser for plant growth, wastewater applications, cattle grazing) less than removal (harvesting of silage/hay and cattle growth).
- BOD and salinity not considered in assessment.

- Screening of site suitability indicated area not suited for irrigation less than 200m from a waterbody (Denmark River).

The applicant provided the following general information on the irrigation.

- High salinity levels of wastewater would be minimised through spray design, infrequency of application and timing to the cool and still of the day.
- High BOD levels of wastewater would be minimal as the applicant has not observed problems in the soil or odour.
- That leaching and surface water runoff would be reduced through the storage of wastewater in the 10,000 L storage tank, with a storage capacity of 3 operational days for July and August operating at full design capacity (400,000 L milk processed per annum).

Key Findings

The delegated officer has reviewed the information gathered from the application and supporting documents and concluded that:

1. *The applicants water balance determined that storage was required for July and August. For a 400,000 L and 170,000 L milk processing input there is approximately 3- and 7-days storage respectively. The applicant does not have enough storage for wastewater. The applicant indicated that production would cease once storage was full.*
2. *The wastewater to be irrigated has no treatment before discharged to land and has excessive concentration levels of TN, TP TDS and BOD compared to recommended concentration values for irrigated water from the ANZECC guidelines for primary industries (2000).*
3. *That phosphorus will leach over the long term, where the premises is bound by 2.1 km of the Denmark River draining to the Wilson Inlet.*
4. *The applicant applies both fertiliser and irrigated wastewater to paddocks.*
5. *Nutrient budget allowed a stock ratio of 1.67 (1 cow and calf) head/ha but has used 1 head/ha elsewhere in the application.*
6. *The nutrient balance used milk processing to wastewater factor of 0.9, and not the 2.13, indicating that wastewater nutrient loading figures may be underestimated.*
7. *Nutrient budget and water balance were based on two different milk input amounts.*
8. *The delegated officer concluded the water and nutrient balances were not mutually supporting and that the irrigation of untreated wastewater will leach salts and phosphorus over time.*

3. DWER technical review

3.1.1 Existing wastewater quality

DWER reviewed the wastewater quality against the National Water Quality Management Strategy Paper No. 4 – Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3 Primary Industries, 2000, ANZECC and ARMCANZ (ANZECC 2000). The ANZECC 2000 Guidelines for Primary Industries is listed in Table 1, and noted the following.

BOD levels

ANZECC 2000 recommends that for primary industries BOD for irrigated wastewater should be less than 15 mg/L. The applicant's wastewater BOD levels are over a 1000 % higher. It is noted that treatment of the wastewater through aspiration in an aerobic treatment tank will reduce BOD.

Nutrient levels

Nutrients including total nitrogen and phosphorus reported levels were higher for primary industries irrigated wastewater recommendations under ANZECC 2000. The current nutrient levels for total nitrogen and phosphorus are 3.3 and 19.1 times higher respectively. Treatment of the wastewater to reduce nutrient concentrations would be beneficial to reduce long-term leaching through the soils of the irrigated area.

TDS and salinity

DWER assessed the levels of salt irrigated to pasture. Salt level concentrations were 1,925 mg/l, this is classified as salty water (1425 - 2850 mg/L), where an irrigation of salt above 1,425 mg/L will result in yield loss for clover and ryegrass (DPIRD 2019). Kikuyu grass is more tolerant. The implications of irrigating with high salt wastewater will impact on the uptake of nutrients at the root zone as salt will inhibit nutrient assimilation. TDS levels were 6 times higher than the recommendation for irrigation to primary industries under ANZACC (2000). The applicant submitted soil tests for the irrigated pasture, and it was noted that the soil did not hold elevated salts. This indicates leaching of salts through the top layers of the soil towards the Denmark River. Over time this could lead to elevated salts building up in the lower paddocks adjacent to the Denmark River.

Overall, if the applicant treated their wastewater to a primary level, it is likely that TDS, BOD, TN, and TP levels would reduce closer to a more sustainable long term irrigation water quality.

3.1.2 Irrigation of wastewater

DWER undertook a water balance and hydraulic and nutrient loading assessment. The following assumptions and outcomes were determined (See Appendix 1 for details).

Assumptions

- Used Bureau of Meteorology (BOM) Denmark weather station 009531 average data from 2002 -2022, evaporation data and trans-evaporation data (2009-2022) from Albany 009500.
- Critical loading rates based on the ability of the vegetation to use the nutrients before they pass through the root zone based on the NSW EPA 1998 guidelines for the establishment of irrigation schemes for the land disposal of wastewater. Where the following loading rate maximums were used. Nitrogen 36 mg/m^2/day, phosphorus 4 mg/m^2/day and BOD 3,000 mg/m^2/day.
- Assessed using 400,000 L milk input contributed to 852,000 L wastewater annually.
- Assessed using 170,000 L milk input contributing 362,100 L wastewater annually.

Hydraulic outcome

- Hydraulic assessment for pasture indicated that input exceed output for May to September inclusive. Where storage of effluent would be required to minimise leaching. This is 5 months of wastewater storage (May to September inclusive) and a 30-week irrigation schedule (October to April).

DWER considered that May and September rainfall can be seasonally variable, and that irrigation can be managed to prevent leaching around rainfall events. However, DWER noted that over the last 10 years (2013-2022) of rainfall data in Denmark, there was an average of 14.1, 17.7 and 16.6 rain days for the months of June, July, and August respectively with monthly average trans-evaporation data for June 1.78 mm, July 1.69 mm, and August 2.11 mm a day. Furthermore, the applicant's water balance demonstrated that July and August required wastewater storage. Therefore, DWER considered that restrictive irrigation measures would be required from June to August over a three-month period that received the highest rainfall and rain days. Considering that these months would contribute to the greatest potential level of leaching and/or surface runoff off due to soil saturation, plant growth dormancy on the coldest / wettest days. DWER determined that:

- Nitrogen, phosphorus, and BOD were not limiting factors over a yearly irrigation period over 55 ha.
- Restrictive irrigation from June to August preventing irrigation when rainfall exceeds 2 mm of rainfall within 24 hours period.
- Current winter storage of wastewater is inadequate.
    - Three-month storage required for 400,000 L milk processed annually is 213,000 L (852,000/12*3). Applicant has a minimum of 3 days.
    - Three-month storage required for 170,000 L milk processed annually is 90,525 L (362,100/12*3). Applicant has a minimum of 7 days.

Wastewater loading rates

DWER calculated the loading rates for total nitrogen, phosphorus, and BOD for 170,000 L and 4000,000 L of milk processed and compared them to the applicant's nutrient balance calculations for wastewater. The department does not know how the applicant calculated their loading rates.

In considering that the applicant will add additional fertiliser to the irrigation areas. DWER calculated a loading limit for whey wastewater irrigation based on DWERs loading calculations for processing 170,000L of milk and added a 10 % margin (buffer for variability) for total nitrogen and phosphorus. A DWER loading limit for BOD was added based on the NSW EPA guidelines of 1,500 kg/ha/month.

Table 3: Nutrient loading calculations of wastewater to land

	Parameter	**Total Nitrogen**	**Total Phosphorus**	**BOD**
DWER calculated loadings from wastewater	Wastewater concentration	400 mg/L	230 mg/L	20,000 mg/L
	Annual load Based on 170,000L milk processed 362,100 L wastewater	144.84 kg/yr	83.28 kg/yr	7,242.0 kg/yr
	Loading rate Based on 55 ha over 52 weeks	2.64 kg/ha/yr	1.51 kg/ha/yr	131.67 kg/ha/yr 0.36 kg/ha/day
	Annual load Based on 400,000 milk processed 852,000 L wastewater	340.80 kg/yr	195.96 kg/yr	17,040.0 kg/yr
	Loading rate based on 55 ha over 52 weeks	6.20 kg/ha/yr	3.56 kg/ha/yr	309.82 kg/ha/yr 0.85 kg/ha/day
Applicants Nutrient balance loading details	Wastewater concentration	400 mg/L	230 mg/L	20,000 mg/L
	Annual load taken from applicant's nutrient balance Based on 187,000 *0.9 processing 168,000 L wastewater	237 kg/yr	74 kg/yr	-
	Loading rate Based on 55 ha over 52 weeks	4.3 kg/ha/yr	1.35 kg/ha/yr	-

DWER Limit	DWER loading rate limit with 10 % margin. Based on 170,000L milk processed 362,100 L wastewater, using the applicant's wastewater sample analysis)	*2.9 kg/ha/yr	1.7 kg/ha/yr	1500 kg/ha/month

*NB: That BOD and total phosphorus loading criteria will be met. The applicant may exceed total nitrogen based on the applicant's nutrient balance calculations.

4. Legislative context

4.1 Part V of the EP Act

The applicant was issued with a works approval W4142/2005/1 on 6 July 2005. The applicant was non-compliant with the works approval with no compliance certificate submitted to the department and the applicant commenced operations, emissions and discharges not authorised by a licence or works approval.

The departments Incident and Complaints Management System (ICMS) had the premises under investigation for unauthorised discharge under the *Environmental Protection (Unauthorised Discharges) Regulations 2004* discharging wastewater (food waste) into the environment.

4.2 Other legislative requirements

Health Act 1911

The disposal of more than 540L/day of wastewater generated from a feed manufacturing facility may require assessment and approval by the Department of Health under the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974.* On discussion with the Department of Health the applicant has not applied to date.

The applicant received development approval under the Shire of Denmark Town Planning Scheme No. 3 on 13 February 2020 for the addition of cellar 3 and domestic sewage disposal. The Shire did not assess and condition cheesemaking wastewater storage and discharge to land.

5. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

5.1 Source-pathways and receptors

5.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises operation which have been considered in this decision report are detailed in Table 4 below. Table 4 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 4: Proposed applicant controls (from application)

Emission	Sources	Potential pathways	Proposed controls
Operation			
Odour	Cheese processing and storage	Air/windborne pathway causing impacts to health and amenity	Manufacturing of cheese and storage within enclosed buildings.
Spills, leaks and overtopping of nutrient laden wastewater storage	Storage of wastewater in sump, tanks, drains and storage vehicle from cheese manufacturing.	Overtopping, spills and leaks of tank and pipes causing contamination of soil and surface waters	10,000 L storage tank 1,300 L sump 3,500 L tank on vehicle Overflow hose/pipe directed to paddocks
Odour from high BOD wastewater storage and disposal (whey) to land	Onsite disposal of wastewater (whey) via irrigation to land	Air/windborne pathway causing impacts to health and amenity	No controls proposed
Nutrient rich wastewater and high salt (whey) to land		Direct discharge to land and seepage / infiltration causing contamination of soil and surface waters.	Irrigate over 55ha, with a return interval greater than 150 days. Separate summer and winter irrigation paddocks Graze and cut hay/ silage to remove nutrients and recycle back to the premises. Log paddocks and volumes irrigated each day. Irrigate application rate 1mm. Farm gate nutrient balance assessment that has additional fertiliser. Stocking rate of 1.67 head/ha
Wastewater (whey) to land with excessive hydraulic loading			Irrigate over 55 ha. Irrigate application rate 1mm with a return greater than 150 days 10,000L storage tank (3 days) 3,500 L tank wastewater vehicle Total wastewater storage capacity of 13, 500L Stocking rate of not more than 1 head / ha.

5.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020), the delegated officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies and is provided for under other state legislation.

Table 5 below provides a summary of potential human and environmental receptors that may be impacted because of activities upon or emission and discharges from the prescribed premises (*Guideline: Environmental Siting* (DWER 2020)).

Table 5: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	**Distance from prescribed activity**
Rural residential	330 m north of the premises boundary
	415 m west of the premises boundary
	160 m east of the premises boundary
	840 m south of the premises boundary
Environmental receptors	**Distance from prescribed activity and environmental elements**
Denmark River (also registered Aboriginal site under *Aboriginal Heritage Act 1972*) Wilson Inlet	Premises has a 2.1 km river frontage with average 30 metre vegetated foreshore zone to centre line of river. 13 km downstream on the Denmark River from the downstream premises boundary.
Denmark River foreshore - unallocated crown land (land identification number 3090787)	2.1 m foreshore frontage with vegetated riparian foreshore.
Public drinking water source area (PDWSA) – Denmark River Catchment	Unassigned, but potentially P2 PDWSA. Objective is risk minimisation.
Waterways Conservation Act 1976 (WWC Act) – Wilson Inlet Management Area	Entire premises located within the Wilson Inlet Management Area
Soil and drainage	Three test pits excavated by the applicant indicated that the soil is sand on top of sandy loam over a clayey subsoil. The sand and sandy loam are on average 50 cm in depth. On average drainage is through the topsoil layers towards surface water bodies and flat land adjacent to the river causing seasonally wet waterlogging areas.
Groundwater	Groundwater if present is in weathered profile or within fractured fresh bedrocks. Shallow groundwater flows along the topography that flows towards two farm dams and first order tributaries of the Denmark River through the irrigation areas. Depth to groundwater is not confirmed. Landgate aerial January 2021, indicates all adjacent property farm dams and soaks contain water. Highest groundwater levels would be expected in September. This indicates that the highest

	seasonal groundwater levels would be within 2 metres of the surface in winter.

5.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and considers potential source-pathway and receptor linkages as identified in Section 5.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 5.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the licence as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 6.

Licence L9350/2022/1 that accompanies this decision report authorises emissions and discharges associated with the operation of the premises i.e. cheese manufacturing and irrigation to land with wastewater activities.

The conditions in the issued licence, as outlined in Table 6 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

Table 6: Risk assessment of potential emissions and discharges from the premises during operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Justification for additional regulatory controls	Licence holder and additional[2] regulatory controls (refer to conditions of the granted instrument)
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Operation								
Cheese processing, storage and application of high BOD wastewater to land via irrigation	Odour	Air/windborne pathway causing impacts to amenity	Rural residential premises 330 m north, 415 m west, 160 m east, 840 m south of the premises boundary	Manufacturing and storage within enclosed buildings Irrigation application rate is 1mm /day 150 days between returning irrigation to land	Minimal effect to amenity at local scale C = Slight Risk event could occur at some time. L= Possible **Low Risk** Acceptable	Y	The delegated officer considered the separation distance from the proposed location of the cheese manufacturing and storage buildings to the closest receptor, the irrigation of wastewater over a large area of land and that no complaints have been received by the department. The delegated officer determining that there was sufficiently large enough distance to receptors for there to be no adverse impacts from odour emissions from the manufacturing and storage of cheese and irrigation of high BOD wastewater to land. The delegated officer determined that the applicants' controls were sufficient and considered them essential to minimise the effects to sensitive receptors. The following applicant controls were conditioned: • All cheese production and storage of cheese must be within fully enclosed buildings. • Irrigation of wastewater must be not greater than 1mm per day • Wastewater irrigation to land must have a minimum of 150 days between irrigation applications.	*Operational requirements* • All cheese production and storage of cheese must be within a fully enclosed building. • Irrigation of wastewater must be not greater than 1mm per day • Wastewater irrigation to land must have a minimum of 150 days between irrigation applications.
Storage of wastewater in sump, tanks, drains and storage vehicle from cheese manufacturing.	Spills, leaks and overtopping of nutrient laden wastewater storage	Overtopping, spills and leaks of tank and pipes causing contamination of soil and surface waters	Denmark River fronting 2.1 m of irrigated paddocks, premises is within an unassigned P2 PDWSA area.	10,000 L wastewater storage tank 1,300 L collection sump 3,500 L irrigation tank Overflow pipe to paddocks.	Mid-level onsite impacts, low level offsite impacts C = Moderate Risk event will probably occur in most circumstances L = Likely **High risk** Maybe acceptable subject to multiple regulatory controls	N	Wastewater from the manufacturing of cheese drains through closed drainage pipes or through open perimeter channels and is collected into a wastewater collection sump. This is pumped into a storage tank or directly to a spray tank mounted on a vehicle for direct irrigation to land. The wastewater is not treated and when storage capacity is full is released to the paddocks through an overflow pipe. The delegated officer reviewed the applicant's proposed controls and considers there is a high risk of impact on downgradient receptors. The delegated officer considered the historical and proposed emergency piped flood irrigation of untreated wastewater, the lack of wastewater storage, no storage infrastructure controls such as alarms or bunds, together with the soil type, soil hydraulic conductivity and distance to 2.1 km section of the Denmark River and the premises lies within an unassigned P2 PDWSA. The delegated officer has determined that additional regulatory controls are required to reduce the risk of impact to an acceptable level. Given that the applicant proposes to irrigate untreated wastewater, controls will be placed to prevent overtopping, spills, and leaks of the storage containments, and removal of excess wastewater beyond the storage capacity of the premises to prevent piped flood irrigation to land. In addition, the applicant's current production limits will be capped to prevent any increase in wastewater irrigation. This cap can be lifted, and production increased within a licence amendment should the applicant be able to demonstrate appropriate storage and wastewater management. The delegated officer considers that the existing storage capacity is not sufficient given that the applicant's water balance and DWERs hydraulic assessment outcome, indicated that inputs exceed outputs and leaching of nutrients would be probable. The applicant has 7 days of storage for their current production of 170,000L of milk per year. Therefore, a condition requiring the applicant to truck off excess wastewater beyond the applicant's storage capacity and to prevent irrigation of wastewater when soils are saturated and rainfall is seasonally high, to prevent leaching of nutrients through the soil and/or overland to the Denmark River. The delegated officer has also specified additional construction and operational controls relating to the storage of wastewater to prevent	*Construction requirements* • **Storage tanks are fitted with levels sensors connected to alarms** Operational requirements • **Overtopping and winter release of wastewater from storage containments must not occur.** • **No discernable seepage or leakage of wastewater must occur.** • **Excess wastewater to storage is trucked offsite.** • **Sensors in storage tanks must be maintained in working condition.** • Wastewater annual irrigation limit will be set at 170,000 L of milk processing. Monitoring reporting • The amount of wastewater trucked off-site and where it was disposed of is recorded.

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Justification for additional regulatory controls	Licence holder and additional[2] regulatory controls (refer to conditions of the granted instrument)
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
							overtopping and spills. The existing storage tank will be fitted with a sensor and alarms that are to be maintained to prevent overtopping and spillage incidents. These conditions are to prevent overtopping, spills, and winter release of wastewater from the storage containments on the premises to prevent contamination of soils and prevent down gradient eutrophication of surface water bodies.	
Onsite disposal of wastewater (whey) via irrigation to land	Nutrient rich wastewater and high salt (whey) to land	Direct discharge to land and seepage / infiltration causing contamination of soil and surface waters.	Denmark River fronting 2.1 m of irrigated paddocks, premises is within an unassigned P2 PDWSA area.	Irrigate over 55 ha, with a return interval greater than 150 days. Separate summer and winter irrigation paddocks. Log daily irrigation to paddocks and volumes. Irrigate application rate 1 mm. Nutrient balance with set fertiliser limits. Harvesting and recycling of silage and hay.	Mid-level onsite impacts, low level offsite impacts to local scale.. C = Moderate Risk event will probably occur in most circumstances L = Likely **High risk** Maybe acceptable subject to multiple regulatory controls.	N	The delegated officer notes the current storage of wastewater (sump, storage, and irrigation tanks) does not treat the nutrients, BOD, TDS, and salts in the wastewater, allowing poor quality water to be discharged to the environment all year round. As a result, the current cheese manufacturing and the proposed increase in manufacturing is likely to contaminate the soil and seasonal groundwater and surface water bodies. The delegated officer reviewed the applicant's controls and considered there is a high risk of impact to the downgradient receptor Denmark River and an unassigned P2 PDWSA. The delegated officer considered the applicant's nutrient budget based on the irrigation of nutrient-laden wastewater will be irrigated when soil is saturated and in the wettest part of the year increasing leaching and eutrophication of downgradient receptors. In addition to specifying the applicant's proposed controls, the delegated officer has determined that additional regulatory controls are required to reduce the impact to an acceptable level. These controls include a wastewater loading limit, installation of accurate volumetric flow meters, restrictions on when irrigation can be undertaken to address the high risk of nutrient leaching in the wettest time of year and wastewater and soil monitoring to determine accurate loading limits and nutrient and salt leaching within soils. The delegated officer considers that loading rate limits for wastewater application are required as the applicant applies additional fertiliser three times a year within the irrigated paddocks. Therefore, irrigation limits have been set based on the applicant's wastewater sample and proposed wastewater discharge for processing 170,000 litres of milk, a 10 % buffer has been provided on the limit to account for wastewater variability (see Table 3). It is noted that the existing irrigated wastewater, is raw and untreated and exceeds the ANZECC short-term irrigation values for TN, TP, TDS, BOD and salt which presents a risk of impacts on plant health and soil structure. That irrigation in the wettest part of the year will likely contribute to an increase in eutrophication of the Denmark River and Wilson Inlet through surface flows and seasonal sub groundwater leaching. Based on this risk the delegated officer considers it necessary to specify that the irrigation will be restricted such that irrigation must not occur in June, July and August, 12 hours before, during or 24 hours immediately after a rainfall event (2mm and above), irrigation must not occur between September to May 12 hours before, during or 24 hours immediately after a rainfall event (10 mm and above), and an irrigation limit set for 170,000 litres of milk processed. To quantify rainfall events a weather station will be conditioned to be installed and rainfall logged daily. To determine accurate loading limits and volumes of wastewater trucked offsite. Volumetric flow meters will be required to be installed and maintained on the outlet of the sump and storage tank that connects to the irrigation truck. Furthermore, twice yearly water quality monitoring of the wastewater will be conditioned to verify water quality parameters and loadings. Sodium, calcium and magnesium ions, and sodium adsorption ratio have been included in the monitoring requirements to monitor risk for dispersive soils within the irrigation area. The delegated officer considers the wastewater monitoring essential as the irrigated water remains untreated and exceeds	Construction requirements • **<u>Flow meters are placed on the outflow pipe of the sump and storage tank.</u>** • **<u>Weather station installed to measure 24-hour rainfall events</u>** Operational requirements • Irrigation of wastewater must be not greater than 1mm per day • Wastewater irrigation to land must have a minimum of 150 days between irrigation applications • **<u>Irrigation is not undertaken 12 hours before, during or 24 hours immediately after a rainfall event.</u>** • Additional fertilliser to paddocks to be recorded.. • Silage/hay must be harvested each year and recorded. • Grazing of irrigated pasture not to exceed 1.67 head/ha. • **<u>Wastewater annual irrigation limit will be set at 170,000 L of milk processing.</u>** • **<u>Nutrient loading limits for TN, TP and BOD</u>** • No irrigation on summer paddocks from May to October. Monitoring and reporting • **<u>Soil testing to occur every 3 years over five sites.</u>** • **<u>Volume (m^3 or kL) of treated wastewater removed for off-site disposal</u>** • **<u>Treated wastewater quality and volume monitoring for wastewater irrigated to areas</u>** • **<u>Reporting of all results of monitoring on an annual basis.</u>** • **<u>Twice yearly sampling of wastewater parameters.</u>** • A log must be kept and submitted once a year detailing dates when paddocks were irrigated, amount

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Justification for additional regulatory controls	Licence holder and additional[2] regulatory controls (refer to conditions of the granted instrument)
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
							ANZECC (2000) water quality parameters for primary agriculture as the wastewater is untreated and poor quality. The delegated officer on advice from DPIRD has conditioned 3 yearly soil testing over five sites to monitor for nutrient leaching and to monitor for sustainable nutrient recycling within the premises. Furthermore, the delegated officer has considered the following applicant controls for nutrient input and outputs will be regulated, including recording harvest biomass each year, grazing rates not to exceed 1.67 cow per ha. Irrigation on winter paddocks is restricted in May to October, and the irrigation application rate is maximised to1mm.	irrigated to land and the daily rainfall. • Head of cattle to be reported each year.
	Wastewater (whey) to land with excessive hydraulic loading			Irrigate over 55 ha. Irrigate all year round at an application rate of 1mm. Irrigation return rate of greater than 150 days. 10,000L storage tank 3,500 L tank wastewater vehicle Log book recording daily amount irrigated onto paddocks. The Irrigated pastures are harvested and grazed.	Low level impact to amenity at local scale. C = Minor Risk event will probably occur in most circumstances L = Likely **Medium risk** Acceptable, generally subject to regulatory controls.	N	The delegated officer reviewed the applicant's controls and considered there is a medium risk of impact to the downgradient receptor Denmark River and an unassigned P2 PDWSA from the proposed irrigation to land from excessive hydraulic loading with wastewater from the storage containments. The delegated officer considered the applicant's water balance indicating that storage of irrigated wastewater was required in July and August. The departments hydraulic assessment indicated that rainfall exceeded evaporation from May to September, and that the applicant proposed irrigation of wastewater all year round including when the soil is saturated and in the wettest part of the year, increasing the potential of leaching and eutrophication to downgradient receptors. In addition to specifying the applicant's proposed controls, the delegated officer has determined that additional regulatory controls are required to reduce the impact to an acceptable level. These controls include a restriction when irrigation can occur, restrictions on irrigation causing runoff and not authorising direct discharge via piped flood irrigation. The delegated officer considered that given the poor quality of the wastewater, that soils are likely to be saturated in the highest rainfall months of June, July and August, that there is likely reduced number of vegetation growth days and therefore nutrient uptake, increasing the potential for wastewater applied during this time to infiltrate past the crop root zone into seasonal groundwater or runoff over land affecting surface water quality of downgradient receptors. Based on this risk the delegated officer considers it necessary to restrict irrigation, preventing irrigation within 12 hours before, during or 24 hours immediately after a rainfall event (2mm and above between June to August, and 10 mm and above between September and May). It is expected that the licence holder will store wastewater during this time and or remove excess wastewater offsite. Furthermore, the applicants practice of discharging wastewater directly to paddocks via pipes as a contingency method will be prohibited.	*Operational requirements* • Maximum irrigation application rate of 1mm. • **Irrigation is not undertaken 12 hours before, during or 24 hours immediately after a rainfall event greater than 2mm between June to August.** • **Irrigation is not undertaken 12 hours before, during or 24 hours immediately after a rainfall event greater than 10mm between September to May** • **No direct discharge of wastewater to paddocks via an overflow pipe.** • Irrigation occurs on a rotational basis ensuring that areas are not irrigated for at 150 days between applications. • **No irrigated generated run-off occurs beyond the boundary of the irrigation areas.** • Vegetation in the irrigated area is harvested once per annual period for hay or silage. • No soil erosion occurs • Health vegetation cover is maintained over irrigation areas *Reporting* • The volume of wastewater removed offsite per year • The logbook of amount of wastewater applied each day and to which paddock.

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020).

Note 2: Proposed applicant controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

6. Decision

To address the potential for immediate impacts to water resources from continued irrigation, and to enable proactive management to protect the downgradient Denmark River and Wilson Inlet, several regulatory controls in addition to the applicant derived controls, have been imposed on the licence. These are:

- limiting the rate and volumes of untreated wastewater that may be discharged to land;
- requiring the installation of equipment to manage wastewater storage and disposal including wastewater volumetric flow meters, wastewater storage tank high level sensor and a rain gauge, and
- soil and wastewater monitoring requirements.

The delegated officer has determined, subject to the regulatory controls outlined in Table 6, that the irrigation of wastewater to land does not present an unacceptable risk of impacts on the environment.

7. Consultation

Table 7 provides a summary of the consultation undertaken by the department.

Table 7: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on & November 2021	None received	N/A
Local Government Authority advised of proposal on 7 November 2022]	The Shire of Denmark replied on the 9 November 2022 indicating that development approvals had been granted on 1 May 2020.	
The Department of Health (DOH) were advised of the proposal on 7 November 2022	The DOH replied on the 22 November 2022 advising that they had no objections subject to the following key control measures: • irrigation occurs in such a way that it does not cause runoff, seepage, erosion or pooling • no irrigation to occur during rainfall, forecast rain or strong winds • setbacks from bores and other non-potable water supplies to be maintained. • fly breeding reduction measures and incident management for spills to be implemented	The delegated officer considered this information within its risk assessment see Table 6.
The Department of Primary Industries and Regional Development (DPIRD) were advised of the proposal on 7	DPIRD replied on 30 November 2022 indicating that they had no objections and provided the following comments: • Recycling of nutrients was appropriate to offset imported nutrients.	

November 2022	• Spreading of whey can be sustainable in the long term when coupled with a soil testing/monitoring program to reduce fertiliser input and monitor phosphorus leaching risk. • The farm gate nutrient balance was considered accurate and representative of nutrient inputs and outputs of the farm. • Stock grazing and harvest recycling are not considered nutrient outputs.	
Applicant was provided with draft documents on 14/12/2022	Applicant responded on the 16 January 2022 which is summarised in Appendix 2	

8. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a licence will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

References

1. *ANZECC 2000, New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3 Primary Industries*.
2. Department of Environmental Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia
3. Department of Water (DoW) 2017, *Understanding Salinity*, available at *https://www.water.wa.gov.au/water-topics/water-quality/managing-water-quality/understanding-salinity.*
4. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
5. DWER 2020, *Guideline: Decision making*, Perth, Western Australia
6. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
7. Department of Primary Industries and Regional Development (DPIRD) 2019 *Water salinity and plant irrigation* (last edited 2019), Water salinity and plant irrigation | Agriculture and Food
8. *New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3 Primary Industries*.
9. NSW EPA 1998, *Environmental & Health Protection Guidelines: On site sewerage management for single households,* NSW EPA Technical Guidelines.
10. US EPA, 2006, *Process design manual, land treatment of municipal wastewater effluent,* Report EPA/625/R-06/016.
11. Vogel C (2022) *Licence application and supporting documents*, Denmark Western Australia.

Appendix 1: DWER hydraulic and nutrient loading calculations

8.1.1 Rainfall

Bureau of Meteorology (BOM) Denmark site 009531, located 8 km south of premises was used for calculations. Data is available for this site from 1897 to present. The data from years from 2002 to 2022 was used. This period is more reflective of climate change and variability on rainfall within the area.

Table 8: Denmark rainfall data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	12	12.2	20.6	102.6	53.8		173	143.2	95.2	102.4	42.8	22.6
2003	17.2	44	52	69.6	74.2	156.4	154.2	194	172.6	62	63	28.6
2004		30.4	43.4	47.4	112.2	180.2	107.4	135.2	53.8	33.2	67.8	9.2
2005	12.2	31	71.4	174.2	82.1	191.4	87.4	149	130.6	136.4	40.8	
2006	33.2	28.2	92.8	82.6	78.3	62.2	154.6	97	68.8	45.2	48.5	13.8
2007	33	4.4	53.6	71.4	103.8	85.2	140.2	142.8	154.2	81.4	19.4	74.8
2008	9.3	10.6	9.6		132.6	158.4	175.4	82.8	130.2	130.8	153	31.2
2009	8.8	22.2	54.2	36.4	111.4	236.2	161.4	184.6	190.6	45.6	34.8	7.6
2010	24.6	6.6	27.4		68.4	129.6	157.8		63.4	57.6	48.2	90.2
2011	86	13.4	10.6	88.4	109.4	121.4	194	144.6	10.6	113.8	73.8	50.8
2012	15	11	11.4	57.6	79	241.2	136	102	173.6	64.2	82.2	47.2
2013	35	15.6	96.4	59	152.6	78.6	120.2	181.6	238.2	58.4	37.2	37
2014	4.4	9.4	21.1	41.6	107	92.4	179.4	40.2	108.4	77	54.4	31.4
2015	7	14.6	43	86.2	81	84.2	132	116.6	70.6	54	25.4	47.6
2016	88	32.6	49	130	140.4	147	123.4	169.2	135	78.4	25.6	57.8
2017	9	49.8	95.8	27.8	75.6	48.8	180.7	188	170.6	84.4	15	44
2018	18.5		21	40	46.7	74.4	190.6	182.6	55.4	68.8	39.6	27.2
2019	29.6	4.6	37.4	56.8	45.2	121.8	94.4	146.6	87.8	75.6	55.4	15.6
2020	47.7	22	53.4	48.2	159.3	145.2	148.2	217.2	138.3	26	126.3	21.5
2021	27	57.8	40.3			207.9	212.5	133.9	122.8	106.8	64.7	10.1

2022	12.4	18.1	60.1	107.5	106.7	130.2	80.1	127.5	60.4	135.3		
mean	28.05	21.13	46.85	68.22	95.62	131.63	151.13	144.90	118.24	71.70	53.93	39.84

8.1.2 Climatic data

The department used rainfall data from BOM site 009531 and evaporation data from Albany airport BOM site 009500 (50 km east southeast of the premises).

Using both BOM and DPIRD data, rainfall exceed evaporation from May to September.

Table 9: Climatic data assessment for irrigation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Mean Rainfall (mm)	28.05	21.13	46.85	68.22	95.62	131.63	151.13	144.90	118.24	71.70	53.93	39.84	From BOM website Site 009500 2002-2022	http://www.bom.gov.au/climate/d
Mean daily evaporation (mm)	6.7	6.3	5.1	3.4	2.2	1.9	2	2.4	3	3.7	4.9	6.2	From BOM website (need to select All available statistics)	
Calculated mean monthly evaporation (mm)	207.7	176.4	158.1	102	68.2	57	62	74.4	90	114.7	147	192.2	Calculated, using data from BOM website	
Mean monthly evaporation (mm)	153	130	116	74	51	43	44	53	63	84	106	140	From DPIRD document / data	Document: Evaporation data for Western Australia (Resource Management Technical Report No. 65), 2003
Not adjusted with 0.75 factor	220	170	150	91	63	47	49	67	84	106	150	199		https://weather.agric.wa.gov.au/
Rainfall exceeds evaporation?													Number months rainfall exeeds evaporation:	Number of weeks can irrigate for:
Using BOM data	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	5	30
Using DPIRD data	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	5	30

Section 5.1 of DWERs (2018) Draft Guidance on the establishment and management of irrigation schemes for the land disposal of wastewater requires wastewater produced during wet periods to be stored in a suitably sized water storage (tank or pond) and irrigated during the drier periods of the year.

8.1.3 Hydraulic loading

DWERs hydraulic loading calculations uses US EPA 2006. The hydraulic loading is not a limiting factor at the premises.

Table 10: Hydraulic loading calculations

Preliminary assessment of the wastewater hydraulic loading at the site

Section 5.1 of Draft Guidance on the establishment and management of irrigation schemes for the land disposal of wastewater

At a first approximation, the land area required to ensure that wastewater can be applied to land at a suitable hydraulic loading is given by the equation:

$$A = (3.65 \times Q)/ (L \times T_{app}) \qquad \text{(Eqn. 5.1)}$$

Where:

A = land area (hectares)
Q= flow rate of wastewater (m^3/day)
L= wastewater hydraulic loading to soil (cm/week)
T_{app} = period of wastewater application each year (weeks)

Calculating Q		
Total irrigation volume of	852	kL/year
Based on (see below) weeks of irrigation:		
30 weeks	28.40	kL/week (m^3/week)
This (above) can be estimated from the graph (below) or using climatic data nearest to the site.	21.70	m^3/day

			Other vegetation type	
		Pasture	Tree2	
Q	m^3/day	21.70	21.70	
L	cm/week	4		loading rate (generic for pasture, from US EPA 2006 document, Table 5-3) [Note Steve's document says about 4 cm/week]
L	cm/week			loading rate (generic for trees, from US EPA 2006 document, Table 5-3)
T_{app}	weeks/year	30 weeks	30 weeks	period of application (based on map from Steve Appleyard, see below; and water balance calculations (see other tab).
conversion		3.65	3.65	
L x P		120	0	
Q / LP		0.18	#DIV/0!	
A	ha	0.50	1.92	
		1.21	ha (combined area required to irrigate, if more than one vegetation type)	

Calculating P	
The period each year when irrigation can be carried out at the premsies is assumed to be:	
5	months of the year where rainfall exceeds potential evaporation (based on climatic data)
30	weeks of the year that irrigation CAN take place

Land required for irrigation is calculated to be approximately	1.2	ha	(based on total irrigation volume of	852 kL/year	irrigating	30 weeks per year	
Total irrigation area available is	55.00 ha	Therefore hydraulic loading rate is	NOT a limiting factor for irrigation at the premises.				

8.1.4 Nutrient loading

Table 11 outlines the nutrient loading calculations for 39 week irrigation period. Nitrogen, phosphorus and BOD were adequate for land areas. The calculations are based on the NSW EPA 1998 Appendix 6.

The following formulas were used.

$$A = \frac{C \times Q}{L_x}$$

Where

A	=	land area (m^2)
C	=	concentration of nutrient or BOD (mg/L)
Q	=	treated wastewater flow rate (L/d)
L_x	=	critical loading rate of nutrient or BOD ($mg/m^2/d$)

The critical loading rates for nitrogen (L_n) and phosphorus (L_p) are based on the ability of vegetation to use these nutrients before they pass through the root zone. For example, the L_n for perennial pasture varies between 18 and 36 $mg/m^2/day$, while L_p varies between 2 and 4 $mg/m^2/day$.

The critical loading rate for organic matter (L_o) of 3000 $mg/m^2/day$ generally means that required land areas based on organic matter loading will not be limiting.

Table 11: Nutrient loading calculations

If irrigation for 39 weeks a year over 55 ha											
Nitrogen					**Phosphorus**			**BOD**			
C	400				C	**230**		**C**	20000	mg/L	
Q	4367.2				Q	**4367.2**		Q	4367.2	L/day	
L_N	36				L_P	**4**		L0	3000	mg/m2/d	
Total Irrigation Area:		55	ha					Total Irrigation Area:		55	
C x Q	1746880				C x Q	**1004456**		C x Q	87344000		
CxQ/L	48524.44	m^2			CxQ/L	**251114.00**	m^2	CxQ/L	29114.67	m2	
A =	4.85	ha			A =	**25.11**	ha	A =	2.91	ha	
Limiting Factor =		**None**									
Irrigation area is sufficient											

Irrigation of nitrogen, phosphorus and BOD is sufficient over a 55 ha or 29 ha area.

Appendix 2 Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of applicant's comment	Department's response
Licence		
Assessed productions capacity	Applicant requests that the assessed production capacity value to be changed to 265,000 L milk. Applicant considered that cap at 170,000L does not acknowledge the improvements that have been undertaken to date of the premises.	The department risk assessed the proposal with the applicants' current improvements on the premises. A lack of wastewater storage was determined. Should the applicant increase their wastewater storage, then an increase through a licence amendment would be considered. The production cap will remain.
Condition1, Table 1 Item 3 Requirement 5. Requirement 8	Request to allow the 10,000 L storage tank to be used for firefighting purposes. Option to use emergency overflow unlikely as production will cease once wastewater storage is full rather than tank wastewater offsite.	DWER will update condition to allow firefighting. DWER will add the applicants control that operations for milk processing to cease once storage vessels are full, overflow pipe condition remains.
Condition 1 Table 1 Item 4	Request for flow meter to be removed. There is a flow meter on all inputs into the cheese production and should wastewater be removed it can be visually measured on the vehicle or a tank meter can be used to record a volume.	DWER notes this information and does not agree. Flow meter will accurately measure the amount discharged to land as well taken offsite.
Condition 1 Table 1 Item 7	Applicants request that the 1.67 head of cattle be removed from the licence. Applicant recommends using DPIRD stocking rates or land management approach to allow for flexibility to run different livestock, age, and densities.	DWER notes this information but does not agree. The stocking rate has been provided by the applicant and justified through their water and nutrient balances.
Condition 2 Table 2 Item 1	Applicant stated comment as '*per Table 1 9.'*	DWER considers that applicant means Condition 1 Table 1 Item 4. DWER notes this and does not agree, See comments above in Condition1 Table 1 Item 4.
Condition2 Table 2 Item 2	Applicant wishes to install a mechanical water level marker rather than the electronic wired flashing alarm. The tank and marker are visible from the cheese production room.	DWER notes this information and agrees.
Condition 5 Table 3 Items 3, 4	Applicants request that wastewater irrigation restrictions for times of year and when rain occurs is removed. The Applicant considers that the land is fast draining and suitable distant from the river, where loadings can be reduced if irrigation rate is a concern.	DWER notes this information and does not agree.
Condition 5 Table	Clarify what harvest means as the harvested silage and hay within the property do	Harvest has been defined in the definition section of the licence.

Condition	Summary of applicant's comment	Department's response
3 Item 8	not cross the farm gate.	
Condition 5 Table 3 Item 9	Suggest DWER consider property land management approach and ensure total fertiliser inputs including whey are appropriate for farm production.	DWER notes this information.
Condition 6 Table 4	Applicants request that N, P and BOD loading limits match an annual input of 265,000 L of milk production plus a 10% buffer.	DWER notes this information and does not agree. A loading limit would only be increased once a production increase has been granted. Should the applicant increase their wastewater storage, then a production increase through a licence amendment would be considered.
Condition 7 Table 5	Applicants request that spot wastewater sampling occurs once a year rather than twice, as the wastewater is unlikely to vary, and have the sample taken in April.	DWER notes this information and does not agree. Should samples prove to be consistent over time, then an annual sample could be considered through a licence amendment.
Condition 8 Table 6	Request that surface sample be composite x 30 cores, 0-10cm to match pasture responses in WA. Suggest deep sample be 30-50, as 50 cm is in the clay layer. It will be difficult to infer association from whey and other land use inputs.	DWER notes this information and agrees to 30 composite samples 0-10 cm, deeper sample 40-50 cm.
Condition 14 Table 7	Cattle grazing information would be better as annual nutrient balance. Do you mean hay and silage harvested only and exported from the premises or for forage distribution? Why wastewater in graphical form with only one data point.	DWER notes this information. DWER notes this and will clarify the requirement to include forage redistribution and removal from the premises. Wastewater will be collected twice a year and over time more data will be provided to visually determine changes in wastewater quality. Only the first sample will be a one data graphical point.
Decision Report		
Section 2.2.1	Applicant advised that wastewater irrigation paddocks are 55ha. Hay and silage are exported from property. Soil sampling was in January 2021 0-10 cm, and soil table unit is in hectares not number of paddocks	DWER notes this information and has updated information in the report.
Section 2.3 assumptions	Applicant advised that the water balance considered pasture growth not grazing. Grazing stock rate 1 cow and calf/ha. Forage redistribution recycles but does not reduce nutrients inputs to farm. Irrigated whey 168,000 L diluted wastewater volume 398,3000L. Liveweight gain is only the dairy heifers which are exported from the property. The stocking grazing rates misses the beef breeding herd.	DWER notes this information.
Section 2.3 Outcomes	Applicant stated water balance for maximum design capacity 400 kL milk with irrigation contributing 0.1mm/month	

Condition	Summary of applicant's comment	Department's response
Section 2.3 Key findings Section 3.1.2 Irrigation	Applicant stated that there was 4 days wastewater storage volume and production would cease when wastewater storage is full. Stock ratio is 1 cow and calf/per ha, nutrient balance used whey concentration by whey volume.	
Section 5.2 Risk ratings	Storage spills should be revised from high to medium risk as the cheese starter cultures treat the wastewater and BOD reduces over time.	