Government of Western Australia
Department of Environment Regulation

Decision Report

Review of Existing Premises

Division 3, Part V *Environmental Protection Act 1986*

Licence Holder:	Derby Industries Pty Ltd
ACN:	009 033 612
Licence Number:	L6932/1988/11
File Number:	2010/002314
Premises:	CM Farms Nambeelup Lot 89 Gull Road NAMBEELUP WA 6207 Lot 89 on Plan 741 Certificate of Title Volume 1112 Folio 243 Lot 109 on Plan 741 Certificate of Title Volume 1113 Folio 439 excluding the areas defined in Attachment 1
Date of report:	Thursday, 16 August 2018
Status of Report	Final

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Definitions of terms and acronyms

Term	Definition
AACR	Annual Audit Compliance Report
Action Criteria	Trigger values defined in the Licence that require the Licence Holder to take action
AER	Annual Environment Report
ANZECC Guidelines	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
ASTM D6747	Standard Guide for selection of techniques for electrical leak location of leaks in geomembranes
AS/NZS 5667.1	Australian Standard AS/NZS 5667.1 Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples
AS/NZS 5667.10	Australian Standard AS/NZS 5667.10 Water Quality – Sampling – Guidance on sampling of waste waters
AS/NZS 5667.11	Australian Standard AS/NZS 5667.11 Water Quality – Sampling – Guidance on sampling of waste waters
BoM	Bureau of Meteorology, Australian Government
Category/Categories (Cat.)	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CEO	Chief Executive Officer of the Department of Water and Environmental Regulation
CS Act	*Contaminated Sites Act 2003* (WA)
C-Wise	WA Composts Pty Ltd trading as C-Wise
DEC	Department of Environment and Conservation, Western Australia
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
Decision Report	This document
Delegated Officer	An officer under section 20 of the EP Act.
DoW	Department of Water, Western Australia
EPA	Environmental Protection Authority, Western Australia

Term	Definition
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPP	*Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992*
Existing Licence	Licence L6932/1988/11 granted on 21 October 2010
Hardstand	An area engineered to reduce hydraulic conductivity
HDPE	High Density Polyethylene
Hydraulic Conductivity	Describes the ease with which a fluid (usually water) can move through the pore spaces or fractures. It depends upon the intrinsic permeability of the material and the density and viscosity of the fluid. Hydraulic conductivity is expressed as metres per second (m/s).
ICMS	DWER's Incident and Complaints Management System
Licence Holder	Derby Industries Pty Ltd
Mushroom Exchange	Mushroom Exchange Pty Ltd
mV	In the measurement of Oxidation Reduction Potential, mV means millivolts.
Nambeelup Farm	Nambeelup Farm is a term used to refer to the three licensed premises, CM Farms (Licence L6932/1988/11), WA Composts Pty Ltd trading as C-Wise (Licence L8410/2009/2) and Mushroom Exchange Pty Ltd (Licence L7210/1997/10).
NEGP	National Environmental Guidelines for Piggeries, Australian Pork (2010)
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	Is defined in the EP Act to mean a person who is in occupation or control of a premises, or part of a premises, whether or not that person is the owner of the Premises or part of the premises.
OEPA	Office of the Environmental Protection Authority
Premises	CM Farms Piggery - Nambeelup
Prescribed Premises	Premises prescribed under Schedule 1 to the EP Regulations
Review	A risk-based licence review conducted in line with DWER published Guidance Statements
Revised Licence	The amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Site Map	The maps in Schedule 1 of the Licence
SPU	Standard Pig Unit as defined in the NEGP
WWTP	Wastewater Treatment Plant

1. Purpose and scope of assessment

On 3 October 2016, the Licence Holder was notified that the CEO of the former Department of Environment Regulation (DER) determined that a risk-based Review of Licence L6932/1988/11 for the intensive piggery at the Premises was required. Following the Department's investigations of odour complaints in the Mandurah area, the Department identified that premises situated at Nambeelup Farm were likely to be the cause of odour experienced in the Mandurah area.

The Review is documented in this Decision Report.

This Review has been undertaken in accordance with DWER's published regulatory risk-based framework, including *Guidance Statement: Decision Making* and *Guidance Statement: Risk Assessment.*

2. Background

Table 1 details the Prescribed Premises Categories that are held by the Licence Holder for the Premises. The Premises are an intensive piggery operated under Licence L6932/1988/11 by the Licence Holder who took over the operations from George Weston Foods Ltd in 2009.

Table 1: Prescribed Premises categories

Classification of Premises	Description	Approved Premises production or design capacity or throughput
Category 2	Intensive piggery: Premises on which pigs are fed, watered and housed in pens.	22,000 animals

The Premises are one of three premises which make up Nambeelup Farm. Table 2 details the current operations within Nambeelup Farm.

Table 2: Nambeelup Farm Premises

Operator	Prescribed Premises Category	Design Capacity
WA Composts Pty Ltd (C-Wise)	67A: Compost manufacturing and soil blending	90,000 tonnes per year
	61: Liquid waste facility	60,000 tonnes per year
Derby Industries Pty Ltd (CM Farms)	2: Intensive Piggery	22,000 animals
MushroomExchange Pty Ltd	67A: Compost manufacturing and soil blending	37,000 tonnes per annual period

DWER is also reviewing the licences held by C-Wise and Mushroom Exchange.

3. Overview of Premises

3.1 Infrastructure

The Premises facility infrastructure as it relates to Category 2 activities is detailed in

Table 3 with reference to the site plan shown in Figure 1.

Table 3: Premises category 2 infrastructure

Infrastructure	
Prescribed Activity Infrastructure Category 2	
1	Five conventional piggery sheds
2	18 deep litter sheds/eco-shelters
3	Wastewater treatment system (WWTP)
4	Wastewater treatment ponds: • One anaerobic wastewater pond (Pond 0; 14,625 m^3) • Three aerobic ponds - Pond 2 (1 mm HDPE; 16,000 m^3), Pond 5 (1 mm HDPE; 33,000 m^3) and Pond 6 (1 mm HDPE; 21,300 m^3)
5	Carcass composting tunnel

Figure 1: Site plan with Premises infrastructure

3.1.1 Conventional piggery sheds

The Premises has five conventional piggery sheds used for housing gestating, farrowing, growing, and breeder developer stock. Each shed houses between 600 and 1,100 animals.

The sheds are enclosed and have concrete partially slatted floors and steel shutter sides. The walls are fitted with adjustable shutters that can be raised and lowered as required. The roofs are constructed with open vents. The partially slatted concrete floors have underfloor drainage that connects to a central drainage channel. The sheds are equipped with tipper-buckets located at the top end of each shed drain that allows water to be flushed through the sheds automatically or manually.

Feeding systems in the sheds are either automatic or manual with predetermined feeding times and rates. Some new pens within one shed have been fitted with an automated on-demand feeding system. The feed is specifically designed for pigs and contains an enzyme designed to reduce the concentration of nutrients (nitrogen and phosphorous) in the waste.

Each shed has a quarantine area used to house a small number of sick and injured animals.

3.1.2 Eco-shelters

The Premises also have 18 deep litter shelters (eco-shelters). The eco-shelters have concrete floors and concrete bunker walls, a domed shelter, and are open at each end. The floors are covered with hay which is used to absorb and collect waste material.

Each eco-shelter houses between 40 and 50 pigs for four weeks at a time.

3.1.3 Wastewater treatment plant (WWTP)

Wastewater from the conventional sheds is directed to the WWTP through concrete channels and drains as shown in Figure 2.

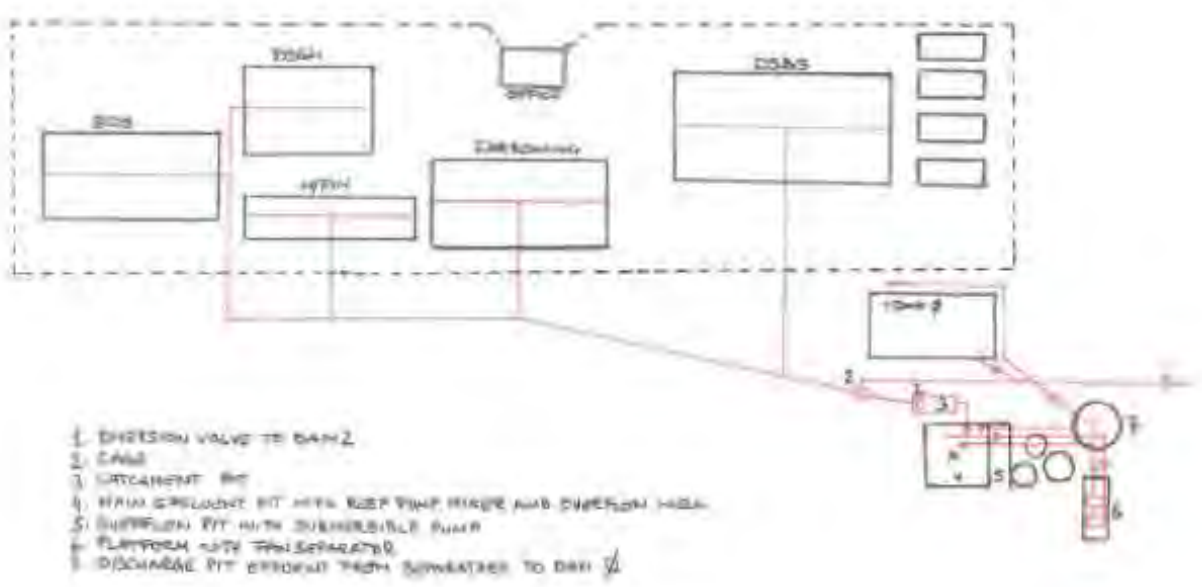


Figure 2: Premises drainage infrastructure (supplied by Licence Holder)

The WWTP layout is shown in Figure 3. Prior to entering the WWTP, the wastewater passes through a screen cage and pit that catches large solids and objects to stop them entering the plant. After the screen cage and pit, the wastewater flows into the main effluent pit that contains a mixer. The wastewater is then pumped to one of two fan separators where solids are removed, and the liquid effluent is directed to the discharge pit, where it is pumped to

Pond 0.

The main effluent pit and discharge pit have an emergency overflow where, in the event of a blockage or pump failure, wastewater can be directed to an overflow pit where it can be pumped back to the main effluent pit or the discharge pit.

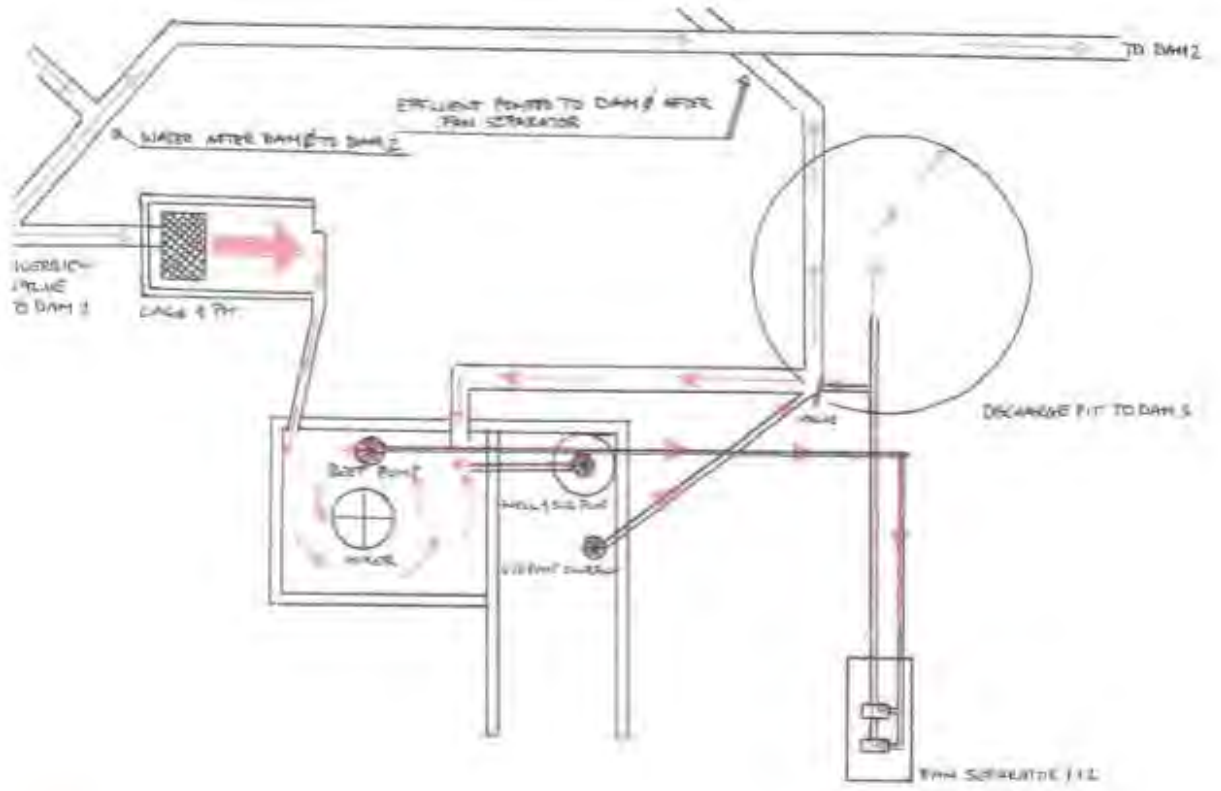


Figure 3: Premises WWTP (supplied by Licence Holder)

3.1.4 Wastewater treatment ponds

The Premises currently use four ponds for wastewater treatment (refer to Figure 1).

- Pond 0: anaerobic (HDPE lined, 14,625m^3);
- Pond 2: facultative (HDPE lined 16,000m^3);
- Pond 5: facultative (HDPE lined 33,000m^3); and
- Pond 6: facultative (HDPE lined 21,300m^3).

Ponds 1, 3 and 4 are no longer used by the Licence Holder. Pond 1 has been replaced by Pond 0 and is currently being decommissioned (desludged). Ponds 3 and 4 are not part of the operational Premises.

The construction of the wastewater treatment ponds is discussed in more detail in section 0.

3.1.5 Pig carcass tunnel

Pig carcasses are placed in a compost tunnel adjacent to the C-Wise Premises. The tunnel has a concrete base, concrete walls on two sides with a dividing wall in the middle and bunding. The tunnel is graded to direct leachate towards the WWTP.

3.2 Operational aspects

3.2.1 Animal numbers

As described above, the Premises operate a combination of conventional sheds and eco-shelters. Once piglets reach 21 weeks of age, they are moved to the Licence Holder's Mogumber (Gingin) premises at a rate of 1,000 per week. Approximately 100 pigs are retained for improving gene stock.

The current licensed production or design capacity is a maximum 22,000 animals on the Premises at any one time. The maximum number of animals held on the Premises each month is reported to DWER through the Premises' AERs. In September 2016, the pig numbers were reported to be 14,228, which is a similar number to the maximum for the previous reporting year. The average number of pigs held at any one time is approximately 13,000.

3.2.2 Solid waste management

The Licence Holder does not store any significant quantities of solid wastes at the Premises, with all waste material being taken to the adjacent composting premises operated by C-Wise.

Solid wastes generated at the Premises include:

- spent bedding;
- solid material from WWTP fan separators;
- sludge from the de-sludging of wastewater treatment ponds; and
- carcasses.

The eco-shelters are cleaned every four weeks, with the spent bedding (hay and manure) removed straight to C-Wise for incorporation into the composting process.

The separated solids from the WWTP fan separators are deposited on a concrete pad that drains back to the WWTP. The solids are collected and transferred to C-Wise for incorporation into the composting process.

The sheds and eco-shelters are cleared of pig carcasses every day and the quarantine sections are managed on a weekly basis. Approximately eight carcasses are collected each week. The carcasses are taken to the carcass tunnel, where they are placed in one of the two sections and covered with compost material provided by C-Wise to facilitate biological breakdown.

Once the section is full, the carcasses are left to decompose for approximately six months and the other section is used. The composted material is removed to C-Wise for incorporation into their composting process.

3.2.3 Liquid waste management

The conventional sheds are cleaned (hosed-down) regularly depending on the hygiene requirements of the animals. Water and waste are washed through the slatted floors into the central drainage channel. The tipper-buckets at the end of each shed are filled gradually over a three hour period with wastewater from Ponds 5 or 6. When full, the buckets automatically tip and flush the wastewater in the central drainage channel to the WWTP. The flushing can also be instigated manually and on-demand.

The flushed wastewater is directed to the WWTP where it is screened, mixed, and the solids separated. If there is an operational need to by-pass the WWTP, wastewater can also be directed to Pond 2.

After the WWTP, wastewater is pumped to the anaerobic pond (Pond 0). Water from Pond 0 flows to the facultative Pond 2, which then flows to facultative (storage/evaporation) Ponds 5

and 6. Ponds 5 and 6 are equipped with sprinklers which can be used to aerate the wastewater and facilitate evaporation. Water from Ponds 5 and 6 is reused in the Premises to flush the conventional sheds.

Prior to 2016, water from Ponds 5 and 6 was pumped to the C-Wise premises for use in the composting process. Runoff from the usage area (the Western Hardstand) at C-Wise was then directed back to the Premises (Pond 1 at that time). This practice was stopped by the Department as it was concluded that the returned water was disrupting the pond treatment process.

The Licence Holder (in conjunction with C-Wise) has proposed that this practice is resumed, with water being pumped from Pond 5 or 6 and runoff returned to Pond 2. It is assumed that the water balance will be maintained through the pump and return system, with any increased run-off generated by rainfall etc. being offset by water consumed in the composting process. C-Wise will be required to install systems to trap solids and debris being discharged to Pond 2.

3.2.4 Pond desludging

The Licence Holder is currently desludging Pond 1 (not currently operational) at a rate of approximately 4,000m^3 per year.

During desludging, the liquid fraction of the desludged material is directed back into the wastewater treatment ponds, and the solid fraction is dried and collected by C-Wise and used in their composting processes.

The Licence Holder advised the Department during a site visit conducted on 11 October 2016 that once Pond 1 has been desludged, the operational ponds will be desludged.

3.2.5 Wastewater discharge

The Existing Licence includes a surface water discharge point (point D) to a line string drain that discharges to the Serpentine River 2.7 km west-northwest from the Premises. The line string drain is located on the northern Premises boundary and is approximately 650m from the wastewater ponds.

Historically, the Premises were a significant point source contributor of nutrients to the Peel-Harvey catchment through the discharge of wastewater to the line string drain. The Licence Holder has not reported a wastewater discharge into the drain since 2009 due to improvements in stormwater and wastewater management on the Premises.

Key findings: The Delegated Officer has reviewed the information regarding wastewater discharge and has found:

1. Since 2009, the Premises have not discharged wastewater from Pond 5 to a stormwater drain.
2. Wastewater treatment, storage, and reuse infrastructure is available to manage wastewater at the Premises.
3. Wastewater is also removed from the Premises to the adjoining composting facility operated by C-Wise.

Based on the above key findings, the Delegated Officer has not assessed the discharge of wastewater from the Premises to the environment as part of this Review and has removed the discharge point in the Revised Licence.

4. Legislative context

4.1 Contaminated sites

Lots 89 and 109 on Plan 741 were classified as contaminated – restricted use under the *Contaminated Sites Act 2003* on 19 March 2010. The classification was based on the identification of elevated levels of nutrients in groundwater beneath the site. At the time of classification, available monitoring data suggested that the contaminant plume was stable and was unlikely to migrate beyond the property boundary due to natural attenuation processes. Ongoing periodic groundwater monitoring was noted to be required in accordance with relevant licence conditions under the EP Act

DWER undertook a review of the site's classification under the CS Act during early 2018, this review included the assessment of groundwater data resulting from routine licence monitoring, and the results of detailed site investigations undertaken during 2016 and 2017. Upon completion of the review, DWER concluded that the classification remains appropriate. However, several uncertainties and data gaps were identified that require further action to be taken to address the contamination status of the site. The classification remains contaminated – restricted use, however the 'nature and extent', 'reasons for classification' and 'restrictions on use' were updated on 1 June 2018 to reflect the additional technical information that has become available since the site was originally classified in 2010. Formal notices of the update to the site classification were issued to all relevant parties, including the licensees, on 11 June 2018.

4.2 Lease agreement

The Licence Holder currently leases Lots 89 and 109 on Plan 741 from George Weston Foods Limited and subleases parts of Lot 89 to C-Wise and Mushroom Exchange. The lease expires on 7 November 2018 with an option to extend it to 7 November 2023.

4.3 Planning approvals

The piggery has been operating at the Premises since the 1970's. The Shire of Murray has provided the Department with a copy of a council report from 1977 showing approval to establish a piggery at the Premises.

The Shire of Murray issued the Licence Holder with a Certificate of Registration to operate an offensive trade at the Premises on 9 May 2017. The registration is valid to 30 June 2018.

4.4 Licence to take water

The Licence Holder holds Groundwater Licence No. GWL96250 issued by the Department under the *Rights in Water and Irrigation Act 1914,* to take up to 420,000kL of groundwater per year from the Upper Leederville aquifer for use in compost production, intensive piggery purposes, and for irrigation of up to 4ha of lawns and gardens.

4.5 *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992*

Section 60(1) of the EP Act states that '*The CEO shall in considering an amendment of a licence or an application for a works approval or a licence for the transfer thereof ensure that the works approval or licence or amendment or transfer thereof is consistent with any approved policy*'.

The Premises is located on the boundary of the *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992* (EPP), and therefore the Delegated Officer has considered the requirements of this policy.

The EPP sets environmental quality objectives for the Peel Inlet-Harvey Estuary to help rehabilitate and protect it from degradation. The policy states the use and values of the estuary as:

- For studying the natural environment;
- Habitat for a diverse range of fauna and flora;
- Commercial and amateur fishery;
- Recreation, tourism and landscape amenity; and
- A focus for residential development.

The basis for protection of the estuary as stated in the EPP is:

- *Nutrient enrichment of the Estuary has been caused by the clearing of native vegetation in the policy area and by land uses that result in nutrients, especially phosphorus, leaching into waterways in the policy area and then flowing into the Estuary.*
- *Nutrient enrichment in the Estuary has stimulated the excessive growth of algae, causing the degradation of the Estuary and creating a serious public nuisance.*

The objectives of the EPP include a median load of phosphorus flowing into the estuary of less than 75 tonnes, with the median load of phosphorus from the Serpentine River being less than 21 tonnes.

The EPP states that its objectives are to be achieved and maintained through:

- *Implementation of planning policy including Metropolitan Regional Scheme;*
- *Appropriate land management by landholders and management authorities in the Policy area;*
- *Advice from government services to landholders in the area; and*
- *Local and State Government authorities ensuring that decisions and actions are compatible with the objectives and maintenance of Policy's objectives.*

4.6 Part V of the EP Act

This section covers Works Approvals and Licences issued under Part V of the EP Act and compliance with the conditions of those instruments.

4.6.1 Guidance Statements

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

DWER Guidance Statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Land Use Planning (February 2017)*
- *Guidance Statement: Licence Duration (August 2016)*

Works approvals and licence amendments

Table 4 provides a list of works approvals and licences granted for the Premises since 2009 when the licence was transferred to Licence Holder. Each works approval and licence amendment is further detailed in the table below.

Table 4: Instrument log

Instrument	Issued	Description
L6932/1988/10	22/01/2009	Licence L69/32/1988/10 was transferred from George Weston Foods Ltd to the Licence Holder on 22 January 2009. The licence was for a category 2 intensive piggery; category 61 liquid waste facility; and a category 67A compost manufacturing and soil blending facility.
L6932/1998/11	21/10/2010	The eleventh version of Licence L6932/1988 was issued to the Licence Holder on 21 October 2010 with an expiry date of 26 October 2015. The licence contained the same categories and conditions as the previous version of the licence.
W4720/2010/1	21/10/2010	Works Approval – Decommissioning Ponds 3 & 4 and construction of Pond 6 – HDPE lined. Works Approval W4720/2010/1 was issued to the Licence Holder on 21 October 2010 for the installation of an additional aerobic pond (Pond 6). The application stated that the additional pond was required as Ponds 3 and 4 were up to 50% full of sludge and had a reduced capacity to store and treat wastewater. The PVC liners of these ponds had also become damaged. The works approval application stated that the pond would be lined with 1mm thick HDPE, have a volume of 21,300m^3, and a separation distance of more than 2m from the base of the pond to the groundwater level. A compliance document stating that the pond had been constructed in accordance with the requirements of the works approval was received by the Department of Environment and Conservation (DEC) on 29 April 2011 confirming that the liner had been installed as per the manufacturer's specifications.
W4997/2010/1	01/09/2011	Works Approval – Pond 5 (aerobic) refurbishment, extension and lined with HDPE. Works Approval W4997/2011/1 was issued to the Licence Holder on 1 September 2011 for the extension and relining of Pond 5. The works approval application stated that the pond extension would take the pond from a volume of 22,000m^3 to 33,000m^3 and that it would be lined with a 1mm thick HDPE liner. The new pond dimensions would be 52m wide by 237m long by 2.5m deep. DER does not have a record of a compliance document being submitted for the completion of these works. However, DER Officers have confirmed during site visits that the pond has been constructed and is operational.

Instrument	Issued	Description
L6932/1988/11	15/12/2011	Licence amendment following WA Composts Pty Ltd obtaining separate licence to operate a composting facility at Nambeelup Farm (L8410/2009). The licence conditions were updated and improvement requirements placed in the licence to compare the operations to the NEGP (National Environmental Guidelines for Piggeries). How the improvement requirements were addressed is discussed in section 4.8.1.
W5679/2014/1	17/07/2014	Works Approval – Pond 2 (aerobic) lined with HDPE. Works Approval W5679/2014/1 was issued to the Licence Holder on 17 July 2014 for the lining of Pond 2 with a 1mm thick HDPE liner. The works approval application stated the pond's dimensions as 42m wide by 147m long by 1.2m deep with a volume of 16,000m^3 The works approval application stated that the HDPE liner would conform to *Water Quality Protection Note 26: Liners for containing pollutants, using synthetic membranes* (Department of Water 2013). DER does not have a record of a compliance document being submitted for the completion of the works. However, DER officers have confirmed during site visits that the pond has been constructed and is operational.
L6932/1988/11	23/10/2015	Licence Amendment – Extend licence duration by 12 months to allow for the re-assessment of the risk of all emissions and discharges from the Premises.
L6932/1988/11	28/01/2016	Licence amendment to allow construction of a second anaerobic pond (Pond 0). Licence L6932/1988/11 was amended on the 28 January 2016 to allow for the installation of a new anaerobic pond (Pond 0) with a volume of 14,625m^3. Three improvement requirements were included in the amended licence that related to the installation of a groundwater monitoring bore in the vicinity of Pond 0, the monitoring of the new bore for baseline groundwater quality, and for reporting information to DER. The Licence Holder submitted compliance documents to DER on 12 July 2016 that stated the pond lining had been installed in accordance with the works approval application and provided a certificate from the contractor who installed the liner confirming that the liner joint welds had been tested and installed as per the manufacturer's specifications.
Amendment Notice	13/10/2016	Licence L6932/1988/11 was amended by notice on 13 October 2016 to extend the licence duration to 26 October 2017. This extension was to allow this licence Review to take place.

Compliance inspections

The following compliance inspections were conducted by the Department between October 2013 and October 2016.

Compliance inspection 23 October 2013

The Department conducted a compliance inspection of the premises on 23 October 2013. The compliance inspection report noted several non-compliances and non-determined findings. The Licence Holder provided information to address the issues raised as shown in Table 5.

Table 5: Issues raised at 23 October 2013 inspection

Issue raised	How issue was addressed
Some weed growth on Pond 1.	The Licence Holder stated that the weeds were sprayed and photos were provided to DER on 31 December 2013.
Pond outlets are not trapped to prevent carryover of solids.	The Licence Holder advised that 'T' pieces had been ordered and installed (31 December 2013).
Groundwater samples were not analysed for total nitrogen.	The Licence Holder advised future analysis of total nitrogen will be requested.
Improvements requiring the Licence Holder to compare the Premises operations against the NEGP including an action plan for bringing the operations in line with the guidelines had not been completed by the due date.	The improvements were completed after the due date.
The AER for 2012 was not submitted by the deadline and did not contain total nitrogen groundwater monitoring.	The report was provided to the Department on 31 December 2013.
Records for fuel tank inspections were not provided.	The Licence Holder submitted a test report on ULP Tanks 1 and 2 stating that they has passed the precision test. (19 February 2014).
Discharge meter design, installation, calibration and operation not sighted to ensure compliance with AST4747.	The Licence Holder provided a report on the discharge meter design, installation, calibration and operation to the Department on 20 Feb 2016.
Records of monthly pig's numbers were not provided.	The Licence Holder stated in a letter to the Department on 20 February that pig numbers were provided in the AER and provided a copy of pig numbers.

Compliance inspection 8 March 2016

The Department conducted a licence compliance inspection on 8 March 2016. The inspection identified that the anaerobic pond (Pond 1) was most likely not operating as designed due to the pond having never being desludged. The anaerobic pond not operating effectively could result in potential odour issues with the reuse of the wastewater for flushing the conventional sheds and its use in the C-Wise composting process.

Table 6: Issues raised at 8 March 2016 inspection

Issue raised	How issue was addressed
Operational and regulatory controls in place were not sufficient to mitigate odour emissions emanating from the solid waste containment areas. Due to the ineffectiveness of the wastewater treatment system, reuse of the wastewater to flush the conventional piggery sheds is likely to contribute to odour emissions.	Water quality from Pond 5 was analysed in July 2016. The Licence Holder has ceased use of Pond 1 since the commissioning of Pond 0.
Treatment of wastewater was not likely to be sufficient to allow for the waters to be used in the C-Wise compost process.	
Pond 1 contained excess sludge, which was likely to be stopping the pond system from operating effectively.	

As a result of the inspection, the Department sent a letter to the Licence Holder requesting analytical results for the wastewater used for flushing the conventional sheds. The Licence Holder provided wastewater quality data to the Department for sampling events conducted across the WWTP on 4 May 2016 and 15 July 2016. A summary of the results is shown in Table 7. The water quality data shows a general reduction in total phosphorus (TP), total nitrogen (TN), and Biochemical Oxygen Demand (BOD) as the wastewater moves through the WWTP.

Table 7: Wastewater quality from sampling conducted on 4 May and 15 July 2016

	4 May 2016			15 July 2016		
	WWTP mixing	Pond 0 inlet	Pond 2 outfall (to pond 5)	WWTP	Pond 0	Pond 5
TP mg/L	280	90	34	22	33	31
TN mg/L	1400	940	760	800	880	430
BOD mg/L	6300	1200	540	2100	870	340
TDS mg/L	4340	4560	5040	3350	3630	4040

Compliance inspection 9 December 2016

The inspection identified that the wastewater treatment pond system had been upgraded, with the new anaerobic Pond 0 installed and operational. This upgrade improved the quality of wastewater, as substantiated by the analysis provided to the Department following the March 2016 inspection. At the time of inspection, the wastewater recirculated back to the conventional sheds for flushing was being sourced from Pond 5.

It was observed that the pipe directing effluent from the WWTP to Pond 0 was elevated above the water level of Pond 0, which caused increased disturbance of the wastewater and increased exposure to air. However, no unreasonable odour was detected within the vicinity of Pond 0.

Odour was detected within the immediate vicinity of the conventional sheds, but the odour was not unreasonable beyond the vicinity.

4.6.4 Site visit 27 May 2016

A DWER Officer attended the Premises on 27 May 2016, in response to odour complaints received that day. Pond 0 (which had not yet formed a crust) and Pond 2 were identified as potential sources of the odours which had been observed off-site that day.

The officer observed large bubbles and some sludge rising to the surface of Pond 2. These bubbles were observed across approximately one third of the surface area of the Pond. The bubbles were thought to be biogas being released due to biological and chemical reactions occurring within the sludge; however, the composition of the gas being released was not known.

4.6.5 Site visit 11 October 2016

Officers visited the Premises on 11 October 2016 to confirm the Premises operations and processes. During the site visit, Officers inspected the conventional sheds, the eco-shelters, WWTP, wastewater treatment ponds, and the carcasses composting tunnel.

Photos from the site visit are included in Appendix 4.

At the time of the visit, the piggery was operating normally with pigs housed in the conventional sheds and the eco-shelters. The Licence Holder confirmed that the number of pigs on site was reflective of recent and forecast operations. Upgraded pens had been installed in one conventional shed with improved pen barriers and flooring, and an on-demand feeding system.

The WWTP and wastewater treatment ponds were operating normally. A replacement fan separator was present on site awaiting installation at the WWTP. A crust was noted as developing on Pond 0. No desludging of Pond 1 was taking place at the time of the visit.

Pig carcasses were being collected at the time of the visit and taken to the carcass composting tunnel.

4.6.6 Site visit 5 July 2017

DWER Officers observed Pond 2 while attending C-Wise on 5 July 2017. Large bubbles, thought to be biogas, were again observed rising to the surface of Pond 2.

4.6.7 Annual reports

The annual reporting period for the Licence is the calendar year, with AERs due for submission to the Department on or before 28 January in each year.

2013 Annual Environment Report

The AER for the reporting period 1 January 2013 to 31 December 2013 was received by the Department on 31 January 2014. The report stated that all conditions of the Licence had been complied with. The report noted that the Department had received intermittent odour complaints, but the source had not been determined.

2014 Annual Environment Report

The 2014 AER was received by the Department on 28 January 2015. The report advised that all conditions of the licence had been met for the reporting period. The AER included a summary of water discharged through emission points B and D, which shows that there has been no discharge through point B since prior to 2009 due to the installation of the wastewater ponds on the Premises since the Licence Holder took over the site.

Groundwater monitoring during the reporting period showed that nutrient and TDS concentrations were elevated in monitoring bore MW11S and that this appeared to be consistent with data from previous years.

2015 Annual Environment Report

The 2015 AER was received by the Department on 28 January 2016. The report stated that all conditions of the Licence have been complied with and noted that the Department had received complaints and that an odour survey was being conducted. Groundwater results showed monitoring bore MB11S had elevated levels of nutrients (total nitrogen and total phosphorous).

2016 Annual Environmental Report

The report for the 2016 monitoring period was received by the Department on 27 January 2017. The report shows the groundwater quality across the premises is fairly consistent with previous years. The report noted that all conditions were complied with and supplied the compliance information for Pond 0.

Compliance history check

The Department's records show that the Licence Holder has received two letters in regards to potential non-compliance with licence conditions;

- 26 November 2013 for vegetation growing on ponds, the outlets from ponds were not trapped to prevent carry over, and groundwater monitoring did not meet the requirements of the licence; and
- 8 October 2012 for the use of Ponds 3 and 4 for wastewater treatment when the licence specifically precluded the use of those ponds.

The Department's records do not show any enforcement action taken against the Licence Holder for the operation of the Nambeelup Premises.

Monitoring data and investigations

Groundwater monitoring

The Department undertook a review into the groundwater monitoring data provided by the three premises at Nambeelup Farms over the 2010 to 2017 period. Details of this review are included in Appendix 4.

Key findings: The Delegated Officer has reviewed the groundwater monitoring programs and has found that:

1. A shared approach and consistent methodology for all Nambeelup Farm premises will facilitate a better understanding of contamination events and the effectiveness of controls.
2. Synchronising monitoring bore sampling across all three sites is necessary to allow more comprehensive and meaningful data interpretation.
3. Mercury zinc and arsenic should be included in the monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed.
4. The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of groundwater contamination caused by nutrient-rich leachates derived from organic materials.

The Delegated Officer has reviewed the spatial configuration of the existing monitoring bore network and has found:

5. The existing monitoring network, when used as an integrated network across premises boundaries, is sufficient to identify whether containment infrastructure such as ponds and Hardstands are effectively controlling leachate emissions.
6. The monitoring network is not able to identify contamination sources at a small spatial scale such as a single pond. Additional investigations in the form of pond seepage rate measurements are required for this purpose.
7. The monitoring network includes bores located up and down hydraulic gradient at varying distances from the potential operational contamination sources allowing the determination of a suitable background level against which bores influenced by site sources can be compared.
8. The current network does not allow detailed tracking of contamination and plume delineation and is insufficient to inform on the risk of impacts on sensitive receptors.

The Delegated Officer has reviewed groundwater monitoring data illustrated in Appendix 4 and concluded that:

9. Groundwater monitoring results infer that the groundwater flow in the area of interest is in a south-westerly direction.
10. High nutrient levels in multiple bores indicate that containment infrastructure integrity may be compromised resulting in significant seepage from sources potentially at all three premises.
11. A groundwater contamination plume is likely to extend from the operational area in a south-westerly direction indicating an open pathway to impact sensitive environmental receptors located downgradient from the premises.

The Delegated Officer has reviewed groundwater monitoring data from CM Farm bores illustrated in Appendix 4 and concluded that:

12. High nutrient levels above background levels have been detected in multiple bores surrounding the CM Farms infrastructure indicating the presence of nearby sources. It is, therefore, necessary to confirm by testing containment infrastructure to ensure it is effective.
13. From the location of the impacted bore, it is inferred that one or multiple CM Farm ponds have significant seepage rates.
14. Given the observed fluctuations and high levels of contaminants recorded, the current biannual sampling regime is not sufficient to adequately document environmental performance and determine contamination sources.
15. High nutrient levels in bore CM11S and bores CM10S and CM09S indicate that a groundwater contamination plume originating at the operational area has mobilised and is moving in a south-westerly direction where it is likely to impact sensitive receptors. To determine if the plume has reached the Premises boundary the installation of an additional groundwater bore near the southern boundary is required.

Figure 4: Groundwater monitoring bore locations for Nambeelup Farm Premises

Odour

Due to a marked increase in complaints received by the Department in the Mandurah area (Appendix 5, Fig. 1), the Department undertook the Mandurah Odour Investigation to ascertain which odour sources were the major contributors to odour impacts in the Mandurah area and if possible, to determine the odour impact extent of those sources. Details of the complaints and the investigation are included in Appendix 5, with the final odour investigation included in Appendix 6.

Key findings: The Delegated Officer has reviewed the odour complaint information and odour investigation and has found:

1. There is a potential pathway for odours to travel over 8km from the premises.
2. Odour emissions observed in the Mandurah area are mainly attributable to the Nambeelup Farm premises.

A Technical Expert Report was prepared by the Department's Air Quality Services function in November 2016. The report includes a review of the documentation shown in Table 8, which was provided to the Department by the Licence Holder.

The report is included in Attachment 7.

Table 8: Odour investigation reports

Document	Author	Date of document
Hardcopy report: *Draft Investigation of Odour Emissions from Nambeelup Precinct Operations.*	David Pitt, Environmental Alliances Pty Ltd (ENVALL)	July 2016
Wastewater quality Laboratory Report (ARL job number 16-03831 Revision 01) contained as an attachment in a hardcopy request for advice from the Department's Acting Executive Director Compliance and Enforcement.	Analytical Reference Laboratory (ARL)	20 June 2016

Key findings: *The Delegated Officer has reviewed the information regarding the premises in the Department's Technical Expert Report and has found:*

1. The report identifies that leachate runoff from C-Wise was entering the decommissioned Pond 1 at the Premises and that overflow from Pond 1 was entering Pond 2 and was promoting anaerobic conditions in some sections of the pond.
2. Since the site visits and the production of the Department's Technical Expert Report, the leachate run-off from C-Wise has been prevented from entering Pond 1 and has been directed to the ponds at C-Wise.C-Wise have requested that water from Pond 2 be used as part of their wetting process and the run-off from a 1,545m^2 area be directed back to Pond 2 through a solids capture system. The volume and quality of water is not expected to impact Pond 2 with an expected loss over an annual period due to loss of water in the C-Wise wetting process.
3. Pond 1 has been replaced by Pond 0 (anaerobic pond) which is now operational.

Applicable standards and guidelines

National Environmental Guidelines for Piggeries 2010

4.8

4.8.1 In the context of this Review, the NEGP represent the most appropriate industry guidance when considering intensive piggeries. This guideline supersedes the former Western Australian Department of Agriculture and Food (DAFWA) publication *Environmental Guidelines for New and Existing Piggeries* (2000), which has been rescinded.

The amended licence that was issued on 8 December 2011 included an improvement requirement for the Licence Holder to submit a report comparing the Premises operations to the NEGP.

The Department received the report on 27 August 2012. The report identified four areas of improvement:

- Wastewater Pond 2 had a freeboard of 300mm rather than the recommended 500mm;
- One conventional shed had a small quantity of hose-down water escaping outside the shed onto the surrounding concrete apron with some possibly making its way to bare soil;
- The fuel bowser serviced by an underground fuel tank did not have any means of containment if there was spillage from the bowser; and
- An above ground fuel tank did not have appropriate bunding.

The report advised the following improvement actions had been carried out:

- Desludging of Pond 2 resulting in the freeboard increasing to 500mm. Desludging to continue at a rate at which C-Wise can utilise the sludge solids;
- Concrete bund installed to stop run-off escaping the shed;
- Bunding installed around the fuel bowser; and
- The above ground fuel tank was removed.

5. Consultation

DWER met with the Shire of Murray and the City of Mandurah during the Review. No formal comments were received from these stakeholders.

The Review was advertised on the DWER website for a period of 25 calendar days from 24 October 2017. No comments were received from the public.

6. Location and siting

6.1 Siting context

Nambeelup Farm is in the locality of Nambeelup in the Shire of Murray and is approximately 60km south of Perth, and approximately 10km northeast of Mandurah townsite. The premises location is shown in Figure 5.

Figure 5: Regional location of Nambeelup Farm

The relative location of the three Nambeelup Farm premises is shown in Figure 5. The immediate surrounding land is predominantly undeveloped land and rural properties, with a number of commercial kennels located to the south. Murrayfield airport, a small private airport run by the Royal Aero Club of Western Australia, is located directly south of the Premises.

Figure 6: Delineation of Nambeelup Farm premises (CM-Farms Premises is Lot 89 and 109)

6.2 Residential and sensitive Premises

The approximate distances to residential receptors from the operational area of the Premises are shown in Table 9 and on Figure 7. Distances were measured using the Intramaps Mapping System on the Shire of Murray's website.

Table 9: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Murrayfield Airport	500m south of the operational area
Rural residential Premises 1	Approximately 1,000 m south-west
Rural residential Premises 2	Approximately 1,400 m south-east
Nearest residential development (Stake Hill)	Approximately 3,000 m north-west
Southern portion of Stake Hill residential area	Approximately 3,300 m north-west
Barrangup residential area	Approximately 4,000 m south-west
Mandurah townsite	Approximately 10,000 m south-west

Figure 7: Distance to residential receptors from CM-Farms operational area

6.3 Specified ecosystems

The distances to specified ecosystems are shown in Table 10 and on Figure 8 and Figure 9.

Table 10: Specified ecosystems

Specified ecosystems	**Distance from the Premises**
Nature reserve	Crown land vested in the Conservation Commission of Western Australian for the conservation of flora and fauna is located approximately 470m to the south of the Premises.
Threatened Ecological Communities and Priority Ecological Communities.	A threatened ecological community is located approximately 5km to the south-west of the Premises.
Rare flora.	The Premises are located within an area approximately 20km by 9km known to contain declared rare flora.
Other relevant ecosystem values	**Distance from the Premises**
Environmental Protection Peel Inlet – Harvey Estuary Policy 1992	The Premises are within the EPP area
Rights in water and irrigation act 1914 • Surface Water (Serpentine River System) • Groundwater (Murray)	The Premises are within the Policy area

Groundwater and water resources

The distances to groundwater and water sources are shown in Table 11.

Table 11: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental Value
Groundwater	Groundwater is generally less than 2m from the ground surface across the Premises area (see Figure 10). Data provided by Marillier, 2012 indicate that the regional direction of groundwater flow may be in a west to north-westerly direction towards the Serpentine River (see Figure 11). There may be local variations in flow direction near Nambeelup Farm due to the presence of water table management drains, seepage from ponds, and local groundwater abstraction. This is evident in small-scale groundwater monitoring and contours at the Nambeelup Farm area documented by Geo and Hydro (2010)[1] that indicate groundwater flow in a south-westerly direction.	There are several abstraction bores within the vicinity and down hydraulic gradient from the Premises which are used for livestock watering and irrigation (see Figure 12).
RAMSAR wetland	Peel-Yalgorup System (Peel Estuary-Harvey Inlet) located over 11km west-southwest of the Premises.	Wetland of international significance.
Geomorphic Wetlands	There are five conservation category wetlands within 1km of the Premises operational areas: • One approximately 1km south-west of the Premises; • Two approximately 800m and 600m south-east of the Premises; and • Two approximately 400m and 800m north of the Premises.	Conservation category Wetlands (see Figure 8).

[1] Geo and Hydro Environmental Management Pty Ltd 2010: Watertable contours across Custom Compost Lot 230 Nambellup Rd Nambellup, Figure 5. Submitted by Custom Compost

Groundwater and water sources	Distance from Premises	Environmental Value
Waterbodies	The Nambeelup Brook is located approximately 2km east of the Premises. The Serpentine River is located approximately 2.5km west of the Premises. Goegrup Lake is approximately 5km south west of the Premises and is fed by both the Serpentine River and Nambeelup Brook.	All three waterbodies are Conservation category (western end of Nambeelup Brook only) and ultimately drain to the Peel Harvey Estuary.

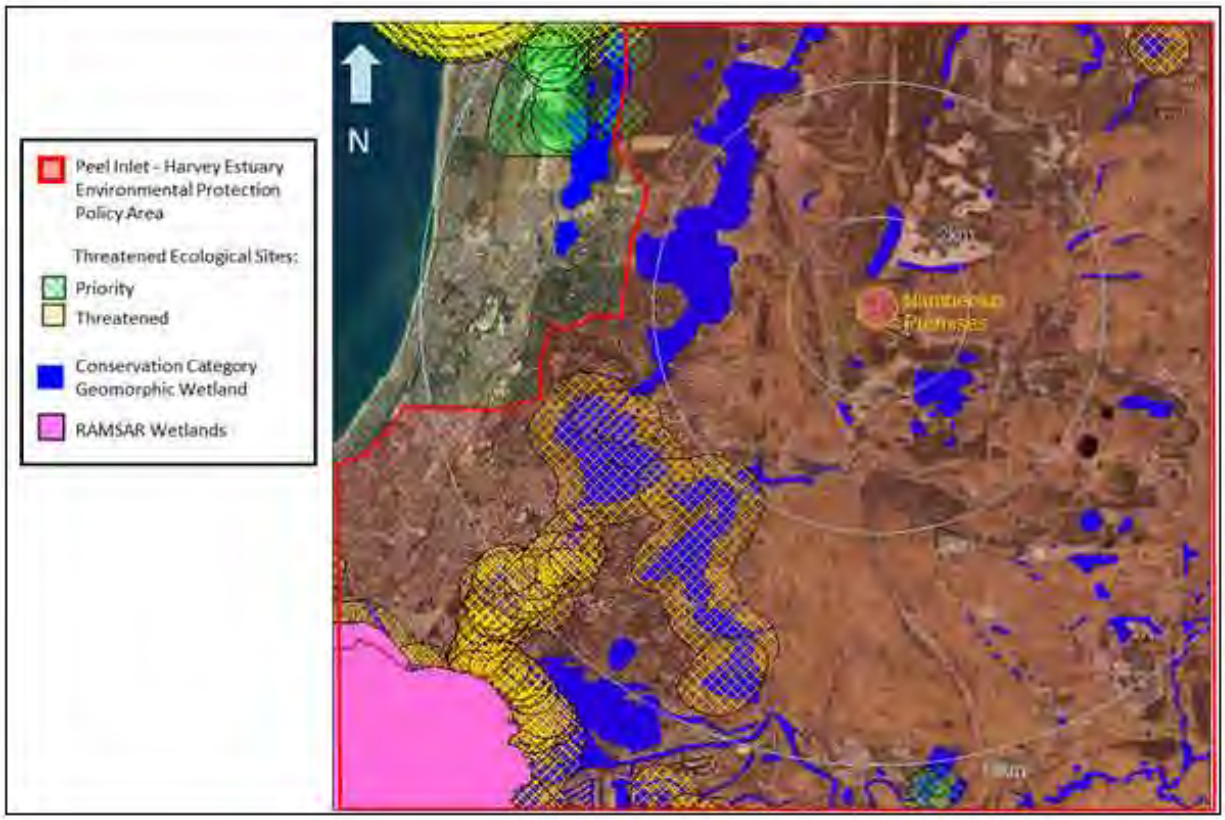


Figure 8: Specified ecosystem and water resource locations within regional area

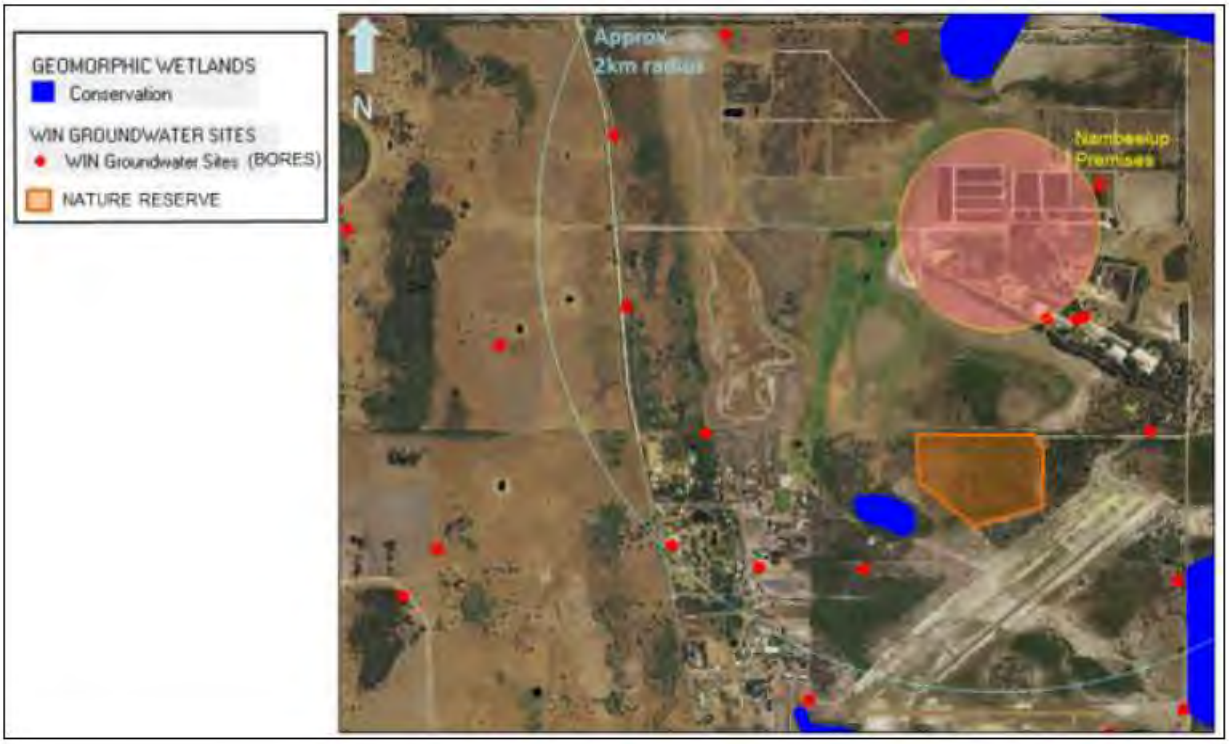


Figure 9: Specified ecosystem and water resource locations within local area

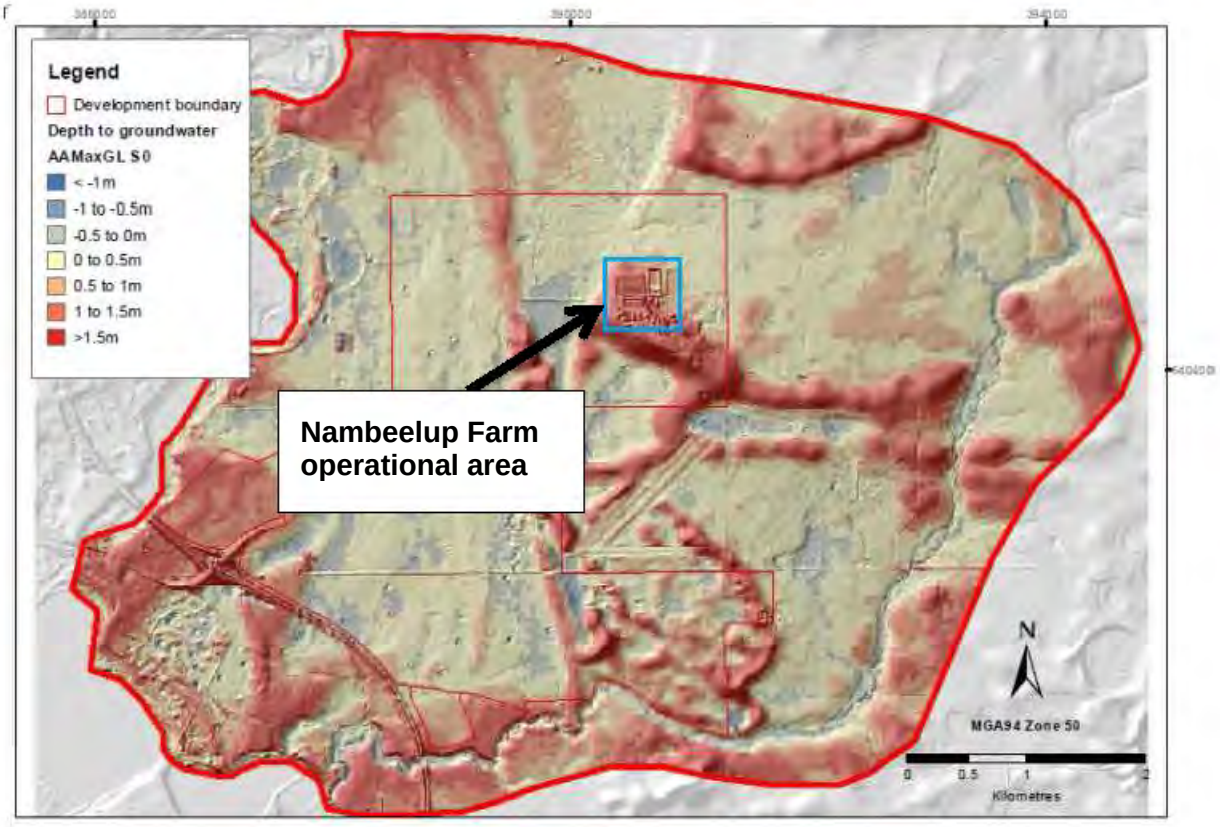


Figure 10: Depth to groundwater (Marillier, B 2012)

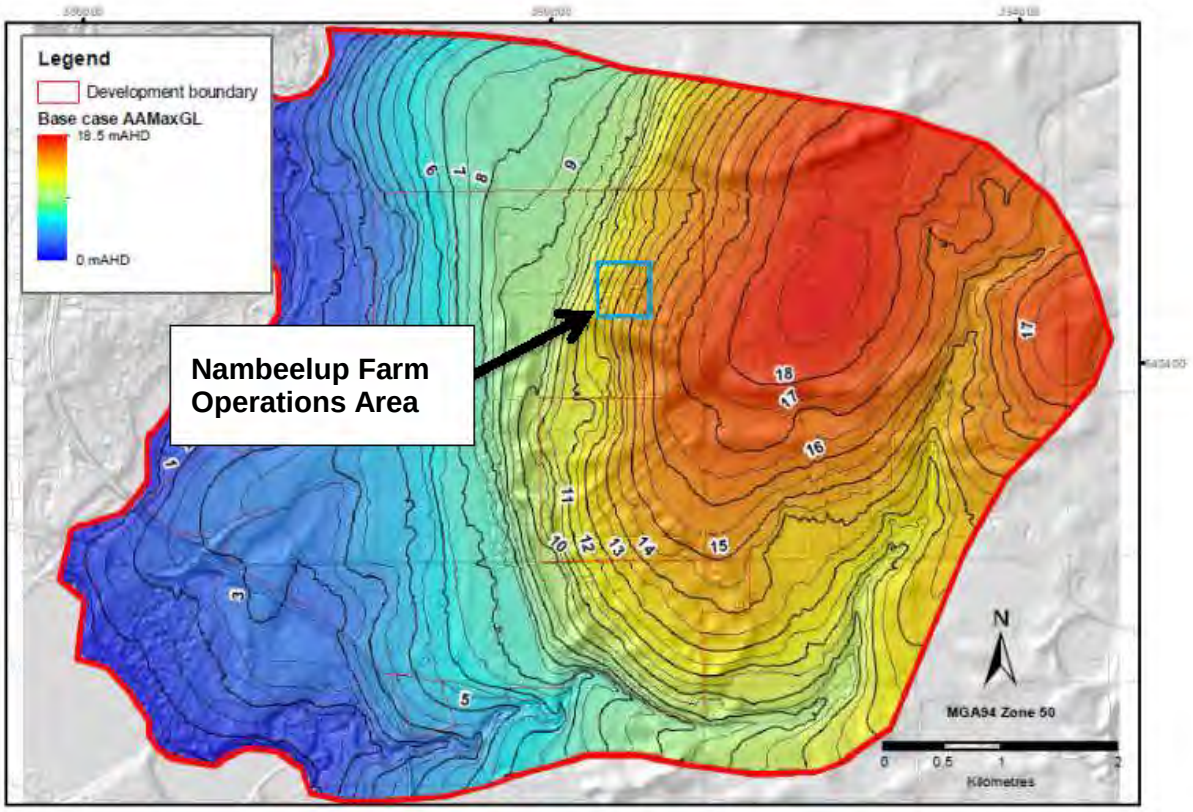


Figure 11: Annual Average maximum groundwater level (Marillier, 2012)

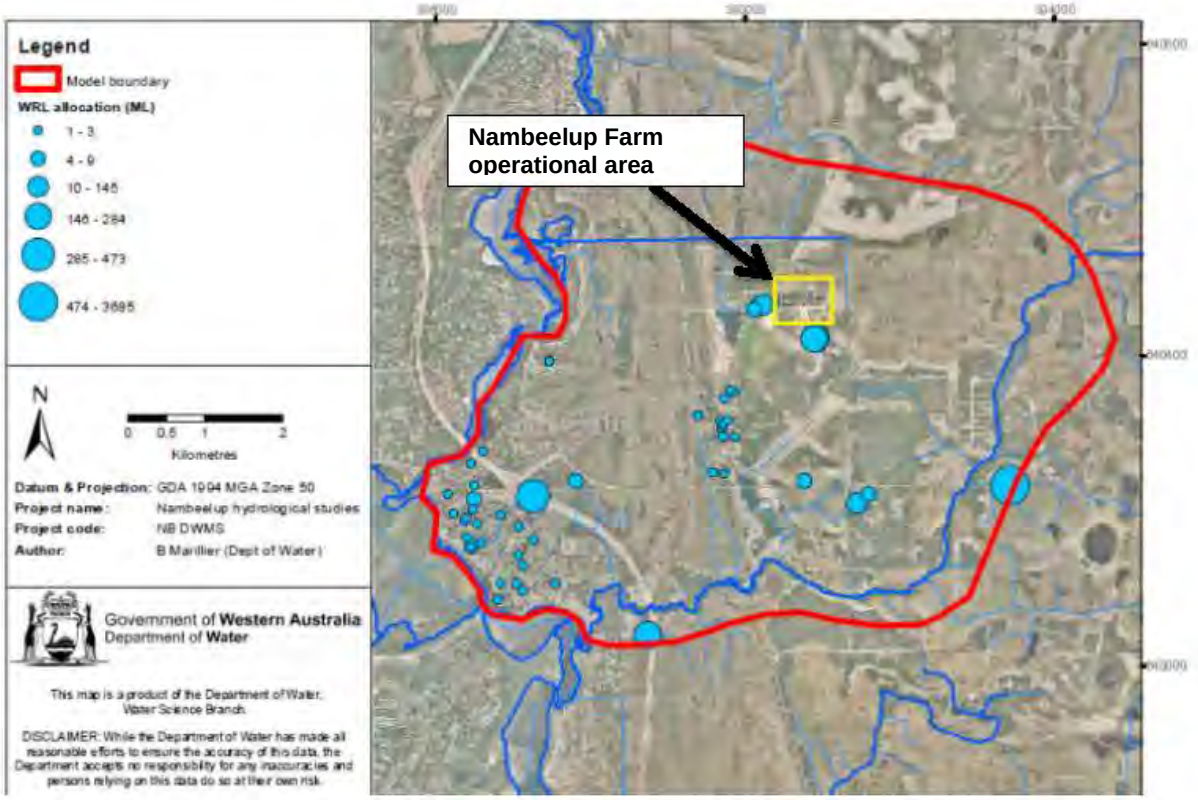


Figure 12: Water extraction bores

6.5 Soil type

The Premises are underlain by sandy sediments that comprise the Bassendean Sand and Gnangara Sand units of the superficial formation which has a combined thickness of approximately 10m in the area. These sediments are in turn underlain by the sandy sediments that comprise the Rockingham Sand unit. The superficial formations and the Rockingham Sand unit together form an extensive unconfined aquifer that that has a combined saturated thickness of 40m to 50m in the area (Hall *et al*., 2010; Marillier, 2012).

6.6 Meteorology

6.6.1 Wind direction and strength

The following wind roses (Figure 13) provide the annual wind direction and strength (km/h) for 9am and 3pm between the years 1988 and 2001 in Mandurah (BoM 2016). The region has a dominant wind direction consisting of easterly winds during the morning and south-westerly winds in the afternoon.

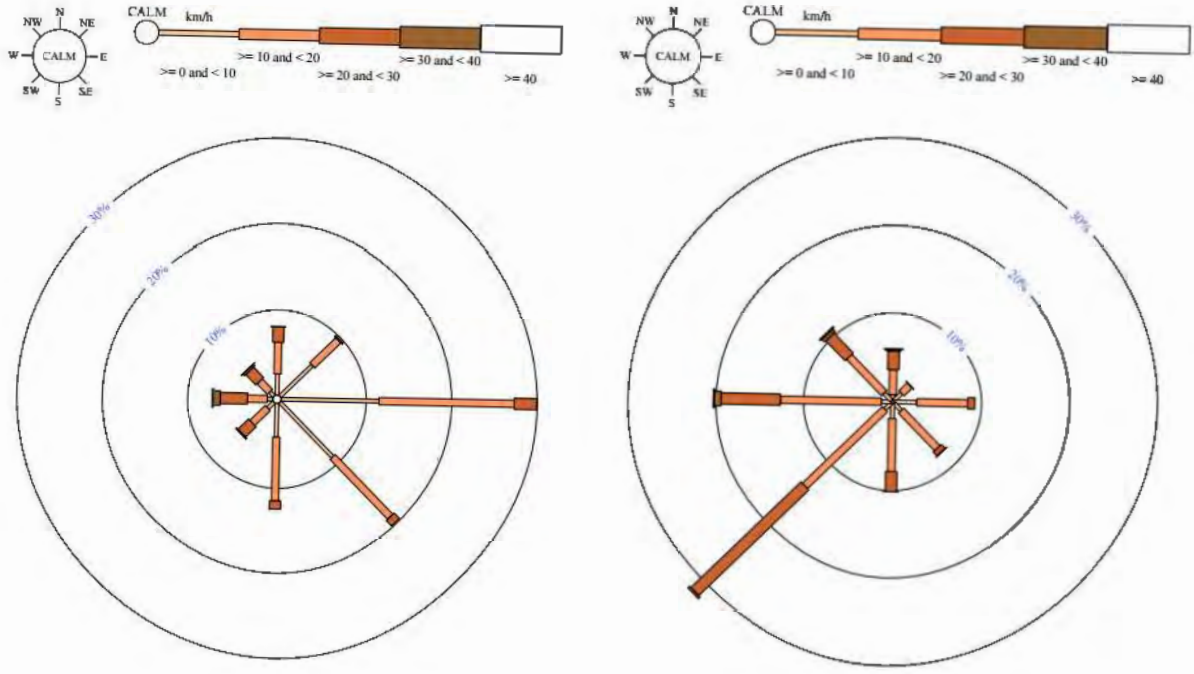


Figure 13: Wind roses for Mandurah at 9am and 3pm (BoM 1988-2001)

It is important to note that these wind roses show historical wind speed and wind direction data for Mandurah and should not be used to predict future data.

6.6.2 Rainfall and temperature

The Nambeelup locality experiences mild, wet winters, and hot, dry summers. Figure 14 shows the mean rainfall and maximum temperatures for Mandurah for the period 2001-2016. Mandurah receives a mean annual rainfall of approximately 670mm.

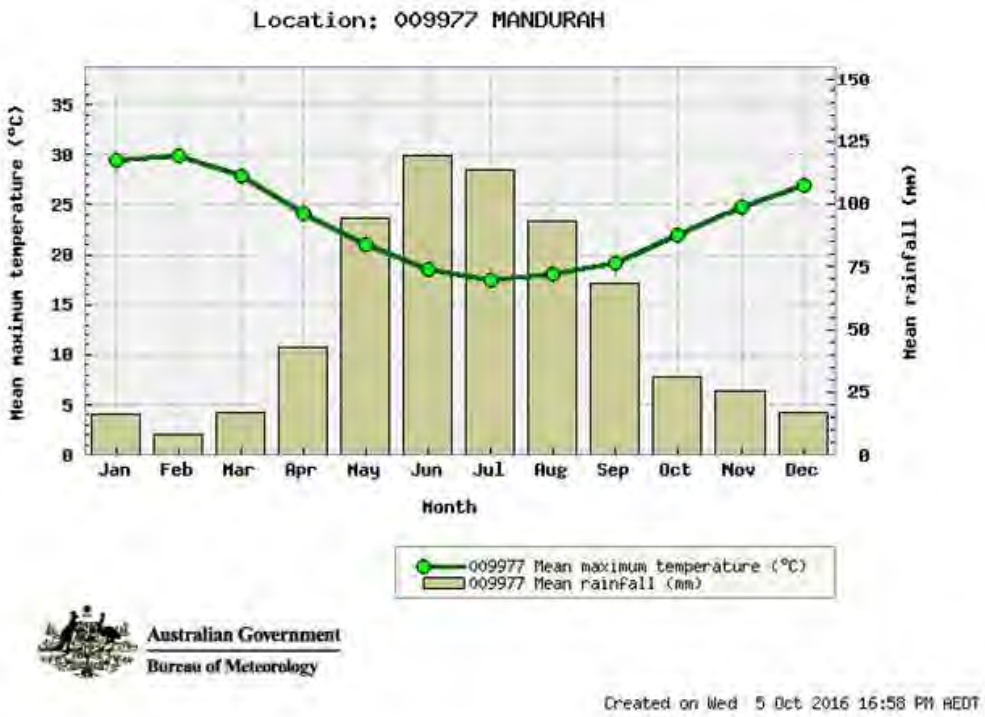


Figure 14: Mean temperature and rainfall at Mandurah (BoM 2001-2016)

7. Risk assessment

7.1 Confirmation of potential impacts

Identification of key potential emissions, pathways, receptors and confirmation of potential impacts are set out in Table 12. Table 12 also identifies which potential emissions will be progressed to a full risk assessment. Some potential emissions/impacts may not receive a full risk assessment where a potential receptor or pathway cannot be identified.

Table 12: Identification of key emissions during operation

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
Source (see Section 3.1 for infrastructure)	**Conventional piggery sheds and eco-shelters, carcass composting tunnel**	Solid and liquid wastes	Wastewater and leachate: Run-off from Hardstand Seepage through Hardstand	Peel-Yalgorup RAMSAR Wetland Peel Inlet and Harvey Estuary EPP	Overland flow Seepage through soil Transport through groundwater	Increased phosphorus load on the Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters Contamination of surface waters at the point of groundwater expression Impact on the biological diversity of wetland flora and fauna including thrombolites and waterbird species Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Groundwater (abstraction bores)	Overland flow Seepage through soil	Contamination of groundwater supply for users	Yes	See section 7.4

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
Source (see Section 3.1 for infrastructure)	**Conventional piggery sheds and eco-shelters, carcass composting tunnel**	Solid and liquid wastes	Wastewater and leachate: Run-off from Hardstand Seepage through Hardstand Pond liner rupture	Geomorphic Wetlands – conservation category wetlands	Overland flow Seepage through soil Transport through groundwater	Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Nambeelup Brook			No	Nambeelup Brook is located approximately 2.5km up-hydraulic gradient of the premises. No pathway is present.
				Serpentine River			Yes	See section 7.4
				Premises and adjoining land	Overland flow Seepage through soil	Contamination of soil	Yes	See section 7.4
				Nature reserve	Overland flow Seepage through soil Transport through groundwater	Impact on the biological diversity of sensitive ecological communities	Yes	See section 7.4
				Threatened Ecological Communities and Priority Ecological Communities.			Yes	See section 7.4
			Odour	Residential receptors – nearest residence approx. 1090m south-west Patrons of airfield located 500m south	Air (windborne)	Amenity impacts	Yes	See Section 7.5
	Conventional piggery sheds and eco-shelters, and site traffic	Housing and transport of pigs	Noise	Residential receptors – nearest residence approx. 1,090m south-west Patrons of airfield located 500m south	Air (windborne)	Amenity impacts	No	Sufficient separation distance. Nearest residential receptors are 1km from the premises. *Noise Regulations* apply.

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
Source (see Section 3.1 for infrastructure)	**Collection, treatment, and storage of wastewater**	WWTP and wastewater treatment ponds	Wastewater discharges caused by overflows, breach of containment, liner damage, seepage or leakage	Peel-Yalgorup RAMSAR Wetland Peel Inlet and Harvey Estuary EPP	Overland flow Seepage through soil Transport through groundwater	Increased phosphorus load on Peel Inlet and Harvey Estuary catchment leading to contamination of surface waters Contamination of surface waters at the point of groundwater expression Impact the biological diversity of wetland flora and fauna including thrombolite and waterbird species	Yes	See section 7.4
				Groundwater (abstraction bores)	Overland flow Seepage through soil	Contamination of groundwater supply for nearby users	Yes	See section 7.4
				Geomorphic Wetlands – conservation category wetlands	Overland flow Seepage through soil Transport through groundwater	Contamination of surface waters at the point of groundwater expression Contribute to eutrophication and algal blooms which can impact ecosystem function	Yes	See section 7.4
				Nambeelup Brook			No	Nambeelup Brook is located approximately 2.5km up-hydraulic gradient of the premises. No pathway is present.
				Serpentine River			Yes	See section 7.4
				Nature reserve	Overland flow	Impact on the	Yes	See section 7.4

			Potential Emissions	Potential Receptors	Potential Pathway	Potential Impacts	Continued to detailed risk assessment?	Reasoning
				Threatened Ecological Communities and Priority Ecological Communities	Seepage through soil Transport through groundwater	biological diversity of sensitive ecological communities	Yes	See section 7.4
				Premises and adjoining land	Overland flow Seepage through soil	Contamination of soil	Yes	See section 7.4
			Odour	Residential receptors – nearest residence approx. 1,090m south-west Patrons of airfield located 500m south	Air (windborne)	Impacts to amenity and wellbeing	Yes	See section 7.5

Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 13 below.

Table 13: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 14 below.

Table 14: Risk criteria table

Likelihood The following criteria has been used to determine the likelihood of the risk / opportunity occurring.		Consequence The following criteria has been used to determine the consequences of a risk occurring:		
			Environment	Public Health* and Amenity (such as air and water quality, noise, and odour)
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **on-site impacts**: catastrophic • **off-site impacts local scale**: high level or above • **off-site impacts wider scale:** mid level or above • Mid to long term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **on-site impacts**: high level • **off-site impacts local scale**: mid level • **off-site impacts wider scale**: low level • Short term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **on-site impacts**: mid level • **off-site impacts local scale**: low level • **off-site impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **on-site impacts**: low level • **off-site impacts local scale**: minimal • **off-site impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **on-site impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the Guidance Statement: Environmental Siting.

* In applying public health criteria, DWER may have regard to the Department of Health's, Health Risk Assessment (Scoping) Guidelines

"on-site" means within the prescribed Premises boundary.

Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 15:

Table 15: Risk treatment

Risk Rating	Acceptability	Treatment
Extreme	Unacceptable.	Risks will not be tolerated. DWER may refuse application.
High	Acceptable subject to multiple regulatory controls.	Risk event will be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk event is acceptable and will generally not be subject to regulatory controls.

Risk of wastewater and leachate impacts

General hazard characterisation and impact

There are no point source emissions of wastewater to surface water or groundwater associated with the operation of the premises. However, emissions of wastewater and leachate high in nutrients and metals may occur.

Wastewater analysis from the premises is shown in Table 7 of section 4.6.3.

The NEGP states that piggery effluent water can typically contain metals including copper (0.00-0.28mg/L), iron (0.9-1.61mg/L), manganese (0.00-0.05mg/L) and zinc (0.16-1.27mg/L)

Emissions of leachate directly to soils onsite may result in seepage or overland flow to groundwater or adjoining land. The soil at the premises is fine to coarse sand which is considered likely to allow leachate seepage to move through the soil profile. The depth to groundwater is approximately two meters which increases the likelihood of leachate seepage reaching groundwater. This may result in the contamination of the soils and groundwater within and adjacent to the Nambeelup Farm premises, which may impact nearby users.

DWER's GIS mapping system indicates that groundwater in the area may have a TDS concentration of 500 to 3000 mg/L, and is considered to be fresh to brackish. Therefore the groundwater is considered a receptor of beneficial use as it may be considered potable, suitable for irrigation or livestock. This is consistent with the presence of groundwater extraction bores in the area as identified in Section 6.4.

Rising groundwater, the result of mounding, has the potential to intercept the root zone of native vegetation. This may lead to an oversaturation of soils and/or accumulation of salts that can impact the growth of native vegetation.

If the flow of contaminated groundwater reached the nature reserve located approximately 700m south west of the premises, this could result in impacts to the health and diversity of flora and fauna within the reserve.

The pathway for emissions to surface water may be via overland flow or within groundwater flow. Contaminated groundwater may be expressed within the Geomorphic Wetlands and the Serpentine River, which are both down-gradient of the premises. Emissions may contribute to the phosphorus load within the Peel Inlet and Harvey Estuary, which is fed by the Serpentine River. Threatened Ecological communities are also located in the vicinity of the conservation category wetlands and are likely to be impacted by any contamination of the groundwater and surface water in the area.

The expression of contaminated groundwater in surface water bodies may result in eutrophication and the excessive growth of algae. Algae growth may impact the survival of existing organisms through light and oxygen restriction and cause the degradation of the surface water value and beneficial use. Contamination in the groundwater and/or the wetlands may impact the biological diversity of threatened ecological communities.

Sources

Emissions of leachate may occur from the following sources at the premises, as shown in Table 16.

Table 16: Potential sources of wastewater and leachate discharges to land

Source	Potential event
Pig accommodation (conventional sheds and eco-shelters)	• Uncontained effluent runoff • Leaching through Hardstand • Uncontained leachate from spent eco-shelter bedding
WWTP	• Uncontained wastewater runoff (containment failure, overtopping) • Uncontained leachate from separated solids • Leaching through Hardstand
Wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6).	• Uncontained wastewater runoff (containment failure, overtopping) • Leaching through pond liner due to liner damage/faults or ponds intersecting groundwater resulting in increased seepage. • Seepage from desludged material • Returned water from the C-Wise premises
Decommissioned wastewater treatment ponds (Ponds 1, 3 and 4)	• Seepage through clay liner • Breach of liner through desludging • Seepage from desludged material
Carcass composting tunnel	• Uncontained leachate from composting pile

Criteria for assessment

The following guidelines are considered appropriate assessment criteria to assess the potential impact on the beneficial use of groundwater.

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC & ARMCANZ (2000) for livestock drinking water quality.

The following guidelines are considered appropriate assessment criteria to assess the potential impact on groundwater dependent and freshwater ecosystems and surface water quality.

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC & ARMCANZ (2000) for slightly–moderately disturbed ecosystems (95% protection level trigger values).

Licence Holder controls

The Licence Holder's controls to reduce and manage wastewater and leachate emissions are set out in Table 17.

Table 17: Licence Holder controls for wastewater and leachate emissions

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
Conventional sheds	Enclosed sheds. Concrete partially slatted floors above underfloor effluent collection sumps and drains. Effluent flush system (tipper bucket system). Effluent flushed to a central drain and directed to the WWTP via underground concrete drainage.	Daily inspection of pens and drainage system. As required hose-down of pens. Effluent flush system activated automatically every three to four hours or manually as required. Use of feed designed to reduce nutrient content of waste.	Piggery sheds
Eco-shelters	Concrete floor, concrete bunker walls, and dome shelter. Bedding provided to contain effluent. Bedding replaced at least every eight weeks.	Daily inspection of eco-shelters. Additional bedding added as required. Spent bedding removed from Premises (not stored on Premises).	Eco-shelters

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
WWTP	Screen cage and pit to remove large solids. Concrete pits (sides and bases). Overflow storage available. Bunded to prevent the inflow of stormwater to the WWTP. Separated solids stored on concrete Hardstand graded to return leachate to the WWTP.	Daily inspection of WWTP. Weekly cleaning of the screen cage and pit. Wastewater can be diverted around WWTP to Pond 2. Separated solids removed from Premises (limited storage on the Premises). WWTP discharges to Pond 0.	WWTP
Wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6).	All ponds lined with HDPE (at least 1mm thick). Total pond capacity of 84,925m^3. Anaerobic treatment provided by Pond 0. Aerobic treatment provided by Ponds 2, 5 and 6. Run-off from C-Wise pre-wetting area after pass through a solid separation system.	300mm freeboard maintained in the ponds. Treated wastewater used on the Premises or removed from the Premises. Vegetation prevented from growing on lined pond embankments. Aerobic pond surfaces kept clear of vegetation. Desludging of ponds to commence after desludging of Pond 1 is complete.	Pond 0, Pond 2, Pond 5 and Pond 6
Wastewater treatment ponds (Pond 1, 3 and 4)	Clay lined (unknown integrity). Not in operational use. Collection of leachate run-off from C-Wise stopped. Active decommissioning programme.	4,000m^3 of sludge removed each year. Sludge is dewatered on impermeable base with run-off graded back to wastewater treatment ponds. Dried sludge removed from Premises (not stored on Premises).	Pond 1, Pond 3 and Pond 4

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
Carcass composting tunnel	Concrete floor and bunker walls. Graded to return leachate to the WWTP.	Carcasses covered with compost material. Compost process takes place for six months to allow the full breakdown of organic material.	Carcass composting tunnel

Key findings: The Delegated Officer has reviewed the information regarding the wastewater and leachate impacts from the premises and has found:

1. There are several potential sources of wastewater and leachate present on the premises.
2. Groundwater is likely to be within two meters below ground level and the soils beneath the site are sand, indicating high permeability.
3. There are several potential receptors present. Groundwater is considered a pathway and receptor.
4. Historical groundwater monitoring indicates elevated levels of nutrients in the groundwater above background levels around the operational areas of the Premises and down-hydraulic gradient of these areas.
5. All wastewater treatment ponds are lined with HDPE and have been relined since 2011. No compliance documentation could be located for the liners installed in Ponds 2 and 5.
6. There has been no pond overflow event since 2009. Maintenance of sufficient pond capacity is reliant on the reuse of wastewater in the premises and at C-Wise.
7. There are other sources of wastewater and leachate on Nambeelup Farm at C-Wise and Mushroom Exchange.

Consequence

The guidelines for livestock drinking water quality indicate that concentrations of total dissolved solids between 2000-3000mg/L may result in a reluctance of poultry to drink, and levels above 3000mg/L may result in a decline in animal condition (poultry is the most sensitive of the livestock considered) (ANZECC & ARMCANZ 2000). The recent monitoring results (2016-2017 averaged data) showed that a number of bores exceeded 2000mg/L (CW01, CW02, CW05(A), CM08S and CM11S). The highest results were from Bores CM11S and CW05(A), which are located on the western perimeter of the operational areas, and were above 3000mg/L.

The guidelines for slightly to moderately disturbed ecosystems provides a 95% protection trigger level value of 0.9mg/L for ammonia (ANZECC & ARMCANZ 2000). The recent monitoring results (2016-2017 averaged data) show that the majority of the bores within the Nambeelup Farm Premises exceed that trigger level to some degree. However, a number of bores (CM11S, CW05(A), CW02 and ME01) show levels of ammonia in excess of 30 times the trigger level. The results for bores CM11 and CW05(A) were 127 and 144 times higher than the trigger level respectively.

Bore CM10S is inferred to be downgradient of the operational areas and is the closest bore to the conservation category wetlands and the nature reserve. The results for this bore show an ammonia level of 6mg/L, however, it is located approximately 400m from these receptors.

Based on the key receptors (potential beneficial use of groundwater within and adjacent to the Nambeelup Farm premises, the nearby nature reserve and wetland, and the EPP area with its nutrient load management requirements), the Delegated Officer has determined that leachate from individual sources could cause low-level off-site impacts to the groundwater quality and the nearby nature reserve and wetland, and nutrient inputs into the EPP area with a risk that specific consequence criteria are not being met. Therefore, the Delegated Officer considers the consequence to be **Moderate**.

7.4.6 Likelihood of consequence

Conventional sheds and eco-shelters

Based upon the premises infrastructure and Licence Holder controls the Delegated Officer has determined that the likelihood of wastewater and leachate impacts to the beneficial use of groundwater from the conventional sheds and eco-shelters will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

Wastewater treatment system

Based upon the premises infrastructure, Licence Holder controls, historical monitoring data, and other potential sources of wastewater and leachate in the area, the Delegated Officer has determined that the likelihood of wastewater and leachate impacts to the beneficial use of groundwater from the wastewater treatment system could occur at some time. Therefore, the Delegated Officer considers the likelihood to be **Possible**.

Wastewater treatment ponds 0, 2, 5 and 6

Based upon historical monitoring data showing signs of groundwater contamination, the assumption that the separation between the base of these ponds and groundwater is less than 2m, and taking into account the premises infrastructure, Licence Holder controls and other potential sources of wastewater and leachate in the area, the Delegated Officer has determined that the likelihood of wastewater and leachate impacts to the beneficial use of groundwater from the wastewater treatment ponds is likely to be occurring. Therefore, the Delegated Officer considers the likelihood to be **Likely**.

Wastewater treatment ponds 1, 3 and 4

Based upon the unknown integrity of the pond liners, groundwater monitoring data showing contamination close to these ponds, and taking into account Licence Holder controls and other potential sources of wastewater and leachate in the area, the Delegated Officer has determined that the likelihood of wastewater and leachate impacts to the beneficial use of groundwater from ponds 1, 3 and 4 is likely to be occurring. Therefore, the Delegated Officer considers the likelihood to be **Likely**.

Carcass composting tunnel

Based upon the premises infrastructure and Licence Holder controls the Delegated Officer has determined that the likelihood of wastewater and leachate impacts to the beneficial use of groundwater from the carcass composting tunnel will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

7.4.7 Overall rating

Conventional sheds and Eco-shelters

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of wastewater

and leachate emissions from the conventional sheds and eco-shelters impacting groundwater during operation is **Medium.**

Wastewater treatment system

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of wastewater and leachate emissions from the wastewater treatment system impacting groundwater during operation is **Medium.**

Wastewater treatment ponds 0, 2, 5 and 6

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of wastewater and leachate emissions from the wastewater treatment ponds impacting groundwater during operation is **High.**

Wastewater treatment pond 1, 3 and 4

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of wastewater and leachate emissions from pond 1, 3 and 4 impacting groundwater during operation is **High.**

Carcass composting tunnel

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of wastewater and leachate emissions from the carcass composting tunnel impacting groundwater during operation is **Medium.**

Collective sources

Considering the multiple potential sources of leachate within the Premises and within the other Nambeelup Farm Premises, the Delegated Officer has determined that the multiple sources contribute to an increased overall consequence from the emissions, as they may result in a greater cumulative volume of leachate emitted and therefore increase the severity of the impact on receptors. The Delegated Officer has determined that leachate emissions from the Nambeelup Farm premises collectively could cause mid-level off-site impacts and could, therefore, have a **Major** consequence.

The Delegated Officer considers that the likelihood of a major impact resulting from the Nambeelup Farm premises collectively is **Possible**.

The Delegated Officer has determined that the overall rating for the collective sources is **High**.

7.5 Risk of odour impacts

7.5.1 General hazard characterisation and impact

Individual responses to odour emissions may vary depending on age, health status, sensitivity, and odour exposure patterns. Perceived odour intensity may increase or decrease on exposure. Community response to an odour can include annoyance, potentially leading to stress and loss of amenity. Exposure to repeated odour events can create a nuisance effect.

Exposure times and frequency of odour emissions depend on day to day activities and weather conditions.

The location of the Premises adjacent to C-Wise and Mushroom Exchange can result in cumulative odour impacts from Nambeelup Farm premises. The cumulative effect is considered to increase the consequence and likelihood of odour emissions from the Premises.

Sources of odour on the Premises are shown in Table 18 below.

The Mandurah Odour Investigation identified that odour from Nambeelup Farm can be recognised up to 8.5km from the Premises, within the suburbs around Mandurah.

Table 18: Potential sources of odour

Source	Potential event
Pig accommodation (conventional sheds and eco-shelters)	• Odour from pigs and effluent • Odour from bedding
WWTP	• Odour from wastewater (including wastewater transfer and mixing) • Odour from separated solids
Wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6)	• Odour from the anaerobic treatment of wastewater (including generation of odorous gases) • Odour from the aerobic treatment of wastewater (including spray aeration of wastewater) • Odour from desludging
Decommissioned Wastewater treatment ponds (Ponds 1, 3 and 4)	• Odour from desludging
Carcass composting tunnel	• Odour from decomposing carcasses

Criteria for assessment

The general provisions of the EP Act make it an offence to cause or allow unreasonable emissions which includes emissions of odour that unreasonably interfere with the health, welfare, convenience, comfort or amenity of any person.

Licence Holder controls

This assessment has reviewed Licence Holder odour management, with the controls set out in Table 19.

Table 19: Licence Holder infrastructure controls for fugitive odour emissions

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
Conventional sheds	Sheds are naturally ventilated through adjustable wall shutters and open roof vents. Effluent flush system (tipper bucket system). Effluent flushed to a central drain and directed to the WWTP via underground concrete drainage.	Daily inspection of pens and drainage system. As required hose-down of pens. Effluent flush system manually activated every week or more frequently as required. Use of feed designed to reduce nutrient content of waste. Pig carcasses removed daily to composting tunnel.	Piggery sheds
Eco-shelters	Bedding replaced at least every eight weeks.	Daily inspection of eco-shelters. Spent bedding removed from Premises (limited storage on the Premises).	Eco-shelters
WWTP	Separation of solids.	Daily inspection of WWTP. Weekly cleaning of the grizzly screen. Separated solids removed from Premises (limited storage on Premises).	WWTP
Wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6).	Anaerobic treatment provided by Pond 0. Aerobic treatment provided by Ponds 2, 5 and 6.	Crust developing on Pond 0. Sprinkler are only used mid-morning to late afternoon.	Pond 0, Pond 2, Pond 5 and Pond 6
Wastewater treatment ponds (Pond 1)	Not in operational use. Collection of leachate run-off from C-Wise stopped. Active decommissioning programme.	4,000m^3 of sludge removed each year. Dried sludge removed from Premises.	Pond 1, Pond 3 and Pond 4

Source	Control(s)	Operation details	Reference to Issued Licence Premises Layout Map
Carcass composting tunnel	Carcasses composted.	Carcasses covered with compost material. Compost process takes place for six months to allow the full breakdown of organic material.	Carcass composting tunnel

Key findings: The Delegated Officer has reviewed the information regarding the Odour impacts from the Premises and has found:

1. The Premises do not meet the calculated separation distances (NEGP Level 1) for the protection of residential receptors.
2. The three Nambeelup Farm premises are likely to have a cumulative odour impact.
3. Odour emissions from Nambeelup Farm area have had a demonstrated impact on receptor amenity.
4. The majority of potentially odourous wastes are removed from the Premises to C-Wise.
5. The creation of potentially odourous events in Pond 1 and Pond 2 as a result of run off from C-Wise has been stopped.
6. The wastewater treatment ponds remain the main potential source of odourous events.

7.5.4 Consequence

Based upon the sensitivity of residential receptors and the large residential population which odour from Nambeelup Farm has previously impacted, the Delegated Officer has determined that odour emissions from individual sources may cause mid-level local impacts to amenity. Therefore, the Delegated Officer considers the consequence to be **Moderate**.

7.5.5 Likelihood of consequence

Conventional sheds and Eco-shelters

Based upon the distance to sensitive receptors, the history of complaints in the area, and the results of odour investigations, the Delegated Officer has determined that odour impacts from the conventional sheds and eco-shelters could occur at some time. Therefore, the Delegated Officer considers the consequence to be **Possible**.

Wastewater treatment system

Based upon the distance to sensitive receptors, the history of complaints in the area, and the results of odour investigations, the Delegated Officer has determined that odour impacts from the wastewater treatment system could occur at some time. Therefore, the Delegated Officer considers the consequence to be **Possible**.

Wastewater treatment ponds 0, 2, 5 and 6

Based upon the distance to sensitive receptors, the history of complaints in the area, and the results of odour investigations, the Delegated Officer has determined that odour impacts from the wastewater treatment ponds could occur at some time. Therefore, the Delegated Officer

considers the consequence to be **Possible**.

Wastewater treatment pond 1, 3 and 4

Based upon the distance to sensitive receptors, the history of complaints in the area, and the results of odour investigations, the Delegated Officer has determined that odour impacts from pond 1, 3 and 4 could occur at some time. Therefore, the Delegated Officer considers the consequence to be **Possible**.

Carcass composting tunnel

Based upon the distance to sensitive receptors, the history of complaints in the area, and the results of odour investigations, the Delegated Officer has determined that odour impacts from the carcass composting tunnel could occur at some time. Therefore, the Delegated Officer considers the consequence to be **Possible**.

7.5.6 Overall rating

Conventional sheds and Eco-shelters

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour impacts on sensitive receptors from conventional sheds and eco-shelters is **High**.

Wastewater treatment system

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour impacts on sensitive receptors from the wastewater treatment system is **High**.

Wastewater treatment ponds 0, 2, 5 and 6

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour impacts on sensitive receptors from the wastewater treatment ponds is **High**.

Wastewater treatment pond 1, 3 and 4

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour impacts on sensitive receptors from pond 1 is **High**.

Carcass composting tunnel

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 13) and determined that the overall rating for the risk of odour impacts on sensitive receptors from the carcass composting tunnel is **High**.

Collective sources

Considering the multiple potential sources of odour within the Premises and within the other Nambeelup Farm Premises, the Delegated Officer has determined that the multiple sources contribute to an increased overall consequence from the emissions, as they may result in greater cumulative odour emissions and therefore increase the severity of the impact on amenity. The Delegated Officer has determined that odour emissions from the Nambeelup Farm premises collectively could cause high-level impacts to amenity and could, therefore, have a **Major** consequence.

The Delegated Officer considers that the likelihood of a major impact resulting from the Nambeelup Farm premises collectively is **Likely**.

The Delegated Officer has determined that the overall rating for the collective sources is **High.**

Summary of risk assessment and acceptability

A summary of the risk assessment and the acceptability of the risks with treatments are set out in Table 20. Controls are described further in section 8.

Table 20: Risk assessment summary

	Emission		Pathway and Receptor	Licence Holder controls	Impact	Risk Rating	Acceptability with treatment (conditions on instrument)
	Type	**Source**					
1A	Wastewater and leachate	Conventional sheds and eco-shelters	Seepage through soil to groundwater Overland flow and migration through groundwater to EPP area, geomorphic wetlands, Serpentine River, on-site and adjoining lands.	Conventional sheds have concrete floors with underfloor drainage to the WWTP Eco-shelters are concrete lined and have straw bedding that is deep enough to absorb any liquid waste and is replaced every 4 weeks	Contamination of groundwater supply for nearby users Impact to flora and fauna at nearby nature reserve Contamination of surface waters and impacts to ecosystem function.	Moderate consequence Unlikely **Medium risk**	Acceptable subject to Licence Holder controls conditioned
1B		WWTP		Concrete lined pits and tanks		Moderate consequence Possible **Medium risk**	Acceptable subject to Licence Holder controls conditioned

	Emission		Pathway and Receptor	Licence Holder controls	Impact	Risk Rating	Acceptability with treatment (conditions on instrument)
	Type	**Source**					
1C		Wastewater treatment ponds (0, 2, 5 & 6)		Ponds are lined with 1mm HDPE and maintain a 300mm freeboard		Moderate consequence Likely **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned
1D		Wastewater treatment pond 1, 3 and 4		Pond is currently being desludged at a rate of 4,000m^3 a year		Moderate consequence Likely **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned
1E		Carcass composting tunnel		Concrete lined tunnel with sufficient dry material to stop leachate Tunnel drains to wastewater treatment plant pit		Moderate consequence Unlikely **Medium risk**	Acceptable subject to Licence Holder controls conditioned
2A	Odour	Conventional sheds and eco-shelters	Air (windborne) Residential receptors – nearest residence approx. 1,090m south-west Patrons of airfield located 500m south	Conventional sheds flushed weekly Eco-shelter bedding changed at least every 8 weeks Pig mortalities removed daily Pig diet changed to reduce odourous compounds	Amenity impacts on residential receptors and users of airfield.	Major consequence Possible **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned

	Emission		Pathway and Receptor	Licence Holder controls	Impact	Risk Rating	Acceptability with treatment (conditions on instrument)
	Type	**Source**					
2B		WWTP		Solids are removed from Premises		Major consequence Possible **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned
2C		Wastewater treatment ponds (0, 2, 5 & 6)		Pond 0 has developed a crust Pond 2 aerated when required		Major consequence Possible **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned
2D		Waste water treatment pond 1		Pond 1 is currently being desludged		Major consequence Possible **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned
2E		Carcass composting tunnel		Pig carcasses are covered with 300mm of organic material and allowed to compost for 6 months		Major consequence Possible **High risk**	Acceptable subject to Licence Holder and DER regulatory controls conditioned

8. Determined Regulatory Controls

8.1 Summary of controls

A summary of the risks with corresponding controls is set out in Table 21. The risks are set out in the assessment in section 7, and the controls are detailed in this section 8. Controls will form the basis of conditions of the Licence.

Table 21: Summary of regulatory controls to be applied

		Controls					
		8.2 Animal holding limit	8.3 Infrastructure and equipment	8.4 Operational controls	8.5 Groundwater Monitoring	8.6 Wastewater treatment pond monitoring and actions	8.7 Specified actions
Risk Items (see risk analysis in section 7)	1A Wastewater and leachate from conventional sheds and eco-shelters	•	•	•	•		
	1B Wastewater and leachate from WWTP	•	•	•	•		
	1C Wastewater and leachate From wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6)	•		•	•	•	•
	1D Wastewater and leachate from Decommissioned wastewater treatment ponds (Ponds 1, 3 and 4)			•	•		•
	1E Wastewater and leachate carcass composting tunnel	•	•	•	•		
	2A Odour from conventional sheds and eco-shelters	•		•			

		Controls					
		8.2 Animal holding limit	8.3 Infrastructure and equipment	8.4 Operational controls	8.5 Groundwater Monitoring	8.6 Wastewater treatment pond monitoring and actions	8.7 Specified actions
Risk Items (see risk analysis in section 7)	2B Odour from WWTP	●	●	●			
	2C Odour from wastewater treatment ponds (Pond 0, Pond 2, Pond 5, Pond 6)	●	●	●		●	
	2D Odour from Decommissioned wastewater treatment ponds (Ponds 1, 3 and 4)			●		●	●
	2E Odour Carcass composting tunnel	●	●	●			

Animal holding limit

The Licence Holder is limited to holding a maximum of 22,000 animals on the premises at any one time.

Grounds: *The Review has been carried out based on a maximum of 22,000 animals being held on the Premises at any one time. An increase in pig numbers would increase the risk associated with odour and wastewater and leachate generation. A maximum holding limit has been set based on the current licence approved capacity. The maximum number of animals held in each conventional shed, pen, or eco-shelter is governed by animal welfare standards and guidelines.*

Specified infrastructure and equipment controls

Wastewater, leachate, and odour infrastructure and equipment

The following environmental controls, infrastructure and equipment must be maintained and operated onsite for leachate and odour management:

- Five conventional sheds enclosed with adjustable shutter walls and roof vents, concrete partially slatted floors, underfloor concrete drainage system connected to the wastewater treatment plant and with an effluent flush system (tipper bucket);
- Eighteen eco-shelters, with concrete floors, concrete bunker walls and dome shelter roofs;
- Wastewater treatment plant consisting of, a screen cage, concrete pits, two fan

separators and discharge point to Pond 0;

- four wastewater treatment Ponds 0, 2, 5 and 6 lined with HDPE;
- pond sprinklers;
- Carcass composting tunnel consisting of a concrete floor graded to return leachate to the WWTP and bunker walls.

Note: Operational requirements are based on current Licence Holder controls. Existing wastewater treatment pond operational requirements have been included from the Existing Licence to ensure efficient operation of the treatment system.

Grounds: Specific operational requirements have been included regarding the timing of the use of the sprinklers at Pond 5 and 6; the depth of cover required for carcasses at the carcass composting tunnel; and the maximum quantity of separated solids that can be stored on the Premises. These requirements have been added to clarify existing Licence Holder controls and to ensure that the risk of odour impacts is minimised.

The Premises infrastructure is required to be maintained to ensure that odour emissions and potential groundwater impacts are mitigated.

The maintenance of the existing infrastructure and construction of any new infrastructure to the specified standard is necessary for the mitigation of leachate impacts to groundwater. The specification of a hydraulic conductivity of less than 1.0×10^{-9} m/s for the hardstand and drainage infrastructure will ensure that seepage of leachate and consequently groundwater contamination from these locations are adequately controlled. The Delegated Officer notes that groundwater monitoring results indicate that there is likely considerable seepage from the existing wastewater collection and storage infrastructure. A requirement for the Licence Holder to undertake testing to determine the seepage rates through the pond liners is included as a specified action within section 8.7.

8.4 Operational controls

8.4.1 Groundwater contamination control

A vertical freeboard of 300mm must be maintained in all wastewater treatment ponds.

Grounds: The Delegated Officer considers that the requirement to maintain a freeboard of 300mm at all times ensures that there is sufficient storage in the event of a high rainfall event to prevent overtopping of the ponds.

The screen cage at the outfall of the conventional shed that leads to the WWTP must be operational at all time and must be cleaned at least weekly.

Grounds: The screen cage is designed to stop solids entering the WWTP to prevent blockages and overflows. If not used or cleaned regularly there is an increased chance of blockages that may cause overflows of wastewater or stop the WWTP from operating effectively.

Screened solids must be removed at a rate that ensures that no solids or leachate is emitted from the concrete bunded screened solids area.

Grounds: Screened solids are high in nutrients and could potentially cause a groundwater contamination risk if allowed to escape the concrete bunded storage area.

Enough bedding must be placed in the eco-shelters to ensure that no waste escapes from the shelters and bedding must be changed at least every four weeks.

Grounds: Bedding within the eco-shelters absorbs the pig effluent. Without sufficient bedding, there is potential for emissions of liquid waste from the eco-shelters to become a source of groundwater contamination.

Spent bedding must be removed from the Premises on the same day it is removed from the eco-shelter.

Grounds: Spent bedding contains a significant volume of pig effluent and could be a potential source of groundwater contamination if allowed to leach into the soil when stockpiled on the Premises. This is also a potential source of odour emissions.

8.4.2 Odour impact controls

The conventional shed shall be flushed using the tipper bucket system at least weekly using water from Pond 5, Pond 6, or clean water.

Grounds: Weekly flushing will ensure that pig waste is not allowed to build up within the sheds and become a source of unreasonable odour. This is in line with the NEGP.

Pig carcasses must be removed from the conventional sheds and eco-shelters daily and placed in the carcass composting tunnel

Grounds: Removal of pigs daily will stop carcasses becoming a source of odour.

Sprinklers must not be used before 10am or after 4pm, or on weekends or public holidays.

Grounds: Operation of sprinklers has the potential to cause odour emissions. By ensuring that they are not operated during times when odour impacts are likely, the likelihood for impacts to occur is reduced.

8.5 Groundwater monitoring actions and reporting

8.5.1 Groundwater monitoring requirements

The Licence Holder is required to carry out ongoing quarterly groundwater monitoring at all bores on the Premises for the following parameters:

- Standing water level
- pH
- Total dissolved solids (TDS)
- Mercury
- Zinc
- Arsenic
- Nitrate-nitrogen
- Nitrite-nitrogen
- Ammonium-nitrogen
- Total nitrogen
- Total phosphorus

The Licence Holder is required to conduct a once-off groundwater monitoring event for the following metals:

- Cadmium
- Chromium
- Copper
- Iron

- Manganese
- Nickel
- Lead

The Licence Holder will be required to undertake all groundwater monitoring following the methods specified in AS 5667.1 and AS 5667.11 and have the results tested by a NATA accredited laboratory for the analytes specified.

Note: The monitoring is based on the existing monitoring requirements but has been expanded to include additional bores adjacent to Pond 0, bore MW12 once it has been constructed, parameters mercury, zinc and arsenic, and at an increased frequency of quarterly intervals.

The Licence Holder will be required to install an additional groundwater monitoring bore on the southern boundary of the Premises to provide further data closer to the sensitive receptors south of the Premises. The monitoring data from all three Nambeelup Farm premises will in future be interpreted collectively; therefore this requirement on the Revised Licence is also relevant to addressing the leachate risk from the other Nambeelup Farm premises. Further investigation or regulatory control may be required in future depending on the groundwater quality results obtained from the additional bore.

As discussed in Section 4.1, DWER will also be undertaking a review of the site classification under the CS Act.

Grounds: Due to high levels of groundwater contamination documented from the groundwater bores at the Premises (Appendix 4), quarterly monitoring is required to allow for a more thorough interpretation of monitoring results. The Department will be able to use the monitoring results to assess whether appropriate progress has been made or whether additional controls need to be implemented. The parameters required to be sampled have been expanded to include additional contaminants and to be consistent with monitoring carried out at the other Nambeelup Farm premises, and relevant to the materials received, used, and stored at the three premises. The bore network has been expanded to include the bores installed around Pond 0 as well as MW12 that is required to be installed as per section 8.7.2.

Mercury, zinc and arsenic have been included in the quarterly monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed on an ongoing basis. The once-off monitoring for other metals is required to detect the presence and levels of these metals, through ongoing monitoring for these metals is not currently considered necessary. If the results show there has been an impact, the Delegated Officer may review the current groundwater monitoring parameters.

The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of groundwater contamination caused by nutrient-rich leachates derived from organic materials.

The requirement to have the samples taken using a specified method and analysed in a specified laboratory is considered appropriate in ensuring the quality of the data submitted.

8.5.2 Groundwater monitoring reporting

The Licence Holder will also be required to provide a quarterly report of groundwater monitoring results (excluding the last quarter of the year), which includes a summary of results above the background levels (as determined in Appendix 4) for the previous quarter and the raw monitoring data in Excel format.

The Licence Holder will also be required to report all groundwater monitoring results on an annual basis. This report will be required to contain raw data in excel format, comparison of data against groundwater background levels (as determined in Appendix 4) and ANZECC

stock water guidelines, and details of sampling quality assurance and quality control.

Grounds: The Delegated Officer considers that this reporting is appropriate to monitor groundwater impacts at the Premises, and the specification of the reporting requirements is sufficient to enable DWER to analyse the data. The data will be used to determine the adequacy of infrastructure controls and assess for groundwater impacts resulting from infrastructure defects, failure, or malfunction (e.g. pond seepage as a result of liner failure). DWER may review the appropriateness and adequacy of the licence controls based on the review of the monitoring data.

The quarterly reporting frequency provides a mechanism for DWER to be informed of issues and respond to an exceedance of background levels within a shorter timeframe than if the exceedance was only reported annually.

8.6 Wastewater treatment pond monitoring and actions

8.6.1 Wastewater treatment pond monitoring requirements

The Licence Holder is required to undertake monitoring of pond water at the Premises for the following parameters:

- Oxidation Reduction Potential (ORP)
- Dissolved oxygen (DO)
- pH
- Temperature
- Biological oxygen demand (BOD_5)
- Volume of sludge

The ORP, DO, pH and temperature must be monitored within each pond weekly.

The Licence Holder will be required to desludge a pond when sludge is at more than 30% capacity. Capacity is calculated as pond water volume, not including freeboard.

The Licence Holder will be required to undertake a once-off monitoring event for the following parameters:

- Total nitrogen
- Total phosphorus

Grounds: Pond water quality sampling was requested by the Department in June 2016 for all ponds at Nambeelup Farm for the purpose of evaluating the potential for the production of odourous compounds. Pond water quality analysis results are further discussed in Appendix 7 highlighting the need to improve the water quality for odour reduction.

Ongoing monitoring is therefore considered necessary to assess whether the ponds are working effectively and to evaluate the potential for the production of odourous compounds. A monitoring regime of all operational ponds at the Premises has been specified in the Licence, with the parameters based on those analysed in June 2016 at all the Nambeelup Farm premises.

Oxidation Reduction Potential (ORP) has been selected as a suitable parameter to define biochemical reactions which produce odour. By ensuring that the ORP is monitored, DWER and the Licence Holder can monitor ponds to ensure sulfide formation is minimised and the development and emission of odour reduced.

Additionally, ORP can be easily measured in the field producing results quickly thus enabling swift corrective actions. It is therefore preferable to parameters that require laboratory analysis.

Desludging of the ponds will ensure that the operational capacity of the ponds is maintained. The buildup of sludge in the aerobic ponds can also promote anaerobic conditions that increase the risk of odourous compounds being generated.

The Delegated Officer has determined that once-off monitoring for total nitrogen and total phosphorus is required to provide the concentrations necessary for an estimation of the emission rate of nitrogen and phosphorus through the pond liners (the requirement for the Licence Holder to provide this estimation is addressed within section 8.7.1).

8.6.2 Wastewater treatment pond monitoring reporting

The Licence Holder will be required to provide a quarterly report (excluding the final quarter of the year) containing:

- a summary of pond monitoring results for the previous quarter including Oxidation Reduction Potential and dissolved oxygen; and
- the raw data in Excel format.

This information will also be required to be provided within an annual report, which shall also include time series graphical plots and details of sampling quality assurance and quality control.

Details of any sludge removal from the ponds will be required within an annual report.

Note: Following the issue of the Revised Licence, a program of inspections for the Nambeelup Farms premises will be undertaken to assess compliance with the Revised Licence and the effectiveness of the licence conditions. The management of the ponds will be a particular focus, including observations to determine the frequency of occurrence of bubbles (suspected biogas) being released from any ponds. Further investigation will be required if this is observed to be ongoing.

Grounds: The Delegated Officer considers that the prescribed water quality monitoring and the criteria based actions are required to ensure that ponds are adequately managed so that odour generation is minimised. DWER will use the reported information on pond management to assess whether ponds have been appropriately managed or whether additional controls are required. DWER may also request pond management data outside the annual reporting timeframe as part of compliance inspections or complaint investigations.

8.7 Specified actions

8.7.1 Pond liner integrity testing

The Licence Holder will be required to carry out liner integrity testing on all ponds within the Premises. This testing must be carried out within 12 months of the grant of the revised Licence.

The results of the liner integrity testing must be reported to the Department within one month of the completion of the testing for each pond.

If damage to the pond liner is detected, an upgrade plan must also be provided at this time.

Grounds: Nambeelup Farm is classified as contaminated under the CS Act. Groundwater monitoring carried out across Nambeelup Farm suggests that sources of contamination are present. The monitoring is not able to confirm the exact location of sources within the Nambeelup Farm premises; however the ponds are potential sources.

Given the potential for the ponds to be sources of contamination, a requirement for the Licence Holder to test liner integrity has been included in the Licence. The Licence Holder will be required to test the integrity of the liners according to the most appropriate method determined by ASTM D6747: *Standard guide for selection of techniques for electrical leak*

location of leaks in geomembranes.

In the current operational setting, pond liners are potentially exposed to considerable wear and tear. Examples are UV damage that occurs over time, particularly when liners are not covered and liner damage caused by upward pressure due to shallow groundwater.

The Delegated Officer has determined that it is necessary to estimate the seepage rate and the rate of nitrogen and phosphorus emissions from the ponds to allow further consideration of the potential risk to receptors and to verify that the mass of phosphorus emissions are not inconsistent with the environmental quality objectives of the Peel Inlet-Harvey Estuary EPP. DWER will consider the estimations submitted. If the seepage rates from the ponds are considered to be too high, additional regulatory controls may be needed.

8.7.2 Installation of additional groundwater monitoring bore

The Licence Holder is required to install an additional groundwater monitoring bore near the southern boundary of the premises.

Grounds: Several bores across the Premises show levels of nutrients above the background levels. Groundwater monitoring results indicate that the groundwater is moving in a south westerly direction. As there is a sensitive receptor (Nature Reserve) to the south west of the premises, an additional groundwater monitoring bore is to be installed on the south western boundary to provide further data closer to the sensitive receptors south of the Premises.

8.7.3 Depth to groundwater investigation

The Licence Holder is required to conduct an investigation into the depth to groundwater from the base of the wastewater treatment ponds to the maximum groundwater level.

Grounds: The risk to groundwater increases with reduced separation distance. If the separation distance is not sufficient, seepage from ponds may be a significant source of groundwater contamination. Knowledge of separation distance is also important for assessing whether there may be upward pressure on liners that could lead to damage particularly for ponds that are not continuously filled.

The groundwater report will be used to determine the appropriateness of the pond systems and verify the specified control measures are in place. DWER may review the appropriateness and adequacy of the Revised Licence controls based on the details of the report together with the results of the liner testing. Additional controls may be required to mitigate the risk from any ponds that do not have a sufficient separation distance.

8.7.4 Desludging decommissioned ponds

The Licence Holder is required to desludge the decommissioned wastewater treatment ponds as per Table 22. All desludged material must be removed from the Premises or stored on a Hardstand that meets the hydrological conductivity requirement of less than $1.0x10^{-9}$m/s and is graded to drain potentially contaminated leachate to the WWTP. All dried sludge must be removed from the Premises.

Note: Decommissioned Pond 1 is currently being desludged at a rate of 4,000m^3 per year. As the decommissioned ponds are a likely source of groundwater contamination, the Licence Holder must remove the sludge from all decommissioned wastewater treatment ponds.

Table 22: Sludge removal from decommissioned ponds

Location as shown on Premises Layout Map	Completion date	Disposal options
Pond 1	April 2019	Remove from the Premises or store on a Hardstand that meets the hydrological conductivity requirements of less than 10^{-9}m/s and which drains to the wastewater treatment plant, prior to removal from the Premises.
Pond 3	April 2020	
Pond 4	April 2021	

Grounds: As the current liner integrity of the decommissioned ponds is unknown and the groundwater monitoring from bores closest to Ponds 1, 3 and 4 shows very high levels of nitrogen and phosphorus, the Delegated Officer considers them to be a significant groundwater contamination risk. The Delegated Officer has determined that desludging the decommissioned ponds will remove the potential source of groundwater contamination and odour.

9. Appropriateness of Licence conditions

The conditions in the revised Licence have been determined in accordance with DWER's *Guidance Statement: Setting Conditions*.

Condition Ref	Grounds
Emissions	This condition is valid, risk-based and consistent with the EP Act.
Record-keeping	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.
Animal holding limit	These conditions are valid, risk-based and contain appropriate controls (see section 8).
Infrastructure and equipment controls	
Operational controls	
Groundwater monitoring	
Wastewater Treatment Pond monitoring and actions	
Specified actions	
Ongoing reporting	These conditions are valid and are necessary reporting requirements to ensure compliance and assessment of environmental performance.

DWER notes that it may review the appropriateness and adequacy of controls at any time, and that following a review, DWER may initiate amendments to the Licence.

10. Licence duration

Giving consideration to the current lease period for the Premises, the Revised Licence has an expiry date of 26 October 2019, which is a one year extension on the expiry date of the existing Licence. The Licence period will therefore extend beyond the current lease period. However, this is considered to be a low risk as the lease is expected to be extended beyond that expiry date. Should the lease not be extended and on-going management of the site is considered necessary, the Department can consider issuing a Closure Notice on the Premises. The Issued Licence duration may be extended in future should the lease for the Premises also be extended.

11. Licence Holder consultation

The Licence Holder was provided with a draft Revised Licence and decision report on 29 March 2017 for an initial consultation period. The Licence Holder was provided with an updated draft Revised Licence and decision report on 13 February 2018 for a second consultation period.

The Licence Holder provided comments which are summarised along with DWER's response in Appendix 2.

12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this decision report (summarised in Appendix 1). This assessment was also informed by a site inspection by Department officers on 11 October 2016.

Based on this assessment, it has been determined that the Revised Licence will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Jonathan Bailes
Acting Senior Manager Process Industries
Delegated Officer under section 20 of the Environmental Protection Act 1986

Appendix 1: Key documents

In-text references			
	Document Title	**In-text ref**	**Availability**
1	Bureau of Meteorology - Climate data online. Accessed 5 October 2016	BOM 2016	bom.gov.au
2	Hall, J., Kretschmer, P., Quinton, B. and Marillier, B., 2010. *Murray Hydrological Studies: Surface water, groundwater and environmental water*. *Conceptual model report*. Department of Water, Water Science Technical Series, Report WST 16	Hall et al., 2010	www.water.wa.gov.au
3	*National Environmental Guidelines for Piggeries, Second Edition (Revised) 2010,* Australian Pork Limited	NEGP	www.australianpork.com.au
4	Marillier, B., 2012. *Nambeelup groundwater modelling report: Supporting document for the Nambeelup district water management strategy*. Department of Water Science Technical Series, Report No WST 47	Marillier, 2012	www.water.wa.gov.au
5	United States Environmental Protection Agency (US EPA), 2011. Principles of design and operations of wastewater treatment pond systems for plant operators, engineers, and managers. (457 pages) Accessed 3 March 2017.	US EPA, 2011	https://www.epa.gov/sites/production/files/2014-09/documents/lagoon-pond-treatment-2011.pdf
6	Works Approval W4720/2010/1– Decommissioning Ponds 3 and 4 and construction of Pond 6 – HDPE lined	W4720/2010/1	Accessed at http://www.dwer.wa.gov.au
7	Works Approval W4997/2010/1 – Pond 5 (aerobic) refurbishment, extension and lined with HDPE	W4997/2010/1	
8	Works Approval W5679/2014/1 – Pond 2 (aerobic) lined with HDPE	W5679/2014/1	
9	Zang, R.H., Dugba, P.N. and Bundy, D.S. 1997 *Laboratory study of surface aeration of anaerobic lagoons for odor control of swine manure.* Transactions of the American Society of Agricultural and Agricultural Engineers 40(1): 185-190	Zhang, Dugba and Bundy 1997	-

Other documents		
	Document Title	**Availability**
10	CM Farms (26 April 2017). Letter *CM Farms – Nambeelup Draft Licence L6932/1988/11.* Attached within the following email: Chorrez, J. (CM Farms) (26 April 2017) *CM Farms - Nambeelup (Comments to Draft License - 2017 04 26*) [Email]	DWER records (A1418321)
11	Land Insights (acting on behalf of CM Farms) (2 March 2018). Letter *Licence Review and Amendment of Licence L6932/1988/1 Lots 89 and 109 (203) Gull Road, Nambeelup.* Attached within the following email: Rasmussen, S. (Land Insights) (2 March 2018) *Licence Review L6932 1998 11 - CM Farms Nambeelup* [Email]	DWER records (A1628146)
12	Land Insights (acting on behalf of CM Farms) (5 June 2018). Letter *Licence Review and Amendment of Licence L6932/1988/1 Lots 89 and 109 (203) Gull Road, Nambeelup.* Attached within the following email: Taylforth, M. (Land Insights) (5 June 2018) *RE: Licence Review L6932 - CM Farms* [Email]	DWER records (A1694541)
13	Licence amendment application – WQM, 23 October 2015	DWER records
14	Compliance Inspections	DWER records
15	Annual Audit Compliance Reports and Annual Environment Reports	DWER records
16	DER (6 July 2017) File Note: Site Visit – C-Wise	DWER records
17	DER (10 June 2016) File Note: Nambeelup Site Visit (CM Farms piggery, C-Wise, Costa mushroom compost) following odour complaints, 27 May 2016.	DWER records
18	DER *Guidance Statement: Regulatory principles*	Accessed at http://www.dwer.wa.gov.au
19	DER *Guidance Statement: Setting conditions*	
20	DER *Guidance Statement: Licence duration*	
21	DER: *Guidance Statement: Decision Making*	
22	DER *Guidance Statement: Risk Assessment*	

Appendix 2: Summary of Licence Holder's comments on risk assessment and draft conditions

Table 1: Licence Holder's comments in response to the draft decision report and Licence provided to the Licence Holder on 29 March 2017.

Comments provided 26 April 2017		
Section	**Comment**	**DWER response**
Condition 1	Leachate Emissions/Odour Emissions	No change. This condition applies to all emissions.
Condition 11	Maximum number of animals to be held is 22,000 with a maximum SPU number of 12,500. With 22,000 animals the SPU number would be around 17,200	Licence updated
Condition 12 – Table 2 Item 6	Pond 5 can also discharge to pond 6	Licence updated
Condition 22 – Table 3 Column 1	The reason for arsenic analysis is unclear	The decision report has been updated to clarify why arsenic sampling is required
Condition 22 – Table 3 Column 3	Monthly sampling appears excessive, quarterly sampling (one/season) should be adequate.	The Delegated Officer has revised the sampling required and agrees quarterly sampling is sufficient.
Condition 25 – Table 4 Column 1	Biological oxygen demand should read biochemical oxygen demand	Licence updated
Condition 25 – Table 4 Column 2	Dissolved oxygen measurement in pond 0 [anaerobic pond] is N/A	Licence updated
Condition 25 – Column 1, 2, and 3	Volume of sludge: various methods for sludge height measurements are available: -The use of a sludge judge is one method of measuring sludge build up in a pond. To conduct this process will require at least 3 to 4 people (2 in a boat and 1-2 on banks as required by OH&S).	Sludge depths are required to be measured to ensure sludge volumes in the wastewater treatment ponds are not reducing the functionality of the ponds.

Comments provided 26 April 2017		
Section	**Comment**	**DWER response**
Condition 29 - Table 5 Column 5	Table 5 Column 5 requires an overnight water balance test. -Pond 6 is empty and a visual inspection did not reveal any damage to the liner. -Pond 5 has a small amount of water in it (300 mm) and a visual inspection did not reveal any damage to the liner An overnight water balance test on all ponds will take approximately a week to complete (according to consultants that would carry out the test), the test requires that there is not inflow to the pond system while the test is being carried out, this would not be feasible with wastewater being directed to the wastewater system 7 days per week. An electrical integrity test is complex and extremely costly and similar to the above mentioned test requires no inflow into the dams for a period of a week.	The draft licence conditions were revised to require initial seepage testing using the over-night water balance method. This requirement was further clarified through the Licence Holder's comments provided on 5 June 2018..
Condition 34	Sludge removal usually requires a pond to retain unused for at least 12 months to enable the pond to dry-out to facilitate de-sludging	The timeframe for sludge removal from Ponds 3 and 4 has been discussed with the Licence Holder. The Revised Licence has been updated to reflect the timeframes agreed for sludge removal.

Table 2: Licence Holder's comments in response to the draft decision report and Licence provided to the Licence Holder on 13 February 2018.

Comments provided 5 June 2018		
Section	**Comment**	**DWER response**
Condition 3	Number 2 - 18 Eco-shelters on site [not 12] Number 9 – the carcass tunnel is not roofed	Licence and decision report updated
Condition 7	Eco-bedding is replaced every 4 to 8 weeks	Licence and decision report updated
Condition 8	Confirmation that spent eco-bedding can still be provided to CWise as has been past practice	The Delegated Officer confirmed spent eco-shelter bedding can be disposed of at CWise

Comments provided 5 June 2018		
Section	**Comment**	**DWER response**
Condition 11	It has been confirmed with the Department that this condition is referring to the 'sprinklers' located on Ponds 5 and 6 and this condition will be modified to remove the word 'aerators'.	Licence and decision report updated
Condition 14	Wastewater treatment pond monitoring, DO, pH and temperature The Licence Holder proposes to semi-continuously monitor H_2S and periodically sample odour rather than monitoring water quality parameters in particular DO, for the following reasons : • 1mg/L of DO in piggery waste waters is not being achievable or a reflection of piggery ponds functionality; • Costs associated with aeration to achieve 1mg/L of DO; and • OHS issues with sampling wastewater treatment ponds	The Delegated Officer considered the use of oxidation reduction potential (ORP) instead of dissolved oxygen (DO) as an indicator of potential odour generation from the ponds. As an alternative to the DO action criterion of 1mg/L, an ORP action criterion of -25mV was considered as a level which may prevent the generation of hydrogen sulfide. However, following further consideration the Delegated Officer has determined that due to the complexity of the potential reactions within the pond, neither parameter is entirely appropriate as a single indicator of the risk of odour emissions from the ponds. Therefore, this action criterion may not be an effective control. The DO action criterion has been removed from the pond monitoring condition. The ambient monitoring of H_2S and odour as proposed by the Licence Holder is considered problematic due to the cumulative effect of the three Nambeelup Farm premises and multiple odour sources within them; and that H_2S is one of many odorous compounds that could be produced by the wastewater treatment ponds. The Licence and decision report have been updated to require the weekly monitoring of ORP and DO in Ponds 2, 5 and 6 – consistent with the other licences. The collection of this data in the context of ongoing review of pond performance will guide if further controls are required (including the use of pond aerators).

Comments provided 5 June 2018		
Section	**Comment**	**DWER response**
Condition 17	The Licence Holder proposes a change to the *completion date, test* and *method.* At this stage it is proposed that electrical testing of the dams is proposed. Our investigations and discussion with practitioners indicate that the Ham and Baum [overnight water balance test] method has not been used for some years. It is possible to instead undertake an electrical leak detection test. This test can occur with water in the dams so will not significantly impact the operation of the site, however with winter approaching and the site becoming wetter it is suggested that the *completion date* be extended to *within 12 months from date of issue.* At this stage the testing approach is still under evaluation. The final approach will depend on chemical analysis of the pond water and sludge levels. This information should be to hand in the next couple of weeks.	The Licence has been update to remove the overnight seepage test. The Licence requires the Licence Holder to conduct a liner integrity test. The timeframe has also been updated to require all wastewater treatment pond liners to be tested within 12 months of the issue of the Licence. Reports on each ponds liner integrity are due 1 month from the test taking place.
Condition 20	Depth to groundwater report to be provided within 12 months to enable time for site investigations and reporting. (Note, it is currently proposed that a single groundwater depth report be prepared across the entire site in conjunction with the other site tenants. This information is currently being prepared).	Groundwater monitoring is currently available. It is unclear if bores and ponds have been surveyed however the Delegated Officer has determined that three months is sufficient time to gather this information and prepare a depth to groundwater report.

Comments provided 5 June 2018		
Section	**Comment**	**DWER response**
Condition 21	CM Farms is in a process of emptying and de-sludging the waste water treatment ponds on the site. This is a program that will occur over several years, to facilitate the ongoing operation of the site and take into account seasonal constraints on working in and around the pond system. The water content of the sludge is significant and takes some time to dry naturally. It is too thick for pumping and thus requires mechanical removal using an excavator. The usual practice is to create sludge rows with intermediate drainage channels in the pond to allow for the sludge to dry. The water content within each pile remains high and requires regular turning to dry to a point where it becomes suitable for excavation and loading to a truck and storage at CWise. This drying process takes time and can only occur during the summer months. With unseasonal summer rain, as has occurred over the past two summers, the process of drying the sludge has taken even longer than expected. As an example, a timeline showing the steps of desludging Dam 1 is attached to this letter. In summary, the currently empty Dam 1 still contains wet sludge due to 100mm of rain over January, coupled with the milder than usual temperatures of this summer. As such, we require that each dam be given a timeframe of at least two summers.	The Licence and decision report have been updated by extending the timeframe for desludging of decommissioned ponds by an extra 12 months. The Delegated Officer has determined that if operational conditions do not allow the ponds be desludged in accordance with the specified timeframe, the Licence Holder can apply to extend the timeframes as required with appropriate justification and risk assessment.

Appendix 3: Photos from site visit 11 October 2016

Photo 1 – Conventional shed showing window and tipper buckets

Photo 2 – Tipper buckets for conventional sheds

Photo 3 – Conventional shed showing slatted floors for drainage

Photo 4 – Eco-shelter showing straw bedding

	
Photo 5 – Eco-shelter showing domed roof, concrete walls and straw bedding	Photo 6 – Carcass composting tunnel

	
Photo 7 – WWTP inlet from conventional sheds showing gross solids cage	Photo 8 – WWTP showing separated solids within bunded area

	
Photo 9 – WWTP discharge pit	Photo 10 – Pond 0 inlet from WWTP

	
Photo 11 – Pond 0 developing a crust, and showing outfall to pond 2.	Photo 12 – Pond 2 inlet from Pond 0

	
Photo 13 – Pond 2 (right) Pond 5 (Left)	Photo 14 – Decommissioned Pond 3

	
Photo 15 – Decommissioned Pond 4	Photo 16 – Pond 6

Appendix 4: Groundwater monitoring analysis and review

1. Monitoring programs

Groundwater monitoring has been undertaken at each of the three premises (C-Wise, CM Farms and Mushroom Exchange) according to their licence conditions. Available data spans the timeframe from 2010 to 2017. Sampling intervals have been variable with CM Farms and C-Wise monitoring biannually and Mushroom Exchange in quarterly intervals. Interpreting groundwater data in the context of the entire site encompassing all three bore networks is made more difficult by unsynchronised sampling events.

Key findings

The Delegated Officer has reviewed the groundwater monitoring programs and has found that:

- *A shared approach and consistent methodology for all premises will facilitate a better understanding of contamination events and the effectiveness of controls.*
- *Synchronising monitoring bore sampling across all three sites is necessary to allow more comprehensive and meaningful data interpretation.*

2. Monitoring analytes

The monitored analytes are largely consistent for all three operations reflecting that nutrients are the main contaminants likely to enter the groundwater from storage ponds and processing areas. Monitoring analytes include:

- Total nitrogen (C-Wise, CM Farms) / total inorganic nitrogen (Mushroom Exchange)
- Ammonia nitrogen
- Nitrate nitrogen
- Nitrite nitrogen
- Total phosphorus
- pH
- Total dissolved solids

Nutrient-rich seepage can change the chemical environment within the soil leading to the mobilisation of metals and metalloids from the soil into the groundwater. Measuring this secondary contamination needs to be considered as part of the standard monitoring analyte suite, particularly with regards to potentially toxic elements such as mercury zinc and arsenic that can have impacts on human health.

While CM Farms and Mushroom Exchange potential discharges conform with the selected suite of analytes except for metals, C-Wise is receiving a range of controlled liquid wastes such as waste oil and industrial wash water that can contain a variety of other contaminants not captured by the current monitoring regime. There is a risk that controlled liquid wastes such as industrial wash waters have introduced Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), which are known to be persistent, bioaccumulative and toxic. It is therefore required that testing for these substances is included in the next groundwater monitoring event to determine whether PFAS is present in the groundwater.

Key findings

The Delegated Officer has determined that:

- *Mercury, zinc and arsenic should be included in the monitoring suite of analytes to ensure that the potential risk to human health and the environment from this type of contamination can be assessed.*
- *The selected suite of analytes with the addition of selected metals is considered appropriate for the characterisation and detection of groundwater contamination caused by nutrient-rich leachates derived from organic materials.*
- *The current monitoring regime is not sufficient to detect contamination from the range of controlled liquid wastes currently received by C-Wise.*
- *Testing for PFAS should be included in the next groundwater monitoring.*

3. Monitoring bore network spatial configuration

The locations of groundwater bores in relation to operational infrastructure such as ponds and Hardstands are shown in Figure 1. It is expected that contamination levels detected in groundwater bores are highest where the bore is closest to the source of the contamination and that attenuation occurs with greater distance from the source.

Small-scale groundwater contours at the Nambeelup Farm area have been documented by Geo and Hydro (2010)[2].

The contours indicate that the dominant groundwater flow in this area is in a westerly to south-westerly direction. Bores located down hydraulic gradient from contamination sources are therefore expected to show higher levels of contaminants than those located up hydraulic gradient.

C-Wise

C-Wise bores (CW01-04A) 'frame' the operational pond area by being located near corners of a rectangle drawn around the ponds. An additional bore (CW05A) is placed at the north-western corner of the Hardstand area of the composting operation. Bores are located close to potential sources of contamination so that monitoring can seek to detect any seepage and therefore provide information on the likely effectiveness of pond lining and leachate management systems.

Based on the proximity to the C-Wise storage ponds and the dominant groundwater flow, bores CW01 and CW05A would be expected to show higher levels of contaminants if leakage from the ponds occurred. Although located up hydraulic gradient, the close proximity of bore CW02 to C-Wise and CM Farm ponds makes it possible that impacts from either ponds' leakage will be detected in this bore. Bore CW05A has the potential to be impacted by potential seepage from multiple sources including the storage ponds of C-Wise, CM Farms and leachate seepage from the C-Wise Hardstand area.

Bore CW01 located between the C-Wise and CM Farm ponds should detect seepage from both pond clusters. Bores CW03A and CW04A are located up hydraulic gradient and thus would be less impacted by seepage plumes.CW03A is further away from the ponds than CW04A and is therefore expected to have the lowest contaminant levels.

The C-Wise bore network, consisting of five bores, should be capable of detecting any contamination originating from the main operational areas of ponds and Hardstand. However,

[2] Geo and Hydro Environmental Management Pty Ltd 2010: Watertable contours across Custom Compost Lot 230 Nambellup Rd Nambellup, Figure 5. Submitted by Custom Compost

some of the bores may be influenced by contamination from other premises which makes the clear attribution of sources more difficult. In addition, there are no C-Wise bores south of the ponds and Hardstand despite the likelihood that a contamination plume would travel downgradient in a south-westerly direction.

Figure 1: Groundwater monitoring bore network for CM Farms, C-Wise and Mushroom Exchange

Mushroom Exchange

Mushroom Exchange maintains five monitoring bores located close to their operational infrastructure. Bores ME02 and ME03 are north of the ponds, bores ME04 and ME05/S east of the Hardstand, and bore ME01/S west of the ponds. Due to their proximity to the infrastructure, the bores should be capable of detecting any contamination caused by seepage from the ponds and Hardstand. Bores ME01/S and ME02 may also be influenced by potential contamination plumes from C-Wise ponds located north of the bores. There is no Mushroom Exchange bore south-west of the infrastructure which is the likely direction in which a contamination plume originating from the Mushroom Exchange ponds or Hardstand would travel.

CM Farms

CM Farms maintains a network of ten monitoring bores of which three are located close to infrastructure and the remaining seven at varying distances west, north-west and south-west from the ponds and hardstand.

Bore CM11S is situated west of Pond 5 where it is likely to capture groundwater contamination originating from the adjacent pond cluster. There are no further CM bores near this pond cluster but C-Wise bores CW01and CW02 east of the pond cluster, as well as CW05A southwest of the ponds, should also detect any contamination originating from the ponds.

In February 2016, three new monitoring bores were installed at the new Pond 0. Two shallow bores CMWS01 on the western side and CMWS02 on the eastern side of the pond. A deep bore (CMDW03) has also been installed on the western side of the pond. The bores should be able to detect any contamination originating from Pond 0 but will potentially also be influenced by any contamination plumes from sources located at the C-Wise and Mushroom Exchange premises. Monitoring data from the new bores at Pond 0 are not included in this analysis due to only limited data points being available at the time of assessment.

Bores CM09S and CM10S are located approximately 500m west and 800m south-west of CM Farms ponds respectively. Being hydraulically downgradient from CM Farms, C-Wise and Mushroom Exchange sources, they should be able to detect any contamination plumes from all up gradient operations. The ability to identify distinct sources, however, becomes more difficult the further the bores are away from source locations.

The remaining six bores are located at distances from 700m to 1500m from operational sources. Bores at these distances will reflect background conditions if they are located up-gradient and to varying degrees will capture contamination from operational sources depending on their distance and direction from the source.

Key findings

The Delegated Officer has reviewed the spatial configuration of the existing monitoring bore network and has found:

- *The existing monitoring network, when used as an integrated network across premises' boundaries, is considered sufficient to identify whether containment infrastructure such as ponds and Hardstands are effectively controlling leachate emissions.*
- *The monitoring network is not able to identify contamination sources at a small spatial scale such as a single pond. Additional investigations in the form of seepage rate measurements are required for this purpose.*
- *The monitoring network includes bores located up and down hydraulic gradient at varying distances from potential operational contamination sources allowing the determination of a suitable background level against which impact bores influenced by site sources can be compared.*
- *The current monitoring network does not allow detailed tracking of contamination and plume delineation and is insufficient to inform on the risk of impacts on sensitive receptors.*

4. Monitoring data analysis: Contaminant concentrations, sources and groundwater flow

The available monitoring data has been analysed by:

- Comparing contaminant levels found near operational infrastructure with background levels.
- Reviewing contaminant concentrations in the context of groundwater flow and the location of contaminant sources and receptors.
- Reviewing and interpreting data trends identifying correlations and fluctuations.

Groundwater monitoring data maps have been created showing levels of contaminants in bores across the monitoring network for total phosphorus (TP), total nitrogen/total inorganic nitrogen (TN/T(I)N), and total dissolved solids (TDS). Data was summarised by

calculating concentration averages for each analyte from each bore. For Figure 2 concentration averages were obtained from data between 2010 and 2017 and for Figure 3 concentrations were averaged over the period from 2016 to late 2017 only. The shorter timeframe provides a picture of the current situation while the longer timeframe considers contamination history.

A background groundwater quality level for selected analyte concentrations was derived using data from bore CM06S. The bore is located up hydraulic gradient, to the north-west of the three Nambeelup premises. It is therefore not likely to be influenced by contamination sources from the premises. An Upper Tolerance Limit (UTL) is calculated for each background contaminant concentration according to a defined statistical approach (DoEQ, 2014). The set confidence level is 95%. Contaminant concentrations from other bores can then be compared against the calculated UTLs to understand whether monitoring results from the other bores differ from background levels. The UTLs are shown in Table 1 as Background levels.

To aid data visualisation and interpretation data are displayed in a spatial context in Figure 2 and Figure 3. Data was simplified by distributing values over five categories based on a background level multiplier as outlined in Table 1.

Table 1 Groundwater contamination categories.

Analytes	Units	Guideline	Background levels (UTL CM06S)	<2x	<3x	<4x	<5x	>5x
TN	mg/L	2#	8.11	16.22	24.3	32.4	40.6	>40.6
TP	mg/L	0.2#	2.17	4.34	6.51	8.68	10.9	>10.9
TDS	mg/L		764	1528	2292	3056	3820	>3820

Department of Environment Regulation Contaminated sites guidelines (DER2014)

A summary of monitoring results between 2010 and 2017 is provided in Figure 2 showing that the highest contaminant levels occurred in operational areas near the ponds and attenuate with distance to the source. Nutrient levels in some bores exceeded the selected reference background level by more than five times indicating the presence of contaminant sources. Given the proximity to ponds and hardstands, this containment infrastructure may be compromised resulting in significant seepage. The fact that bores at different premises next to different pond clusters are affected also points to multiple contamination sources.

The results also infer the groundwater flow direction as south-westerly. Consistently, there are higher concentrations down hydraulic than up hydraulic gradient.

The contamination levels detected in bores CM09S and CM10S indicate that a groundwater contamination plume may extend from the operational area in a south-westerly direction towards sensitive environmental receptors located downgradient from the premises. To delineate the full extent of such a contamination plume would require more detailed groundwater investigations.

A comparison of Figure 2 and Figure 3 shows a similar pattern between averaged results over the long term (2010-2017) or over the short term (2016 – 2017), specifically that contamination concentrations are higher down hydraulic gradient than up hydraulic gradient. Decreases in contaminant concentrations are observed in some bores in most recent times particularly up hydraulic gradient from Mushroom Exchange pond clusters and C-Wise pond clusters (Figure 3). Down hydraulic gradient improvements in concentrations are more difficult to identify as a consistent observation across all contaminants. There are both lower and higher concentrations for some contaminants in bores down hydraulic gradient from ponds and hardstands when comparing historic averages with recent averages.

Key findings

The Delegated Officer has reviewed groundwater monitoring data illustrated in Figure 2 and Figure 3 and concluded that:

- *Groundwater monitoring results infer that the groundwater flow in the area of interest is in a south-westerly direction.*
- *The levels of nutrients in multiple bores indicate that containment infrastructure integrity may be compromised at all three premises resulting in seepage to groundwater.*
- *A groundwater contamination plume is likely to extend from the operational area in a south-westerly direction towards sensitive environmental receptors located downgradient from the premises.*

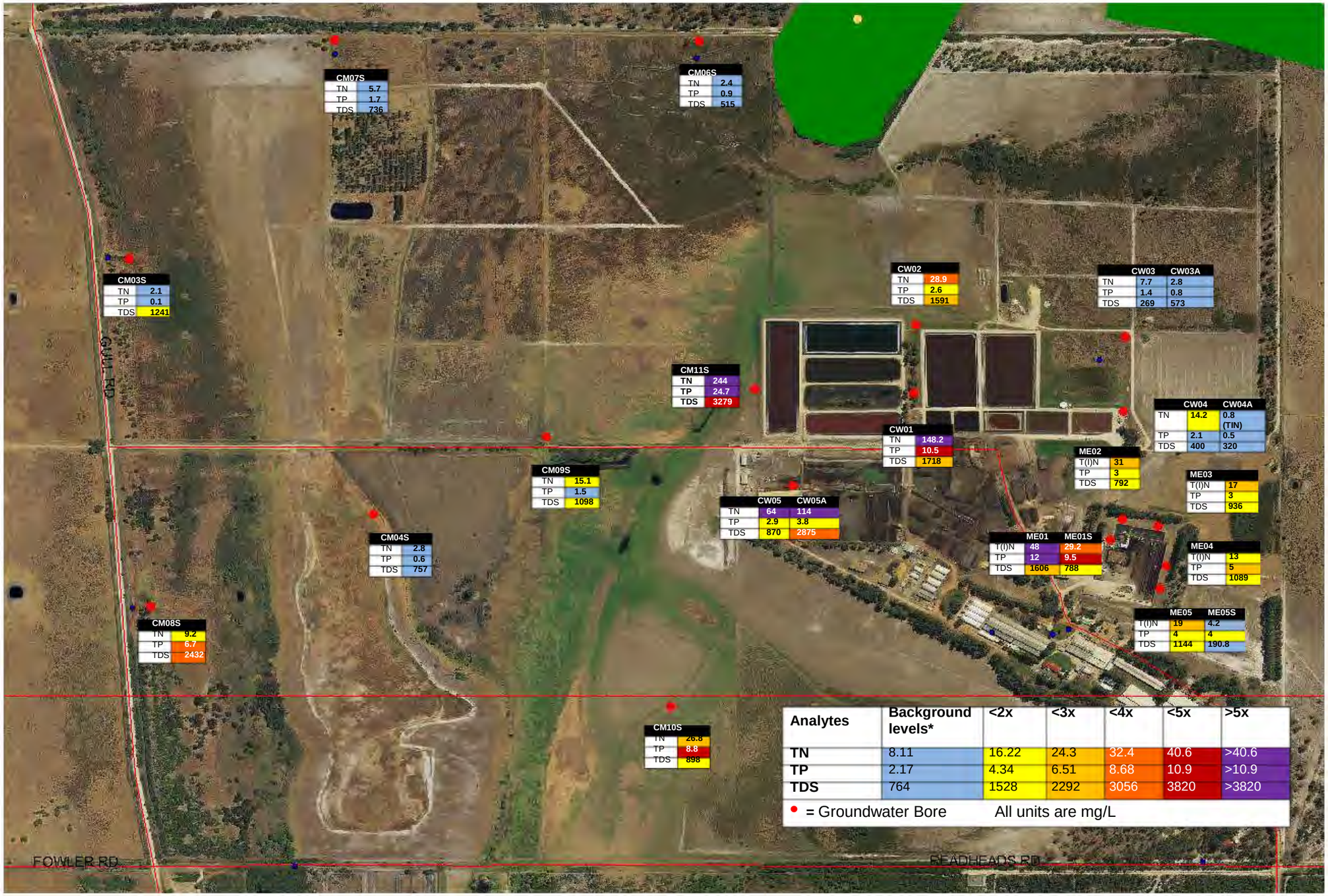
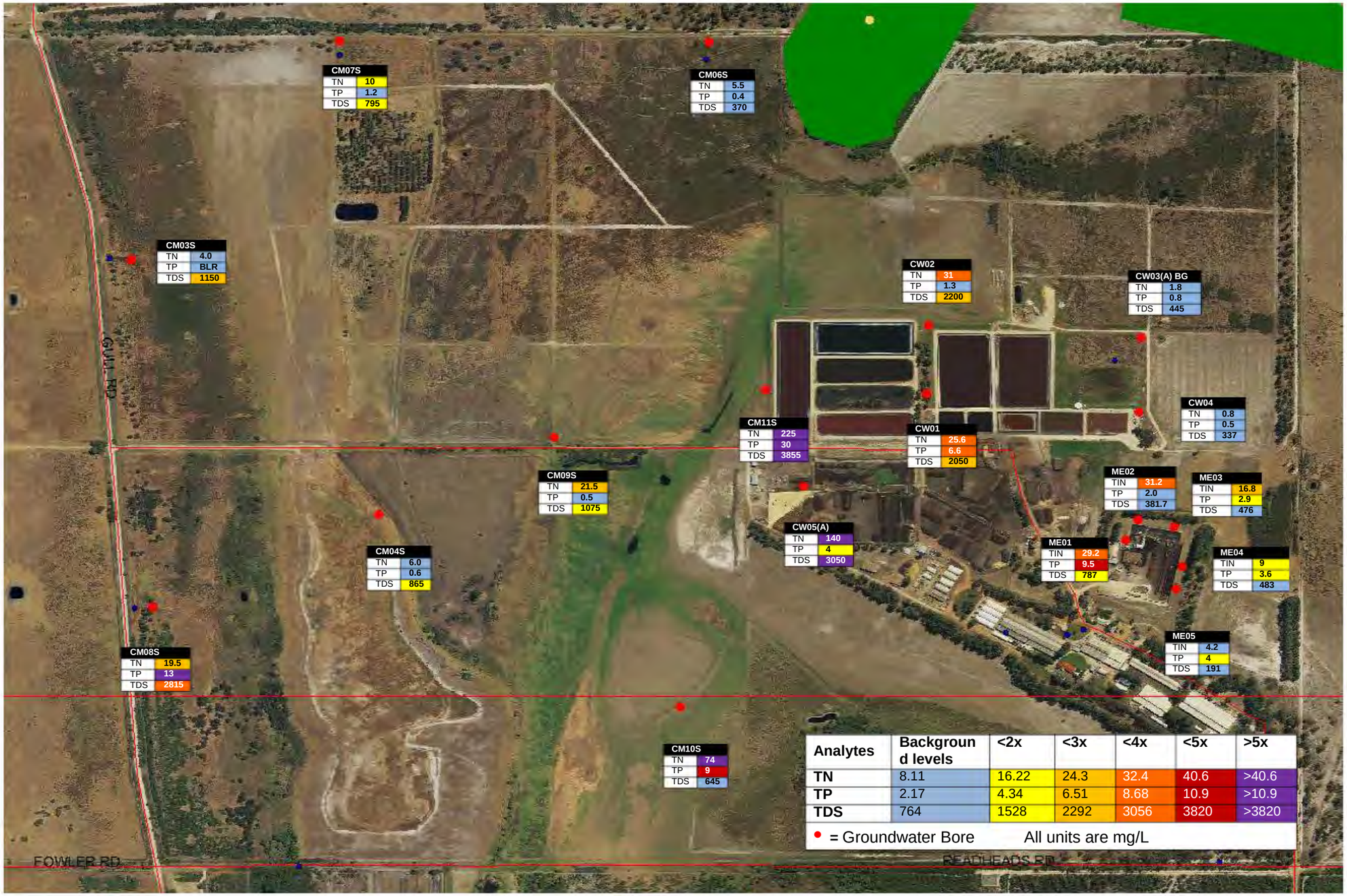


Figure 2 Groundwater monitoring results. Values for each analyte represents an average for data from 2010 to 2017. Selected analytes: Total Nitrogen (TN) or alternatively Total Inorganic Nitrogen (TIN), Total Phosphorus (TP) and Total Dissolved Solids (TDS).

*** Background levels were calculated using a statistical analysis from the data from CM06S for further details see Section 4**



Analytes	Background levels	<2x	<3x	<4x	<5x	>5x
TN	8.11	16.22	24.3	32.4	40.6	>40.6
TP	2.17	4.34	6.51	8.68	10.9	>10.9
TDS	764	1528	2292	3056	3820	>3820

● = Groundwater Bore All units are mg/L

Figure 3: Groundwater monitoring results Values for each analyte represents an average for data from data for 2016 - 2017 in mg/L. Selected analytes: Total Nitrogen (TN) or alternatively Total Inorganic Nitrogen (TIN), Total Phosphorus (TP) and Total Dissolved Solids (TDS).

Data averaged from sampling events: CM May and October 2016, CW: CW1 June and October 2016 CW2, CW3A and CW5A June and October 2016 CW4A January 2017

ME July, October 2016 and January, April 2017.

*** Background levels were calculated using a statistical analysis from the data from CM06S for further details see Section 4**

5. Detailed analysis of contaminant concentrations

For a more detailed analysis, data trends as graphed in Figure 4 are reviewed and discussed in the following paragraphs. The data is based on the information received from the licence holders submitted in Annual Environmental Reports (AERs). The bores have been renamed to accommodate the display of all bores on a single map. While the numbering has been retained, a two-letter prefix has been added to denote ownership according to licence holder (CW = C-Wise, CM = CM Farms, ME= Mushroom Exchange). The three C-Wise bores CW03A, CW04A and CW05A, were installed between 2010 and 2017 and have replaced bores CW03, CW04 and CW05. The replacement bores are located in approximately the same locations as the bores that were replaced.

To facilitate data visualisation and comparison, the data are presented as line graphs in Figure 4. The data, however, is not continuous consisting of separate, distinct data points.

C-Wise

Monitoring data from C-Wise is graphed in Figure 4.

Total inorganic nitrogen (T(I)N) is an important analyte that can indicate the presence of nutrient-rich leachate. When comparing the concentrations of T(I)N across the C-Wise bore network (Figure 4a), it is evident that bore CW03A and previously bore CW03 as well as CW04A, and previously CW04 are consistently showing lower levels of T(I)N. Bore results from CW03 and CW03A are consistent with background levels. This is also true for CW04A and CW04, except for data before January 2014. These levels are up hydraulic gradient from potential contamination sources such as ponds and hardstands. Results from bore CW01 located west of the C-Wise ponds shows concentrations significantly elevated (more than 5 times) above background levels. Equally, bore CW02 is impacted by above background concentrations, except for sampling dates between July 2013 and January 2014. Notably, from February 2015 to most recent sampling in October 2016, there is an increasing trend in concentration. Data availability for bore CW05/5A is limited but particularly the most recent data points from February 2015 to June 2016 show significantly elevated concentrations (more than 5 times) above background levels. The results indicate that there is likely to be active sources near bores CW01, CW02 and CW05A contributing to T(I)N levels elevated above background.

The concentrations of T(I)N are closely related to the concentrations of nitrate, nitrite and ammonia.

When comparing nitrate and nitrite levels with T(I)N concentrations, the nitrate results for bores CW01 and CW04/4A account for much of TN while TN in bores CW02 and CW05A is dominated by ammonia. The ammonia levels for recent data points are high with 120mg/L of ammonia recorded in the latest sample from June 2016.

Together with T(I)N, TP describes the nutrient component of wastewaters and leachates. Elevated TP levels can have detrimental impacts on native plants and promote algal blooms in water bodies. The Peel Inlet Harvey Estuary Environmental Protection Policy (EPP 1992, s. 6, 7) specifically addresses the need to reduce nutrient inputs including phosphorus from its policy area which includes the Nambeelup premises.

TP levels in bore CW01 have consistently been significantly (between 4 and 5 times) above background levels (Figure 4e), and a recent result from bore CW05A from June 2016 also indicates an elevated level. However, data return for bore CW05A has large gaps and is therefore hard to interpret with regards to any trends. The concentrations in the remaining bores CW02, CW03/3A and CW04/4 appear to have remained consistent with background levels at least since July 2013. The results indicate that there are potentially active contaminant sources near bores CW01 and CW05A contributing to TP levels elevated above background.

The pH levels separate mainly bore CW04 and CW03 (pH between 4 and 5) against bores CW01 and CW05A (pH between 6 and 7) (Figure 4g). This separation is consistent with findings derived from the other analytes including TDS that infer greater impact of nutrient leachates on bore CW01 and CW05A.

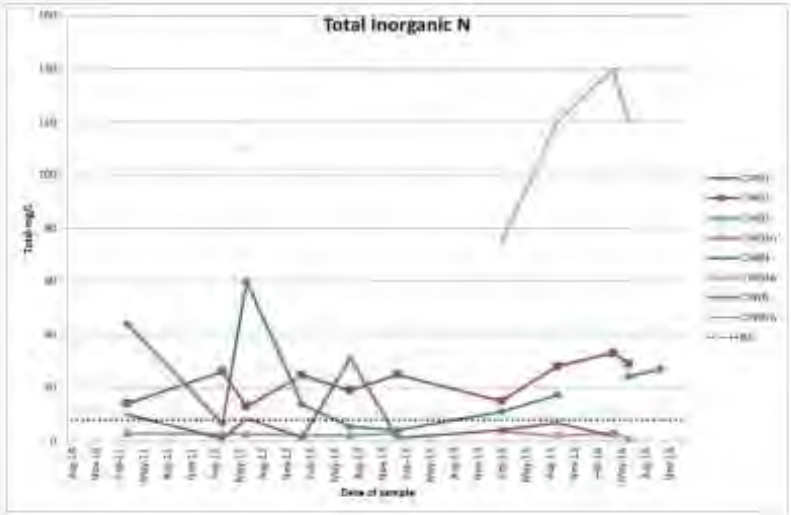
Elevated levels of TDS were recorded in bores CW01, CW02 and CW05A (Figure 4f).

Key findings

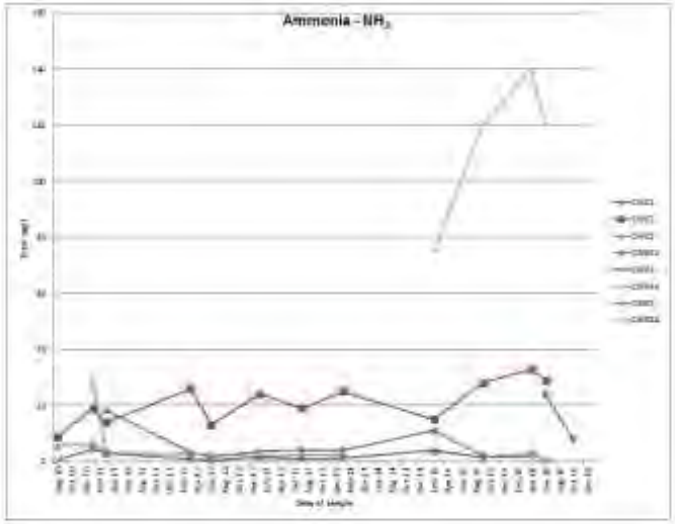
The Delegated Officer has reviewed groundwater monitoring data from C-Wise bores illustrated in Figure 4 and concluded that:

- *The submitted data has significant gaps requiring improvements in data quality and consistency in future submissions.*
- *High ammonia levels have been detected in bore CW05A indicating the likely presence of a nearby contamination source.*
- *Given the observed fluctuations and levels of contaminants recorded in some bores, the current biannual sampling regime is not considered sufficient to document environmental performance and determine contamination sources adequately.*
- *High nutrient levels in multiple bores indicate that there is likely to be a contaminant source or sources nearby, which need to be identified. It is, therefore, necessary to confirm through testing that containment infrastructure on site is effective.*

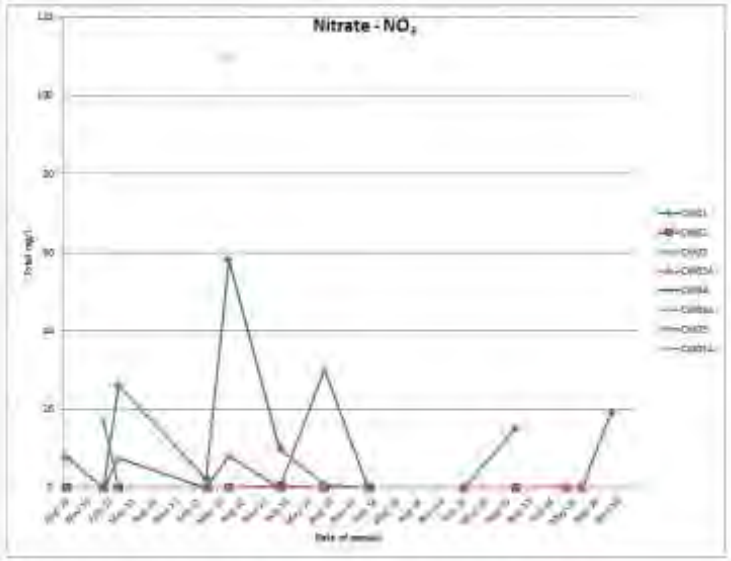
a) Total Nitrogen in relation to BG



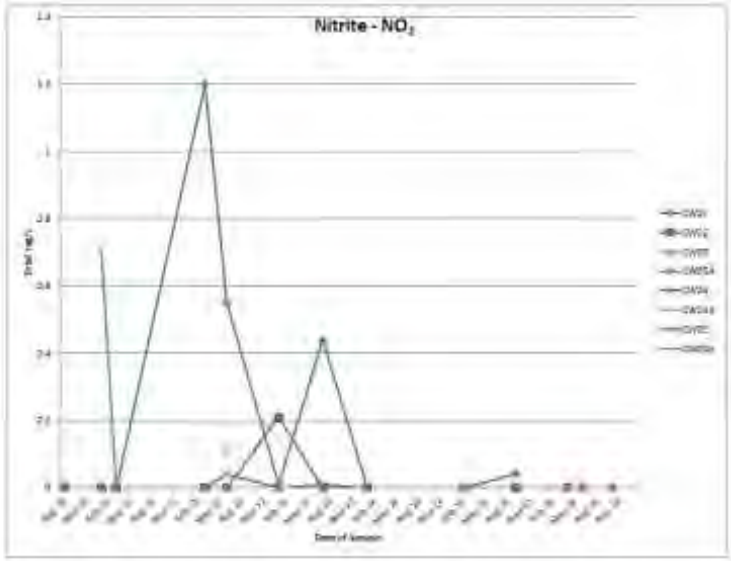
b) Ammonia concentrations



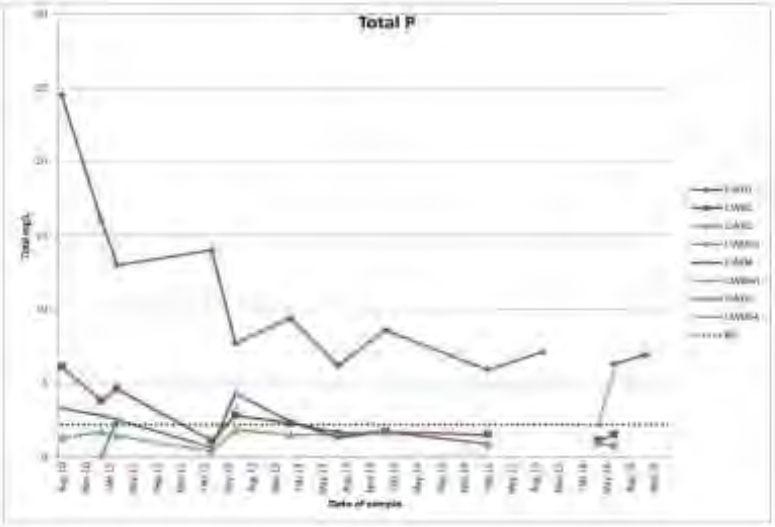
c) Nitrate concentrations



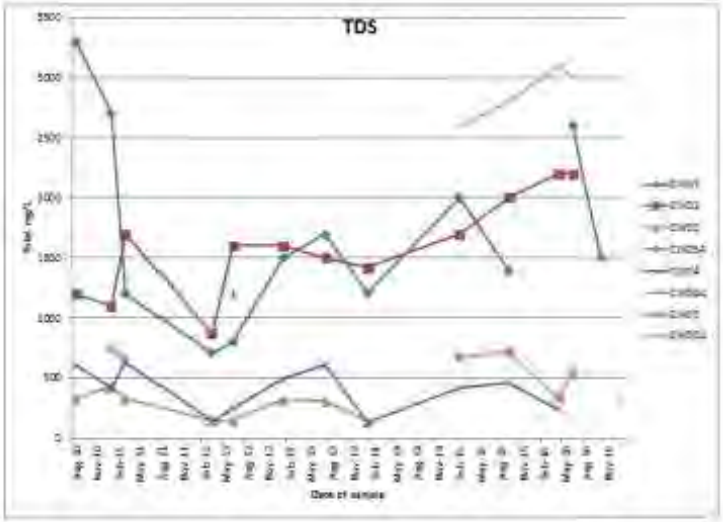
d) Nitrite concentrations



e) Total Phosphorus in relation to BG



f) Total Dissolved Solids concentrations



g) pH

Figure 4 Groundwater monitoring data submitted by C-Wise, 2010 to 2017.

CM Farms

Monitoring data from CM Farms has been graphed by analyte in Figure 5. High levels of TN (more than 5 times background levels) have been recorded from bore CM11S (Figure 5a) which is located west of Pond 5. High levels also occurred in bore CM10S in June 2016, but the level dropped significantly in October 2016. It is unclear what could cause such a fluctuation. Recent results also show bore CM09S and CM08S above background levels. These results indicate that there are potential contaminant sources up hydraulic gradient from the bores that may be impacting on TN concentrations. Given the proximity of bore 11S to CM Farms ponds, these could be an active contamination source. They could also affect bore CM10S which is located 800m south-southwest from CM11S and down hydraulic gradient from the ponds. In addition, the results from bore CM09S could be impacted by the same contaminant source due to its location approximately 500m southwest of bore CM11S.

Ammonia and Nitrate levels are graphed in Figure 5b-c. Nitrite has not been graphed as it remained below detection level for the entire monitoring period. Concentrations of Ammonia and Nitrate show elevated levels and fluctuating patterns in bore CM11S indicating potential impacts from a nearby contamination source.

Bore CM11S also recorded high levels (more than 5 times background levels) of TP and similar to TN the graph shows substantial fluctuations. There is some graph alignment between TN and TP between May and October 2015 indicating they are likely to be caused by the same contamination source. It is likely that this source is one or multiple CM Farm ponds located close to CM11S. The fact that there are large nutrient spikes indicate that there may have been some events such as operational activities that contributed to increased nutrient seepage. It is unclear, however, what these events were.

Data spikes are also observed in bores CM11S, CM09S and CM08S for TDS (Figure 5f) and it is unclear what these are caused by.

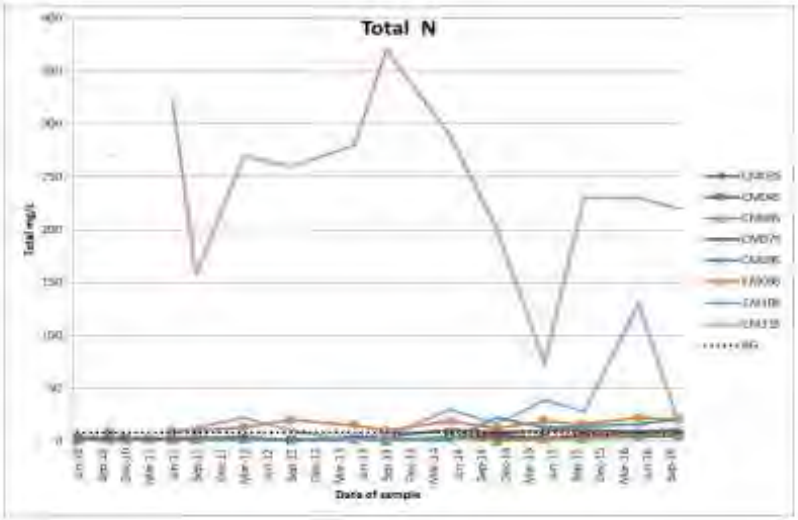
It is possible that data spikes reflect some level of seasonality and rainfall pattern but such a pattern is not clearly discernible. The cause is more likely to be data integrity issues relating to sampling methodologies.

Key findings

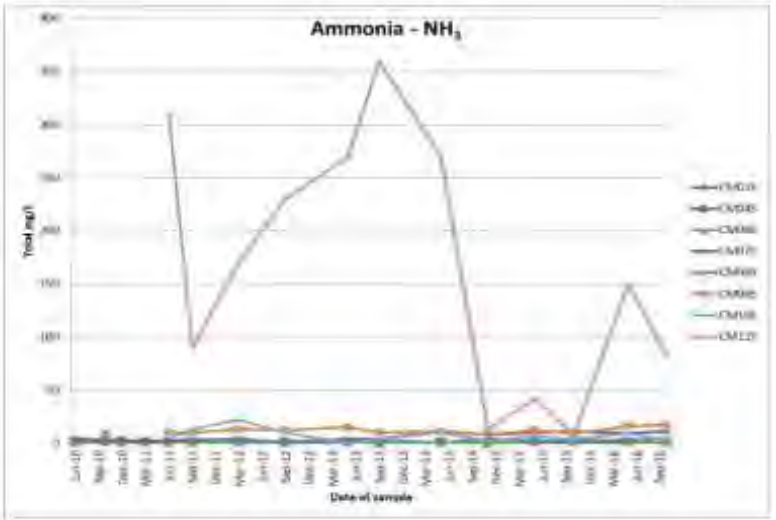
The Delegated Officer has reviewed groundwater monitoring data from CM Farm bores illustrated in Figure 5 and concluded that:

- *High nutrient levels have been detected in bore CM11S indicating the likely presence of a nearby contamination source.*
- *From the location of the impacted bore, it is inferred that one or multiple CM Farm ponds could be the contamination source.*
- *Given the observed fluctuations and high levels of contaminants recorded, the current biannual sampling regime is not sufficient to adequately document environmental performance and determine contamination sources.*
- *High nutrient levels in bore CM11S and bores CM10S and CM09S indicate that a groundwater contamination plume originating in the operational area may have mobilised and moved in a south-westerly direction towards sensitive receptors.*

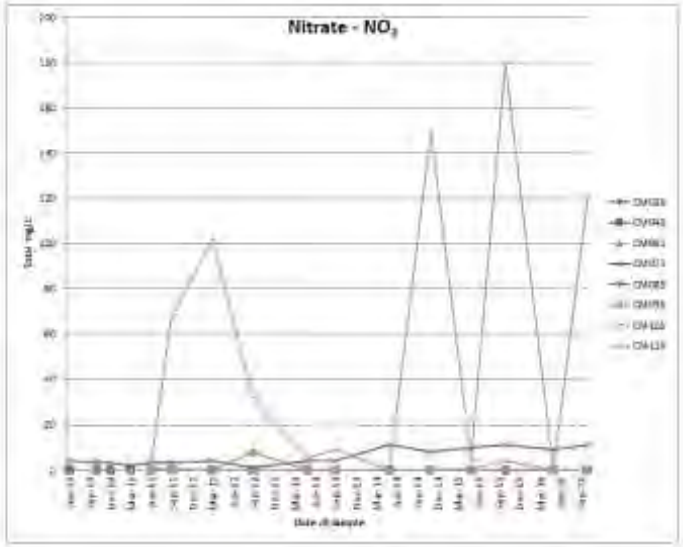
a) Total Nitrogen in relation to BG



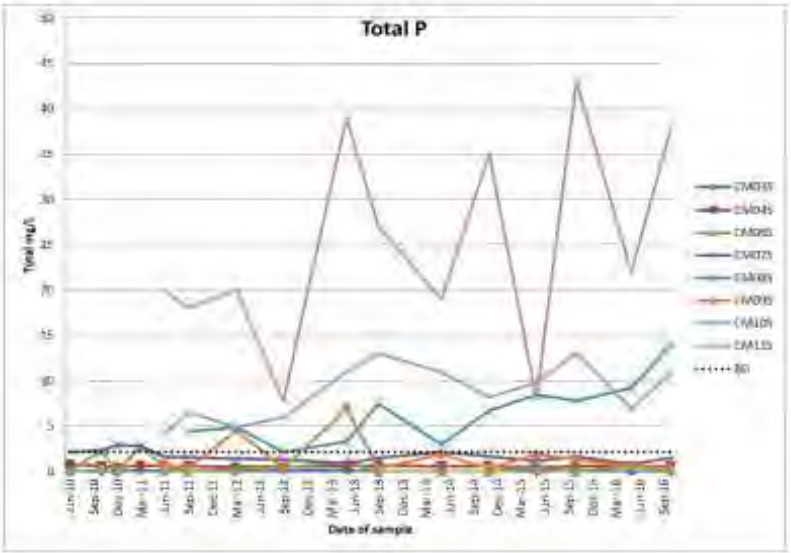
b) Ammonia concentrations



c) Nitrate concentrations



d) Total Phosphorus in relation to BG



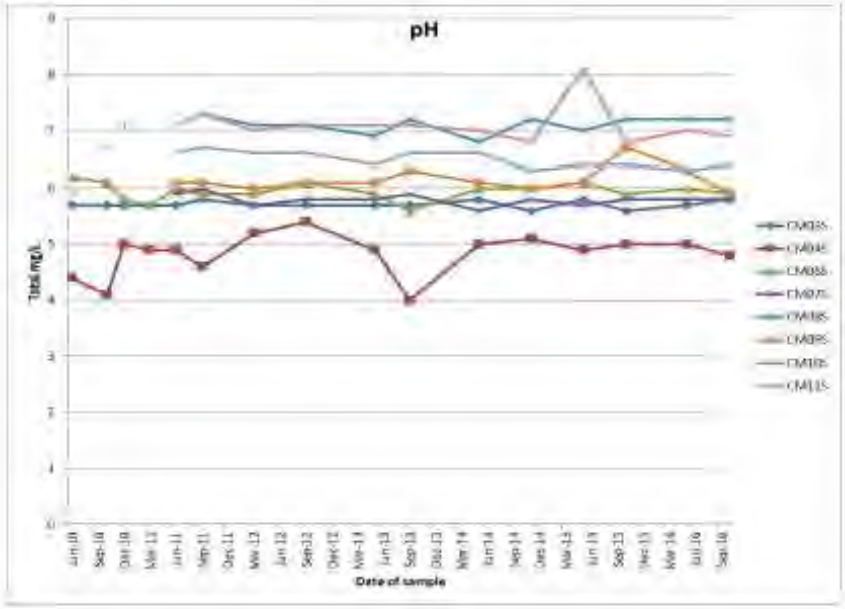
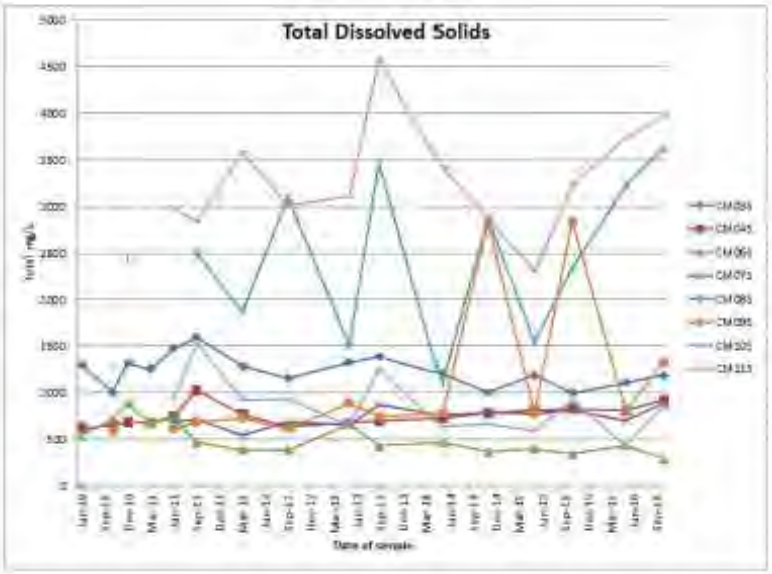
e) pH	f) Total Dissolved Solids concentrations
	

Figure 5 Groundwater monitoring data submitted by CM Farms, 2010 to 2016

Mushroom Exchange

Monitoring data from Mushroom Exchange has been graphed by analyte in Figure 6. In contrast to data from C-Wise and CM Farms, the data from Mushroom Exchange has been collected in quarterly intervals which provides greater detail and data resolution. However, the quarterly sampling intervals are not consistent, and there are some data gaps.

Nitrogen-based nutrient concentrations are shown in Figure 6a-d. T(I)N levels graphed in Figure 6a show high concentrations and large fluctuations over the historical time series. Such data fluctuations are difficult to interpret in light of describing any trends. Generally, T(I)N concentrations in bores ME01 and ME02 are higher and above the background level compared to bores ME03 and ME04. This is consistent with a downgradient location of bores ME01 and ME02 in relation to possible sources from the Mushroom Exchange pond cluster. ME01 and then ME02 appear to be the most impacted bores on the premises. Recent data points from October 2016 and January and April 2017 show a trend of declining concentrations of T(I)N in bores ME01S and ME02.

Concentrations of ammonia, nitrate and nitrite show patterns and fluctuations that are not easily explained. There may be some alignment with T(I)N data, however. The data for ammonia in bore ME01 (Figure 6b), for instance, mirrors the data for T(I)N in the same bore (Figure 6a). Data points for nitrate (Figure 6c), however, are more closely aligned with T(I)N concentration in bores ME03, ME04 and ME05 (Figure 6a).

A review of the time series of TP concentrations (Figure 6e) generally shows high concentrations and large fluctuations over the historical time series, but recent sampling events indicate a reduction in TP concentrations with levels in bore ME02 reaching background concentrations.

When comparing recent TP and T(I)N concentrations (Figure 6a, e) the similarities support the conclusion that the source of contamination is the same for both and consists of leachate rich in T(I)N and TP. The data also indicate that bore ME01 is differently impacted than the other bores, possibly due to its location.

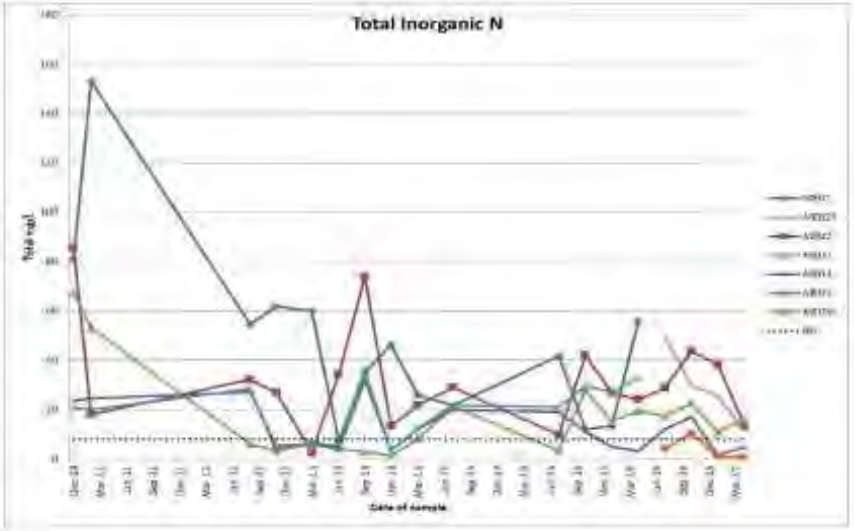
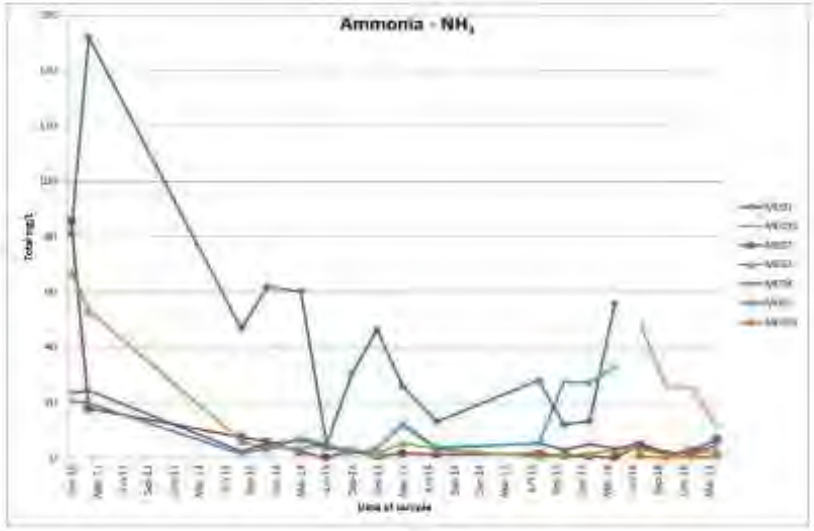
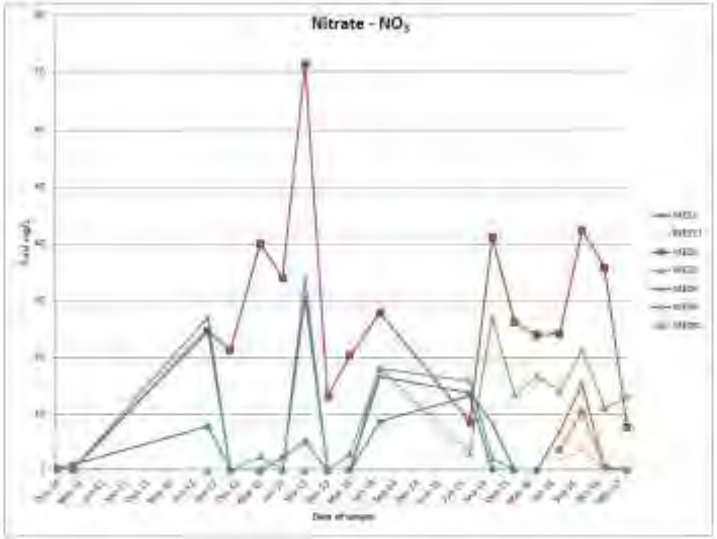
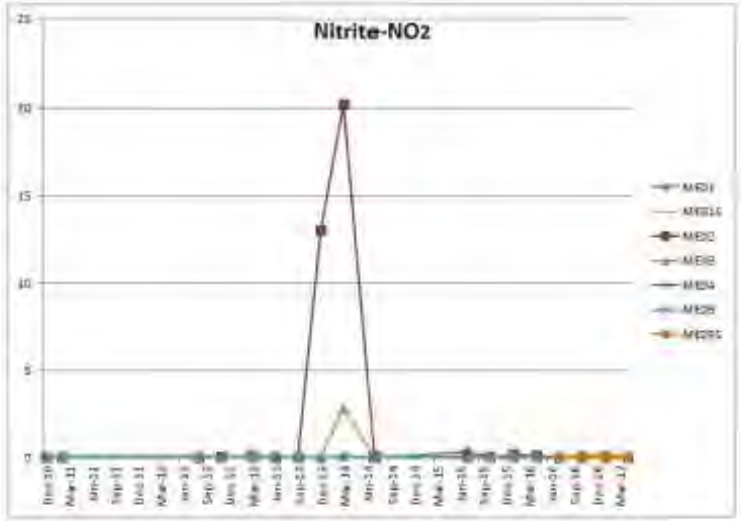
TDS levels in all bores show a declining trend over the long term historically. Most recent data appear to be somewhat stable (Figure 6).

PH levels show a sudden decline in all bores between April 2016 and July 2016 but have been stable over the most recent period (Figure 6g).

Key findings

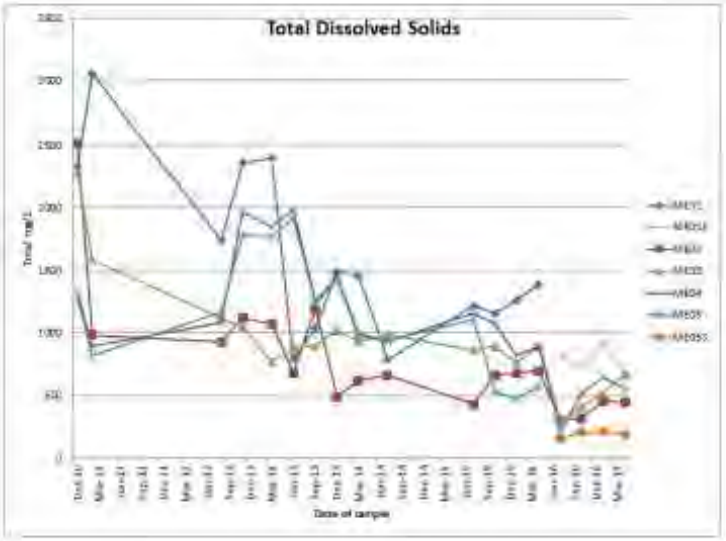
The Delegated Officer has reviewed groundwater monitoring data from Mushroom Exchange bores illustrated in Figure 6 and concluded that:

- *The submitted data has some gaps highlighting the importance to ensure that data quality and consistency is maintained in future submissions.*
- *High nutrient levels above background have been detected in multiple bores surrounding the Mushroom Exchange infrastructure indicating the likely presence of a nearby contamination source. It is, therefore, necessary to confirm through testing that containment infrastructure on site is effective.*

a) Total Inorganic Nitrogen in relation to BG	b) Ammonia concentrations
	
c) Nitrate concentrations	**d) Nitrite concentrations**
	

e) Total Phosphorus in relation to BG

f) Total Dissolved Solids concentrations



g) pH

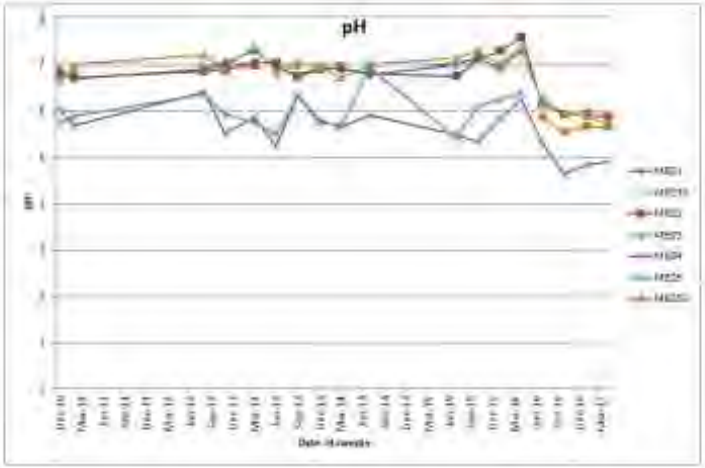


Figure 6 Groundwater monitoring data submitted by Mushroom Exchange, 2010 to 2017

Appendix 5: Odour Impact Analysis

1. Complaints

From October 2015 the former DER began to receive an increase in odour complaints which were recorded in the Department's Incident and Complaints Management system as potentially being related to the Nambeelup premises due to location, odour characterisation, the similarity with complaints made at the same time and/or statements made by the complainant. Figure 1 shows the number of odour complaints recorded each month from August 2014 to January 2018 where the Nambeelup Farm was listed as a potential source.

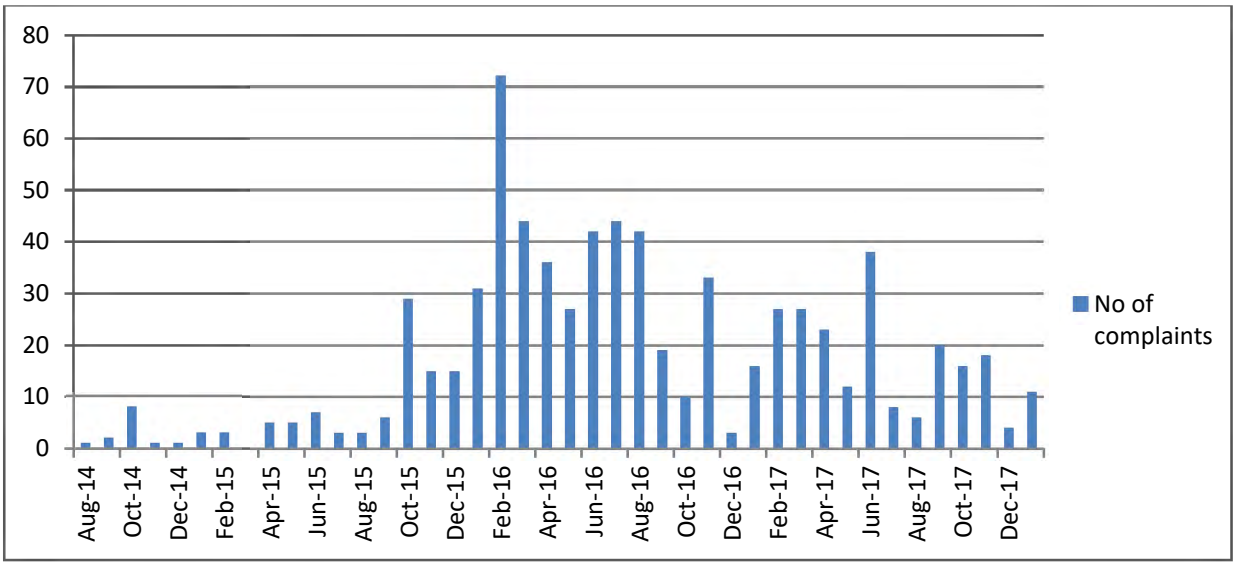


Figure 1: Complaints attributed to Nambeelup Farms

2. Desktop Assessment

Given the significant increase in complaints over the 2016 annual period, a desktop assessment was undertaken to determine whether the odour complaints could be reasonably attributed to the Nambeelup Farm area based on likely wind direction. This initial screening tool is based on wind direction averages from the Bureau of Meteorology.

Figure 2 demonstrates the suburbs where complaints were received from (where a suburb was given) and the dominant wind directions for the Mandurah area. The data indicate that the majority of complaints during 2016 were received from suburbs that are predominately downwind and in closest proximity to the Nambeelup Farm area.

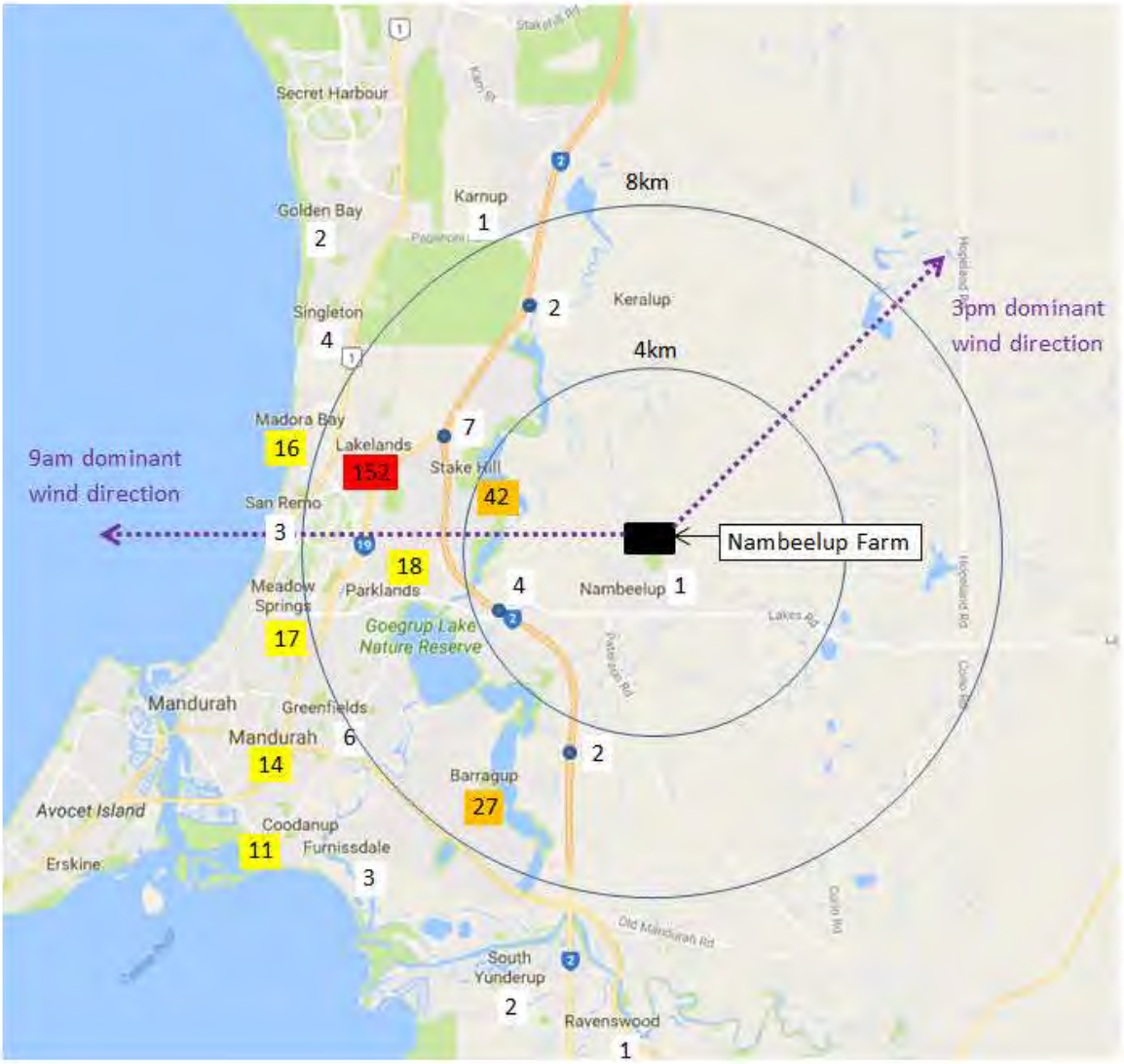


Figure 2: Number of complaints per suburb in 2016 (where suburb was provided at time of complaint)

On a number of occasions, there were multiple complaints made on the same day. The meteorological data were analysed for these events which demonstrated that complaints were made at times when the suburbs were likely to be experiencing wind from the direction of Nambeelup Farm. Figures 3 and 4 below demonstrate the location of complaints and the recent wind direction for complaints made on the 18 March and 11 April respectively.

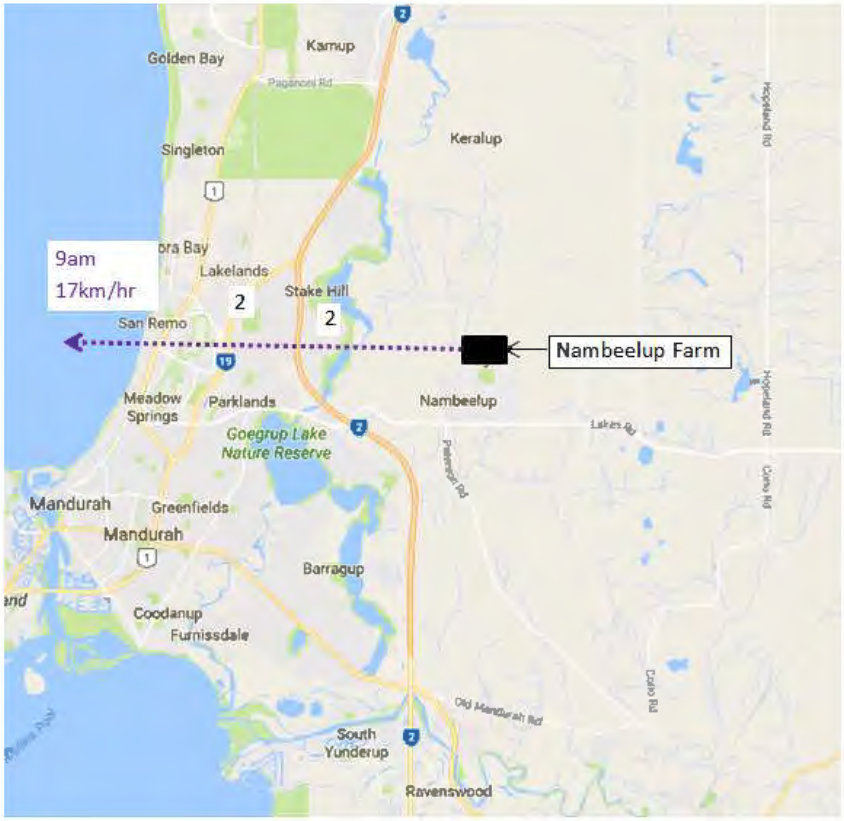


Figure 3: Four complaints made on the 18 March 2016

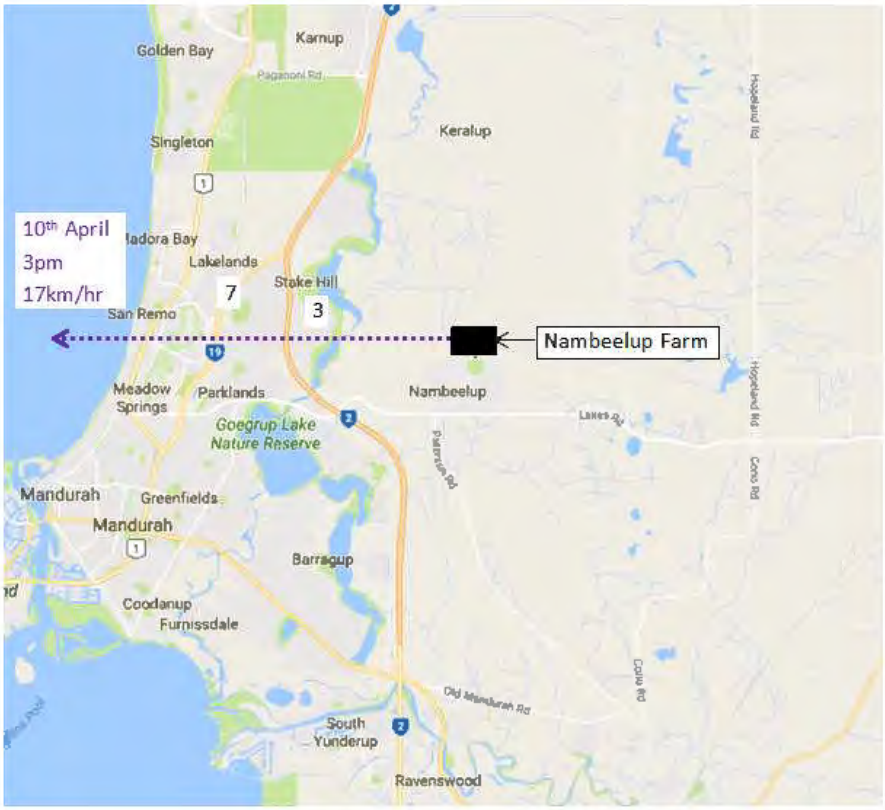


Figure 4: Ten complaints made on the 11 April 2016

The complaints data also demonstrates that the outlying suburbs more than 8 kilometres from the premises reported complaints at the time when recent wind directions were likely to place them downwind of the Nambeelup Farm. Figure 5 demonstrates complaints made near Karnup were received on the 18 February where morning winds were SSE and afternoon winds were SE.

Figure 5: Seven complaints made on the 18 February 2016

While the wind directions are averaged data for the area, it demonstrates that on many occasions the complaints were made in locations where the wind directions could reasonably attribute the Nambeelup Farm area as a potential source of odour, and indicate that there is a potential pathway for odours to travel from the premises to the receptor location.

4. Odour Investigation

As complaints began to increase at the end of 2015, DER conducted the Mandurah Odour Investigation at the start of 2016, with seven surveys conducted by DER Officers during April to June of 2016. The purpose of the survey was to ascertain which odour sources were the major contributors to odour impacts in the Mandurah area and if possible, to determine the odour impact extent of those sources. The investigation was carried out independent of any complaints and was based on weather data provided by the Department of Agriculture with supplementary weather data taken by DER Officers on the ground at the point of assessment. The full investigation report is attached as Appendix 6.

The following Figures 6 and 7 are taken from file notes in support of the investigation and demonstrate that odours could be identified at over 8km from the premises and that the assessment involved taking measurements upwind of the premises.

Figure 6: Location of odours observed 19 May 2016

Figure 7: Location of odours observed 2 June 2016 (blue dots indicate no odours observed upwind)

The findings of the report demonstrate that, while there are a number of potential natural odour sources (lakes and rivers) as well as two other Prescribed Premises in the Mandurah area, in the majority of cases the odour observed by DER Officers was attributable to Nambeelup Farm. Odours from Nambeelup Farm were also observed up to 8.5km from the premises which further correlates to a number of complaints made in suburbs over 8km away.

3. Key findings

The Delegated Officer has reviewed the odour complaint information and has found:

1. *There is a potential pathway for odours to travel over 8km from the premises*

5. Specific complaint validation

Verification of individual odour complaints on the ground is difficult due to the need to be in close proximity at the time of the complaint. On the 27 May 2016 DER Officers were in the Nambeelup area to conduct the Mandurah Odour Investigation, and two complaints were received by DER at this time. DER Officers were, therefore, able to validate these complaints by recording odours observed in the area just before the complaints were made and up to an hour after the complaints were made. These observations and shown in Figure 7. During the period of observation the one minute average wind directions at the Pinjarra weather station ranged between east north-easterly and south easterly, and the one minute average wind speeds ranged from 0.29m/s and 1.5m/s (data sourced from the Department of Agriculture and Food).

Figure 8: Odour complaints and DER observations – 27 May 2016

6. Key findings

The Delegated Officer has reviewed the information regarding the odour investigation and has found:

1. *Odour emissions observed in the Mandurah area are mainly attributable to the Nambeelup Farm Premises*
2. *Odour impacts have been confirmed up to 8.5 km from the Premises*

Appendix 6: Technical Expert Report – Mandurah Odour Investigation

Government of Western Australia
Department of Environment Regulation

REPORT

Technical Expert Report

Report on Mandurah Odour Investigation (MOI) Project

Version: Final

September 2016

DER2016/000081

Document control

Document version history

Date	Expert name / position	Version	Role
17/07/16	Philippe Najean Senior Air Quality Officer	Draft	Author
19/07/16	David Griffiths Senior Air Quality Officer	Final	Reviewer
29/08/16	Kerry Laszig Director Environmental Sciences	Final	Executive review

Corporate file information

File number and/or name	File owner or custodian	File location
DER2016/000081	Philippe Najean Senior Air Quality Officer	Booragoon

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Questions regarding this report should be directed to:
Department of Environment Regulation
Locked Bag 33 Cloisters Square
PERTH WA 6850
Phone: +61 8 6467 5000
Fax: +61 8 6467 5562
Email: info@der.wa.gov.au
Web: www.der.wa.gov.au

Accessibility This document is available in alternative formats and languages upon request.

Expert's details

Personal details: Author

Name	Philippe Najean
Employer	Department of Environment Regulation
Position title	Senior Air Quality Officer
Classification level	SC3
Recognised field of expertise	The author is recognised as an expert by the Department of Environment Regulation (DER) in odour, process, chemical engineering and data analysis

Qualifications and experience

The qualifications and experience and technical capability relevant to the provision of this advice is as follows:

Qualification

Qualification	Year obtained	Additional comments
Master Degree, Chemical Process Engineering	1996	Graduated from Ecole des Mines St Etienne & Polytechnique Institute of Grenoble (France)
Environmental Engineering Degree	1996	Focus: process design and management of operations dedicated to waste, air, water and soil treatment

Professional experience

Employer	Position	Tenure
Department of Environment Regulation (including predecessor agencies)	Senior Air Quality Officer	2008 – present
IRSN Paris (French Institute for Radiological Protection and Nuclear Safety)	Olfactometry Laboratory Manager	2001 - 2007

Other – Publications/memberships/associations etc

Publications

DER Technical Report: Community Odour Monitoring Program (COMP) Leeming and Willetton, January to April 2011, Final Report – March 2012

DER Technical Report: Report 1 - Final reports from odour investigations around the Southern Metropolitan Regional Council's Regional Resource Recovery Centre in Canning Vale – October 2008

Refereed Papers / Conferences / Exhibitions

Najean P. (keynote speech), Odour Regulation & Odour Management: a possible and necessary synergy *OMCTS* Sept 2015 Toronto, Canada

Odour management: Challenges and Opportunities - An International Perspective, *Mini-Symposium Waste Management Association of Australia*, May 2013, Perth, Australia

Case studies: olfactometry and chemical odour source assessments, *ECRIN (French Environmental Association) Working Group*, 2006, Paris, France,

Case study: Limitations for olfactometry and chemistry assessments, *Envirorisk Exhibition*, Sept 2005, Aix-en-Provence, France

Case study & European Standard EN13725, *Eurodeur-Biorodeur*, June 2005, Paris, France

International odour regulation and French position, *National Technical Day, French Minister of Environment*, Feb 2005, Paris, France

Olfactometry and chemistry duality for odour assessment (poster and speech), *Envirorisk Exhibition*, Sept 2004, Lille, France

Odour Treatment Technologies, *Eurodeur-Biorodeur*, June 2004, Paris, France

Waste Water Treatment Plant case study: odour source assessment, *Eco-Industries Exhibition*, March 2004, Metz, France

Odour Nuisance Survey Methodologies, *Eurodeur-Biorodeur*, June 2003, Evreux, France

French Odour Standards, *Eurodeur-Biorodeur*, June 2002, Pau, France

Lectures

University of Western Australia – Project & Risk Management: an "odorous" case study, *University of Western Australia Master students, May 2013*, Perth, Australia

Odour Science Generalities and Case Studies, *Murdoch University Master students, May 2013*, Perth, Australia

Odour Science: generalities and case studies, *lecture to the Board and post-doc students of the Environmental Engineering Department of Murdoch University*, June 2012, Perth, Australia

Odour generalities, Case study: odour field survey SMRC 2008, Odour

Assessments: limitations and ways forward, *Department of Environment and Conservation internal workshop*, Feb. 2010, Perth, Australia

Introduction to the odour science, *Curtin University* Master students, May 2011, Perth, Australia

Odours: from subjectivity to objectivity, *Water Corporation WA*, March 2011, Perth, Australia

Odours: from subjectivity to objectivity, *Engineer Australia and Cheme*, Nov. 2010, Perth, Australia

Summary details

TO:	Germaine Healy, A/Director Compliance & Enforcement, DER
PREPARED BY:	Philippe Najean *
REVIEWED BY:	David Griffiths *
SUBJECT	Mandurah Odour Investigation Project

* The details of these experts is summarised below (see Expert's details).

This advice was prepared for Compliance and Enforcement to provide information on odour sources that may be contributing to the large number of odour complaints received from the Mandurah area in late 2015 and early 2016. I have coordinated and supervised the odour surveys and reported the results and interpretation according to the scope below.

Scope of advice
As per the authorised and approved project scope of the Mandurah Odour Investigations Project – Contentious Issues Management Group – 22 April 2016, DER officers conducted odour field surveys in the area of Mandurah between April and June 2016. Monitoring was conducted in public areas in Mandurah and its suburbs. Odour field surveys were carried by Air Quality Services officers and DER officers from other functional areas. Air Quality Services officers analysed the data and produced this technical expert report. The main focus of the project was to investigate the role of potential odour sources triggering odour complaints in Mandurah area.

In designing and implementing the project and preparing this report, I have also:

- Considered the VDI 3940 Part2.2006 standard "Measurement of odour impact by field inspection – Measurement of the impact frequency of recognizable odours – Plume measurement"
- Undertaken site inspections and field reconnaissance;
- Undertaken odour field measurement; and
- Undertaken comprehensive data processing and analysis

My technical expert report is as follows.

Executive Summary

DER has received intermittent complaints about odour in the Mandurah area since 2014. In 2015 and early 2016 complaints steadily increased, peaking at over 70 complaints in February 2016.

A number of industrial prescribed premises and natural sources of odour were identified as potentially having a role in contributing to odour impacts in the area. The Mandurah Odour Investigation (MOI) was proposed by DER to ascertain which odour sources were the major contributors to odour impacts in the Mandurah area and if possible, to determine the odour impact extent of those sources.

Odour field surveys were performed using odour assessors positioned at various locations and times in the vicinity of each of the identified potential odour sources.

The area to be surveyed was chosen following DER odour complaints analysis and locations of the identified potential odour sources.

Of the eleven prescribed premises initially identified that could potentially impact on the Mandurah area, the following five were retained for the surveys:

- The Waste Water Treatment Plant (WWTP) on Gordon Road;
- The Waste Transfer Station, Corsican Pl;
- A group of three premises, referred as Nambeelup Premises which include:
    - CM Farms – Nambeelup Derby Industries Pty Ltd;
    - Wandalup Farms - Mushroom Exchange Pty Ltd
    - C-Wise WA Composts Pty Ltd

Four major natural sites were identified as potential odour sources in this area:

- Paganoni Lake;
- Black Swan Lake;
- Goegrup Lake; and,
- The Serpentine River between Keralup and Goegrup Lake.

The sensitivity of the odour assessors used in the field was validated.

Survey times were based on meteorological forecasts showing appropriate conditions regarding wind direction (NE to SE pre-defined sector), wind speed below 10 m/s (likely dilution of any odours) and no rain.

Five odour field surveys were carried out early morning and two early evening between 7 April and 2 June 2016.

Assessors were initially dispatched downwind of the identified potential odour sources and performed odour surveys at pre-determined measurement points in their allocated zones. Further measurements were then taken at various locations determined during the course of the survey.

The keys findings are outlined below and presented on Figures B1 to B8 in Appendix B.

Odours from the natural sources including Black Swan Lake, Goegrup Lake and sections of the Serpentine River were recognised by assessors during a small number of single measurements. These odours were identified when close to the source (up to 450m for the lakes and 800m for the Serpentine River).

The April to June period of the year is not likely to be the period with highest odour emissions from the natural sources. During the summer season, dried and potentially odorous lake floors and river banks were in contact with air and sun with odours occurring via breakdown of organic matter. In March 2016, there were several episodes of rain resulting in higher water levels, flooding river and lake beds and banks, and consequently decreasing the potential for odour emissions from these sources.

Odours from the waste water treatment plant (WWTP) on Gordon Road were recognised at one measurement point only, very close to the plant.

Odours from the waste transfer station on Corsican Place were recognised between 50 and 800m for most measurements and at 1,200m during one single measurement. Odours were described as refuse, organic odour and garbage.

Odours from the Nambeelup Premises were recognised between 1,200 and 8,500m and were mainly described as putrid, compost, manure, organic and green waste odours. Verifications undertaken by the field operator and the panel were able to confirm that the Nambeelup Premises was the origin of those odours and that no other odour source with similar types of odour was present upwind of this site.

Objectives

This project aims to investigate which natural sources and industrial activities, among the potential odour sources identified in Mandurah area, may have a role in odour impacts in the Mandurah area, including the suburbs of Lakelands, Parklands, Stake Hill and Meadow Springs.

1.0 Introduction

DER has received intermittent complaints relating to odours in the Mandurah area since 2014. In 2015, complaints steadily increased peaking in February 2016 (Figure 1).

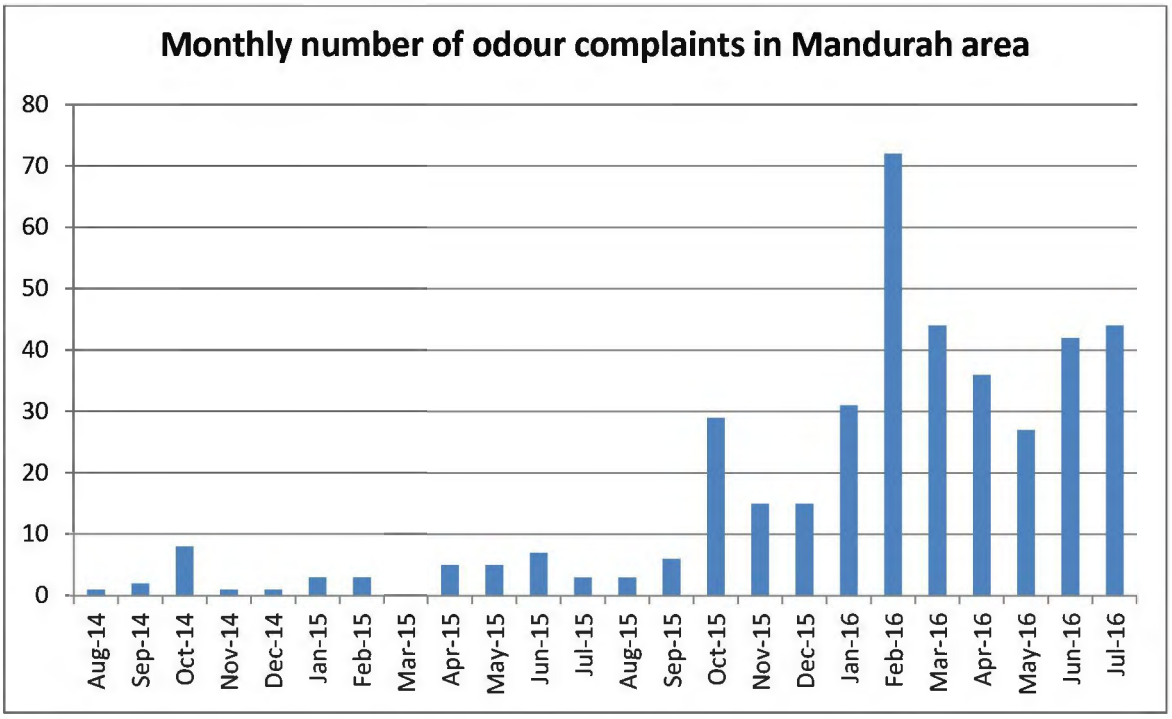


Figure 1: Monthly number of odour complaints reported to DER

A number of industrial prescribed premises and natural sources of odour were identified as potentially having a role in contributing to odour impacts in the area. The Mandurah Odour Investigation (MOI) was proposed by DER to ascertain which odour sources were the major contributors to these impacts and if possible, to determine the odour impact extent of those sources. The MOI was performed by odour assessors at various locations and times in the vicinity of the identified potential odour sources.

2.0 Project description

DER odour complaints were reviewed prior to planning the odour field surveys. This review was used to locate appropriate measurement points and determine appropriate wind directions and time periods to perform the odour field surveys.

Spatial distribution of odour complaints was mapped from DER's complaints database. Primary areas of interest for this odour survey were ascertained from this map.

The complaints analysis also identified early morning and late afternoon as suitable times to conduct the odour surveys.

There are eleven premises which hold licences under Part V Division 3 of the *Environmental Protection Act 1986* operating in the Mandurah area including, waste water treatment plants, waste transfer stations, composting operations, piggeries and liquid waste facilities. Every prescribed facility was inspected by DER officers in early 2016 to verify compliance with their licence conditions. Following inspections, five

prescribed premises were regarded as potential odour sources that may impact the surveyed area:

- The Waste Water Treatment Plant (WWTP) on Gordon Road;
- The Waste Transfer Station, Corsican Pl;
- A group of three facilities, referred to as the Nambeelup Premises which includes:
    - CM Farms – Nambeelup Derby Industries Pty Ltd;
    - Wandalup Farms - Mushroom Exchange Pty Ltd
    - C-Wise WA Composts Pty Ltd

Four major natural sites were identified as potential odour sources in this area:

- Paganoni Lake;
- Black Swan Lake;
- Goegrup Lake; and,
- The Serpentine River between Keralup and Goegrup Lake.

The locations of the identified potential odour sources are presented in **Figure A1** in **Appendix A**.

Owing to the numerous, and widely spread, potential odour sources identified, a large number of pre-located measurement points were required. They are presented on **Figure A2** of **Appendix A**.

The purpose of the surveys was to identify odour sources capable of generating downwind impacts in the field. Consequently, field odour assessments were carried out under North-Easterly (NE) to South-Easterly (SE) winds. This sector of wind gave the highest likelihood that at least some measurement points were located downwind of the potential odour sources.

Surveys were conducted by DER officers from April to June 2016.

3.0 Methodology

This project was drafted as an odour source investigation (OSI) to validate the role of the identified potential sources. The OSI was performed in the vicinity of the identified potential sources, following the general requirements of the VDI 3940 Part2 [1]. An OSI, although not as rigorous as an odour field assessment in regards to the methodology implemented and the results obtained, was suitable for the stated scope of the project.

DER assessors were selected and their sensitivity validated using n-butanol pens and following the St Croix Sensory procedures [2].

Assessors then performed odour field measurements while downwind of the identified potential odour sources and assessed whether emissions of those investigated sources were impacting the surroundings.

Five surveys were carried out early morning and two surveys early evening under various regimes of wind speed and directions. Survey dates, periods of the day, and average wind speeds and directions are presented in **Table 1**. Wind speed and wind

directions were recorded with a hand-held anemometer during the survey and represent current conditions at the times and locations of the survey.

Table 1: Dates and periods of odour surveys – average wind directions and speeds during the MOI

Survey #	Date	Period	Average wind speed range(m/s)	Average wind direction
1	7 April 2016	4.15am – 9.15am	0.5 – 2.5	ENE – ESE
2	15 April 2016	5.40am – 9.30am	1 - 2	SSE - ESE
3	10 May 2016	5am – 9.45am	0 - 2	NNE – E
4	19 May 2016	5am – 9.40am	0 – 1.5	ENE – ESE
5	27 May 2016	4.20am – 9.50am	0 – 1.5	NE - ESE
6	30 May 2016	4pm – 9.40pm	< 1	SSE - NE
7	2 June 2016	3.45pm – 10.10pm	0 – 1.5	E - ESE

As the purpose was to investigate if odours from a specific source can be recognised off-site, measurements were carried out at the level of recognition/no recognition of the odour from a specific source. Therefore, odour intensity was not recorded by the assessors. In addition, due to the low temperatures, both in the morning and evening surveys, five minute single measurements only were performed by assessors at each surveyed measurement point rather than the recommended ten minute single measurement.

Suitable forecast meteorological conditions (wind direction within the pre-defined sector, wind speed below 10 m/s (likely dilution of any odours) and no rain) were identified before each survey. All surveys were conducted with five to seven assessors.

Assessors were required to record their findings per measurement point. An example of a log-form is presented in **Figure A3** in **Appendix A**.

Assessors were located downwind of the various identified potential odour sources and performed odour surveys at various measurement points across allocated zones determined during the course of the survey.

4.0 Results and discussions

Results are presented in **Figures B1 to B8** of **Appendix B** with the Figure B1 legend showing the various graphical items used to represent the findings on the maps.

The purpose of the maps is to show the locations where the identified odour sources were recognised in order to investigate the odour impact extent of these source emissions.

A coloured dot indicates the detection of an odour attributed to an identified source during one or several single measurements of 5 minutes each. A white star indicates no odour or an odour other than those attributed to the identified potential sources was recognised during one or several single measurements of 5 minute each at the same measurement point. The majority of other odours recognised during those surveys were: exhaust fumes from passing vehicles, cooking food and chimney wood smoke from residences, vegetation, bush, cigarette smoke or asphalt from nearby roadworks.

Odours (if any) recognised for each identified potential source are discussed below.

Paganoni Lake & Black Swan Lake

Potential odours from both lakes were investigated during every survey except Survey #3.

No odour from Paganoni Lake was recognised (no orange dots on Figures B2 to B8).

Odours from Black Swan Lake were recognised by assessors during only a very small number of single measurements (pink dots on Figures B2, B3 and B6). When recognised, the odour was described as swamp, stagnant water and organic. Odours were recognised at a close distance from the lake (150m to 450m).

Serpentine River (section between Keralup and Goegrup Lake)

The wind regime present during the odour survey period enabled measurement points at Keralup and Stake Hill to be monitored during every survey.

Odours were recognised during a few single measurements only (blue dots on Figures B2 to B8). Odours were described as swampy, musty, peat, stagnant water and organic matter breakdown. Odours were recognised at fairly close distance from the river (50 to 800m). No odour from this source was recognised west of the Kwinana Freeway.

Goegrup Lake

Measurement points north and west of the lake were monitored during every survey.

Odours were recognised during a few single measurements only (green dots on Figures B2 to B8). Odours were described as stagnant water, rotting vegetation, damp, swampy, sewage, peat and decay or stale water. Odours were recognised at close distance from the lake (100 to 500m).

WWTP on Gordon Road

Measurement points north and west of the WWTP were monitored during every survey.

Odour from this source was recognised at one location only, this being at Corsican Place approximately 200m from the WWTP operations. Odours were described as sewage and dirty water.

Waste transfer station on Corsican Place

Measurement points west from the transfer station were monitored during every survey. Odour from this source was recognised at close measurement points mostly ranging from 50m – 800m. One measurement identified recognisable odour at 1,200m.

Odours were described as refuse, organic odour and garbage. Odours were all recognised during the five morning surveys and with no recognisable odours during the evening measurements.

Nambeelup Premises

Odours from this facility were recognised at various locations ranging from 1,200m to 8,500m from the operations.

Odours were described as putrid, compost, manure, organic, green waste, rotten, waste, silage, dung, soil lifter, rancid, fermented manure, pig, garbage and rubbish tip leachate.

Owing to the nature and distance at which this odour was recognised, further steps were undertaken for confirmation:

- Upwind patrol of the area east of Nambeelup Premises under easterly winds. The purpose was to assess whether there were other odour sources with similar odour types upwind the Nambeelup Premises. The patrolled area included Greyhound Retreat, Bush Retreat, Dirk Hartog Drive, Yangedi South Rd and Redheads Rd. No odour was recognised when patrolling these locations while odours were recognised downwind of the Nambeelup Premises that confirmed the likelihood of the Nambeelup Premises as the source of the odours.
- Odours from the Nambeelup Premises were recognised during the evening survey #7 by all assessors at various locations downwind of this source. At Gull Rd, west of the Nambeelup Premises, at the end of the survey, all assessors indicated they could recognise an odour similar to odours they had experienced earlier during the same evening or during previous surveys but stronger.

5.0 Limitations

The purpose of the project was to investigate whether odours from identified potential odour sources could be recognised in the field. The scope did not include recording of the number of times a specific odour was recognised during single measurements or survey days. Consequently, assessments of the frequency of odour recognition per odour type, per odour survey or per measurement point cannot be performed on the data. Similarly, the scope did not require recording of odour intensities recognised by assessors.

The April to June period of the year is not likely to be the period with the highest odour emissions from the natural sources such lakes and river. During the summer season, dried and potentially odorous lake floors or river banks were in contact with air and sun creating organic matter breakdown. In March, there were several episodes of rain. River levels rose during these episodes, flooding river and lake beds and banks; therefore decreasing the potential of odour emissions from these sources.

6.0 Summary

DER officers carried out seven odour field surveys between 7 April and 2 June 2016 in the Mandurah area. The Mandurah Odour Investigation (MOI) project was designed to confirm whether odour from seven sites identified as potential odour sources could be recognised in the Mandurah area. Of these sites, four were natural sites and five were

prescribed industrial premises.

A summary of the findings are outlined below:

- Odours from Black Swan and Goegrup Lakes and also sections of the Serpentine River were recognised on a few occasions, and at relatively close distances. Assessors described odours as swamp, stagnant water, organic, peat, musty, decay, stale water and damp.
- Odours from the WWTP on Gordon Road were recognised at one measurement point only, at approximately 200m from the plant.
- Odours from the waste transfer station on Corsican Place were recognised at distances generally between 50 and 800m. Odour was recognised at 1,200m during one single measurement. Odours were described as refuse, organic odour and garbage.
- Odours from the Nambeelup Premises were recognised at distances ranging from 1,200 and 8,500m and were described as putrid, compost, manure, organic, green waste, rotten, waste, silage, dung, soil lifter, rancid, fermented manure, pig, garbage and rubbish tip leachate. Verification actions undertaken were able to confirm that Nambeelup Premises was the origin of those odours and that no other odour source with similar types of odour was present upwind this site.

7.0 References

[1] VDI 3940 Part 2, 2006, Verein Deutscher Ingenieure - Measurement of odour impact by field inspection – Measurement of the impact frequency of recognizable odours

[2] Alice M. Lay, Charles M. McGinley, P.E., A Nasal Chemosensory Performance Test for Odor Inspectors, Water Environment Federation Odors and Air Emissions 2004 Bellevue, WA: 18-21 April 2004

8.0 Appendices

Appendix A: Identified potential sources, pre-located measurement points and odour log form

Figure A1: locations of the identified potential prescribed premises and natural odour sources

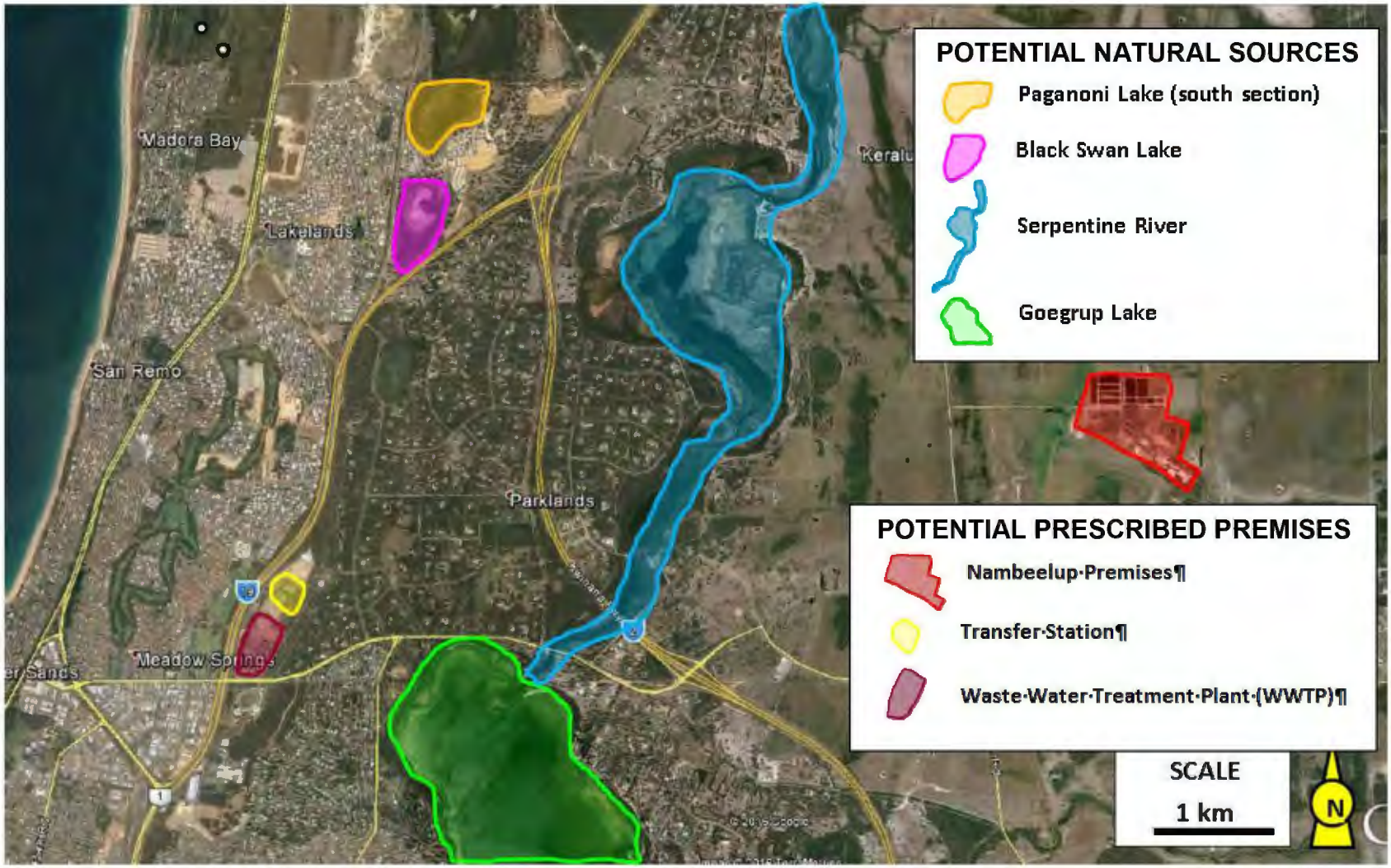


Figure A2: pre-located odour measurement points for the MOI

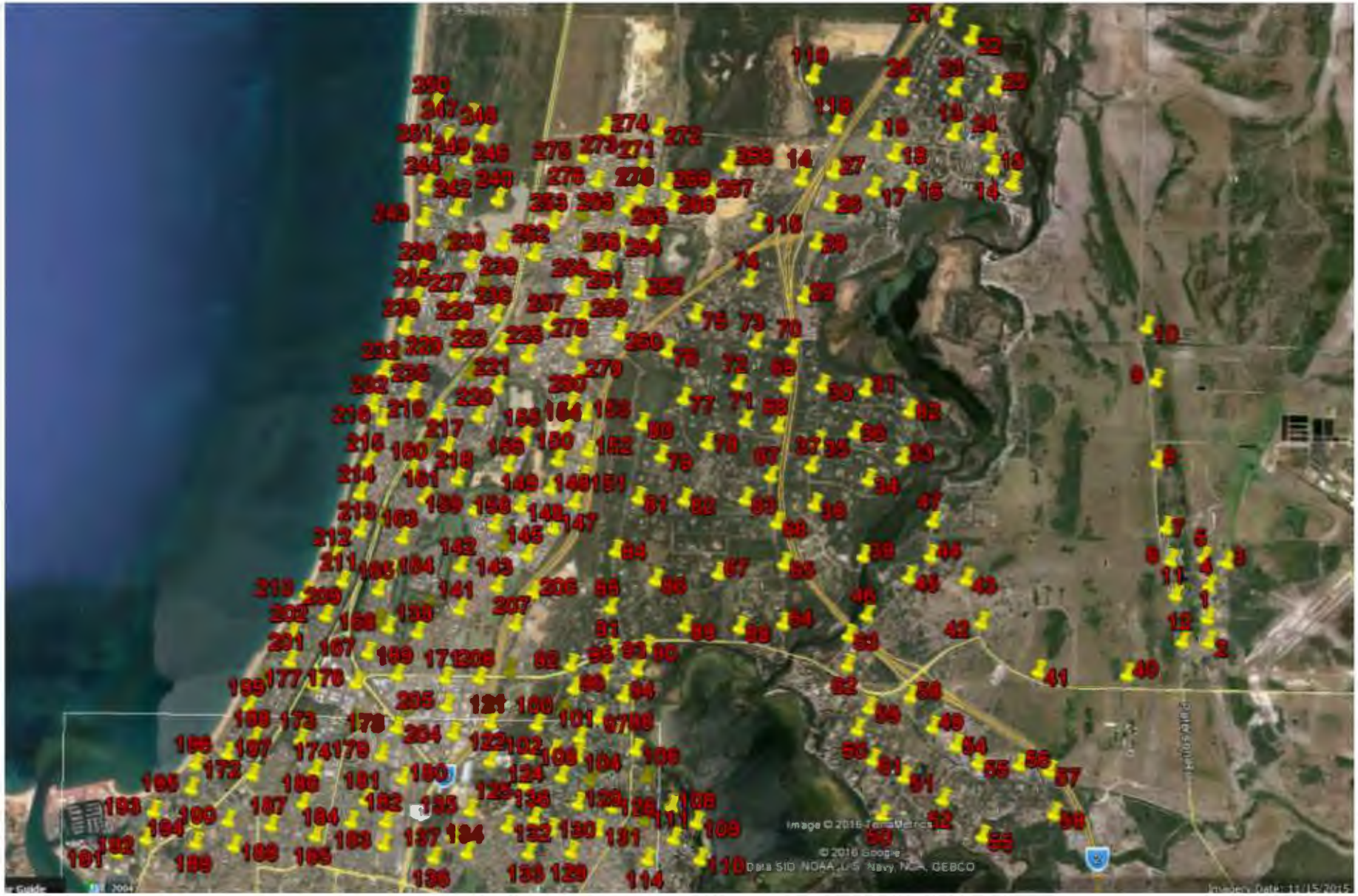


Figure A3: Odour log-form used by odour assessors during the MOI

Mandurah Odour Investigation Form OER / AQS

Assessor initial: ________ Date: ____/____/___

Location: ____

Comments

Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Location: ____

Comments

Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Location: ____

Comments

Wind Direction

Start time: ___h ___min

Min	00 s	10 s	20 s	30 s	40 s	50 s
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						

Appendix B: Results of the seven odour surveys carried out during the MOI

Figure B1: Legend of the odour survey findings

Figure B2: Findings of Survey #1 - 7 April 2016

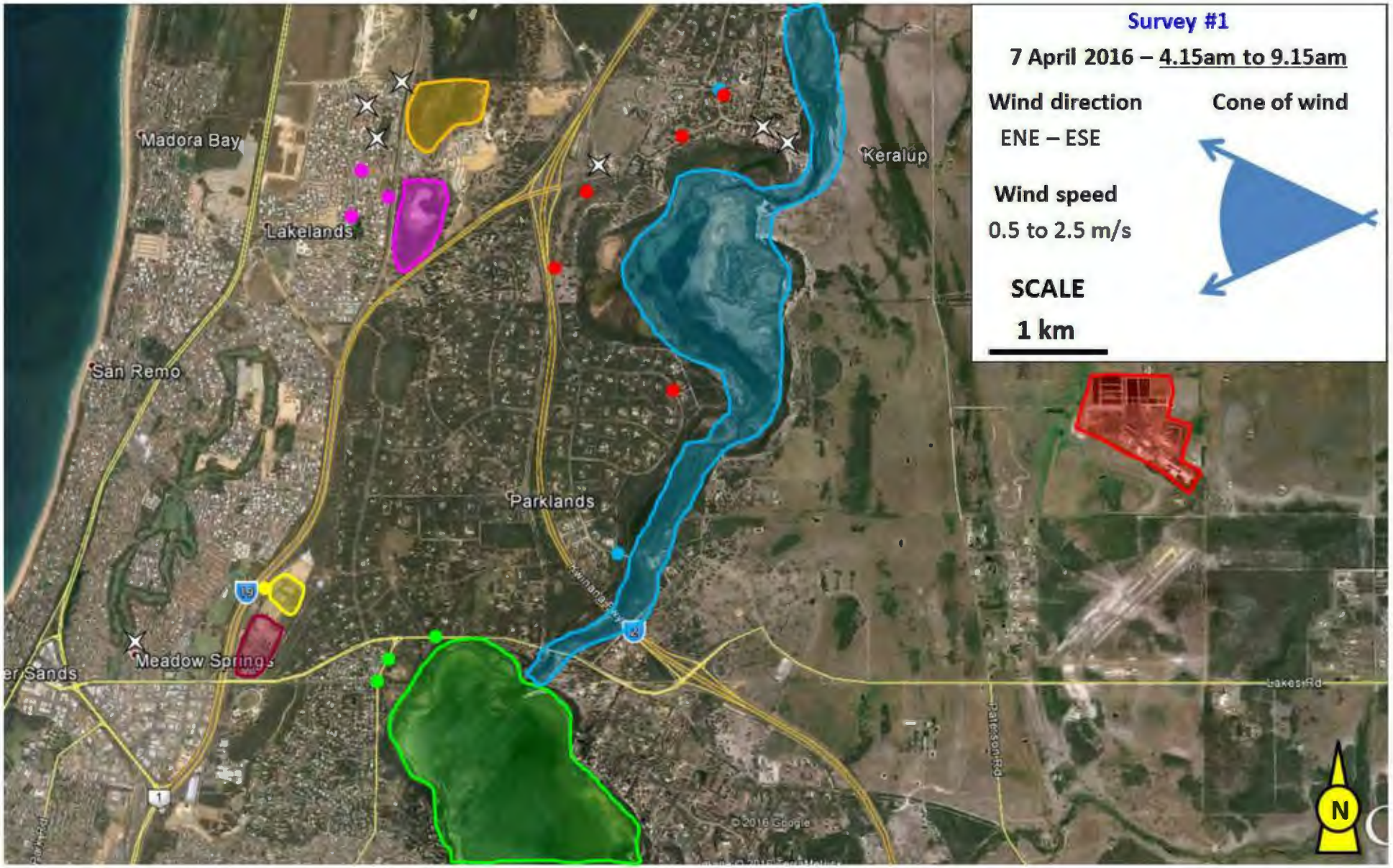


Figure B3: Findings of Survey #2 - 15 April 2016

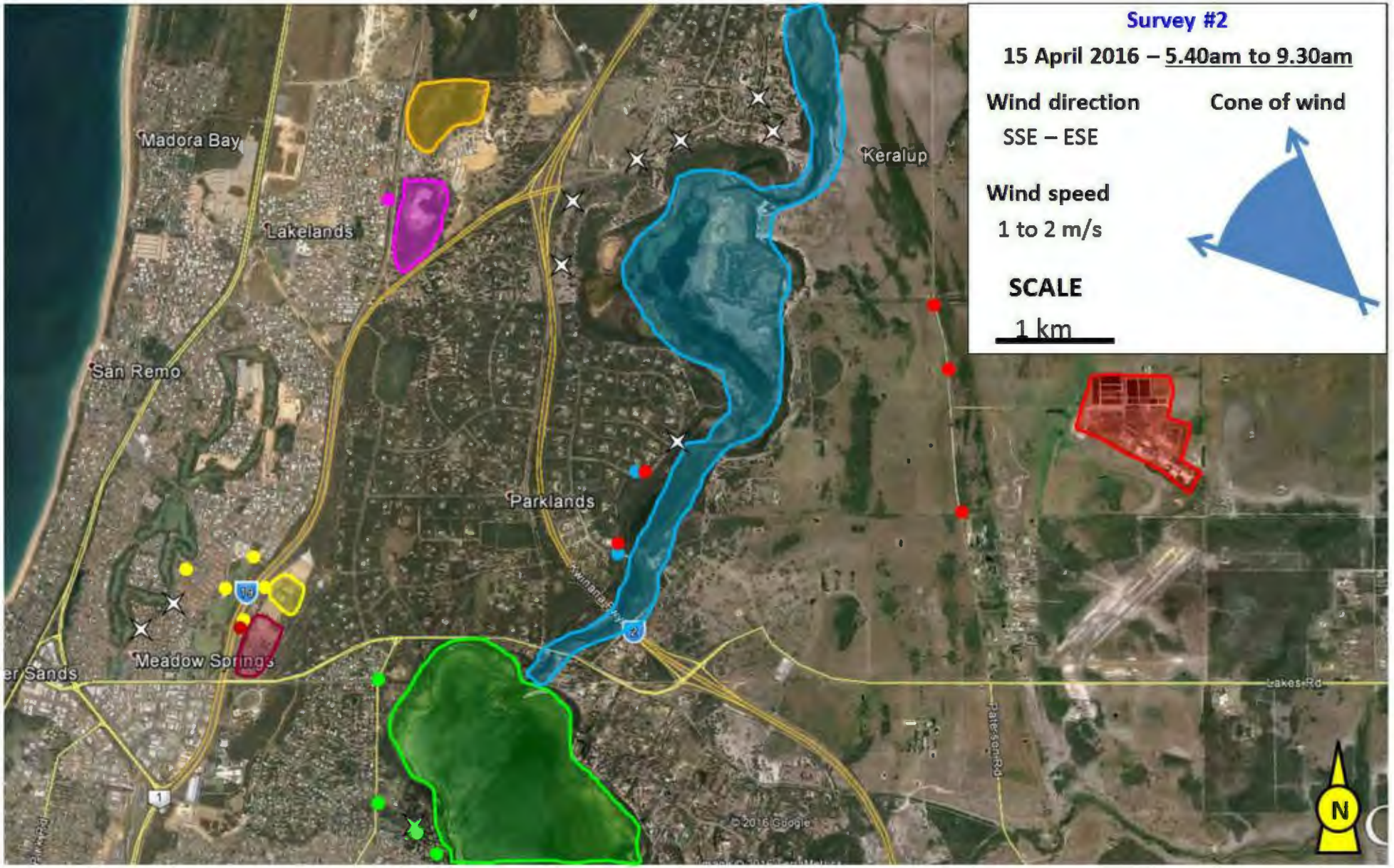


Figure B4: Findings of Survey #3 – 10 May 2016

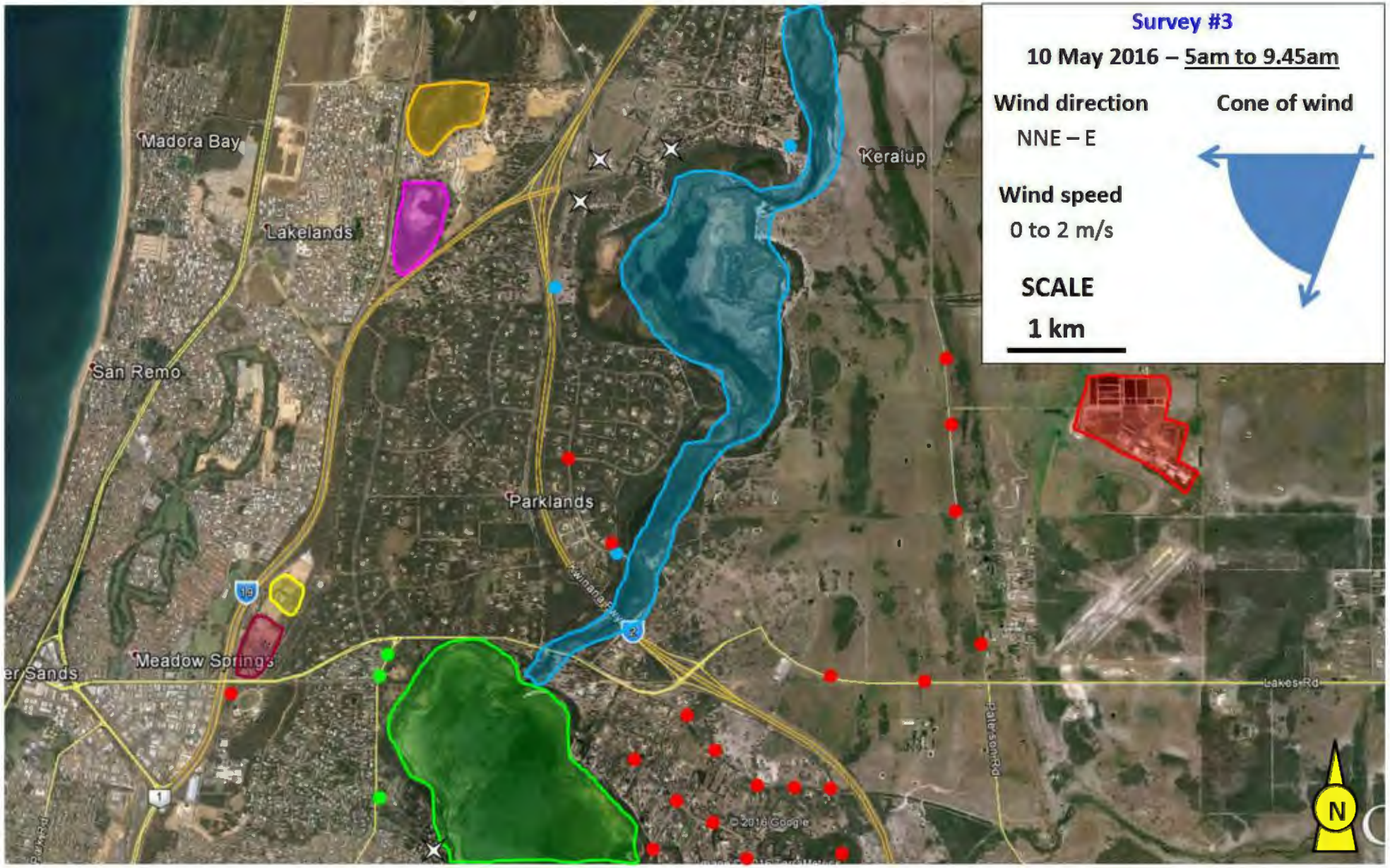


Figure B5: Findings of Survey #4 – 19 May 2016

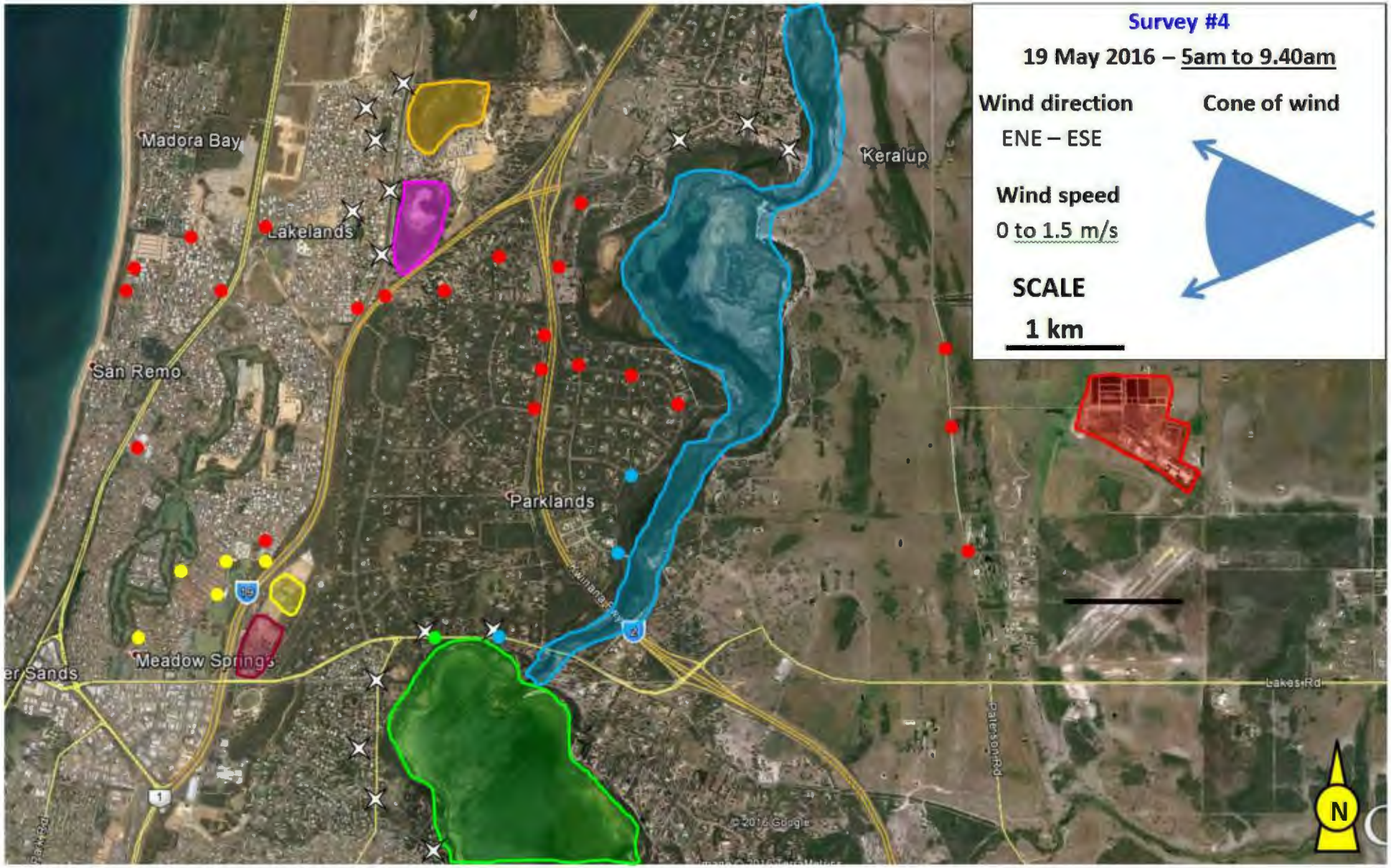


Figure B6: Findings of Survey #5 – 27 May 2016

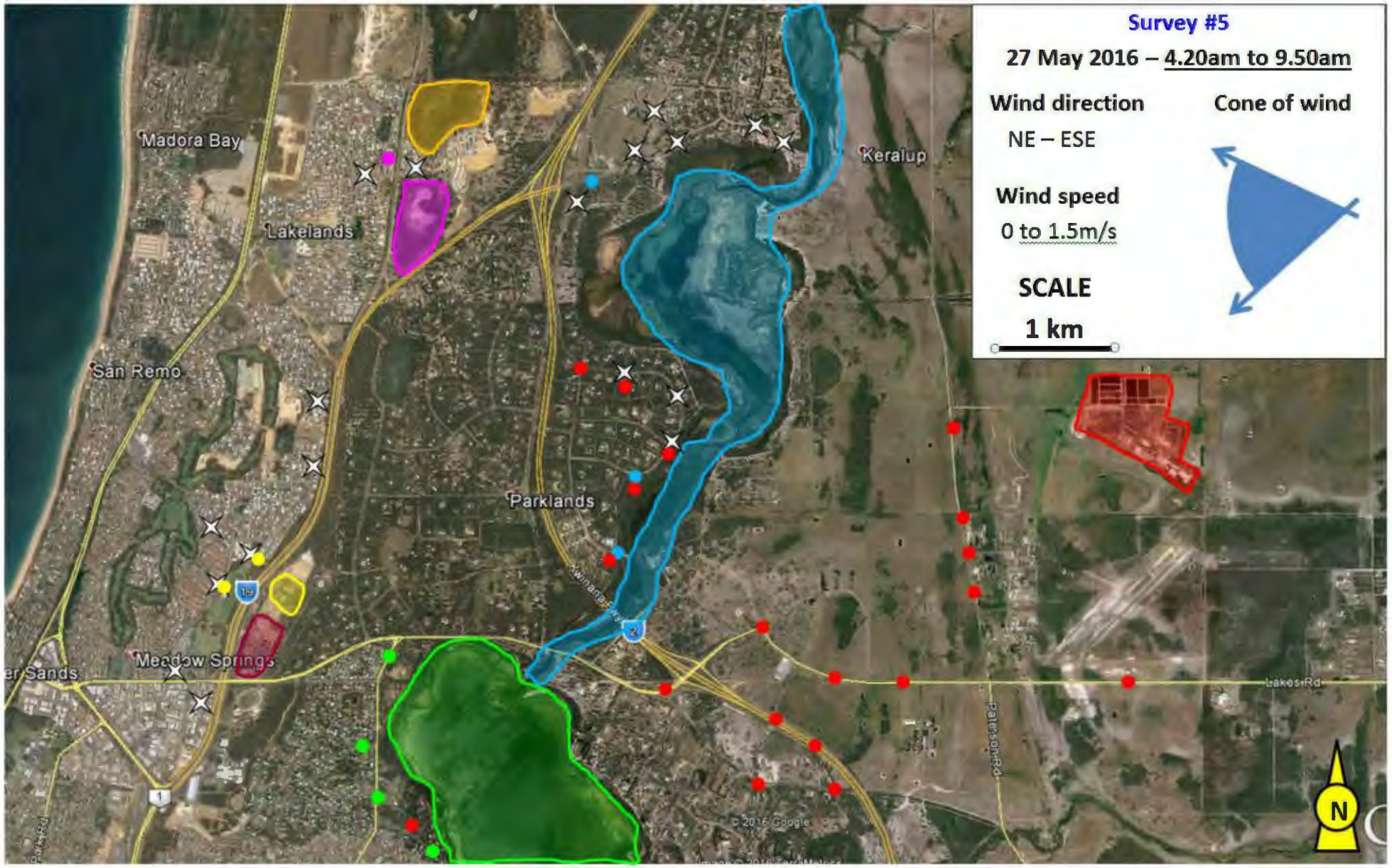


Figure B7: Findings of Survey #6 – 30 May 2016

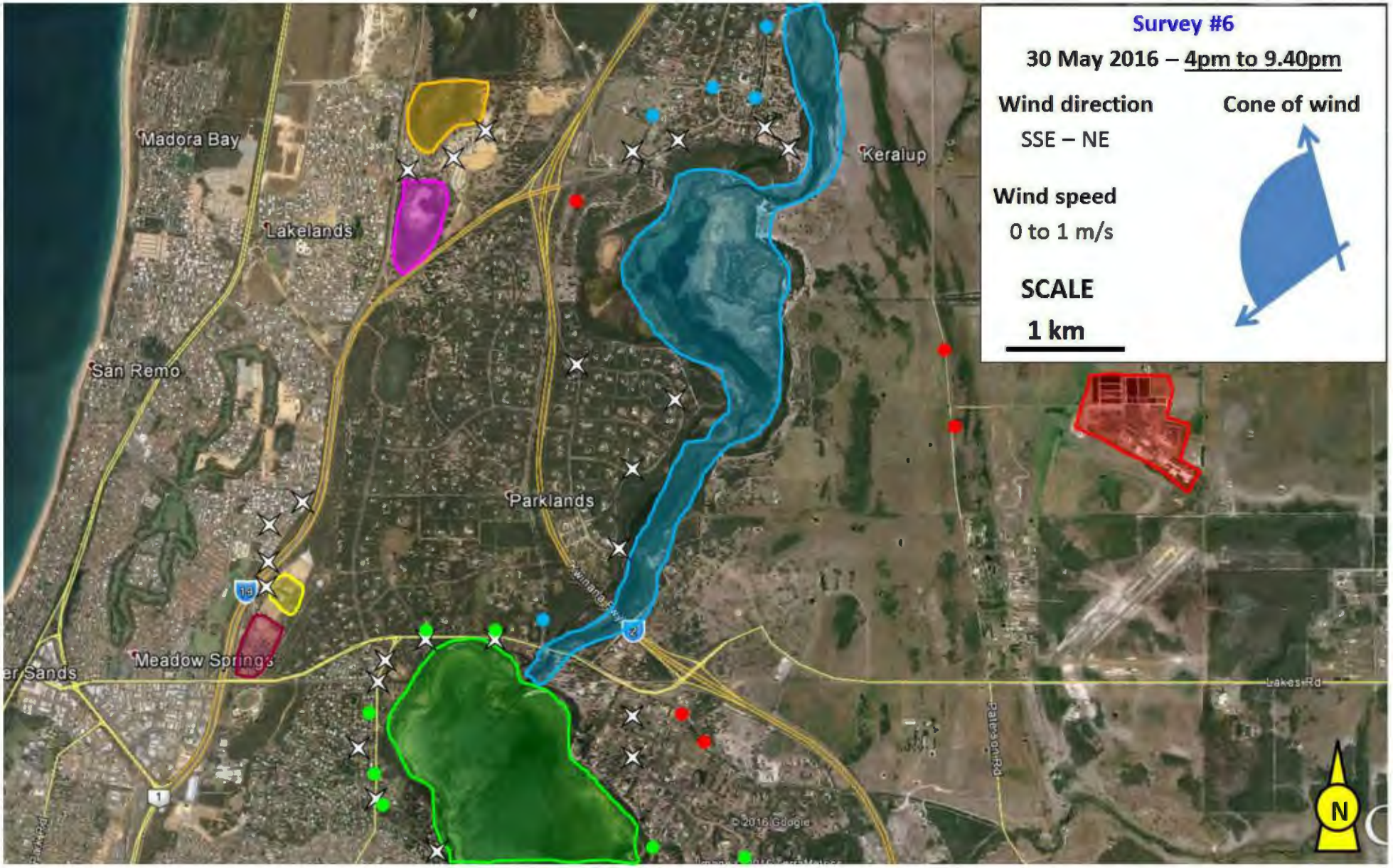
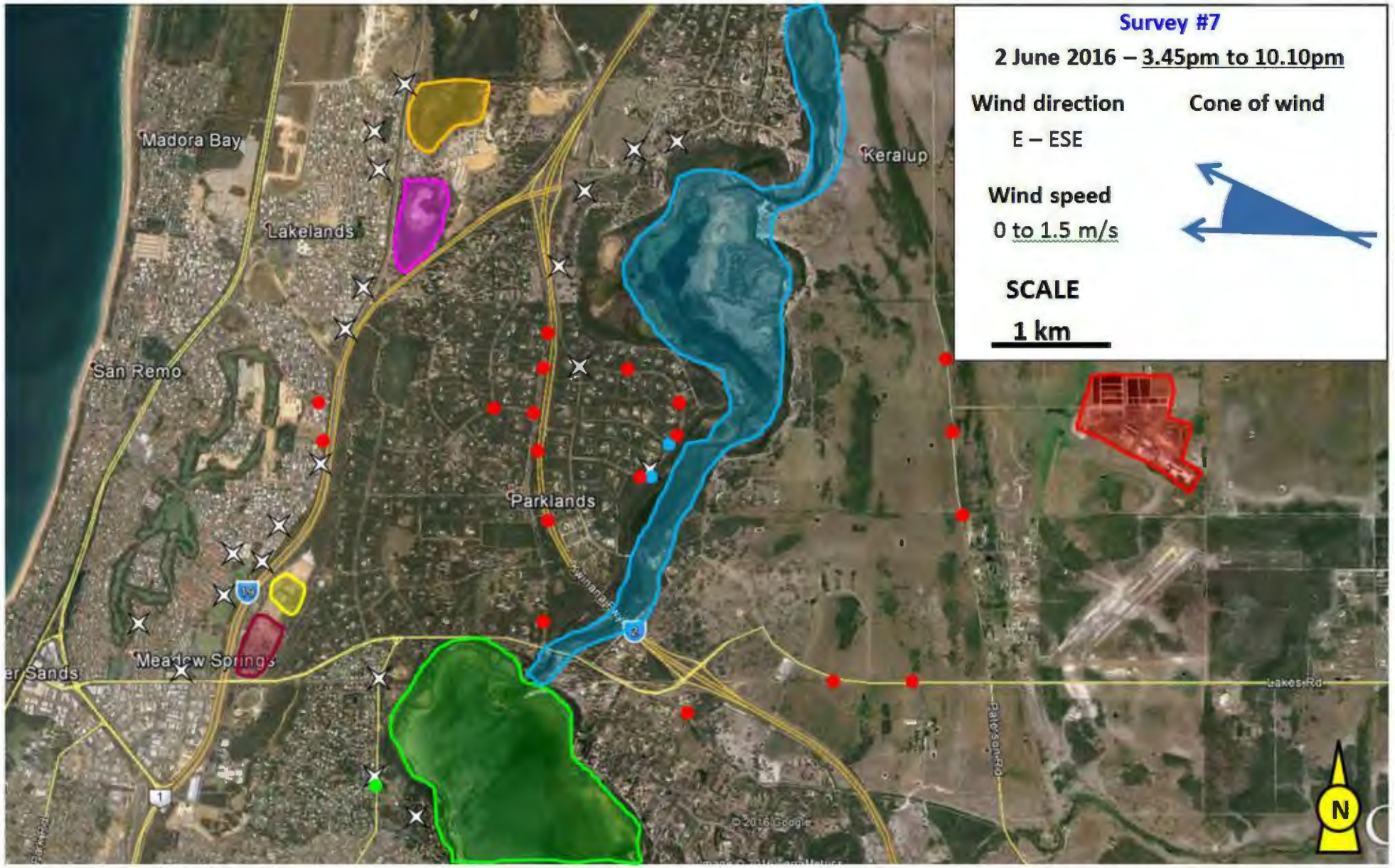


Figure B8: Findings of Survey #7 – 2 June 2016



Expert's details

Personal details: Reviewer

Name	K. David Griffiths
Employer	Department of Environment Regulation
Position title	Senior Air Quality Officer
Classification level	SC3
Recognised field of expertise	The reviewer has relevant training and expertise in odour impact assessment methodology and data analysis.

Qualifications and experience

The qualifications and experience and technical capability relevant to the provision of this advice is as follows:

Qualification

Qualification	Year obtained	Additional comments
Graduate Diploma in Computing Studies, U of Canberra	1990	
Bachelor of Science (Hons Physics), UWA	1982	

Professional experience

Employer	Position	Tenure
Department of Environment Regulation (DER) and predecessor agencies	Senior Air Quality Officer, and Environmental Officer, Air Quality Services	1995 - current
Department of Environmental Protection	Computing Scientist, Air Quality Management Branch	1992-1995

Other – Publications/memberships/associations etc

Peer reviewed papers

Air Quality

Griffiths, K.D., 2014. Disentangling the frequency and intensity dimensions of nuisance odour, and implications for jurisdictional odour impact criteria. Atmospheric Environment 90 125-132.

Griffiths, K. D., 2013. A risk-based procedure for broiler farm separation distance calculations. Proceedings of the 21st Clean Air & Environment Conference, Sydney, Australia.

Griffiths, K.D., 2009. Patterns in Odour Criterion Percentiles and Their Implications For Odour Regulation. Proceedings of the 19th International Clean Air and Environment Conference, Perth.

Forum and Conference Workshop presentations

Griffiths, K. D., 2013. Untangling the frequency and intensity dimensions of nuisance odour. *CASANZ Modelling Special Interest (ModSIG) Workshop, 21st Clean Air & Environment Conference, Sydney, Australia.*

Griffiths, D., 2012. A brief tour of Odour Regulation in WA. AQCC Air Quality Forum, Perth.

Griffiths, D., 2009. SRDM – A Statistics Reporting Dispersion Model written in the R language. Odour and Modelling Workshop, 19th International Clean Air and Environment Conference, Perth.

Griffiths, D., 2009. WA Odour Regulation – What Works and What Doesn't. Odour and Modelling Workshop, 19th International Clean Air and Environment Conference 2009, Perth.

Griffiths, D., 2007. An Efficient Method of Verifying S-Factor Formula Performance using Ausplume. Odour and Modelling Workshop, 18th International Clean Air and Environment Conference, Brisbane.

Professional Memberships:

Clean Air Society of Australia and New Zealand (CASANZ)

Signatures

Author Name Philippe Najean	Signature
Position Senior Air Quality Officer	Date 6/9/2016
Reviewer Name David Griffiths	Signature
Position Senior Air Quality Officer	Date 6/9/2016

Appendix 7: Technical Expert Report – Review of 'Investigation of Odour Emissions from Nambeelup Precinct Operations' and Nambeelup farm precinct water quality laboratory report

Government of Western Australia
Department of Environment Regulation

REPORT

PAPER

Technical Expert Report

Review of:

- *"Investigation of Odour Emissions from Nambeelup Precinct Operations"*
- *Nambeelup farm precinct water quality Laboratory Report*

Version: Final

November 2016

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Date	Name	Role
xx/xx/xx	David Griffiths: Senior Air Quality Officer Philippe Najean: Senior Air Quality Officer	Author
xx/xx/xx	Adrian Blockley: Principal Expert (Air Quality)	Reviewer

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Questions regarding this report should be directed to:
Department of Environment Regulation
Locked Bag 33 Cloisters Square
PERTH WA 6850
Phone: +61 8 6467 5000
Fax: +61 8 6467 5562
Email: info@der.wa.gov.au
Web: www.der.wa.gov.au

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Content

1. Purpose

This report documents a review by Air Quality Services (AQS) officers(the review) of the draft report *Investigation of Odour Emissions from Nambeelup Precinct Operations* (Environmental Alliances Pty Ltd, July 2016), prepared for C-Wise, Costa and Craig Mostyn Farms (the ENVALL report) and a C-Wise water quality Laboratory Report (the laboratory report) . This review was requested by A/ Executive Director Compliance and Enforcement on 2 September 2016 to inform the development of appropriate regulatory controls in the review of licences of each of the premises at the Nambeelup Farm precinct.

2. Documentation

In preparing this review, AQS has reviewed the following documents:

Table 2.1 Documentation

Document	Author	Date of document	Objective reference
Hard copy report: "Draft Investigation of Odour Emissions from Nambeelup Precinct Operations"	Environmental Alliances Pty Ltd (ENVALL)	July 2016	N/A – hard copy referral
Waste water quality Laboratory Report (ARL job number 16-03831 Revision 01) contained as attachment in hardcopy request for advice from A/ Executive Director Compliance and Enforcement.	Water quality report author: Analytical Reference Laboratory (ARL)	20 June 2016	N/A

3. Introduction

The Department of Environment Regulation (DER) has received intermittent odour complaints in the Mandurah area since 2014.

The three premises:

- Craig Mostyn Group piggery (hereinafter named as CM Farms)
- Costa Group – composting for mushroom growing substrate (hereinafter named as Costa)
- C-Wise WA Composts Pty Ltd (hereinafter named as C-Wise)

located at the Nambeelup Farm precinct (the Nambeelup precinct) were identified as likely contributors to odour impacts in the area following DER's Mandurah Odour Investigation Project 2016 .

The operators of these premises commissioned ENVALL to undertake a study to characterise odour emissions from the precinct. A primary focus of the study was to

delineate between the emissions of the three premises where possible using onsite measurements. A water quality laboratory report was also commissioned by C-Wise.

The resulting reports are the subject of this review by AQS officers. This review has been requested to support the licence review of the three Nambeelup precinct premises initiated by DER.

Particular advice was sought from AQS regarding:

- The findings of the commissioned odour survey.
- The potential for low oxidising reduction potential (ORP) or other characteristics of reused wastewater to contribute to odour emissions.

4. Summary of review findings

4.1. Investigation of odour emissions report

The key findings of this review of the ENVALL report are:

1. Estimates of the relative odour emission rate (OER) of the various sources were made by the ENVALL report. The largest sources, on an average emission rate basis, were identified as:
    a. the C-Wise quicken area receiving liquid waste and mortalities for processing,
    b. the Costa composting operation, and
    c. the Premium and Wandelup composting area of C-Wise (named "*PremMAF MAF Feed wet desp*" in the ENVALL report);
2. Due to the limited E-Nose sampling period, the possibility of other sources contributing significantly greater fractions of the total precinct odour emissions during particular times in operational cycles cannot be excluded. The influence of such emissions peaks and their relative contributions to overall impacts have not been captured in this study;
3. Large average total precinct emission rates were calculated in the report via two separate methods. Odour emission rates of the order of magnitude calculated in the report could potentially cause impacts at distances up to several kilometres from the precinct under some meteorological conditions.

4.2. Water Quality Laboratory Reports

4.2.1. Limitations and important note

The review of the submitted data does not assess whether the dams or ponds are working effectively for the task they have been designed for. The review of the data was performed with the purpose of evaluating the risk of production of odorous compounds according to the various parameters presented in the water quality laboratory reports. In this Technical Expert Report, the discussion about the level of the various parameters being low or high refers to their potential, on their own, or coupled with other parameters, to produce odorous compounds. As such, a low value of ORP refers to the risk of some odorous compounds production and not to a comparison with the targeted ORP set point designed for the pond. AQS experts have professional experience with odours produced by wastewater, but do not have formal

expertise in wastewater quality. This experience includes several cases involving odour emissions from ponds and dams and a review of key water quality parameters that can influence odour production. However, it is recommended that additional advice is sought from a wastewater expert on the laboratory report data.

There is limited information provided in the laboratory reports and the accompanying email about sampling locations and conditions, which may impact on the results and their interpretation. Interpretations provided in this document about the water quality parameters for the various dams of the Nambeelup precinct should be considered in light of the limited contextual information attached to the data. In addition, the presented data is only a snapshot of the water quality in the various dams; time series data, where temporal trends could be identified, would be more definitive.

4.2.2. Water Quality report review

A. C-Wise

In dams 21 and 22, the combined low levels of Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) represent a significant risk of odour emissions from those dams. This conclusion is supported by two additional pieces of information:

- The presence of sulfides and possible mercaptans measured in the air on the side of dam 22 by C-Wise (results provided by [redacted] C-Wise to DER by email on 2 June 2016 – see Appendix 1); and,
- The detection of strong odours (organic / manure / septic / sulphurous odours) while walking on the side and downwind of dams 21 and 22 during a site visit by AQS officer and author Philippe Najean on 27 May 2016.

In addition, the Biological Oxygen Demand (BOD) and Total Nitrogen levels are high in dam 22. The levels of Total Nitrogen and Ammonia are high in dam 21.

B. CM Farms

Based on the authors' understanding of the CM Farms dam network, it is assumed that "inflow" corresponds to dam 1 and "outflow" to dam 5 but this is not clear in the ENVALL report. Levels of ammonia and Total Nitrogen are significantly high in the outflow. Unfortunately, there were no measures of the ORP and DO in those dams.

During a site visit held on 27 May 2016, DER officers detected strong odours downwind of dams 2 and 5 of CM Farms. Release of biogas (large bubbling at the dam's surface) was also observed on this day from dam 2.

C. Mushroom Exchange (Costa)

Monitoring results of the leachate collection water pond from Costa show the potential for producing odour emissions. The pH for this type of pond would be expected to be alkaline; however, results show it is slightly acidic. The ORP value is very low (from an odour production point of view) and sulfide and fatty acid are likely to be produced at this level. All other parameters, i.e. Total Dissolved Solids (TDS), BOD, ammonia and total nitrogen are high

5. Detailed review findings

5.1. Odour emissions assessment

The odour emissions assessment documented in the ENVALL report comprised the following distinct components:

- an E-Nose concentration profiling combined with WindTrax back-calculation dispersion modelling to estimate relative and absolute odour emission rates of individual sources;
- dispersion modelling (CALPUFF) and a field survey to estimate the total facility emission rates;
- an estimation of piggery shed emissions from a literature review.

The main findings of the ENVALL report for the whole Nambeelup precinct are:

- the wastewater treatment ponds (Sub-total ponds in Table 8 of the ENVALL report) contribute 22.6% of the final total hourly average OER for the site while the material handling represents 74.3% (Sub-total Materials Handling in Table 8 of the ENVALL report). The piggery sheds only constitute a small percentage (3.1%) of total site emissions;
- The largest individual source was identified as the *Quicken MAF wet pond mort* (28.1 % of total average hourly emission rate). From DER site visits, this source is assumed to be the Quicken Area of composting of C-Wise receiving the Liquid Waste and animal and bird (poultry) mortalities for processing;
- Other large sources identified include the Costa composting operation (22.3%) and the Premium and Wandelup composting area (called "*PremMAF MAF Feed wet desp*" in the ENVALL report) (10%).

Key observations regarding the ENVALL report are:

a. DER officers visited the Nambeelup precinct prior to and during the Mandurah Odour Investigation Project in 2016. The C-Wise quicken area and Costa operations were identified as being among the largest odour sources in the precinct at the time of the visits.

b. During the visits, DER officers observed that the following dams were also the source of significant odour emissions:

    - Dam 2 and, to a lesser extent, dam 5 of CM Farms;
    - Dams 21 and 22 of C-Wise; and,
    - Leachate collection pond at the Costa facility

    The composting activities of C-Wise and Costa both reuse dam water. This water is reused in large quantities over wide surface areas. It results in odorous sources with large surface areas. The sizeable emissions from the quicken area source of C-Wise is also a likely consequence of the introduction of liquid waste within the composting process.

c. Due to the limited E-Nose sampling times, the possibility of other sources contributing significant fractions of the total precinct odour emissions during particular times in operational cycles cannot be excluded. Emissions peaks

during compost windrow aeration and compost stacking were discussed in Appendix 6 of the report. However, these emissions peaks, and their relative contributions to overall impacts, were not captured in the timeframe of this study;

d. Large uncertainties are expected with many of the calculations used in the report to estimate the total and relative OERs for the site. These uncertainties apply to E-Nose measurements, back calculation and modelling. The limitations are acknowledged in the report;

e. Notwithstanding these uncertainties, the reported site-wide odour emission rate estimates of 8.9 x 10^6 ou.m^3/s and 16.5 x 10^6 ou.m^3/s are very large. Odour emission rates of this order of magnitude could cause impacts at distances up to several kilometres from the precinct under some meteorological conditions;

Only limited detail was provided on the calculation methodology used to estimate total and relative site OERs. For this reason, detailed review of these calculations was unable to be undertaken.

5.2. Water quality data

5.2.1. C-Wise data

It is indicated that the reported data represent an average of the data provided to date. However, the period and number of sets of data are not indicated in the laboratory report.

Parameter	Dam 21	Dam 22
Dissolved Oxygen (mg/L)	0.56	0.56
pH	8.05	8.04
Total Dissolved Solids (ppt)	14,600	14588
ORP (mV)	-368	-369

C-Wise provided the following comments in regards to the table:

- Oxidation Reduction Potential (ORP): If the ORP value is below -380, daily monitoring is conducted. If the ORP has reached -450, a shock treatment using a combination of Sodium Percarbonate, Oceanic Bio Granular Shock and Oceanic Bio Tablet is implemented
- Dissolved Oxygen (DO): The dissolved oxygen should be at least 0.2 ppm. Below this value, the dam is considered to be "anoxic", further aeration / oxygenation shall be applied. Oxygen can be added mechanically (through pumping/recirculation) or chemically (through addition of Sodium Percarbonate).

Sulfides and methane production can potentially occur when ORP values are so low. However, the levels of DO indicate adequate oxygen within the waters to maintain aerobic conditions.

Anoxic conditions are generally reached for DO below 0.5mg/L although C-Wise claims that the DO value should be maintained above 0.2 ppm (equivalent to 0.2 mg/L). In addition, DO levels are very sensitive to temperature with a significant decrease of the DO when temperature only increases slightly. Therefore, it should also be noted that DO values can be lower than that recorded in the table above

during hotter periods of the year with warmer dam water. The water temperature is not reported.

The ORP is low. C-Wise indicates that -380mV is an internal target to trigger daily monitoring, i.e. where the company decides to closely and more frequently monitor this parameter. C-Wise also indicates that sulfides and methane may be produced at low ORP levels. ORP values for dam 21 and dam 22 are within the range where there is a risk of production of sulfides (H_2S), fatty acids and methane. Sulfides and fatty acids are two chemical families of odorous compounds, some of them with low odour detection threshold (ODT), for example mercaptans. Low ODT means that those compounds can be detected at very low concentrations in the air by human nose.

We do not concur with the view of C-Wise that the DO level is high enough to guarantee that aerobic conditions were maintained within the dams. From experience, those combined low DO and ORP values represent a significant risk of odour emissions from those dams which is corroborated by two additional pieces of information:

a. The presence of sulfides and possible mercaptans are confirmed by other data provided by [redacted] C-Wise, in an email sent to DER on 2 June 2016.

Compound / parameter formulation in Multirae	Compound / parameter name	Value
HCHO	Formaldehyde	0.1 - 0.2 ppm
ETO	Ethylene oxide	0.1 - 0.2 ppm
CO	Carbon monoxide	Nil ppm
[illegible]	[illegible]	Nil for all Dams other than Dam 24 which has been measured at 0.3 ppm (oily water)
NH3	Ammonia	0 - 1 ppm
H2S	Hydrogen Sulphide	Nil for all Dams other than Dam 22 which has been measured at 1 - 2 ppm

Those data have been measured using a portable gas detector on the side of C-Wise dams. Note the measurement of 1-2ppm of H_2S on the side of dam 22.

b. Following a site visit on 27 May 2016, DER officers indicated that: "*When walking downwind this dam (dam 21), I could smell a strong organic odour with a manure characteristic. This dam is possibly a source that I have experienced off-site. […] We then walked between dams 21 and 22. When we reached the SW (south-west) corner of dam 22, I experienced a strong organic / manure / septic / rancid and sulphurous odour from this dam. Dam 22 is a possible source that I may have smelt off-site according to the characteristic of the odour".*

Another table reproduced from the laboratory report showing water quality parameters is provided and attached below.

These data are a snapshot with limited information on the conditions and locations of sampling. The following comments are pertinent and raise concerns of the risk of some dams being odour sources:

- The BOD for dam 22 is very high and the ratio between the chemical and the biological demand in oxygen is close to 1 which indicates a large amount of organic material in the pond. This may be related to the high levels of total suspended solids in this dam.
- Total Nitrogen levels are high for both dams 21 and 22 and Ammonia is high in dam 21.

- Dams 23 and 24 receive additional waste that is not related to wastewater from the site.
- Dams 31 and 32 are the final treatment ponds and have lower values for most of the parameters than dams 21 and 22; it is not possible to comment further on those values.

Parameter	Dam 21	Dam 22	Dam 23	Dam 24	Dam 31	Dam 32	Organics outflow	Caralup outflow
Total Nitrogen (mg/L)	1100	1400	970	1400	830	390	2200	850
Ammonia (mg/L)	900	810	290	570	450	25	1600	350
Total Suspended Solids (mg/L)	250	750	130	590	630	880	310	630
BOD (mg/L)	3100	7600	8300	12000	1800	390	1900	880
COD (mg/L)	8700	19000	16000	21000	9130	7600	28000	21007
Ratio C:B	2.8	1.7	1.9	1.8	5.1	19.5	14.7	23.9

In conclusion, the values of the parameters provided by C-Wise, plus DER officers' observations of odour downwind from those dams as well as the additional ambient air monitoring, appear to indicate that dams 21 and 22 present a clear risk of emitting odorous pollutants from the water and are two significant and clearly identified sources of odour on the site.

5.2.2. CM Farms data

The table of parameters provided for CM farm is the following:

Parameter	Inflow to treatment system (mg/L)	Outflow from treatment system for reuse (mg/L)
Ammonia	1000	600
BOD	6300	540
Total Dissolved Solids	4340	5040
Total Nitrogen	1400	760
Total Phosphorus	280	34
Total Suspended Solids	9370	358

As indicated previously, it is assumed that "inflow" corresponds to dam 1 and "outflow" to dam 5 but there is no clear indication in the ENVALL report.

Some points regarding the risk of some dams being odour sources are:

- Surprisingly, the level of total dissolved solids is higher in the outflow than in the inflow;
- The levels of ammonia and total nitrogen are still significantly high in the outflow;
- It is unfortunate that no ORP or DO have been measured as they would have most likely confirmed the poor water treatment achieved at this pond

As discussed in the ENVALL report, dam 1 is full of solids and does not have any water treatment capacity. Raw water running on the surface of the compacted sludge underneath creates a large surface area odour source. It should be noted that dam 1 has been decommissioned since those tests. A new dam (called dam 0) is now receiving the untreated water from the piggery before being directed to dam 2. However, during the site visit on 27 May 2016, DER officers witnessed that dam 1 was not isolated form the network. Dam 1 was still receiving the leachates from the Premium and Wandelup composting area of C-Wise and dam 1 outlet was still feeding dam 2.

Strong odours have been experienced by DER officers on the side and downwind of dams 2 and 5 of CM Farms during a site visit on 27 May 2016. Based on the observations of large biogas releases on dam 2, it is likely that this dam is operating under anaerobic conditions, at least in some of its sections.

In conclusion, the water quality parameters associated with dam operational conditions and odour observations downwind of some CM Farm dams by DER officers show a limited treatment of this water. Therefore, the risk of these dams being significant sources of odour is high. In addition, this water is reused in large quantities on composting areas of C-Wise.

5.2.3. Mushroom Exchange (Costa) data

The table of parameters provided for CM farm is the following:

Parameter	Leachate Pond
pH	6.8
ORP (mV)	-286
Total Dissolved Solids (mg/L)	7,600
Total Nitrogen (mg/L)	1525
Ammonia (mg/L)	730
BOD (mg/L)	5550

The set of values presented in the above table raise concerns regarding odour emissions from the leachate pond and from the composting activities re-using large quantities of this water. The reasons are the following:

- It is recommended a slightly alkaline pH is maintained in leachate ponds; the table above indicates that the pH is slightly acidic. Maintaining an alkaline pH would limit the release of hydrogen sulfide (H_2S);
- The large negative value of ORP is also indicative of increased risks of production of sulfides, fatty acids and even methane;
- The level of Total Dissolved Solids is very high and may be related to the highly elevated level of BOD;
- Total levels of ammonia and nitrogen are very high; in particular they are higher than those from dams 21 and 22 (except for ammonia for dam 21);
- It is unfortunate that no DO levels and water temperature values were provided as they would have most likely confirmed the poor water treatment achieved at this pond.

In conclusion, the water quality from this leachate pond appears to be very poor and the reuse of this water on various operations of Costa activities is likely to result in significant levels of odour emissions. In addition, during site visits on 9 March and 27 May 2016, DER officers observed some large surface areas of running water on the concrete pad of Costa, creating a very significant odour source.

6. Limitations

Please note the following important information relevant to the AQS review:

- Reported data are generally accepted as supplied. AQS does not attempt to verify emission rate data adopted for the modelling assessment, including parameters used in the estimation of emission rates such as measured emission concentrations;
- Pollutants of concern considered by the consultant are odorous compounds. There may be other pollutants emitted at trace levels or other atmospheric processes (e.g. particles associated with organic compounds, semi-volatile species, transient species, complex mixtures, etc.) that may contribute to cumulative concentrations and impacts in the regional airshed. AQS has no reason to believe that such emissions constitute a significant public health risk, but caution that there are few data available to make an assessment at this time;

7. Appendices

7.1. Appendix 1: Email [redacted]

From: [redacted]@cwise.com.au]
Sent: Thursday, 2 June 2016 4:36 PM
To: [redacted]
Subject: Information about personal gas monitors

Hello [redacted]

As requested when you visited our site on Friday 27 May 2016, attached is a photograph of the MultiRae Pro personal gas monitor that our technical staff wear when they are working around the dams. Below is a list of the parameters and typical data that they measure for each parameter when they are near the dams.

If you have any queries, please contact me.

Regards

[redacted]

Compound / parameter formulation on Multirae	Compound / parameter name	Values
HCHO	Formaldehyde	0.1 - 0.2 ppm
ETO	Ethylene oxide	0.1 - 0.2 ppm
CO	Carbon monoxide	Nil ppm
LEL	Lower Explosive Limit	Nil for all Dams other than Dam 24 which has been measured at 0.5% (oily water)
NH3	Ammonia	0 - 1 ppm
H2S	Hydrogen Sulphide	Nil for all Dams other than Dam 22, which has been measured at 1 - 2 ppm.

Figure A1: Photograph attached to email.

Signatures

Author Name David Griffiths	Signature David Griffith.
Position Senior Air Quality Officer Air Quality Services (Studies)	Date 18/11/2016
Author Name Philippe Najean	Signature Ph.
Position Senior Air Quality Officer Air Quality Services (Studies)	Date 18/11/2016
Reviewer Name Adrian Blockley	Signature
Position Air Quality Principal Expert	Date 18/11/2016

Attachment 1: Premises Boundary

The Premises consists of Lot 89 on Plan 741, Certificate of Title Volume 1112 Folio 243 and Lot 109 on Plan 741, Certificate of Title Volume 1113 Folio 439 excluding the following areas:

WA Composts Pty Ltd Premises

	Easting	Northing
1	390650.75	6405416.86
2	391242.67	6405417.29
3	391256.53	6404609.03
4	391076.85	6404601.07
5	391056.00	6404490.79
6	390950.76	6404499.65
7	390922.98	6404403.30
8	390837.97	6404422.38
9	390800.65	6404423.97
10	390780.95	6404363.73
11	390721.84	6404341.07
12	390619.38	6404405.99
13	390404.03	6404403.64
14	390327.20	6404450.82
15	390346.82	6404517.07
16	390614.70	6404524.00
17	390602.54	6405172.20
18	390557.59	6405249.75

MushroomExchange Pty Ltd Premises

	Easting	Northing
1	390978.80	6404489.63
2	390953.40	6404377.67
3	390980.97	6404369.87
4	390979.68	6404362.15
5	390895.00	6404377.44
6	390872.11	6404365.44
7	390905.79	6404300.95
8	391082.22	6404252.00
9	391122.85	6404464.50