Veolia Australia & New Zealand

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #7

July 2019

Final Report

THE ODOUR UNIT PTY LTD

ABN 53 091 165 061
ACN 091 165 061

Level 3, Suite 12
56 Church Avenue
MASCOT NSW 2020

E: info@oodurunit.com.au
W: www.odourunit.com.au

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Report Prepared By: M. Assal & S. Hayes	**Approved By**: T.Schulz	
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CONTENTS

LIST OF FIGURES, PHOTOS & TABLES

FIGURES

PHOTOS

TABLES

APPENDICES

LIST OF ABBREVIATIONS & UNITS

AS/NZS 4323.3	Australian/New Zealand Standard 4323.3: 2001: *Determination of odour concentration by dynamic olfactometry*
AS/NZS 4323.4	Australian/New Zealand Standard 4323.4:2009. *Stationary source emissions - Area source sampling - Flux chamber technique.*
ATF	Alterative Treatment Facility
BOM	Bureau of Meteorology
BWMS	Bioreactor Waste Management System
C & D	construction & demolition
CH_4	methane
CO_2	carbon dioxide
DEM-S	Derived Smoothed Digital Elevation Model
DPE	Department of Planning & Environment
DPI	Department of Planning & Infrastructure
EA 2010	Environmental Assessment Woodlawn Expansion Report (August 2010)
ED1	Evaporation Dam 1
ED3N	Evaporation Dam 3 North
ED3S	Evaporation Dam 3 South
EPL	Environment Protection License
$Fe_2(SO_4)_3$	ferric sulphate
GIS	Geographic Information System
H_2S	hydrogen sulphide
H_2SO_4	sulphuric acid
ha	hectare

HRT	hydraulic retention time
IAC	impact assessment criterion
IFH	Isolation Flux Hood
IMF	Crisps Creek Intermodal Facility
IOA	Independent Odour Audit (2018)
Jerome Analyser	Jerome ® 631-X H_2S Analyser
km	kilometres
KOPs	knock-out pots
kW	kilowatts
L	litres
L/day	litres per day
L/min	litres per minute
L/s	litres per second
LMS	Leachate Management System
LOM	Liquid Odour Method
LTD	Leachate Treatment Dam
LTP	Leachate Treatment Plant
m	metres
m/s	metres per second
m^2	square metres
m^3	cubic metres
MBR	Membrane Bioreactor
mm	millimetres
MSW	municipal solid waste

MW	megawatts
N_2	nitrogen gas
NATA	National Association of Testing Authorities
NO_x	nitrogen oxides
NSW EPA	New South Wales Environment Protection Authority
OER	odour emission rate
ou	odour concentration
$ou.m^3/m^2/s$	specific odour emission rate
$ou.m^3/s$	odour emission rate
ppm	parts per million, by volume
PTFE	polytetrafluoroethylene
QA	quality assurance
RH	relative humidity
RL	reduced level
SCADA	supervisory control and data acquisition
SO_3	sulphur trioxide
SOER	specific odour emission rate
Solid Waste Guidelines 2016	NSW EPA Environmental Guidelines: Solid Waste Landfills (2016)
SRTM	Shuttle Radar Topography Mission
the 2018 Emissions Testing Report	Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: October 2018
the Audit	2018 Independent Odour Audit
the Biofilter Trial Report	Report for the biofiltration trial at Woodlawn Bioreactor dated March 2017

the ED3S May 2016 Report	*Woodlawn Bioreactor Facility Odour Modelling Study - Proposed Addition of ED3S to Leachate Management System* dated May 2016 Report
the Previous Model	The original EA 2010 odour dispersion modelling study used in the *Odour and Dust Impact Assessment (Rev 5)* Report dated 2 August 2010
the Site	Woodlawn Bioreactor Facility, Collector Road, Tarago, NSW
TOU	The Odour Unit Pty Ltd
tpa	tonnes per annum
TWL	Top Water Level
US EPA	United States Environment Protection Agency
USGS	United States Geological Survey
VENM	Virgin Excavated Natural Material
Veolia	Veolia Australia & New Zealand
WALTER	Woodlawn Aerated Leachate Treated Effluent Refiner
WIP 2019	Woodlawn Infrastructure Plan – Phase: June 2019

1 INTRODUCTION

In January 2018, Veolia Australia & New Zealand (**Veolia**) engaged The Odour Unit Pty Ltd (**TOU**) to carry out the seventh Independent Odour Audit (**the Audit**) of the Woodlawn Bioreactor Facility located at Collector Road, Tarago, NSW (**the Site**).

The specific scope of works for the Audit is detailed in *Condition 7* of *Schedule 4* in the *Specific Environmental Conditions - Landfill site* and enforced by *Section 75J* of the *Environmental Planning and Assessment Act 1979* as part of the project approval for the Woodlawn Waste Expansion Project.

1.1 WOODLAWN WASTE EXPANSION PROJECT BACKGROUND

In March 2010, Veolia issued an application to the Department of Planning & Infrastructure (**DPI**) seeking approval to increase the maximum throughput rate of the Woodlawn Bioreactor from 500,000 to 1.13 million tonnes per annum (**tpa**). Simultaneously, Veolia was also seeking to increase the maximum throughput rate of the nearby Crisps Creek Intermodal Facility (**IMF**) to 1.18 million tpa. In addition to these items, the proposal application entailed:

- Installing additional lighting at the Site;
- Extending the approved hours of operation at the Bioreactor and the IMF;
- Increasing the number of truck movements transporting waste to the Bioreactor from the IMF; and
- Increasing the amount of waste transported to the Site by road from regional councils from 50,000 to 130,000 tpa.

Veolia received approval for the Woodlawn Waste Expansion Project on 16 March 2012.

1.2 OBJECTIVES

In accordance with the project approval requirements of *Condition 7* of *Schedule 4* in the *Specific Environmental Conditions - Landfill sites* (DA 10_0012), Veolia is required to carry out an independent odour audit three months from the date of project approval and annually thereafter, unless otherwise agreed by the Director-General. The Audit must:

a. Consult with OEH and the Department;

b. Audit the effectiveness of the odour controls on-site in regard to protecting receivers against offensive odour;

c. *Review the proponents' production data (that are relevant to the odour Audit) and complaint records;*

d. *Review the relevant odour sections of the Air Quality and Greenhouse Gas Management Plan for the project and assess the effectiveness of odour control;*

e. *Measure all key odour sources on-site including:*

   i. *consideration of wet weather conditions providing all raw data used in this analysis;*

   ii. *consideration of (but not limited to) all liquid storage area, active tipping faces, waste cover area, aged waste areas and recirculation of leachate onto waste in the Void;*

   iii. *a comparison of the results of these measurements against the predictions in the EA*

f. *Determine whether the project is complying with the requirements in this approval to protect receivers against offensive odour;*

g. *Outline all reasonable and feasible measures (including cost/benefit analysis, if required) that may be required to improve odour control at the site and; and*

h. *Recommend and prioritise (mandatory and non-mandatory) recommendations for their implementations.*

This is the seventh Independent Odour Audit (**IOA**) commissioned since the Woodlawn Waste Expansion project approval was granted.

1.3 COMPLIANCE WITH AUDIT OBJECTIVES

The Audit consists of the following key items, as required by the project approval:

- **Fieldwork***:* collection of odour samples from key sources (as per *Condition 7 (e)),* recording of relevant field observations and measurements and discussions with Veolia Woodlawn staff regarding the operations of the Bioreactor and IMF. The odour emissions inventory developed in the previous IOAs was used by the audit team as a basis for the sampling program in the Audit;

- **Reviewing***:* a comprehensive review of all new relevant assessments undertaken and documentation since the 2017 IOA. In the Audit, this included a review of:

  - Landfill gas capture and trend since the previous audit;
  - The progress of the long-term leachate management solution via the construction and commissioning of a Leachate Treatment Plant (**LTP**);
  - Leachate quality data;
  - Record of received waste tonnage per month;
  - Odour complaints register and responses by Veolia;
  - Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: October 2018 (**the 2018 Emissions Testing Report**); and
  - Waste Infrastructure Plan –June 2019 (**WIP 2019**).

- **Modelling**: the undertaking of an update and re-run of the site-specific odour dispersion model study used as part of the project approval process; and
- **Reporting***:* a comprehensive summary of all aspects of the Audit, complying with the Audit objectives specified in **Section 1.2**.

The WIP 2019 is a commercial-in-confidence document which is supplied to TOU under privilege to assist with the thorough undertaking of the Audit. All relevant information relevant is extracted and reproduced as required in the Audit report.

1.3.1 Consultation with OEH and the Department

As required in *Condition 7 (A)* of the project approval, TOU engaged in consultation with both the New South Wales Environment Protection Authority (**NSW EPA**) and Department of Planning and Environment (**DPE**) on 8 February 2019 via email correspondence. A copy of the letter issued to the NSW EPA & DPE and responses are appended as **Appendix A**.

1.3.2 Additional Work to Audit requirements

In addition to the approval requirements, the following work components were included in the Audit:

- A comprehensive and detailed discussion regarding the current activities undertaken at the IMF; and
- Odour analysis of collected liquid samples (see **Section 4.2**).

The following report summarises the Audit carried out by the auditors at the Site.

2 THE SITE

2.1 WOODLAWN BIOREACTOR FACILITY BACKGROUND

The Site is located 250 km south of Sydney, within the 6,000 hectares (**ha**) Woodlawn Eco-Precinct, in the Southern Tablelands near Goulburn in New South Wales. An aerial view of the Site, highlighting the key areas as they currently stand, is shown in **Figure 2.1**.

Prior to waste operations, Woodlawn operated as a base metals open-cut mine site during the 1970s and 1990s, processing copper, lead and zinc. Since September 2004, the mine void has been operated as an in-situ Bioreactor, historically receiving putrescible waste solely from the Sydney metropolitan area via the Clyde Transfer Terminal Facility. Since early 2012, receival of waste from local regional areas had commenced.

Waste received and contained within the Bioreactor undergoes anaerobic decomposition resulting in the production of landfill gas. The landfill gas, predominately rich in methane (**CH_4**) and carbon dioxide (**CO_2**), is continuously extracted from the Bioreactor and directly consumed via purpose-built landfill gas-fired engines that form the Site's power plant. Each landfill gas-fired engine can generate up to 1.065 Megawatts (**MW**) of 'green' electricity. All electricity generated is exported to the main grid. The Bioreactor process is described in further detail in **Section 2.2**.

Aside from generating electricity from waste at the Site, Veolia is also undertaking mine rehabilitation works and has established an innovative wind farm, aquaculture and horticulture projects within the Eco-Precinct. As of July 2017, Veolia has also commenced operation of its long-term leachate management solution via the commissioning and optimisation of the LTP at the Site, which falls under a separate development consent and environment protection licence (**EPL**), but at the time of the Audit was in the process-proving stage. The existing treatment plant is still operating at capacity. This feature of the Site is not relevant to the Audit and thus is excluded from a detailed review. However, the Audit has provided commentary on the implication of the LTP in the context of leachate management and odour emissions (see **Section 2.4.6** & **Section 7.2.1.1**).

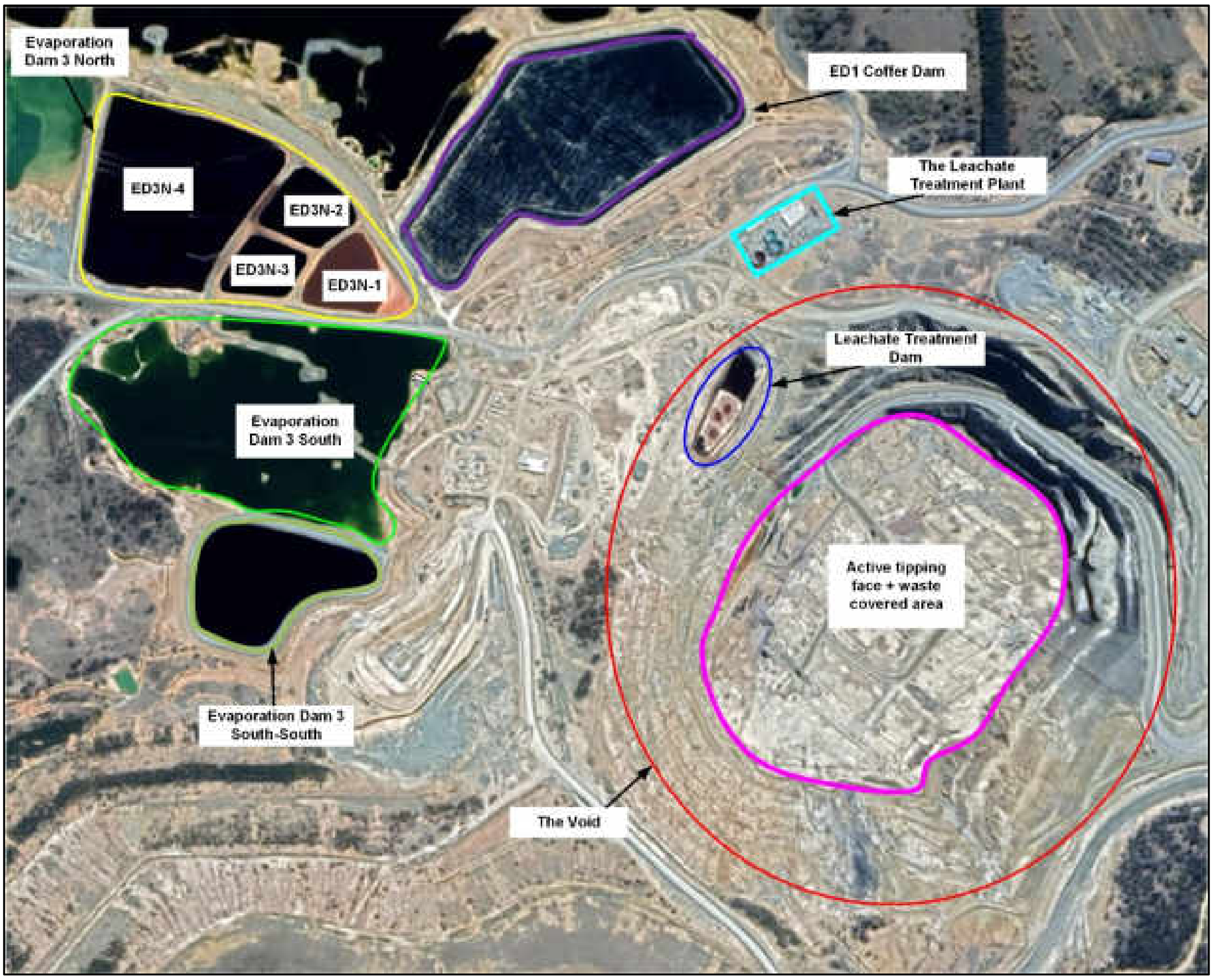


Figure 2.1 – An aerial view illustrating the layout of the Site as of the Audit (**Map source:** Google Earth ®)

2.2 PROCESS OVERVIEW

The Site has the approval to operate between 0600hrs to 2200hrs on Mondays to Saturdays, with no activities on Sundays, Good Friday or Christmas Day. For the Audit, the operational processes at the Site have been categorised under two primary management systems, namely:

1. The Bioreactor Waste Management System (**BWMS**); and

2. The Leachate Management System (**LMS**).

The above management systems are described in concise detail in **Section 2.3** & **Section 2.4,** respectively. Further details regarding these systems are contained in the *Environmental Assessment Woodlawn Expansion Report* dated August 2010 (**EA 2010**).

2.3 BIOREACTOR WASTE MANAGEMENT SYSTEM

At first glance, the Bioreactor surface layout appears to be a simple landfilling operation, consisting of the following:

- An active tipping face;
- Waste covered areas, including daily cover and intermediate cover;
- A mobile tipping platform;
- A leachate recirculation system, which is currently very limited in use as documented in the WIP 2019 (see **Section 2.3.2**); and
- A gas extraction system.

On closer inspection, however, there are complex procedures for the effective operation of the Bioreactor. A consequence of these procedures is a constantly evolving and dynamic site layout that varies temporally and operationally. The key operations of the Bioreactor comprise of, but are not limited to:

- the requirement of covering areas of waste;
- the timing and necessary provisions for a given waste lift;
- the landfill gas collection system, including:
    - the strategic placement and maintenance of the vertical landfill gas extraction wells gridded system;
    - landfill gas collection pipe network;
    - condensate management and the leachate removal system; and
    - individual gas wells in the waste to manage high-risk areas prone to the release of fugitive landfill gas emissions from the surface of the Void;
- setup of the leachate extraction and recirculation system; and
- stormwater management in the Void, including catchment management and stormwater captured within the Void perimeter.

The Void layout and operations prevalent at the time of the Audit are shown in **Figure 2.2**.

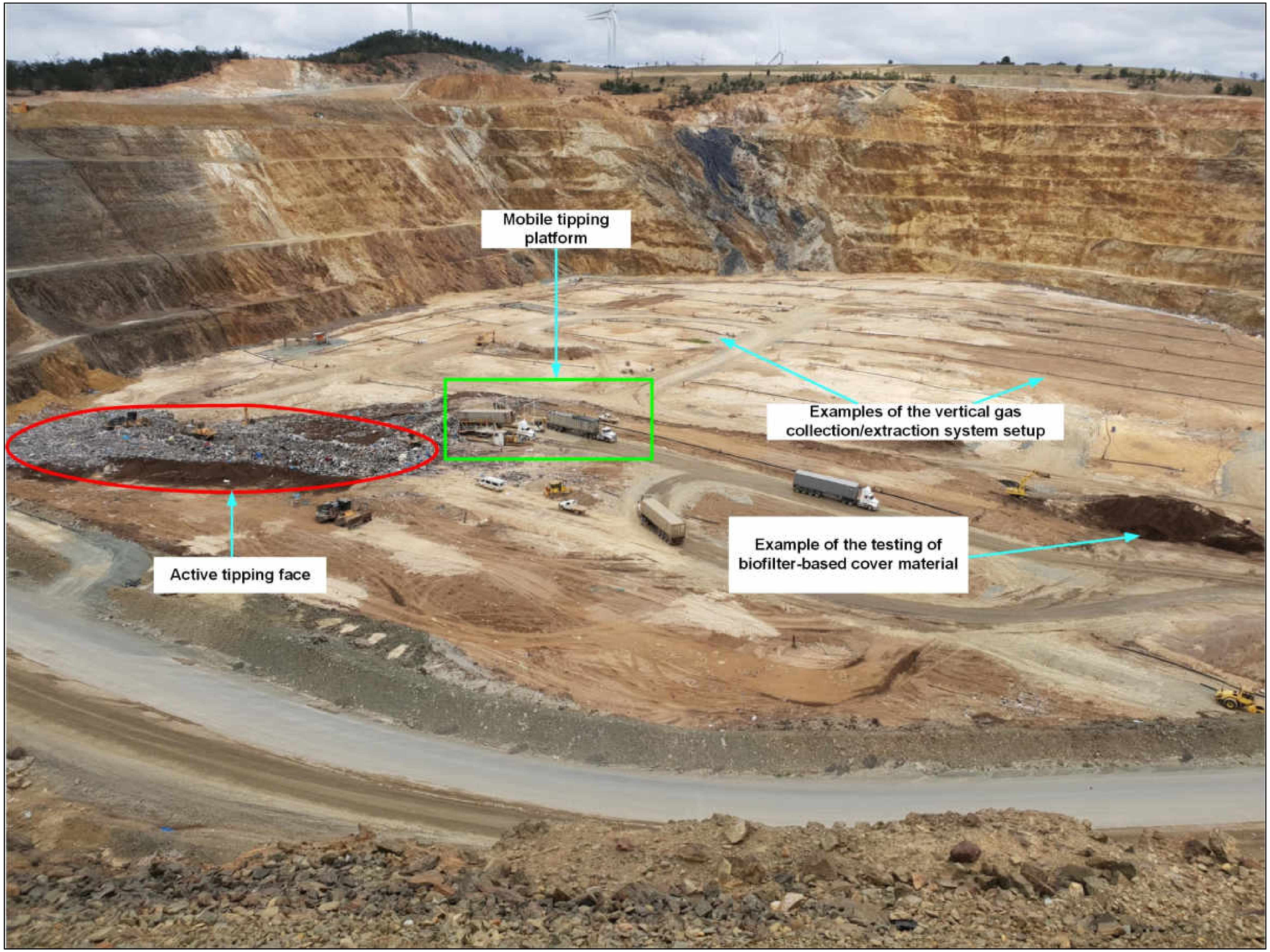


Figure 2.2 – Void layout and operations as found on 21 February 2019

2.3.1 Current procedure for operating the Bioreactor

The current procedure for operating the Bioreactor consists of the receival of putrescible waste transported to Woodlawn by rail from Sydney, after being containerised at one of the Veolia-operated transfer terminal facilities located at Clyde and Banksmeadow. The fully sealed containerised waste is received at the IMF and transported by a series of trucks to the Bioreactor, where waste is unloaded via a mobile tipping platform and subsequently transported by a dozer prior to compaction at the active tipping face area (as highlighted in **Figure 2.2**). The active tipping face area is progressively covered daily. As advised by Veolia in previous audits, covering the active tipping face is an on-going operational process, although the daily active tipping area will vary depending on positioning in the Void, gas infrastructure and weather conditions. It was evident in the Audit that the size of the active tipping face is still well below the area size specified in the EA 2010 (further discussed in **Section 7.2.1.6**).

When required, it is understood by the Audit that the tipping process is supplemented by a hydrogen sulphide (**H_2S**) emission control measure which involves the periodic in-situ addition of metal oxide (haematite and/or magnetite) to the waste as placed, as specified in the WIP 2019. The current procedure for operating the Bioreactor significantly restricts leachate recirculation due to its previously documented impact on landfill gas extraction from leachate pooling - as indicated in the WIP 2019.

2.3.2 Leachate recirculation

The leachate recirculation method currently practised within the Void continues to be via direct injection into dedicated reinjection wells when applied. This has the effect of minimising the exposure of leachate partitioning from the liquid phase to the gas phase through aerosol generation and/or evaporation pathways and subsequently leading to the generation of odorous emissions. As the leachate percolates through the upper layers of waste, a proportion of the liquid is retained in the upper layers of waste. Veolia had previously utilised covered reinjection trenches as part of the leachate recirculation process; however, this is understood to have been discontinued as part of the normal operations of the Bioreactor.

As of the Audit, and based on the WIP 2019, the leachate recirculation has been stopped due to leachate problems and the restriction of the landfill gas extraction caused by the leachate. As such, there is only one reinjection infrastructure being kept as contingency leachate management method when the leachate transfer system experiences any failure. The re-injection point is currently located in the eastern wall of the void, with a 110 mm high-density polyethylene pipe placed into the waste during the previous two lifts. The re-injection point is connected to the ring main and normally in the closed position. In the circumstance of leachate transfer system failure, e.g. pump failure or pipe damage, the valve between the re-injection point and the ring main will be opened to allow the extracted leachate to be re-injected to the waste. The re-injection will be stopped once the leachate transfer system is back to normal operation.

2.3.3 Landfill gas extraction

The landfill gas collection system is constantly expanded to promote better gas capture as waste filling progresses around the Void. The operational management and instalment of landfill gas extraction infrastructure in the Void is extensively described in the WIP 2019, as well as previous waste infrastructure plans reviewed by the audit team. The configuration during placement of waste on the surface of the Void and a waste lift is designed to ensure streamlined gas (and leachate) extraction. All extracted landfill gas is directed to the on-site power station, with moisture removal undertaken via a series of single or double knock-out pots (referred to as **KOPs** in the WIP 2019) along the landfill gas flow lines and the main header line.

2.4 LEACHATE MANAGEMENT SYSTEM

The key features of the LMS include:

- Evaporation Dam 3 North (**ED3N**), also known as evaporation lagoon 1-4;
- Evaporation Dam 3 South-South (**ED3S-S**), also known as evaporation lagoon 5;
- Leachate Treatment Dam (**LTD**); and
- The LTP.

Each of these listed features is described in **Section 2.4.2** to **Section 2.4.5**, respectively. Further details regarding the LMS have been previously documented and can be found in *Chapter 8* of the *EA 2010*, with updated features documented in the WIP 2019.

2.4.1 Volume reduction of treated leachate

It is a condition of the Site's EPL that no leachate (treated or untreated) can be directly discharged from the Site. The only means of volume reduction is through mechanical and/or natural evaporation processes. The details about the mechanical evaporation process of treated leachate are discussed in **Section 2.4.2.1.**

2.4.2 Evaporation Dam 3 North (ED3N)

ED3N pond system covers a total surface area of 6.1 hectares (**ha**), at top water level (**TWL**), and is divided into four (4) discrete lagoons, namely:

1. **ED3N–1:** receives treated leachate from the leachate treatment dam. The pond surface area, as of the Audit, is approximately 0.75 ha;

2. **ED3N–2**: receives treated leachate from the LTD. The pond surface area, as of the Audit, is approximately 0.7 ha;

3. **ED3N–3**: receives treated leachate from the LTD. The pond surface area, as of the Audit, is approximately 0.54 ha. Any overflow from this pond is directed to ED3N-1; and

4. **ED3N–4**: receives treated leachate overflow from ED3N–2, ED3N-3, or treated leachate direct from the LTD. The pond surface area, as of the Audit, is approximately 3.9 ha. There are up to five mechanical evaporators available which draw treated leachate from ED3N-4 to promote evaporation as a means of volume reduction. Further details on the mechanical evaporation process at the Site are described in **Section 2.4.2.1.**

Note: The surface areas and volumes of ED3N were as of 30 April 2019 and completed by an independent surveying company.

2.4.2.1 ED3N - Mechanical evaporation system

2.4.2.1.1 System A

A mechanical evaporation system at the Site is currently active to manage the growing need for volume reduction in the ponds to retrieve storage capacity. The mechanical evaporation system is described and operated as per the WIP 2019. For ED3N-4, the mechanical evaporation system at the Site consists of five Turbomist ® evaporation pump units, each designed to spray 350 litres per minute (**L/min**) of liquid into the air. It is understood that the actual operating performance of the evaporation units is approximately 840-900 L/min, known as System A and as shown in **Figure 2.3**.

2.4.2.1.2 System B

System B, which is a surface spray evaporator system, is composed of six (6) sprays (one in each of ED3N1 - 3 and three in ED3N4) floating in the middle of the dams and controlled by a weather station on the western bank of ED3N4. The operation of System B is in accordance with the feedback provided from the weather station, including temperature, humidity, wind direction and wind speed. Each of the sprayers is controlled independently, with setpoints based on weather conditions. As shown in **Figure 2.3**, the nominal location of each surface spray evaporator and the operating wind direction range are presented as arrows, with the span range visually illustrated. As documented in the WIP 2019, System B is still under a trial period and the setpoints are being tested to ensure the spray mist will not drift out of the dam area. As the humidity and temperature conditions vary across the seasonal cycles, the setpoint for wind speed is modified accordingly. The operation and effectiveness of System B is being regularly reviewed by the Site and setpoints optimised as required. A photo showing the operation of the surface spray evaporator system is shown in **Figure 2.4**.

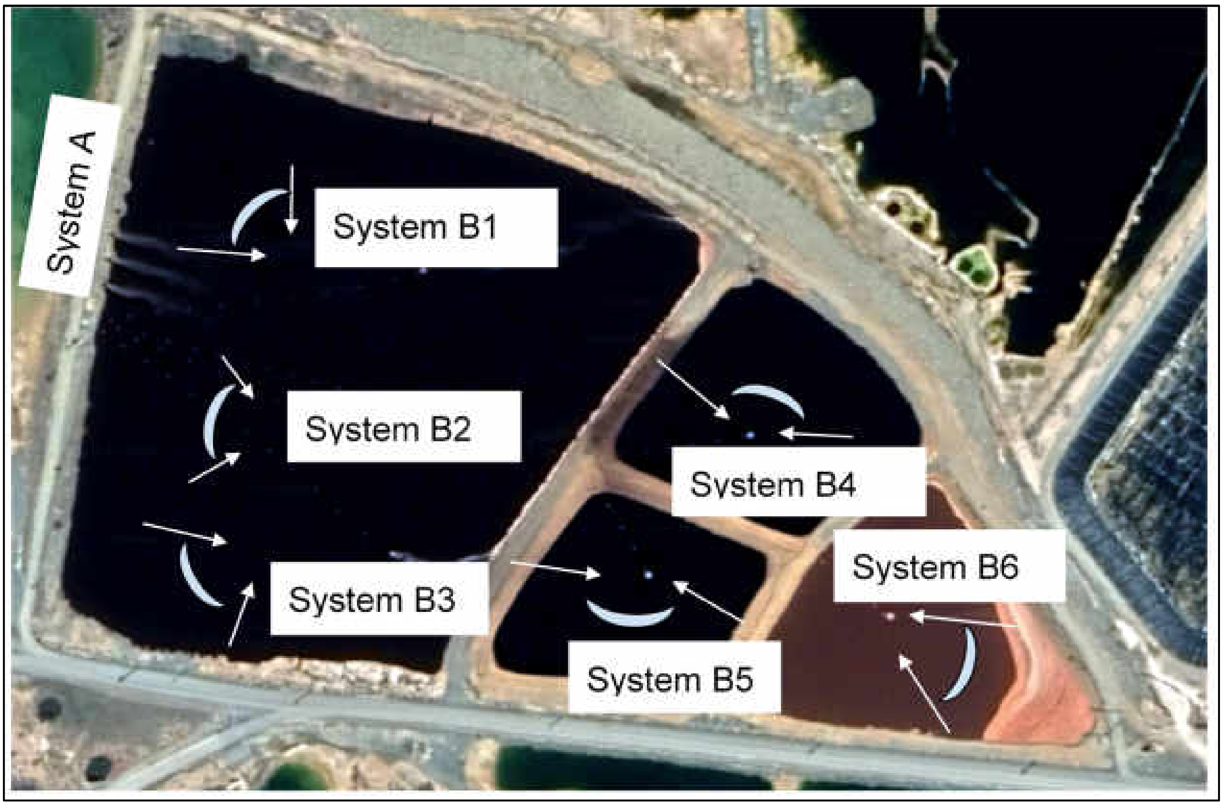


Figure 2.3 – The mechanical evaporation system layout for ED3N (**Source:** WIP 2019)

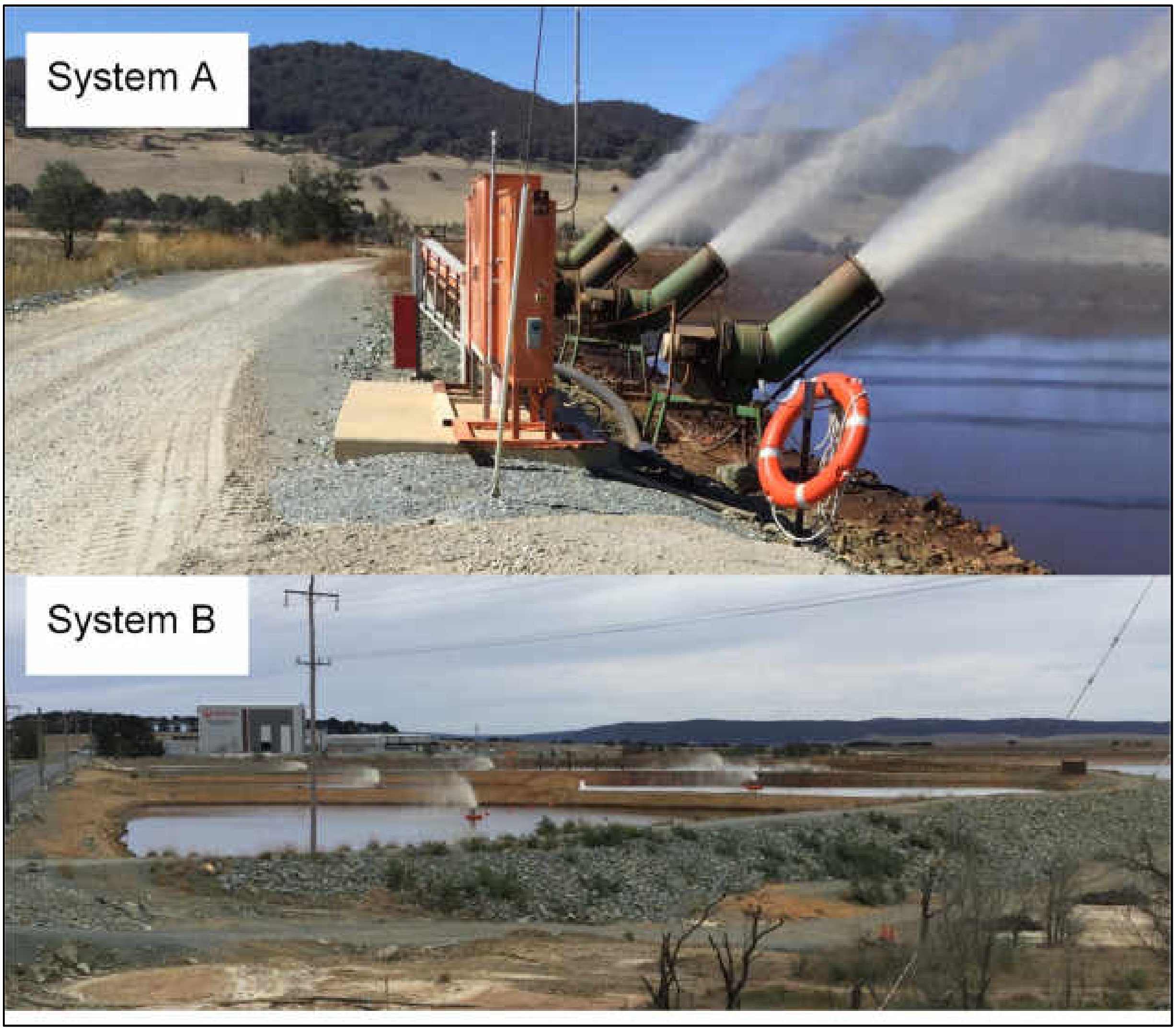


Figure 2.4 – Operation of System A and System B at the Site **(Source:** WIP 2019**)**

2.4.3 Evaporation Dam 3 South-South (ED3S-S)

ED3S-S receives treated leachate from the LTD. The pond surface area at TWL is 2.2 ha. At the time of the Audit, ED3S-S was at approximately 87% volume storage capacity, equivalent to a water surface area of approximately 1.9 ha. A photo of ED3S-S as occurred during the Audit is shown in **Photo 2.1**.

Note: The surface area and volume of ED3S-S was as of 30 April 2019 and completed by an independent surveying company.

2.4.3.1 Mechanical Evaporation System

A ring main evaporation system is installed away from the bank of ED3S-S. A total of four of spray nozzles are installed at the north, west, south and east of ED3S-S, respectively, approximately 2 metres (**m**) away from the bank. The spray nozzles are controlled by an in-situ weather station and operate only when the wind is blowing from a certain direction i.e. behind the bank into the dam. In addition to the ring main evaporation system, ED3S-S has three surface spray evaporators, similar to that described in **Section2.4.2.1.2**. The operation of the surface spray evaporators occurs only during the daytime on weekdays and based on weather conditions.

Photo 2.1 – ED3S-S as found on 20 February 2019

2.4.4 Evaporation Dam 1 Coffer Dam

The Evaporation Dam 1 (**ED1**) coffer dam stores treated effluent from the LTP. The TWL of the ED1 coffer dam is approximately 6.4 ha.

2.4.5 Leachate Treatment Dam

The LTD is in the upper north-western edge of the Void and is an integral part of the LMS at the Site. Leachate from the Void is pumped directly to the LTD as required. Since the 2012 IOA, the LTD was upgraded from a batch-based wastewater treatment system to a continuous configuration. The upgraded system was commissioned in April 2013. Following this upgrade, the LTD process was modified since the previous audit to consist of anoxic and aeration zones and a reduction to the dam level to increase the efficiency of the leachate treatment process. **Photo 2.2** shows the LTD as occurred during the Audit, and **Figure 2.5** illustrates the current continuous treatment configuration for the LTD.

The LTD has a hydraulic retention time (**HRT**) of 33 days (dependent on treatment flow) and is capable of the continuous treatment of approximately 259,000 – 346,000 litres per day (**L/day**) of untreated leachate, equivalent to a current maximum treatment capacity of 3-4 L/s. The raw leachate is pumped from the Void and discharged into the anoxic zone of the LTD for denitrification. Following treatment in the anoxic zone, the leachate migrates to the aeration zone to promote mixing, oxygen transfer and nitrification. The effluent from the aeration zone of the LTD is dosed in-situ with ferric sulphate (**$Fe_2(SO_4)_3$**) and a polymer to facilitate with coagulation and flocculation processes before passing through a settling tank known as the Woodlawn Aerated Leachate Treated Effluent Refiner (**WALTER**). Under this treatment configuration, the LTD requires desludging at a frequency that is determined by Veolia experts. The sludge from the settling tank is returned to the LTD as required. Any sludge from the desludging process (and any excess sludge that may be generated) is transported and returned to the waste in the Void where it is buried and covered. A process of the LTD is provided as **Figure 2.5**.

Photo 2.2 – The LTD as found on 21 February 2019

2.4.6 Leachate Treatment Plant

As previously mentioned in **Section 2.1**, the Site has constructed and commissioned the LTP as the long-term leachate management strategy, which is currently undergoing process-proving. As indicated in the WIP 2019, the LTP is in process proving stage which includes, but is not limited to, biomass growth, biological process tuning and process optimisation. The LTP is located on the northern side of the Void, between the Bioreactor and Evaporation Dam 1 (as shown in **Figure 2.1**), and consists of a membrane bioreactor (**MBR**) treatment system with a design capacity of approximately 4 L/s. The MBR system has been designed as a modified activated sludge biological process to treat the main parameters found in the raw leachate extracted from bioreactor to a higher quality effluent. The LTD and LTP are currently operated simultaneously at the Site, providing a doubling in leachate management and treatment capacities from the Void. A process of the LTP provided as **Figure 2.6**.

The key treatment process stages of the LTP includes:

1. A primary treatment stage, including screening to remove gross solids, large materials and other pollutants;

2. A balance tank to regulate treatment flow;

3. Anoxic Tanks;

4. Aeration Tanks; and

5. An ultrafiltration membrane system.

The product of the process stages above is a high-quality effluent that will be stored in the ED1 coffer dam. Given that the LTP is in the process proving stage, the preliminary critical control points and critical limits are continuously monitored with alarms and automatic shutdown using a dedicated Supervisory Control and Data Acquisition (**SCADA**) controls system if critical limits are reached. Overall, from odour emissions viewpoint, the Audit has obtained preliminary leachate treatment data of the effluent from the LTP and can comment that it is of a quality that will contribute negligible levels of odour. At the time of the Audit visit, ED1 coffer dam was empty.

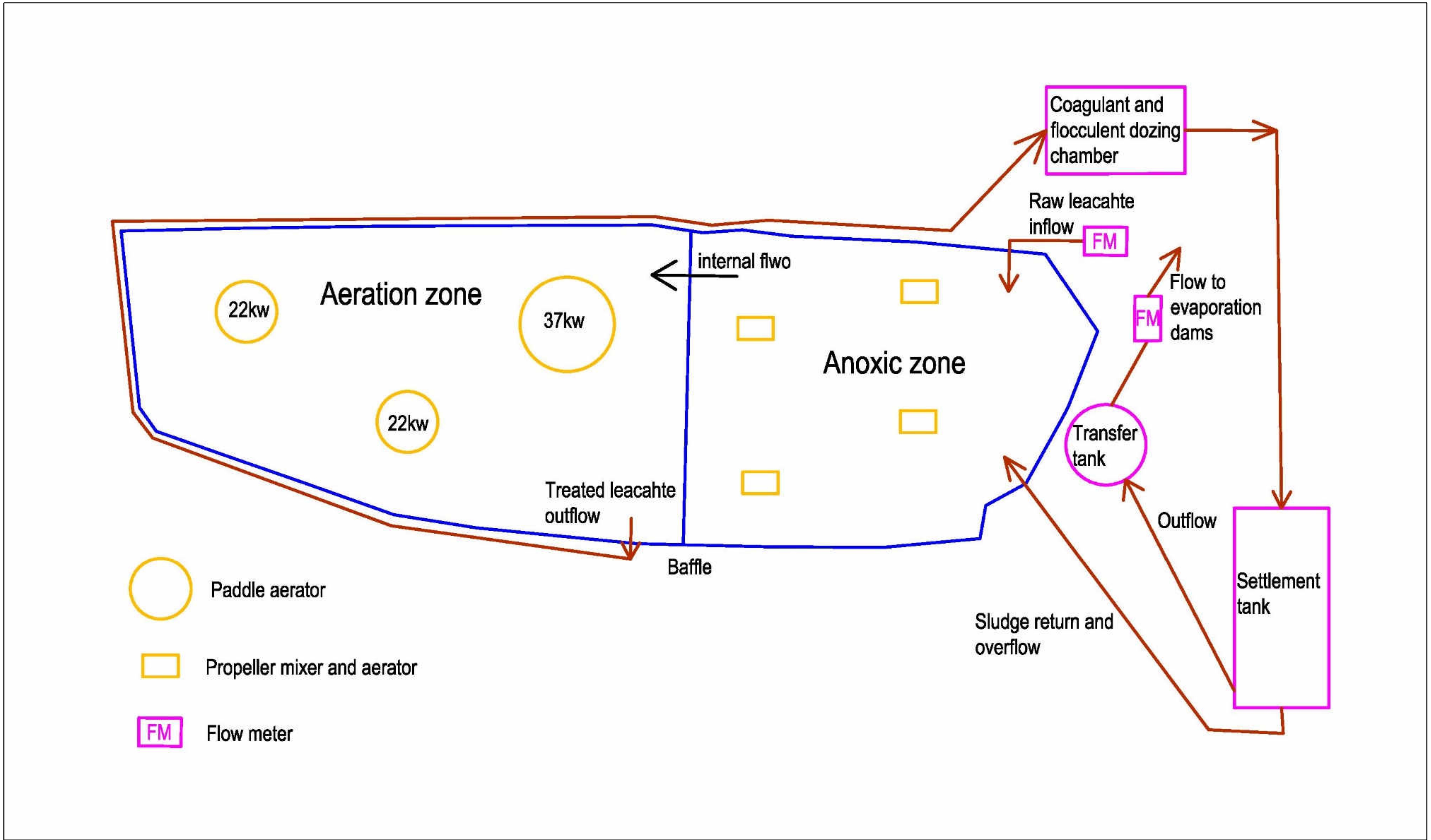


Figure 2.5 – A flow schematic of the current continuous treatment configuration for the LTD at the Site (**Source:** Veolia)

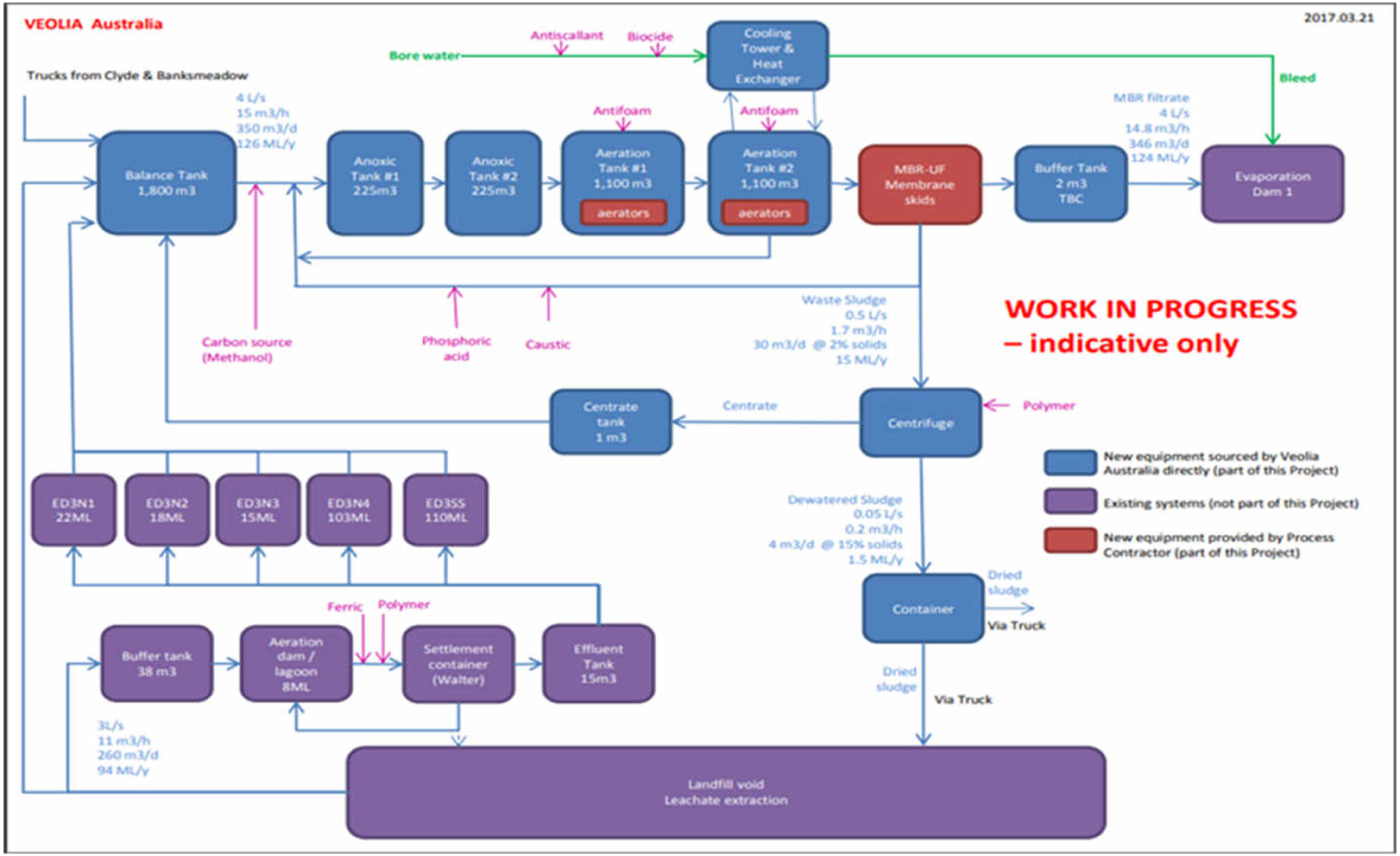


Figure 2.6 – A flow schematic of the upgraded leachate management system at the Site (**Source:** WIP 2019)

2.5 STORMWATER MANAGEMENT

2.5.1 ED3S Stormwater

ED3S continues to receive stormwater runoff which is managed as acid mine drainage. At TWL, the pond surface area is 89.4 ha. A photo of ED3S as occurred during the Audit is shown in **Photo 2.3**.

2.5.2 Stormwater Infrastructure in the Void

During stormwater events, all stormwater pumps operate to ensure stormwater water is pumped to Pond 5 and transferred to ED3S. According to the WIP 2019, the Void has been divided into multiple sub-catchment area as shown in **Figure 2.7**. Each sub-catchment has either natural or engineered drainage and flow control infrastructure, such as concrete dish drains, clay berms, pumps and pipes to manage stormwater captured in the area. These systems minimise the amount of stormwater flow from the Bioreactor walls onto the waste surface of the Void and, in turn, the potential generation of excess leachate from stormwater flows. At the current stage, the stormwater management system is composed of two on-duty pumps, four backup pumps, four buffer ponds, as well as the related water drain, diversion and delivery pipework system.

2.5.2.1 Management of contaminated surface water

Surface water collected on the covered landfill surface is drained to temporary storage ponds and is transferred to Pond 3. Where it is suspected that leachate may have contaminated surface water, a sample is collected for testing of ammonia (a key indicator for contamination) to demonstrate that the water quality is suitable for discharge to ED3S. If it is found that the surface water has encountered waste or leachate, the water will be managed as leachate through the established treatment pathways of the LMS.

2.5.2.2 Management of high rainfall events

Any stormwater into the Void, especially the portion that directly falls on the waste surface of the Void and the runoff from the upper benches, is one major source of excess leachate generation. As documented in the WIP 2019, it is indicated that leachate generation is very sensitive to high rainfall events due to the large, increasing catchment area and partial stormwater interception.

During high rainfall events, large volumes of rainwater fall onto the waste surface. Currently, stormwater is not 100% intercepted from the surface of the waste before becoming contaminated. Following high rainfall events, the leachate extraction system prioritises the extraction of surface water over leachate collected from the sub-surface (i.e. within the Bioreactor). As leachate extraction rate is limited to approximately 2 - 4 L/s at the LTD, owing to the leachate treatment system capacity, these rainfall events result in further accumulation of leachate in the Bioreactor, potential reducing the efficiency of the landfill gas capture infrastructure and management of fugitive landfill gas emissions from the Void. Given the importance of the management of high rainfall events in the Void, the WIP 2019 indicates that an upgrade to the stormwater management system will be undertaken at the Site to minimise excess leachate generation so that stormwater can be diverted to ED3S. This feature of the Void will be examined in the next IOA.

Photo 2.3 – ED3S as found on 20 February 2019

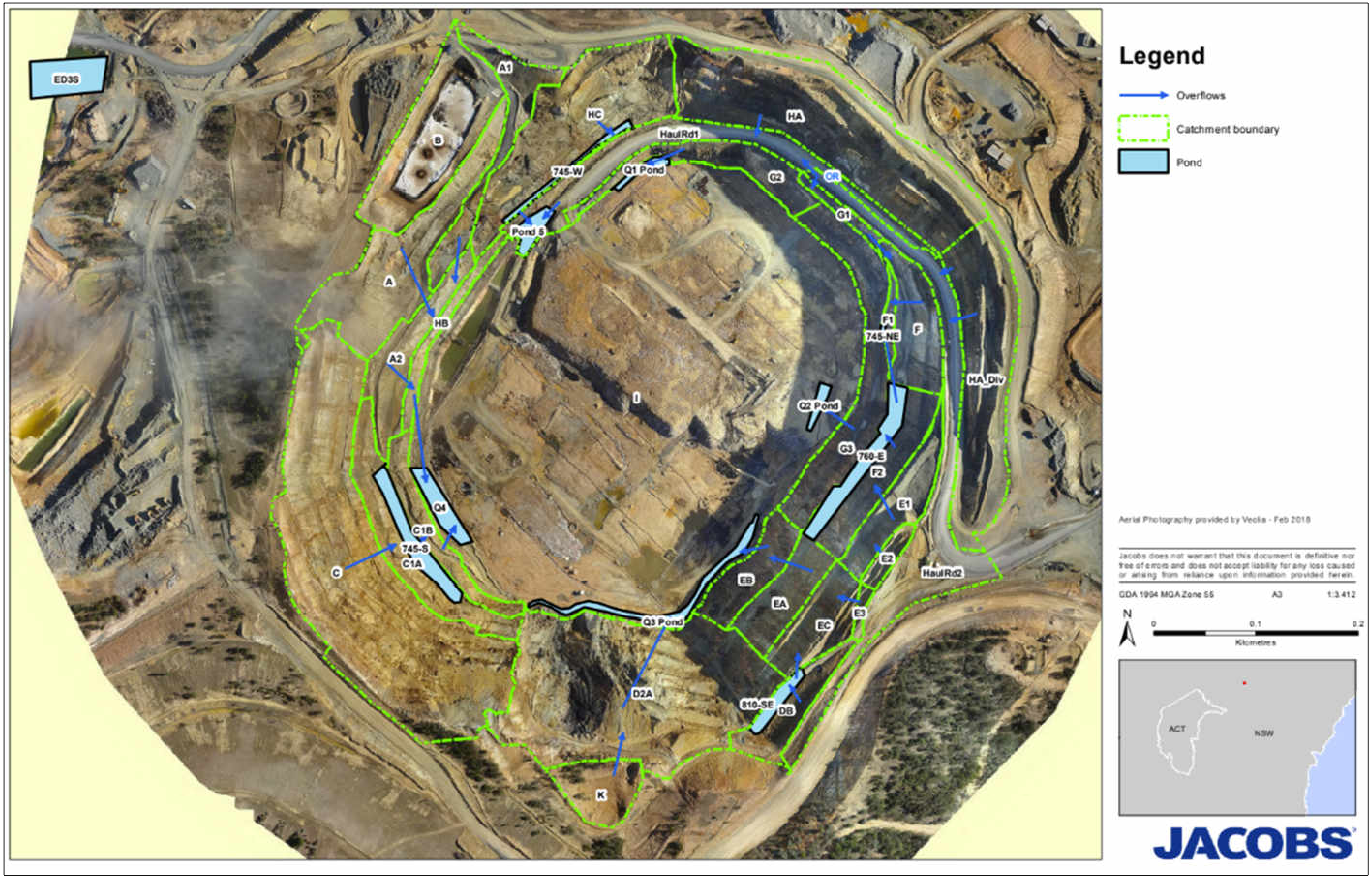


Figure 2.7 – Surface water management strategy in the Void as outlined in the WIP 2019

3 SAMPLING PROGRAM

As per *Condition 7 (e)* of *Schedule 4* in the *Specific Environmental Conditions - Landfill site,* this Audit measured all current and key sources at the Site. As previously highlighted in **Section 1.3**, the odour emissions inventory developed in previous IOAs was used as a basis for the sampling program in the Audit and updated where required.

3.1 SAMPLING SCOPE

The Audit involved the collection of a total of forty-five (45) gas samples, namely:

- Twenty-eight (28) gas samples for odour concentration measurement; and
- Seventeen (17) liquid samples for odour concentration measurement testing using an in-house NATA-accredited Liquid Odour Concentration Determination Method (see **Section 4.2** & **Appendix E** for details). The liquid samples, whilst not being a requirement for the Audit, were collected from the pond sources containing treated leachate, including ED3N-1, ED3N-2, ED3N-3, ED3N-4, and ED3S-S, to quantify the odour emissions caused by the natural or mechanical evaporation of the lagoons liquid contents (see **Section 7.2.1.4** for further details and results).

3.2 SAMPLING SCHEDULE

The sampling program schedule for the Audit is summarised in **Table 3.1.** As shown in **Table 3.1**, there are several key sampling locations at the Site. This includes:

- The Bioreactor;
- ED3N System;
- ED3S System;
- The Landfill Gas System; and
- Other sources in the Void.

The sampling program schedule includes all key sources requested in *Condition 7 (e) of Schedule 4 in the Specific Environmental Conditions - Landfill site* with the following exceptions:

- *Leachate recirculation:* Similar to the 2012 IOA, the Audit was unable to observe and thus collect representative samples for this scenario. Since the completion of EA 2010, Veolia has developed a leachate recirculation system that involves direct injection of leachate into the waste which eliminates the need for spraying over the surface (see **Section 2.3.2**). The audit team understands this will continue to remain normal practice, both for the Audit and future IOAs. Therefore, no suitable access points for the collection of odour samples from this source is – and will continue to be – possible. Notwithstanding this, as previously mentioned in **Section 2.3.2**, there is only one reinjection infrastructure being maintained in the Bioreactor as a contingency for leachate management when the leachate transfer system experiences any failure. Therefore, the use of leachate recirculation technique is not used extensively as part of the normal operation for the Bioreactor. On this basis, it is not considered to be a significant source of odour. Subsequent IOAs will continue to assess the circumstances relating to leachate recirculation within the Void and document any variation in leachate recirculation practices as required.

3.2.1 Wet Weather Conditions

The Site encountered intermittent and very light wet weather conditions the day prior to the Audit visit on 19 February 2019 and during the Audit visit on 20 February 2019. No rainfall was encountered during the Audit visit on 21 February 2019. As a result, the Audit was able to collect odour samples under wet weather conditions and observed the effects of wet weather regarding the need to handle increased levels of leachate and stormwater catchment in the Void.

3.2.2 Crisps Creek Intermodal Facility

No samples were collected from the IMF as all waste transportation is a fully contained process until the displacement of the contents into the Void via the mobile tipping platform.

3.2.2.1 Waste container management

The Audit notes that it is a requirement that all waste containers are to be designed, constructed, and maintained to prevent the emission of odour and be watertight to prevent the leakage of leachate from waste containers during transport and handling activities. This is a condition of consent for the Clyde Transfer Terminal Facility; that is, where the waste containerisation process occurs. As such, and as per previous audits, the Audit team classifies the IMF as a very low-risk source regarding odour. Moreover, and as per previous audits, there are virtually no active pathways for odour emission release from this operation that can be practically measured. Therefore, and as will be discussed in **Section 7.2.1.8** and noted in previous audits, the IMF is not considered to be a significant contributor to the Site's overall odour emissions profile.

Table 3.1 – The Audit sampling program schedule as conducted between 20 February 2019 & 21 February 2019		
Location	**Source Type^**	**No. of samples collected**
The Bioreactor		
Active Tipping Face	Area source	3
Waste Covered Area	Area source	6
Leachate Treatment Dam		
LTD	Area source	2
ED3N Pond System		
ED3N - 1	Area source (3) + Liquid odour measurement (3)	6
ED3N - 2	Area source (3) + Liquid odour measurement (3)	6
ED3N - 3	Area source (3) + Liquid odour measurement (3)	6
ED3N - 4	Area source (3) + Liquid odour measurement (3)	6
ED3S Pond System		
ED3S	Area Source	2
ED3S-S	Area source (3) + Liquid odour measurement (5)	8
TOTAL		**45**

^ see **Section 4** for details

4 SAMPLING METHODOLOGY

The sampling methodologies described in this section are associated with the 'Source Type' descriptions presented in **Section 3.2** - **Table 3.1**. Given the nature and characteristics of the emission sources sampled, the following sampling techniques are adopted in the Audit:

- Area source sampling, as detailed in Section 4.1; and
- The liquid odour measurement method, as detailed in Section 4.2.

4.1 AREA SOURCE SAMPLING METHOD

The objective of the area source sampling was to collect representative odour samples from both solid and liquid surface areas at the Site. This was undertaken using an isolation flux hood (**IFH**). All sampling using the IFH was carried out according to the method described in the United States Environment Protection Agency (**US EPA**) technical report '*EPA/600/8-86/008*', from which Australian Standard 4323.4:2009 (**AS4323.4:2009**) is based upon and is considered an '*Other Approved Method (OM-8)' by EPA (DEC, 2007)*. TOU's IFH adheres to the design specifications, materials of construction and supporting equipment that the US EPA report '*EPA/600/8-86/008*' defines. The IFH has a diameter of 0.406 m, a chamber surface area of 0.126 square metres (**m^2**) and a chamber volume of 30 litres (**L**), equivalent to 0.03 cubic metres (**m^3**), when the skirt of the hood is inserted into the liquid or solid surface by the specified 25 millimetres (**mm**). Dry nitrogen is then introduced to the IFH at a sweep rate of 5 L/min.

As these area sources are open to the atmosphere, wind is a major factor in the release of odorous pollutants from the surface and conveying the pollutant from the source to areas beyond the boundary. The IFH system is designed to simulate the transfer of odorous pollutants by the wind, resulting in a controlled and consistent sampling environment. This is achieved by the flux of near pure nitrogen gas into the IFH that is positioned on the liquid or solid surface. On a liquid surface, this is achieved by floating the IFH within an inflated tyre inner tube. The nitrogen gas then transports the odour from the surface in the same way the wind does, albeit at a very low sweep velocity. This odorous air is then collected for odour and/or chemical analysis. As the IFH has a constant 5 L/min inflow of nitrogen gas to it, the sampling chamber remains under positive pressure and produces a net outflow through the vent on top of the IFH, therefore eliminating any chance of contamination of external air from the atmosphere. The IFH's volume of 30 L and the 5 L/min nitrogen sweep rate results in a gas residence time of six minutes. The US EPA method prescribes a minimum of four air changes as to achieve optimum purging and equilibrium in the hood, and therefore a total of 24 minutes is allowed before sampling commences. The sample is then collected over a 10-minute period to obtain a 20 L sample for odour and/or chemical analysis.

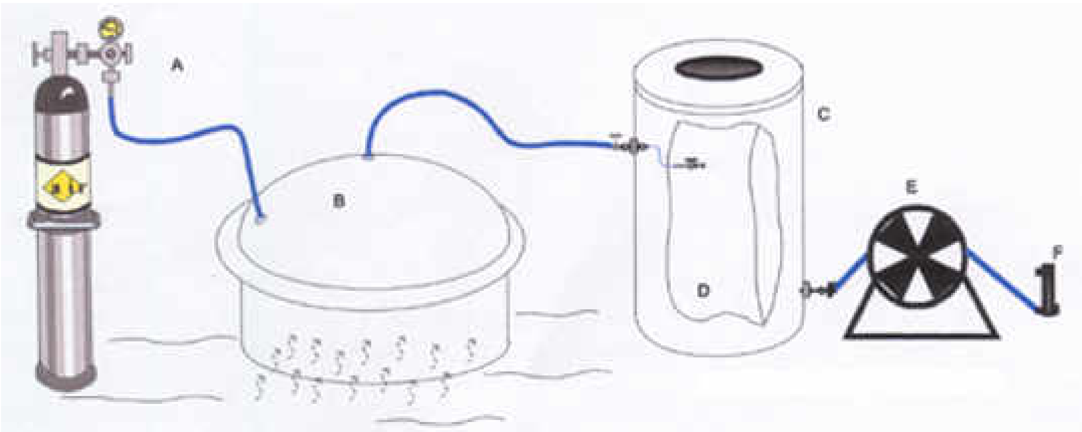
The US EPA method followed by TOU may be summarised as follows (and as described in the schematic of the sampling equipment shown in **Figure 4.1**):

- Dry nitrogen is directed into the IFH via odour free PTFE tubing until it has reached equilibrium. The nitrogen is channelled to a manifold fitted with small outlets above the surface, which direct the air towards the centre of the surface;

- The nitrogen flow (5 L/min) purges the flux hood with a residence time of four times the chamber volume occurring before sampling begins; and

- The odorous sample is drawn through a Teflon tube, into a single-use, odour-free Nalophan sample bag secured inside a drum that is under vacuum. The balance of the gas flow is vented to the atmosphere.

The IFH is manufactured from acrylic resin to ensure it does not contribute to the odour sample. All other surfaces in contact with the sample are made from PTFE or stainless steel. An example of IFH sampling on a solid surface and a liquid surface is shown in **Photo 4.1** & **Photo 4.2**, respectively.

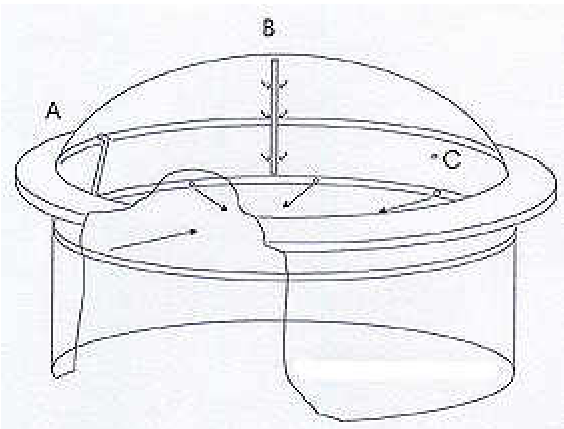


Source: Odotech - Odoflux Isolation Flux Hood Manual

Key

A	Cylinder of medical air, nitrogen or any neutral gas.
B	Isolation Flux Hood (a detailed diagram is shown in **Figure 4.2**)
C	Lung chamber (sampling drum)
D	Nalophan sampling bag
E	Sampling pump
F	Air flow meter

Figure 4.1 - Schematic of the isolation flux hood setup



Source: Odotech - Odoflux Isolation Flux Hood Manual

Key

A	Inlet gas from the gas cylinder.
B	Outlet to sample bag.
C	Additional gas outlet points for other sampling, or temperature and moisture monitoring.

Figure 4.2 – Details of the isolation flux hood chamber

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Photo 4.1 – An example of IFH sampling on a solid surface in the Void as occurred on 21 February 2019

Photo 4.2 – An example of IFH sampling on a liquid surface (ED3-SS) as occurred on 20 February 2019

4.2 LIQUID ODOUR METHOD

4.2.1 Overview

The Liquid Odour Method (**LOM**) was developed by TOU for measurement of the odour release potential from process liquors, which is universally applicable to aqueous solutions containing odorous substances. In simple terms, it measures the odour released when an odorous liquid evaporates. It is directly relevant to the mechanical evaporation units in use at the Site and natural evaporation processes for volume reduction of treated leachate (see **Appendix E** for details on methodology).

5 ODOUR & CHEMICAL MEASUREMENT METHODS

5.1 ODOUR MEASUREMENT LABORATORY

All samples collected for the Audit were tested at TOU's NATA Accredited Sydney Odour Laboratory.

5.1.1 Odour Concentration Measurement

TOU's odour laboratory operates to the Australian Standard for odour measurement '*Determination of odour concentration by dynamic olfactometry'* (**AS/NZS 4323.3**) which prescribes a method for sample analysis that provides quality assurance/quality control and ensures a high degree of confidence in the accuracy, repeatability and reproducibility of results.

The concentration of the gaseous odour samples was measured using a technique known as dynamic olfactometry. Dynamic olfactometry involves the repeated presentation of both a diluted gaseous odour sample and an odour-free air stream to a panel of qualified assessors through two adjacent ports on the olfactometer (known as the Odormat™). TOU utilises four to six trained assessors (or panellists) for sample analysis, with the results from four qualified panellists being the minimum allowed under the AS/NZS 4323.3. For the Audit, four panelists were used.

The method for odour concentration analysis involves the odorous gas sample initially being diluted to the point where it cannot be detected by any member of the panel. The assessor's step- up to the olfactometer, in turn, takes a sniff from each port, then choose which port contains the odour and enter their response. At each stage of the testing process, the concentration of the odorous gas is systematically increased (doubled) and re-presented to the panellists. A round is completed when all assessors have correctly detected the presence of the odour with certainty. The odour is presented to the panel for three rounds and results taken from the latter two rounds, as stated in AS/NZS 4323.3.

The results obtained give an odour measurement measured regarding odour units (**ou**). One (1) ou is the concentration of odorous air that can be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). It is effectively the concentration of an odour at detection threshold level. The odour concentration of a sample expressed in odour units is the number of times the sample must be diluted to elicit a physiological response (the detection threshold level) from a panel. For example, twenty (20) odour units would mean that the odour sample will need to be diluted 20 times for the concentration to be at detection threshold level. This process is defined within AS/NZS 4323.3. The odour units can be subsequently multiplied by an emission rate or volumetric flow to obtain an Odour

Emission Rate (**OER**) or a specific odour emission rate (**SOER**) for area source samples collected using the IFH method (see **Section 4.1** & **Section 5.1.2**).

5.1.2 Specific Odour Emission Rate

For area source samples collected using the IFH method, the results from odour concentration testing, derived in odour units (see **Section 4.1** for details), is multiplied by an emission rate to obtain a SOER. SOER is a measure of odour released from a representative point at a source. The SOER is multiplied by the area of the source to obtain the OER or the total odour released from each source, that is:

- SOER (ou.m^3 m^{-2} s^{-1}) = OC × Q / A; and
- OER (ou.m^3 s^{-1}) = SOER × area of source (m^2)

where:

- OC = odour concentration of compound from air in the chamber (ou)
- Q = sweep gas volumetric flow rate into chamber (m^3 s^{-1})
- A = sample source total surface area (m^2)

The SOER is presented in the units ou.m^3/m^2.s as per convention, and as referred to in the document – Klenbusch, M.R., 1986. USEPA Report No. EPA/600/8-86/008 '*Measurement of gaseous emission rates from land surfaces using an emission isolation flux chamber, - Users Guide'*. The OER is presented in the units' ou.m^3/s as referenced in the AS/NZS 4323.3.

5.1.3 Odour Measurement Accuracy

The repeatability and odour measurement accuracy of the Odormat™ is determined by its deviation from statistically reference values specified in AS/NZS 4323.3. This includes calculation of instrumental repeatability (r), where r must be less than 0.477 to comply with the standard criterion for repeatability. Its accuracy (A) is also tested against the 95th percentile confidence interval, where A must be less than 0.217 to comply with the accuracy criterion as mentioned in the Standard. The Odormat™ V04 complied with all requirements set out in the AS/NZS 4323.3 (see **Appendix B** – Result sheets: *Repeatability and Accuracy*). The calibration gas used was 51.4 parts per million (**ppm**), by volume, n-butanol in nitrogen gas (**N_2**).

5.2 IN-SITU H_2S TESTING USING JEROME 631-X H_2S ANALYSER

All collected samples using the area source sampling method, as described in **Section 4.1**, were analysed for hydrogen sulphide (**H_2S**) using a calibrated Jerome ® 631-X H_2S

Analyser (**Jerome Analyser**). The Jerome is a portable ambient air analyser with a range of 0.003 ppm to 50 ppm. All samples were measured on-site using the Jerome (see **Photo 5.1**), except where H_2S concentrations of greater than 50 ppm were encountered which necessitated the use of colorimetric tubes were used).

Photo 5.1– TOU's portable Jerome 631-X H_2S Analyser

5.2.1 Principle of Operation

A thin gold film, in the presence of H_2S, undergoes an increase in electrical resistance proportional to the mass of H_2S in the sample.

When the SAMPLE button is pressed, an internal pump pulls ambient air over the gold film sensor for a precise period. The sensor absorbs the H_2S. The instrument determines the amount absorbed and displays the measured concentration of H_2S in ppm. During normal sampling, the ambient air sample is diluted in the flow system at a ratio of 100:1. When sampling in Range 0 (where low levels of H_2S is expected) undiluted air samples are drawn across the gold film sensor.

The instrument's microprocessor automatically re-zeros the digital meter at the start of each sample cycle and freezes the meter reading until the next sample cycle is activated, thus eliminating drift between samples.

During the sample mode cycle, bars on the LCD represent the percentage of sensor saturation. Depending on the concentrations, 50 to 500 samples may be taken before the sensor reaches saturation. At that point, a 10-minute heat cycle must be initiated to remove the accumulated H_2S from the sensor. During the sensor regeneration cycle, both solenoids are closed to cause air to pass through a scrubber filter and provide clean air for the regeneration process. The flow system's final scrubber prevents contamination of the environment.

5.2.2 Sample Mode Accuracy

The length of the sample cycle depends on the concentration of H_2S and this determines the level of accuracy in the readings. There are four ranges which have been summarised in **Table 5.1**.

Table 5.1 – Jerome 631-X H_2S analyser: Sample mode

Range	Concentration	Response Time	Accuracy at Mid-range
0	0.001 to 0.099 ppm	30 seconds	± 0.003 ppm at 0.050 ppm
1	0.10 to 0.99 ppm	25 seconds	± 0.03 ppm at 0.5 ppm
2	1.0 to 9.9 ppm	16 seconds	± 0.3 ppm at 5.0 ppm
3	10 to 50 ppm	13 seconds	± 2 ppm at 25 ppm

5.2.3 Zeroing

Prior to testing air samples, the Jerome was zeroed and a blank sample taken using a zero air filter. For each zeroing event in the Audit, the Jerome indicated a nil reading (i.e. 0.000 ppm), indicating that the Jerome was free from any H_2S contamination.

6 ODOUR TESTING RESULTS

This chapter is dedicated to addressing the following audit requirement as outlined in **Section 1.2**, namely:

e. Measure all key odour sources on-site including:

- *i. consideration of wet weather conditions providing all raw data used in this analysis;*
- *ii. consideration of (but not limited to) all liquid storage area, active tipping faces, waste cover area, aged waste areas and recirculation of leachate onto waste in the Void;*
- *iii. a comparison of the results of these measurements against the predictions in the EA.*

All key odour sources at the Site were measured in the Audit, with the results presented in several tables, as follows:

- **Table 6.1** summarises the odour emission results obtained from the Audit and compares the results against the EA 2010 predictions. As there are no EA 2010 predictions for the ED3S Pond System, the results are compared with the emissions data used in the odour modelling study titled *Proposed Addition of ED3S to Leachate Management System* and dated 30 May 2016 as well as the results obtained for the ED3N Pond System in the Audit;

- **Table 6.2** summaries the global mean SOER results derived in the Audit and compares these results to those derived in the previous IOAs conducted between 2012 and 2017; and

- **Table 6.3** compares the derived SOER and H_2S results of all gas samples; and

- **Table 6.4** summarises the liquid odour measurement results.

In **Section 7.5**, **Table 7.4** summarises the odour emission rates from emission sources amenable to quantitative measurements. These sources have been ranked in descending order. The results in **Table 7.4** do not include potential gas pathways and other fugitive emission sources from the waste surface, due to the difficulty in assigning an appropriate emission area for these sources to calculate an OER derived from the SOER and the area. This was a similar constraint in the previous IOAs.

Table 6.1 - The Audit odour emission testings results obtained between 20 February 2019 and 21 February 2019 compared with that adopted in EA 2010						
Source	**The Audit**				**EA**	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER ($ou.m^3/m^2.s$)**	**Odour Character**	**SOER Range ($ou.m^3/m^2.s$)**	**SOER Model Input ($ou.m^3/m^2.s$)**
Bioreactor (The Void)						
Active Tipping Area						
Sample #20 – Active tipping face (less than one day old)	SC19112	23,200	11.4	putrid, garbage, bin juice	1.0 – 7.3*	7.3 (wet fresh waste emission adopted)
Sample #21 – Active tipping face (less than one day old)	SC19113	11,600	5.7	putrid, garbage, bin juice		
Sample #22 – Active tipping face (less than one day old)	SC19114	11,600	5.7	putrid, garbage, bin juice		
Aged Waste	n/m**				0.5	
Waste Covered Area (VENM Cover)						
Sample #23 – Waste Covered Area (P13-P14, Void Perimeter, 150 mm)	SC19115	2,440	1.3	bin juice, garbage, earthy, dirt	0.1 - 0.2* (covered) 7.5 – 23.9*** (fugitive emissions)	0.2 (covered) 23.9*** (fugitive emissions)
Sample #24 – Waste Covered Area (M14-N14, 150 mm)	SC19116	724	0.36	earthy, dirt		
Sample #25 – Waste Covered Area (N11-N12, 150 mm)	SC19117	861	0.43	earthy, dirt		
Sample #26 – Waste Covered Area (J17-J18, 300 mm)	SC19118	724	0.43	earthy, dirt		
Sample #27 – Waste Covered Area (I10-I11, 300 mm)	SC19119	724	0.40	earthy, dirt		
Sample #28 – Waste Covered Area (F13-F14, 300 mm)	SC19120	46,300	26.3	putrid, pineapple		

* includes dry and wet covered waste
** unable to be sampled in the Audit due to access and safety concerns prevailing at the time
*** represents potential gas pathways
n/m = not measured

Table 6.1 (continued) - The Audit odour emission testings results obtained between 20 February 2019 and 21 February 2019 compared with that adopted in EA 2010						
Source	**The Audit**				**EA**	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER ($ou.m^3/m^2.s$)**	**Odour Character**	**SOER Range ($ou.m^3/m^2.s$)**	**SOER Model Input ($ou.m^3/m^2.s$)**
Bioreactor (The Void)						
Leachate Treatment Dam						
Sample #18 – Leachate Treatment Dam (Aerated Zone)	SC19110	332	0.19	pungent, ammoniacal, earthy	0.1 - 7.4*	3.6
Sample #19 – Leachate Treatment Dam (Anoxic Zone)	SC19111	306	0.18	pungent, ammoniacal, earthy		
Leachate recirculation system						
Leachate recirculation system	n/m				1.6 – 2.5	2.5
Landfill Gas Extraction System						
Landfill gas inlet	n/m				n/a	
Catchment Pond (leachate)^^						
Storage Pond 7	n/m				2.1 – 8.8	8.8
Catchment Pond (stormwater)^^						
Storage Pond 3 (Stormwater)	n/m				n/a	

* includes partially / fully treated leachate (dependent on the treatment stage of the process at the time samples were collected)
n/m = not measured
n/a = not applicable
^^ no longer in use

Table 6.1 (continued) - The Audit odour emission testings results obtained between 20 February 2019 and 21 February 2019 compared with that adopted in EA 2010						
Source	**The Audit**				**EA**	
Sample Location	**TOU Sample Number**	**Odour Concentration (ou)**	**SOER ($ou.m^3/m^2.s$)**	**Odour character**	**SOER Range ($ou.m^3/m^2.s$)**	**SOER Model Input ($ou.m^3/m^2.s$)**
Evaporation Dams						
ED3N Pond System						
Sample #15 – ED3N-1	SC19107	470	0.30	rotten egg, earthy	2.1 – 8.8	8.8
Sample #16 – ED3N-1	SC19108	724	0.46	rotten egg, earthy		
Sample #17 – ED3N-1	SC19109	512	0.32	rotten egg, earthy		
Sample #10 – ED3N-2	SC19102	181	0.10	pungent, ammoniacal, earthy	0.1 – 7.4	0.2*
Sample #13 – ED3N-2	SC19105	279	0.18	pineapple, musty		
Sample #14 – ED3N-2	SC19106	362	0.23	pineapple, musty		
Sample #7 – ED3N-3	SC19099	59	0.032	pungent, ammoniacal, earthy		
Sample #8 – ED3N-3	SC19100	70	0.038	pungent, ammoniacal, earthy		
Sample #9 – ED3N-3	SC19101	64	0.035	pungent, ammoniacal, earthy		
Sample #6 – ED3N-4	SC19094	139	0.076	pungent, ammoniacal, earthy	0.1 – 0.7	0.7**
Sample #11 – ED3N-4	SC19103	166	0.10	pungent, ammoniacal, earthy		
Sample #12 - ED3N-4	SC19104	181	0.11	pungent, ammoniacal, earthy		
ED3S-S Pond System						
Sample #1 - ED3S-S	SC19089	332	0.205	pungent, ammoniacal, earthy	0.159***	
Sample #2 – ED3S-S	SC19090	152	0.0938	pungent, ammoniacal, earthy		
Sample #3 – ED3S-S	SC19091	166	0.102	pungent, ammoniacal, earthy		
ED3S Pond System						
Sample #4 – ED3S	SC19092	140	0.086	musty	0.0 - 0.5	0.5
Sample #5 – ED3S	SC19093	49	0.030	musty		

* partially / fully treated leachate
** includes groundwater and fully treated leachate
*** Not obtained from the EA. Source of emission data is the *Woodlawn Bioreactor Facility Odour Modelling Study - Proposed addition of ED3S to leachate management system* - May 2016: Table 2.1
n/a = not applicable
n/m = not measured

Table 6.2 – Global mean SOER results: Comparison between The Audit and previous IOAs

Source	The Audit	2017 IOA	2016 IOA	2015 IOA	2014 IOA	2013 IOA	2012 IOA
Location	**TOU SOER (ou.m³/m².s)**						
ED3N-1	0.356	0.132	0.130	0.132	0.017	0.30	394
ED3N-2 & 3^	0.102	0.129	0.175	0.118	0.049	11.6 ^^^^	0.29
ED3N-2	0.169	0.120	0.148	0.145	0.066	20.1 ^^^	0.21
ED3N-3	0.035	0.139	0.20	0.091	0.032	0.2	0.37
ED3N-4	0.095	0.163	0.248	0.269	0.023	0.0604	0.41
Active Tipping Face	7.59	9.52	8.16	7.51^^^^^	4.28	3.04	8.36
Leachate Treatment Dam	0.186	0.243	0.27	0.276	0.026	0.323	0.46
Construction and Demolition Tip Face	n/a	n/a	n/m	0.326	n/a	0.293	n/a
ED3S	0.058	0.116	0.277	No previous measurements available as ED3S, ED3S-S, and Stormwater Pond 3 are new sources			
ED3S-S	0.134	1.97	0.437				
Stormwater Pond 3	n/a	n/a	n/a				
Storage Pond 7	n/a	n/a	n/a	n/m^^	n/a#		85

^ as specified in the EA 2010
^^ no longer exists
^^^ represents the sub-optimal pond contents that have now been treated (see **IOA 2013 Report** for details)
^^^^ bulk of emissions originating from ED3N-2 (see **IOA 2013 Report** for details)
^^^^^ includes testing results reflecting sampled areas with the polymer slurry applied
# There was no designated area for this location (see **IOA 2014 Report** for details)
n/a = not applicable
n/m = not measured

Table 6.3 – The Audit: Comparison between SOER and measured H_2S results summary

Sample Location	TOU Sample Number	Specific Odour Emission Rate (ou.m^3/m^2.s)	Jerome H_2S reading (ppm)
ED3S System			
Sample #4 – ED3S	SC19092	0.086	0.000
Sample #5 – ED3S	SC19093	0.030	0.000
ED3N System			
Sample #15 – ED3N-1	SC19107	0.30	0.71
Sample #16 – ED3N-1	SC19108	0.46	0.78
Sample #17 – ED3N-1	SC19109	0.32	0.36
Sample #10 – ED3N-2	SC19102	0.10	0.036
Sample #13 – ED3N-2	SC19105	0.18	0.009
Sample #14 – ED3N-2	SC19106	0.23	0.004
Sample #7 – ED3N-3	SC19099	0.032	0.014
Sample #8 – ED3N-3	SC19100	0.038	0.016
Sample #9 – ED3N-3	SC19101	0.035	0.007
Sample #6 – ED3N-4	SC19094	0.076	0.007
Sample #11 – ED3N-4	SC19103	0.10	0.035
Sample #12 - ED3N-4	SC19104	0.11	0.036
ED3S-S System			
Sample #1 - ED3S-S	SC19089	0.205	0.03
Sample #2 – ED3S-S	SC19090	0.0938	0.013
Sample #3 – ED3S-S	SC19091	0.102	0.017
Leachate Treatment Dam			
Sample #18 – Leachate Treatment Dam (Aerated Zone)	SC19110	0.19	0.075
Sample #19 – Leachate Treatment Dam (Anoxic Zone)	SC19111	0.18	0.051
Active Tipping Area			
Sample #20 – Active tipping face (less than one day old)	SC19112	11.4	0.45
Sample #21 – Active tipping face (less than one day old)	SC19113	5.7	0.3
Sample #22 – Active tipping face (less than one day old)	SC19114	5.7	0.2
Waste Covered Area			
Sample #23 – Waste Covered Area (P13-P14, Void Perimeter, 150 mm)	SC19115	1.3	0.012
Sample #24 – Waste Covered Area (M14-N14, 150 mm)	SC19116	0.36	0.001
Sample #25 – Waste Covered Area (N11-N12, 150 mm)	SC19117	0.43	0.00
Sample #26 – Waste Covered Area (J17-J18, 300 mm)	SC19118	0.43	0.00
Sample #27 – Waste Covered Area (I10-I11, 300 mm)	SC19119	0.40	0.00
Sample #28 – Waste Covered Area (F13-F14, 300 mm)	SC19120	26.3	3.0

Table 6.4 – LOM derived odour emission rates for mechanical and natural evaporation methods: As collected on 21 February 2019^^^^

Sample Location	TOU Sample Number	Odour Concentration (ou)	Calculated Liquid Odour Potential (ou/mL)	Mechanical Evaporation Rate (L/min) per evaporator^ η = 20% / 30%	Mechanical Evaporation Odour Emission Rate (ou.m³/s) per evaporator η = 20% / 30%	Mechanical Evaporation Odour Emission Rate (ou.m³/s) ALL evaporators^^^ η = 20% / 30%
Evaporation method: Mechanical						
LOM Sample #15 – ED3N-1	SC19137	279	16.9	70 / 105	System A is not used for ED3N-1, ED3N-2 and ED3N-3, see **Section 2.4.2.1.1**. The OER for the surface spray evaporators has not been quantified in the Audit, as their contribution are considered negligible in the context of other on-site emission sources.	
LOM Sample #16 – ED3N-1	SC19138	181	11			
LOM Sample #17 – ED3N-1	SC19140	197	11.9			
LOM Sample #10 – ED3N-2	SC19160	54	3.27			
LOM Sample #13 – ED3N-2	SC19141	166	10			
LOM Sample #14 – ED3N-2	SC19142	166	10			
LOM Sample #7 – ED3N-3	SC19157	91	5.51			
LOM Sample #8 – ED3N-3	SC19158	64	3.87			
LOM Sample #9 – ED3N-3	SC19159	14	0.847			
LOM Sample #6 – ED3N-4	SC19156	91	5.51		6,430 / 9,650	25,720 / 38,600
LOM Sample #11 – ED3N-4	SC19161	49	2.97		3,470 / 5,200	13,880 / 20,800
LOM Sample #12 – ED3N-4	SC19162	27	1.63		1,900 / 2,850	7,600 / 11,400

Evaporation method: Natural

Sample Location	TOU Sample Number	Odour Concentration (ou)	Calculated Liquid Odour Potential (ou/mL)	Current Surface Area (m²)	Natural Evaporation rate (L/s) ^^	Natural Evaporation Odour Emission Rate (ou.m³/s)
LOM Sample #1 – ED3S-S	SC19121	470	28.5	19,000	92.67	19,100
LOM Sample #2 – ED3S-S	SC19122	215	13	19,000	92.67	8,710
LOM Sample #1A – ED3S-S	SC19123	215	13	19,000	92.67	8,710
LOM Sample #2A – ED3S-S	SC19124	395	23.9	19,000	92.67	16,000
LOM Sample #3 – ED3S-S	SC19139	512	31	19,000	92.67	20,800
LOM Sample #15 – ED3N-1	SC19137	279	16.9	7,500	92.67	4,470
LOM Sample #16 – ED3N-1	SC19138	181	11	7,500	92.67	2,910
LOM Sample #17 – ED3N-1	SC19140	197	11.9	7,500	92.67	3,150
LOM Sample #10 – ED3N-2	SC19160	54	3.27	7,000	92.67	807
LOM Sample #13 – ED3N-2	SC19141	166	10	7,000	92.67	2,470
LOM Sample #14 – ED3N-2	SC19142	166	10	7,000	92.67	2,470
LOM Sample #7 – ED3N-3	SC19157	91	5.51	5,400	92.67	1,050
LOM Sample #8 – ED3N-3	SC19158	64	3.87	5,400	92.67	737
LOM Sample #9 – ED3N-3	SC19159	14	0.847	5,400	92.67	161
LOM Sample #6 – ED3N-4	SC19156	91	5.51	39,000	92.67	7,580
LOM Sample #11 – ED3N-4	SC19161	49	2.97	39,000	92.67	4,080
LOM Sample #12 – ED3N-4	SC19162	27	1.63	39,000	92.67	2,240

^ Mechanical evaporation rate is based on 20% / 30% evaporation efficiency per evaporator.
^^ The natural evaporation rate is based on the mean evaporation rate recorded between May 2007 to June 2012, equivalent to 92.67 mm/month.
^^^ Based on five active and identical evaporators as is the current mode of operation.
^^^^Surface spray & ring main evaporation systems not included in calculation.

6.1 COMMENTS ON RESULTS

The following sections comment on the results presented in **Table 6.1**, **Table 6.2**, and **Table 6.4**.

6.1.1 The Void Samples

The following comments are made based on the Void samples collected in the Audit:

- The sampling locations inside the Void have been nominally shown in **Figure 6.1**. The sample numbers presented in **Figure 6.1** correspond with those in the sampling location column in **Table 6.1**. The conditions prevailing in the Void at the time of the Audit is presented in **Photo 6.1**;

- As presented in **Table 6.2**, the mean SOER results for the Active Tipping Area (SC19112-SC19114) in the Audit is 7.6 ou.m^3/m^2.s, representing a moderate change since the previous 2017 IOA (from 9.5 ou.m^3/m^2.s). The odour character of the active tipping face samples collected in the Audit reported as 'putrid garbage, bin juice', representing a similar finding from previous IOAs. Based on previous IOA results for this source, this variation is considered to reflect normal variation from the active tipping face activity inside the Void;

- The Waste Covered Area samples (SC19115 – SC19120) were collected from covered areas within the Void, including 150 mm and 300 mm VENM cover, at strategic locations designed to quantify the general emissions emanating from the Void; and

- The results for odour measurements collected from the Void perimeter suggested that areas with a biofiltration cover returned a SOER result of 1.3 ou.m^3/m^2/s with a 'dirt, earthy' odour character (SC19115). This result supports the use of biofilter cover as an effective strategy for managing fugitive gas emissions from the Void (compared with the SOER result obtained for SC19120), particularly from the perimeter where shrinkage effects from the Void wall are pronounced as the covered waste consolidates, compacts and decomposes. This finding supports previous IOA data which indicate that a biofiltration cover is an effective method at minimising fugitive gas emission release from the Void surface, when adequately moist and maintained in optimum condition.

Similar to the previous IOA, there were three types of Waste Covered Area samples collected, including:

- **Void Covered Surface Type 1**: The Void perimeter with a minimum biofiltration cover of 500 mm depth. This represents the continued implementation by Veolia of one of the non-mandatory recommendations in the previous 2015 IOA. Veolia has documented the success of the biofiltration trial in a stand-alone report titled

Report for the biofiltration trial at Woodlawn Bioreactor dated March 2017 (**the Biofilter Trial Report**).

- **Void Covered Surface Types 2 & 3:** Areas covered with 150 mm and 300 mm of VENM to evaluate the efficacy of the cover at minimising fugitive odour emissions from the Void surface at different depths as found. The results were as follows:

- The application of VENM on the waste covered areas returned SOER results that ranged between 0.36 $m^3/m^2.s$ and 0.43 $m^3/m^2.s$, with a recorded outlier of 26.3 $ou.m^3/m^2.s$ (SC19120). This variability is likely due to the condition of the cover at the time of sampling. The consistency of the SOER results for most of the sampled location indicates the effectiveness of the current capping and landfill gas extraction (see **Section 7.2.1.2** for more details;

- The measured SOER result for the waste covered area sample SC19120 can be considered as potential fugitive gas emission pathways given the elevated results when compared with the other results (SC19115-SC19119). Notwithstanding these elevated results, this result is close to the EA target of 23.9 $ou.m^3/m^2.s$. This is a positive result and indicates that the emissions from these areas are within the desirable targets set in the EA 2010. This is further supported by the odour modelling study (**Section 8**); and

- The waste covered area sample (SC19118-SC19119), representing a 300 mm depth capped cover (see **Figure 6.1**), that is not categorised as a potential fugitive emission pathway based on the SOER result, is slightly above the EA target of 0.2 $ou.m^3/m^2.s$ (0.4 $ou.m^3/m^2.s$) but not considered to be problematical as shown the odour modelling study (**Section 8**). These SOER results are considered to reflect an effective capping practice within the Void.

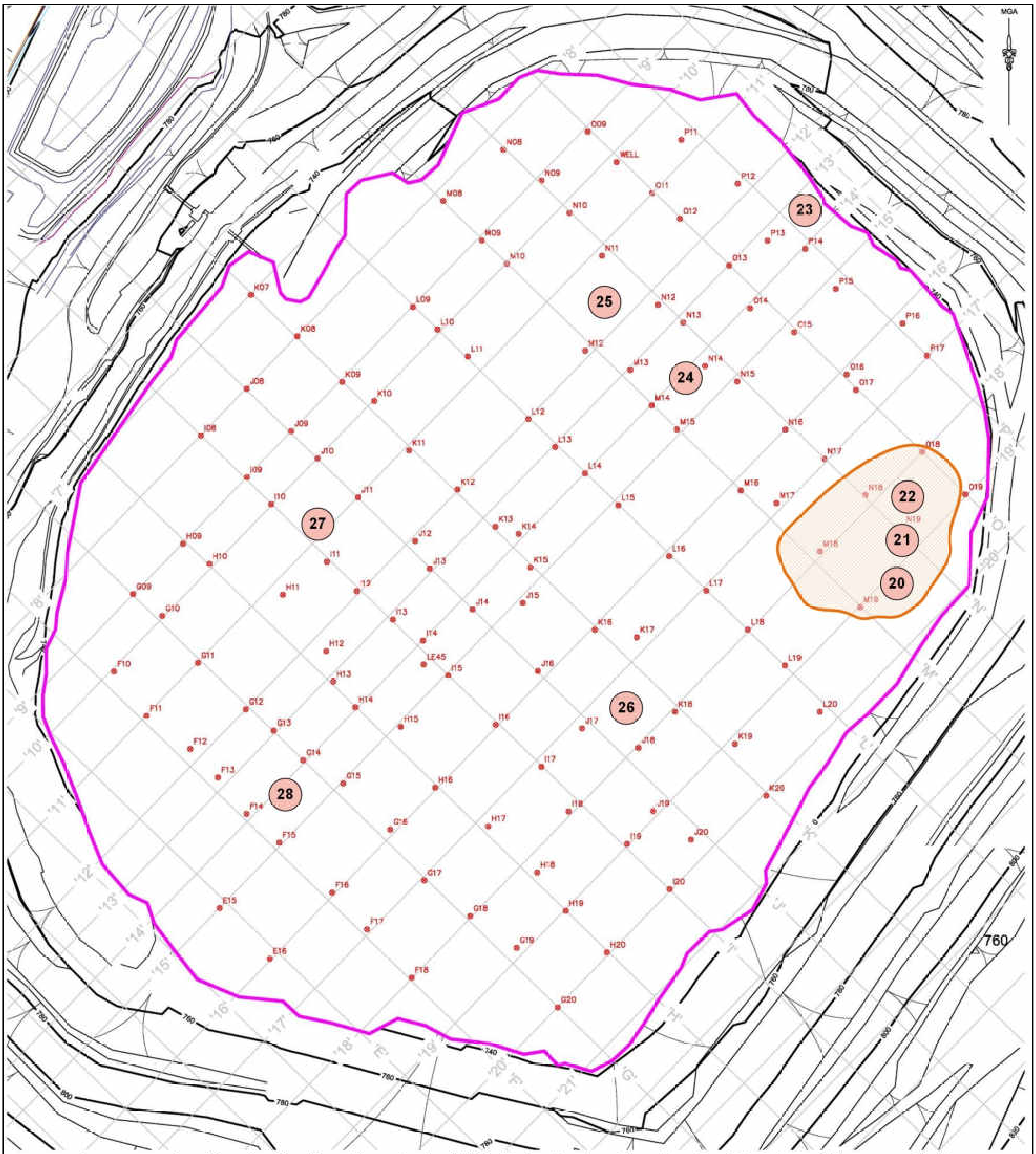


Image reproduced from the Woodlawn Bioreactor Landfill Monitoring Bore Locations (**Drawing 16700-236**) which was supplied by Veolia (Australia & New Zealand)

Legend

Sample location and number

Active tipping face as found during the Audt

Figure 6.1 - Nominal sampling locations within the Void: 20 & 21 February 2019

Photo 6.1 – Conditions prevailing in the Void during the Audit on 21 February 2019

6.1.2 Pond Source Samples – ED3N Pond System

The following comments are made based on the ED3N Pond System samples collected in the Audit:

- All samples from the ED3N system were collected from the bank of the dams. The nominal sampling locations are shown in **Figure 6.2**; and

- All samples collected and tested from the ED3N Pond system (i.e. SC19099 – SC19107) were found to be below the EA 2010 SOER model inputs for each dam. The very low SOER values for all ponds (0.03 – 0.46 ou.m^3/m^2.s) are consistent with the previous IOA results. These consistent results indicate that the leachate treatment quality continues to be optimum and that the LMS at the Site is performing very well from an odour emissions viewpoint.

6.1.3 Pond Source Samples – ED3S Pond System

The following comments are made based on the ED3S Pond System samples collected in the Audit:

- As of the previous IOA, the Audit now includes the ED3S Pond System given that it is now part of the LMS, specifically ED3S-S;

- The SOER results for ED3S were found to below the EA 2010 SOER model input of 0.5 ou.m^3/m^2/s, with the mean results (i.e. 0.058 ou.m^3/m^2.s) below this value;

- Similarly, the SOER results for ED3S-S were found to be low and relatively consistent with results obtained from ED3N and ED3S. This indicates that the treated leachate quality flowing to ED3S-S is of a quality that is conducive with low odour; and

- The SOER input from a report titled *Woodlawn Bioreactor Facility Odour Modelling Study - Proposed Addition of ED3S to Leachate Management System* dated May 2016 Report (the **ED3S May 2016 Report**) used a SOER of 0.159 ou.m^3/m^2.s for the modelling of ED3S-S. The mean result derived from the Audit is 0.134 ou/m^3/m^2.s (see **Table 6.2**). This result is below the modelled value and unlikely to cause any adverse impact beyond the boundary of the Site. This is a positive outcome.

Figure 6.2 – Pond sources nominal liquid & gas sampling locations: 20 & 21 February 2019

6.1.4 Leachate Treatment Dam Samples

The following comments are made based on the LTD samples collected in the Audit:

- The LTD was found to be operating under normal operating conditions at the time of the Audit. There are clearly now two treatment zones in the LTD including an anoxic zone and an aerobic zone. Both zones were sampled as part of the Audit;
- The SOER results suggest that the LTD is not a significant odour emission source. This implies that the LTD was operating in optimum conditions at the time of the Audit from an odour viewpoint;
- The mean SOER result derived in the Audit for the LTD is 0.186 $ou.m^3/m^2.s$. This value is well below the EA 2010 SOER value of 3.6 $ou.m^3/m^2.s$ for the LTD and compares well with the previous IOA result of 0.243 $ou.m^3/m^2.s$; and
- Three surface aerators were in active operation at the time of the Audit. **Photo 6.2** shows the LTD as found during the Audit.

Photo 6.2 – The LTD as found on 21 February 2019

6.1.5 Landfill Gas Samples

The following comments are made based on the landfill gas samples collected in the Audit:

- The Audit determined that it was not necessary to collect an inlet landfill gas sample to the Void based on the testing carried out during the 2018 Emissions Testing Report (see **Appendix D**).

6.1.6 Liquid Odour Measurement Samples

The following comments are made based on the liquid samples collected in the Audit:

- The liquid odour measurement results represent the odour that would be released if the sample were evaporated, either by natural or mechanical means. For this Audit the mechanical and natural evaporation has been used in calculations;

- The natural evaporation rate shown is based on the mean rate at the Site between May 2007 to June 2012;

- An extensive number of liquid samples were collected from ED3N-1, ED3N-2, ED3N-3, ED3N-4 and ED3S-S in the Audit. As such, the dataset obtained in the Audit provides good level of confidence in relation to the leachate quality and odour potential when evaporated; and

- All collected liquid samples analysed via the LOM method were found to be low in odour, with only a 'musty' odour recorded. A 'musty' odour is typically a reliable indicator of optimum pond health and minimal odour release conditions from a treated leachate dam even a high OERs (i.e. the odour emission is of a treated quality odour, such as in the case of a biofilter outlet emission). As such, despite the apparent high OERs as shown in **Table 6.4**, the quality of treated leachate in ED3N and ED3S-S continue to pose a minimal odour risk at the Site; and

- The liquid sample results are consistent with previous IOAs and very unlikely to be problematical with respect to off-site impacts. This outcome is consistent with the results from the collected gas samples from the area source sampling (see **Section 6.1.2**). The implication of this result is discussed in **Section 7.2.1.4**.

6.1.7 H_2S results

The results shown in **Table 6.3** indicate that H_2S is well managed for both pond and non-pond sources at the Site. This is consistent with the odour modelling study results outlined in **Section 8**.

7 AUDIT DISCUSSION

7.1 PREVIOUS AUDIT RECOMMENDATIONS

Table 7.1 & **Table 7.2** outline the mandatory and non-mandatory recommendations documented in the 2017 IOA, respectively, and Veolia's response to those recommendations since that time.

It is important to note that some of these recommendations are, and will continue to remain, an integral part of the on-going process operations and plans at the Site. The WIP 2019 is a comprehensive and technically focused document aimed at educating management, operators and relevant stakeholders on the operational philosophy, and continuous improvement and infrastructure development plans for the BWMS. These on-going process operations and plans are part of the WIP 2019 and include, but are not limited to:

- Planned infrastructure instalments within each waste lift.
- Landfill gas collection system including:
  - The design philosophy for the system of wells beneath the waste profile in the Void;
  - Well extensions; and
  - Horizontal infrastructure and condensate management.
- Continuous monitoring of leachate and gas extraction.
- Remediation actions in the event of equipment failure and process upset in the Void. It also documents the contingency measures in implemented to ensure the sustained operation of the Void in the event of equipment failure and process upset.
- The implementation of operational management programs including:
  - Leachate management;
  - Pumps and pumping solutions; and
  - The expansion of wells in the Void to optimise and improve landfill gas extraction and minimise leachate generation.
- Specific management techniques for:
  - H_2S management;

    - Covering of waste;
    - The design, location and implementation of the biofiltration cover material along the perimeter of the Void, where required;
    - Managing stormwater events as to minimise the generation of leachate; and
    - Management of leachate eruptions, power failures.
- Details on current issues and long-term plan for the Site.

The above on-going process operations (and others) are comprehensively documented in previous Woodlawn Infrastructure Plan (**WIP**), with the latest details provided in the WIP 2019. The Audit notes that the WIP is a 'live' document that is constantly updated as the volume of waste into the Void increases over time.

Veolia made the full document of the WIP 2019 available for review in the Audit. As previously mentioned in **Section 1.3**, the relevant components of the WIP 2019 are incorporated into the Audit report, where required, as this is a commercial-in-confidence document.

7.1.1 Mandatory recommendations

The mandatory recommendations from the 2017 IOA are summarised in **Table 7.1** and include Veolia's response since that time.

7.1.2 Non-mandatory recommendations

The non-mandatory recommendations from the 2017 IOA are summarised in **Table 7.2** and include Veolia's response since that time.

Table 7.1 – 2017 IOA Mandatory Recommendations and Veolia's Response

No.	2017 IOA Mandatory Recommendations	Veolia's Response
1	<u>*Fugitive landfill gas emissions*</u> *Veolia should continue to improve landfill gas capture from the Bioreactor. This continuation is underway with Veolia completing its WIP 2018, which outlines a comprehensive plan that is being implemented to increase gas capture. It also seeks to address current areas of concern and the potential solution outcomes that can be implemented. This is an active (and effective) management approach that will result in a continual improvement in gas capture efficiency and ultimately reduce odour/landfill gas emissions from the Void. The Audit endorses this strategy as the primary measure to reduce odour emissions from the Void and recommends that Veolia continues the implementation of the gas systems detailed in the WIP 2018, including:* ▪ *the planned infrastructure instalments within each waste lift;* ▪ *the continuous improvement to leachate extraction, treatment performance, capacity and efficiency;* ▪ *the continuous improvement in the waste tipping profile, covering and expansion and optimisation of the landfill gas infrastructure;* ▪ *Continuous monitoring of leachate and gas extraction;* ▪ *Remediation actions in the event of equipment failure and process upset in the Void;* ▪ *The implementation of operational management programs including:* o *Leachate management;* o *Pumps and pumping solutions; and* o *The expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction.* *It should be noted that the WIP 2018 is a live document that will be continually updated. Therefore, it will continue to remain a part of the IOA.*	The improvement in gas capture from within the Void is an on-going planning and operational exercise that Veolia will continue to be implemented. This is evident from the WIP 2019, an updated plan for the current and future operations at the Site. Similar to previous versions of the WIP, the WIP 2019 outlines the operational issues and plans to: ▪ improve and optimise leachate flow, treatment and recirculation; ▪ the process-proving of the long-term leachate strategy in the form of the LTP; ▪ improve gas capture through leachate management and infrastructure setup and configuration, ▪ reduce fugitive gas emission to minimise odour; ▪ optimise tipping strategy; and ▪ The connection of more wells/trenches. The WIP 2019 document is 'live' and designed around both a proactive and reactive approach in addressing infrastructure and operational issues. The WIP 2019 also has clear defined goals on targets with respect to gas performance and leachate management. It is understood that Veolia have engaged a university body to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Site – the Audit was not made aware of the outcome from this study.

Table 7.1 continued – 2017 IOA Mandatory Recommendations and Veolia's Response

No.	2017 IOA Mandatory Recommendations	Veolia's Response
2	*Leachate management system* *Continue to adequately maintain and manage the upgraded LMS to ensure it is operating in an optimum state and meeting the leachate quality monitoring targets as outlined in the Leachate Treatment Operation Manual and recommended by Veolia Water. Moreover, continue the implementations planned in the WIP 2018. Both the manual and WIP 2018 should be considered as a 'live' document to reflect any variation in quality and operational demands and identifications of new constraints and/or issues. This should continue to attenuate the potential for significant odour generation from the leachate stored in ED3N & ED3S Pond Systems both now and in the future.* *The Audit also endorses Veolia's plan to upgrade the LMS via the implementation of an MBR Facility, which is understood to have the capacity to treat leachate to a very high quality that will be conducive to very minimal levels of odour (based on the projected BOD and ammonia levels). It is also understood that, at the time of writing, the MBR is in the process of construction.*	It is clear from the on-site observations, odour emissions data collected during the Audit, and the WIP 2019 that Veolia continues to actively manage and improve the LMS. This is also evident in Veolia's implementation of long-term leachate management solution where an LTP is in the process proving phase of operation, resulting in high-quality effluent stored in ED1 coffer dam.
3	*Active tipping face* *Veolia should also continue to develop strategies for the minimising of the exposed active tipping face surface area at all times. It should also proceed and continue with the details in the WIP 2018.*	Based on the WIP 2019, disposed waste is covered daily and at intermediate stages of operation to minimise dust, litter, the presence of scavengers and vermin, fire risk, rainwater infiltration into the waste (and therefore the amount of leachate generated) and the emission of landfill gas at the Site. The active tipping face activities are regularly reviewed and configured to minimise the working surface area.
4	*ED3S-S* *Investigate the possible factors contributing to the elevated SOER results from ED3S-S, as found in the Audit. While not being an issue in the short-term, Veolia should investigate the elevated ED3S-S odour levels as matter as a matter of priority and precautionary measure.*	The Audit undertook an extensive liquid and gas sampling campaign to evaluate the condition of the treated leachate in all pond sources. Based on the results obtained in the Audit for pond sources, it appears that the SOER result obtained for ED3S-S was an aberration and no further action is required by Veolia on this matter.

Table 7.2 - 2017 IOA Non-mandatory recommendations		
No.	**2017 IOA Non-Mandatory Recommendations**	**Veolia's Response**
1	<u>*Fugitive gas emissions*</u> *It is understood that Veolia has engaged a university body to investigate fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor, and, in turn, how to increase the effectiveness of landfill gas extraction from the Void. The outcomes of this study will be reviewed as part of the next IOA. It should be noted, however, that the scope of works and agreement for this study is currently under discussion between Veolia and a university institution. The outcomes from that study will be subject to intellectual property rights which may limit is accessible to form part of the audit process. In any case, Veolia and the auditor will revisit this matter in the next IOA.*	There has been a significant improvement in landfill gas extraction in the Void (see **Section 7.2.1.2.1**) due to a number of factors including an expansion and improvement in the leachate management system through optimisation of surface water catchments, landfill gas infrastructure design, active tipping practices and increased leachate treatment capacity via the commissioning of the LTP. The findings of the university-based study will be incorporated into the WIP 2019.
2	<u>*Refine investigation of odour issues in the community*</u> *Despite the reduction in odour complaints as found in the Audit, Veolia should consider refining its investigation of odour issues in the community, particularly surrounding the most common complainants, as to assess the extent to which odour is present in the community. Such an investigation could include:* ▪ *potential odour transport pathways;* ▪ *undertaking of field odour surveys;* ▪ *assess topography of surrounding land;* ▪ *analysis of climatic data; and* ▪ *a detailed review of odour complaint data.*	Odour complaints have increased since the previous IOA (see **Section 7.4.1**). From a qualitative viewpoint, this increase is unclear given the significant improvement in landfill gas extraction in the Void and expansion and improvement in the leachate management system through optimisation of surface water catchments, landfill gas infrastructure design, active tipping practices and increased leachate treatment capacity via the commissioning of the LTP. Given this outcome, the Audit recommends that Veolia continue its active engagement with the community through its existing odour complaints and response management strategy. The handling and management of odour complaints will be reassessed in the next IOA to evaluate the need for additional forms of community engagement, given that the number of complaints remain historically low (see **Section 7.4.1**).

7.2 DISCUSSION OF AUDIT FINDINGS

The following discussion examines the results of the Audit against each of the conditions of consent relating to the Woodlawn Waste Expansion Project.

7.2.1 Condition 7 (B & D)

Condition 7 (B & D) of the Audit requirements stipulate that the following will be carried out in the IOA:

- Audit the effectiveness of the odour controls on-site in regard to protecting receivers against offensive odour; and
- Review the relevant odour sections of the Air Quality and Greenhouse Gas Management Plan for the project and assess the effectiveness of odour control.

As mentioned in the previous IOAs and complemented by the Audit's on-site experience and discussions with Veolia personnel, there continues to be a range of current and on-going odour controls implemented at the Site designed to mitigate off-site impacts arising from its waste management operations. These revolve around:

1. The leachate recirculation method (see **Section 7.2.1.1**);
2. Optimisation and continuous treatment of excess leachate from the Void (see **Section 7.2.1.1)**;
3. Improvement of landfill gas extraction from the Bioreactor (see **Section 7.2.1.2**);
4. Adequate combustion of landfill gas (see **Section 7.2.1.3**);
5. Improve evaporation capability (see **Section 7.2.1.4**);
6. The continued implementation of biofilter cover material, particularly in know high-risk areas such as the Void perimeter where shrinkage effects are pronounced (see **Section 7.2.1.5**);
7. Using the minimal active tipping face as practically possible (see **Section 7.2.1.6**);
8. Water cart to control dust (see **Section 7.2.1.7**);
9. Transportation of waste in sealed containers until unloading at the Bioreactor (see **Section 7.2.1.8**); and
10. The minimisation of leachate generation during stormwater events through improved surface catchment management (see **Section 7.2.1.10**).

7.2.1.1 Leachate Management Method

7.2.1.1.1 Leachate recirculation

To increase the landfill gas capture through the covered waste surfaces, leachate generated within the Bioreactor is removed when it becomes excess to the field capacity or interferes with gas extraction infrastructure. Any excess leachate that is extracted from the Void flows directly to the LTD for primary leachate treatment (see **Section 2.4** for further details).

The leachate recirculation method currently practised within the Void continues to be via direct injection techniques when required (see **Section 2.3.2**). As explained in previous IOAs, this has the effect of minimising the potential exposure of leachate partitioning from the liquid phase to the gas phase, through aerosol generation and/or evaporation pathways, and subsequently leading to the generation of odorous emissions. The 2012 IOA indicated that Veolia's adoption of this recirculation technique is more effective at minimising odours than previously utilised techniques (such as spray sprinklers). The previous 2013 IOA concurred with this finding.

7.2.1.1.2 Leachate recirculation operational status

As previously mentioned in **Section 2.3.2** and based on the WIP 2019, the leachate recirculation has been stopped due to leachate problems and the restriction of the landfill gas extraction caused by the leachate. As such, there is only one reinjection infrastructure being kept as contingency leachate management method when the leachate transfer system experiences any failure. The re-injection point is currently located in the eastern wall of the void, with a 110 mm high-density polyethylene pipe placed into the waste during the previous two lifts. The re-injection point is connected to the ring main and normally in the close position. In the circumstance of leachate transfer system failure, e.g. pump failure or pipe damage, the valve between the re-injection point and the ring main will be opened to allow the extracted leachate to be re-injected to the waste. The re-injection will be stopped once the leachate transfer system is back to normal operation.

7.2.1.1.3 Optimisation and continuous treatment of excess leachate from the Void

<u>The LTD</u>

The Audit understands that there is no longer a need to store untreated leachate in the evaporation dams following the upgrade improvements made to the LTD system since April 2013 (see **Section 2.4.5** for background details) and the growing waste volumes in the Bioreactor. Moreover, since the 2014 IOA, Veolia has further modified the leachate treatment process by dividing the LTD into two treatment zones, namely (in order of process flow):

- an anoxic zone; and

- an aerobic zone.

The splitting into these zones appears to suggest that the Site has converted the LTD into an activated sludge treatment process, which is aimed at optimising BOD reduction and/or nitrification/denitrification processes through the increasing of sludge age in the process. This modification reflects Veolia's on-going efforts in optimising the treatment process. From an odour emissions viewpoint, the optimisation of leachate treatment has significantly improved the Site's odour emissions profile from pond-related source (see **Section 7.5.1**).

Based on the details above, the Audit continues to support this modification from a leachate treatment perspective, provided that optimum conditions in the LTD are sustained and continue to result in good quality treated leachate that contains none of the original odour characteristics of untreated leachate. It is understood that Veolia continues to regularly monitor the treated leachate quality and performance.

<u>The LTP</u>

The Site has constructed and commissioned an MBR-based facility (i.e. the LTP) as the long-term leachate management strategy. As indicated in the WIP 2019, the LTP is in the process proving stage which includes, but is not limited to, biomass growth, biological process tuning and process optimisation. The LTP MBR-based system has been designed as a modified activated sludge biological process to treat the main parameters found in the raw leachate extracted from bioreactor to a higher quality effluent. The LTD and LTP are currently operated simultaneously at the Site, providing a doubling in leachate management and treatment capacities from the Void.

Based on the above analysis, no further action is required by Veolia on this matter. If, however, there are future operational issues with the LMS, Veolia should take the precautionary measures of notifying the NSW EPA (and any other relevant stakeholders) until the issue is rectified.

7.2.1.2 Improvement of landfill gas extraction from the Bioreactor

Landfill gas extraction at this Site is an on-going operational process. The WIP 2019 indicates that there is a comprehensive plan by Veolia to increase gas capture by undertaking the following key items:

1. The continuous expansion of the new drainage systems to promote gas collection; and

2. Management of leachate via minimising surface water flow, leachate recirculation, improvement in landfill gas infrastructure design and condensate

management, and improvement in continuous treatment capacity and efficiency (achieved via the installation of the LTP).

Further information regarding the design and operation of the landfill gas extraction system has been previously documented in extensive detail in the 2012 IOA Report. As such, it has not been documented in the Audit.

7.2.1.2.1 Landfill gas extraction and fugitive emissions

As outlined in the previous IOAs, it is difficult to calculate a representative odour emission rate from the Void given the dynamic virtue of the surface layout. Therefore, as per previous IOA, an alternative approach has been taken where improvement in landfill gas capture efficiency is used as an indicator of reduced potential for fugitive gas emissions from the Void surface.

Table 7.3 summarises the average monthly landfill gas extraction results over the period between January 2018 and January 2019 and compares this result to that obtained in the 2017 IOA. As can be derived from the results in **Table 7.3**, the monthly averaged landfill gas extraction over the period between January 2018 and January 2019 was approximately 2,407,512 m^3 (gas to generators plus flared). In comparison to the gas extraction result obtained from the previous period in the 2017 IOA (i.e. 1,839,132 m^3), this represents an increase of approximately 31% in total gas extraction volume (equivalent to 568,380 m^3). This result reflects Veolia's on-going efforts to improvement landfill gas extraction from the Bioreactor.

Table 7.3 – Monthly landfill gas extraction between 2017 IOA & the Audit	
Summary table	**Values**
2017 IOA landfill gas extraction ($m^{3/}$month)	1,839,132
The Audit landfill gas extraction (m^3/month)	2,407,512
Improvement performance	**30.9%**

The landfill gas trend between January 2018 and January 2019 is illustrated in **Figure 7.1**.

7.2.1.2.1.1 Fugitive landfill gas emissions

As noted in the previous 2017 IOA, the Audit understands that gas capture is measured against a calculated emissions model issued by the *Australian Government – Clean Energy Regulator*. This aspect is outside the scope of the Audit and is therefore not discussed further. Nevertheless, as demonstrated in previous IOAs, it remains clear that fugitive landfill gas emissions emitted from the Void surface can have a very high odour emission potential if gas capture efficiency were to decline. Therefore, the Audit continues to endorse Veolia's plan to actively improve gas extraction capability from the Bioreactor and the items addressed in the WIP 2019 to achieve this, including:

- Gas field balancing, where individual gas extraction wells in the gas extraction network are monitored routinely for gas composition and pressure. This monitoring aims to achieve the following operational objectives:
  - Adjust wells top optimise landfill gas extraction;
  - Determine if any wells are damaged or malfunctioning;
  - Determine average and highest H_2S exposure;
  - Occupational, health and safety concerns regarding H_2S exposure; and
  - Odour management.
- Monitoring of leachate extraction and treatment, as this improves gas extraction capacities;
- Biofilter cover material on high-risk areas prone to fugitive emissions, particularly in around the Void perimeter (see **Section 7.2.1.5** for further details);
- Optimise tipping strategy, as this ultimately affects the efficiency of landfill gas and leachate;
- The connection of more wells/trenches; and
- The implementation of the long-term leachate strategy via the commissioning of the LTP.

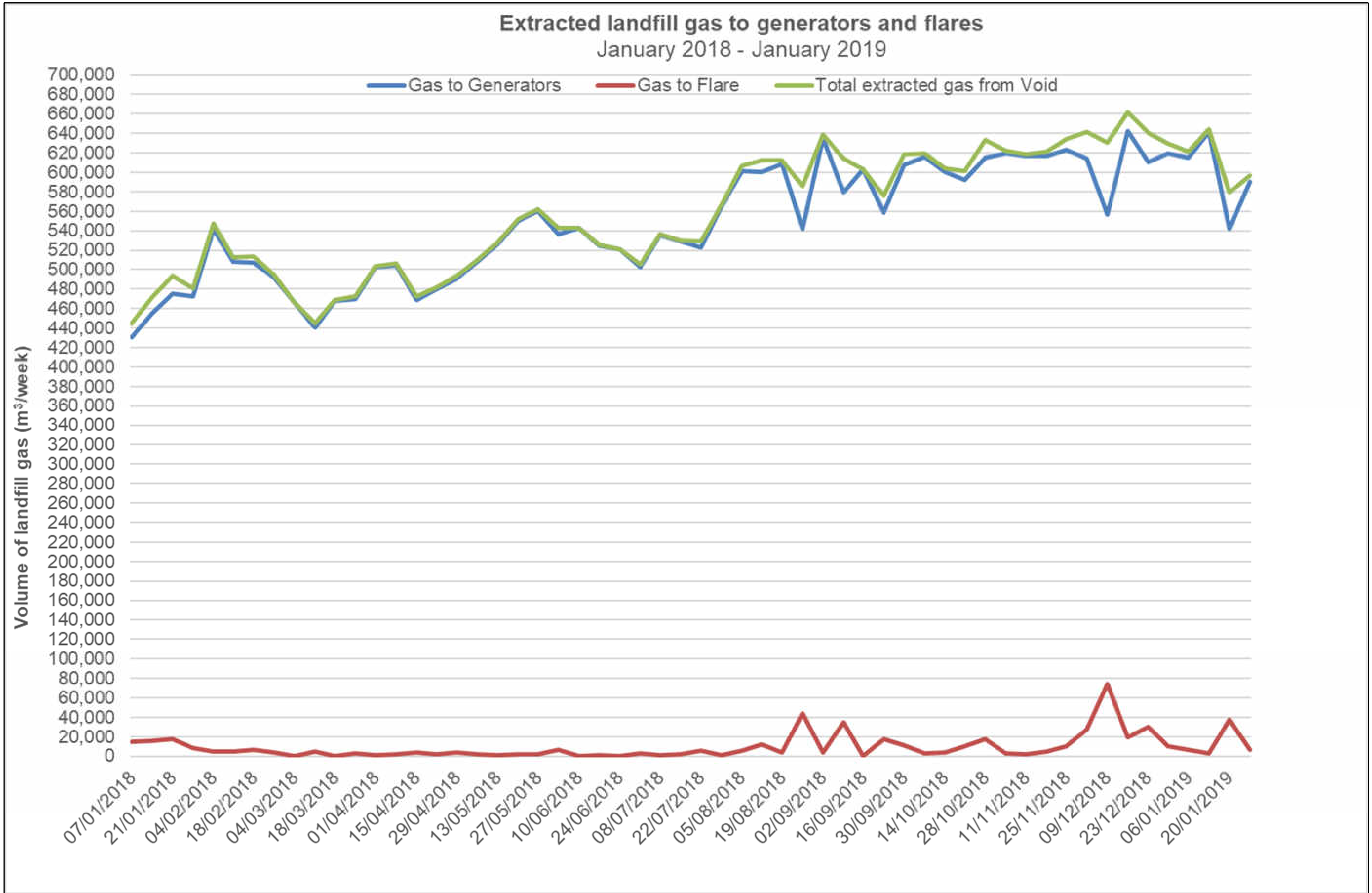


Figure 7.1 – Landfill gas trend between January 2018 and January 2019

7.2.1.3 Landfill gas combustion exhaust quality

According to the 2018 Emissions Testing Report (see **Appendix D**), all combusted gas emissions analysed on NSW EPA Point 8 - Generator No. 2 Exhaust Stack complied with the EPL Limits for NO_x, SO_3/H_2SO_4 and H_2S. The engine load at the time was reported to be 1,065 kilowatts (**kW**). The total hydrocarbon destruction efficiency was found to be 98.8%, indicating efficient combustion of the landfill gas supply to the generators.

Given the outcomes reported in the 2018 Emissions Testing Report and provided the landfill gas engines continue to operate under optimal conditions, and there is no significant deterioration in combustion performance and operating temperature, the landfill gas engine exhaust stacks are not considered to be significant odour emission sources at the Site. These results are consistent with the judgements made in the previous IOAs in that the engine stacks are a minor source of odour (given the operating combustion temperatures) and highly unlikely to result in adverse odour impact beyond the Site boundary. This finding continues to remain valid in the Audit.

7.2.1.4 Improve evaporation capability

Veolia could recommence mechanical evaporation since this activity ceased following the 2012 IOA finding of the odorous quality of the leachate previously-stored in ED3N lagoons. The background for this is well documented in the previous IOAs. The Audit observed that the mechanical evaporators are now active and automated to operate under specific ambient and wind conditions (see **Section 2.4.2.1**).

7.2.1.4.1 ED3N Pond System evaporation and odour potential

The Audit finds that the quality of the treated leachate currently stored in ED3N pond system is relatively comparable to that found in the previous 2017 IOA, where it was found to contain minimal odour emission potential and no evidence of untreated leachate character present in any of the samples collected (see **Section 6.1.2**). This outcome indicates that the leachate treatment quality continues to be optimum and that the LMS at the Site is performing very well from an odour emissions viewpoint. This finding is also consistent with the liquid test results which indicate the liquid odour potential if the liquid was to partition to gas phase either by natural or mechanical evaporation processes. This is discussed below.

7.2.1.4.2 ED3S Pond System evaporation and odour potential

The SOER input from the ED3S May 2016 Report used a SOER of 0.159 ou.m^3/m^2.s for the modelling of ED3S-S. The mean result derived from the Audit is 0.134 ou/m^3/m^2.s (see **Table 6.2**). This result is below the modelled value and unlikely to cause any adverse impact beyond the boundary of the Site. This is a positive outcome.

7.2.1.4.3 Status of evaporation capability from an odour viewpoint

The results derived using the LOM testing is summarised in **Table 6.4** The odour testing results found in the Audit, through conventional area source sampling and the liquid odour measurement potential techniques, indicate very low SOERs and odour concentration values, respectively. Also, the evaporation liquid odour character as determined by the panellists during laboratory testing indicated an 'earthy, musty' character across all samples, suggesting that there is no original, untreated leachate character and favourable treatment of the stored effluent in the ED3N & ED3S-S.

Overall, the Audit deduces that the pond sources at the Site continue to be a minor source of odour at the Site and unlikely to cause adverse odour impacts beyond the boundary. Moreover, the stored contents in ED3N Pond System continues to be suitable for mechanical evaporation and is unlikely to result in adverse odour impact, provided the effluent quality continues to remain of high quality as found in the Audit. The adequate management of the LMS continues to be in the Audit as a mandatory recommendation (see **Section 9.2.2**).

7.2.1.5 The implementation of improved capping material in the form of a biofilter trial program

The Audit found that the biofilter trial program has been extended and continues to be used as a means of managing odour emissions from the Void surface. The biofilter medium cover has shown that it can be effective at attenuating odour from fugitive emission pathways. However, proper management of the biofilter medium is necessary. This includes the regular watering and topping-up of biofilter medium as required. To achieve this, Veolia has developed an action strategy to streamline the management of this material. This is detailed in the Biofilter Trial Report and WIP 2019.

An example of the adoption of biofilter cover strategy in the Void is shown in **Photo 7.1**. The Audit endorses its continued use around high-risk areas prone to fugitive gas emission leaks, where required. As can be seen in **Photo 7.1**, the application of biofiltration material on the batter of the active tipping face is intentional and designed to reduce fugitive gas emissions from new waste covered areas. It is understood that this strategy is adopted as the migration of landfill gas under this landform is primarily horizontal due to the compressive forces from compaction and machinery. No quantification of its effectiveness was possible due to safety and access concerns. Notwithstanding this, a field-based olfactory assessment conducted during the Audit visit indicated that this strategy is effective.

Photo 7.1 – Biofilter cover material applied on the active tipping face batter as occurred on 21 February 2019

7.2.1.6 Using the minimal active tipping face as practically possible

As identified in the previous IOAs, the active tipping face can vary depending on the tonnage input and how the waste is managed. Since the 2015 IOA, the exposed active tipping face was revised to reflect more realistic conditions that are prevalent in the Void (discussed further below). In addition to this, minimising the active tipping face continues to be one of the key performance indicators at the Site for the following reasons (as outlined in previous IOAs):

1. Reduces surface area of potential odour source;
2. Minimises temporary decommissioning of gas extraction infrastructure;
3. Minimises fuel usage, particularly in dozer and compactor; and
4. To meet EPA benchmark techniques.

Photo 7.2 provides a visual indication of the active tipping face area size at the time of the Audit field visit. The original value adopted in the EA 2010 for the active tipping face was 40,000 m^2. This value was later revised to between 4,000 m^2 and 6,000 m^2 in the 2013 IOA to reflect realistic and previous operating conditions occurring at the time. As of the Audit, the current active tipping area is now approximately between 1,000 m^2 and 2,000 m^2, reflecting Veolia's continued efforts at minimising the active tipping face in the Void.

Photo 7.2 - A visual indication of the active tipping face area size as occurred on 21 February 2019

The SOER value determined during this Audit was approximately 7.6 $ou.m^3/m^2.s$. This is close to the SOER value used in the EA 2010 modelling of 7.3 $ou.m^3/m^2.s$. Based on these results and the outcome of the modelling study (see **Section 8**), there is a very low risk that the active tipping face will result in downwind odour impact on the nearest sensitive receptor. Notwithstanding this, it should be noted that:

- Fugitive landfill gas emissions are still judged to be the major contributor to odour emissions from the Void, as previously highlighted in **Section 7.2.1.2**; and
- Veolia has optimised operational practices such as the active tipping surface area is being kept to a minimum. This practice has a significant effect on the rate of emission from this source. That is, any reduction in the exposed waste surface

area will result in a proportional decrease in emissions from the active tipping face, and vice versa.

The Audit finds that current practices at the Site relating to the active tipping face are conducive to the minimisation of odour from this source.

7.2.1.7 Water cart to control dust

Use of the water cart is an ongoing operational activity, which is effective at minimising dust generation. This was visually evident during the fieldwork component of the Audit. The Audit observed that the operating practice of using a water cart to control dust continues to be an on-going practice at the Site. On the above basis, no further action is required by Veolia for this component of the Site's operations.

7.2.1.8 The use of the truck wash bay

The use of the truck wash bay at the Site was observed to be consistently used by trucks upon exiting the Void. The consistent use of the truck wash bay is good practice at minimising potential odour emissions off-site that may be related to truck vehicle movement.

Based on TOU observations, the Audit suggests that Veolia review the following aspects relating to the use of the truck wash bay:

- The coverage of sprays at the wash bay and its ability to thoroughly clean a recently emptied truck. This will minimise transient levels of odour that may be detectable and associated with truck movement in the community.

7.2.1.9 Transportation of waste in sealed containers until unloading at the Bioreactor

Similar to the previous IOAs, the Audit has found that the current measures used for waste transport operations are very effective at mitigating any odour emissions. The Audit team inspected the IMF and conducted a brief downwind olfactometry assessment to determine any presence of waste-based odour. The inspection did not find any evidence of any waste-based odour being emitted at the IMF. On this basis, the Audit determines that there is still no need to sample the IMF as it is very unlikely to generate problematical odour emissions. This is provided that the waste containers used in the process continue to be adequately maintained and remain fully sealed during waste transportation. As such, current practices should be continued and monitored. A photo of the IMF as found during the Audit on 1 February 2017 is shown in **Photo 7.3** & **Photo 7.4.**

Based on TOU observations, the Audit suggests that Veolia review the following aspects relating to the transportation of waste in sealed containers to facilitate in the minimisation of odour from this area/activity:

- The washing practice associated with the sealed containers; and
- The maintenance of the sealed containers.

Photo 7.3 - The IMF facing south-west as observed during the Audit inspection visit on 20 February 2019

Photo 7.4 - The IMF facing south-east as observed during the Audit inspection visit on 20 February 2019

7.2.1.10 The minimisation of leachate generation during stormwater events

As indicated in **Section 2.5.2,** the WIP 2019, the surface water in the Void is managed in sub-catchments as shown in **Figure 2.7.** Each sub-catchment has either a natural or engineered drainage and flow control infrastructure, such as concrete dish drains, clay berms, pumps and pipes, to manage surface water. These sub-catchment areas are intended to minimise the amount of surface water flow from the Bioreactor walls onto the waste. This aims to minimise the potential generation of excess leachate from surface water flows.

7.2.1.10.1 Management of high rainfall events

As previously mentioned in **Section 2.5.2.2**, any stormwater into the Void, especially the portion that directly falls on the waste surface of the Void and the runoff from the upper benches, is one major source of excess leachate generation. As documented in the WIP 2019, it is indicated that leachate generation is very sensitive to high rainfall events due to the large, increasing catchment area and partial stormwater interception.

During high rainfall events, large volumes of rainwater fall onto the waste surface. Currently, stormwater is not 100% intercepted from the surface of the waste before becoming contaminated. Following high rainfall events, the leachate extraction system prioritises the extraction of surface water over leachate collected from the sub-surface (i.e. within the Bioreactor). As leachate extraction rate is approximately 2 - 4 L/s, owing to the leachate treatment system capacity, these rainfall events result in further accumulation of leachate in the Bioreactor, potential reducing the efficiency of the landfill gas capture infrastructure and management of fugitive landfill gas emissions from the Void. It should be noted, however, that the leachate extraction rate represents normal operation but not the peak treatment capacity that can be managed by the LTD. Under normal operating conditions, the Site can maintain a certain freeboard in the LTD to be able to hand a peak flow from the Void. Nevertheless, given the importance of the management of high rainfall events in the Void, the WIP 2019 indicates that an upgrade to the stormwater management system will be undertaken at the Site to minimise excess leachate generation so that stormwater can be diverted to ED3S. This feature of the Void will be examined in the next IOA.

7.3 CONDITION 7 (C)

Condition 7 (C) of the Audit requirements stipulates that the following will be carried out in the IOA:

- Review the proponents' production data (that are relevant to the odour audit) and complaint records

The production data that is relevant to the Audit include:

- Waste throughput to the Bioreactor;

- On-site evaporation data (from the 2012 IOA); and
- Landfill gas consumption in the generators and flare system.

This Audit obtained updated data relating to waste throughput to the Bioreactor, complaint records, and evaporation data from Veolia for the Site since the previous 2016 IOA. These were reviewed as part of the Audit and are appended as **Appendix D.** Complaint log records indicate that the necessary fields required by the *EPL Condition M4 Recording of pollution complaints* are being documented by Veolia.

On the above basis, the Audit is satisfied that all relevant record-keeping duties continue to be adequately maintained.

7.4 CONDITION 7 (F)

Condition 7 *(F)* of the Audit requirements stipulates that the following will be carried out in the IOA:

- *Determine whether the project is complying with the requirements in this approval to protect receivers against offensive odour.*

This Audit has examined compliance or otherwise with *Condition 7(F)* from three perspectives, namely:

- Odour complaints data review and analysis and associated response from Veolia (discussed in **Section 7.4.1**); and
- Compliance with the modelling-based, project-specific odour performance goal of 6 ou (discussed in **Section 8**).

The above points have been discussed in **Section 7.4.1** and **Section 8**.

7.4.1 Odour complaints analysis and response from Veolia

The odour complaints data logged by Veolia and associated response letters were reviewed and analysed in the Audit. **Figure 7.2** illustrates the seasonal distribution of logged odour complaints between 8 October 2010 and 31 March 2019.

The odour complaints analysis indicated the following:

- Since the previous 2017 IOA, over the period of 27 March 2018 and 24 March 2019, there were 53 logged odour complaints, equivalent to a 62% increase in logged complaints, despite Veolia's continuous efforts in odour management at the Site;

- The logged odour complaints data continue to not assist in identifying the nature or likely source of the problematic odours. This appears to be an on-going challenge in the community liaison process; and
- Veolia responded to each logged complaint over the period between 27 March 2018 and 24 March 2019. All responses can be found in **Appendix D**.

From a qualitative viewpoint, the increase in odour complaint is unclear to the Audit given the significant improvement in landfill gas extraction in the Void and expansion and improvement in the leachate management system through optimisation of surface water catchments, landfill gas infrastructure design, active tipping practices and increased leachate treatment capacity via the commissioning of the LTP.

Given this outcome, the Audit recommends that Veolia continue its active engagement with the community through its existing odour complaints and response management strategy. The handling and management of odour complaints will be reassessed in the next IOA to evaluate the need for additional forms of community engagement, given that the number of complaints remains historically low. As such, the refinement in community engagement remains as a non-mandatory recommendation in the Audit to ensure this matter is provided with the opportunity of continuous improvement (see **Section 9.3.2** for more details).

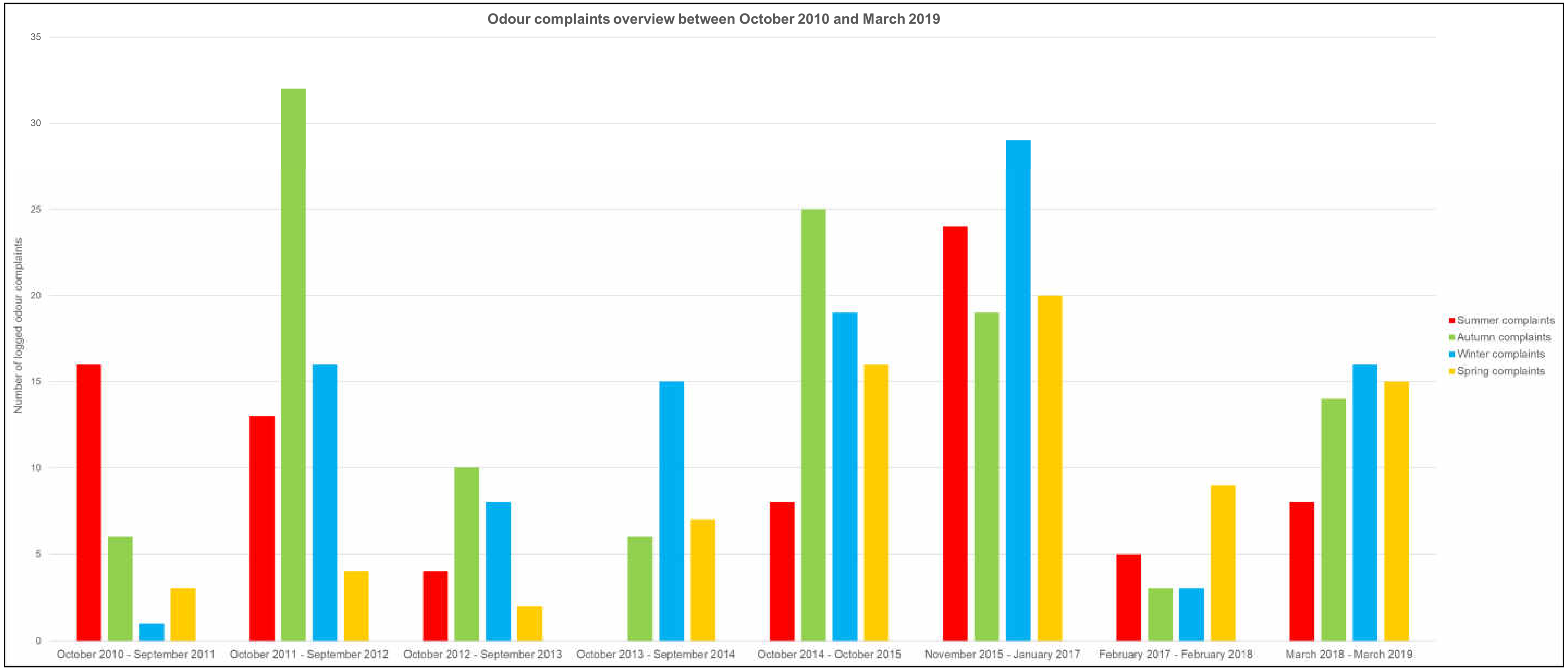


Figure 7.2 - Number of logged odour complaints between October 2010 and March 2019

7.5 ODOUR EMISSIONS INVENTORY DISCUSSION

As per the recommendation of the previous IOAs, the Audit recommends using an overall odour emissions inventory for the Site and examined it as to place into context the emissions from any single source.

Table 7.4 details the odour emission inventory for the Site as determined by the testing carried out in the Audit and compares these results with predictions of emissions contained in the EA. It also makes a comparison with the impact of the revised areas (where applicable) for each odour emission source as found in the Audit.

It is acknowledged that there are odour emissions not listed in this inventory, emanating mostly from sources where quantitative measurement or even estimates are difficult. These include the fugitive odour releases from the Void, previously described as potential gas pathways, arising from gas leakages from the covered areas and around the walls of the Void and leachate recirculation air pressure relief vent. Despite these omissions, it is considered that the incomplete inventory remains to have real value and is discussed later (see **Section 7.5.2**).

Table 7.4 - Measurable odour emission rates for the Site ^

Parameters					The Audit		2017 IOA		2016 IOA		2015 IOA		2014 IOA		2013 IOA			2012 IOA		EA		
Location	**Current Area (m^2)**	**2016 Area (m^2)**	**2014 Area (m^2) ^^**	**2012 Area (m^2)**	**SOER (ou.m^3/m^2/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER 2012 Area (ou.m^3/s)**	**OER - Current Area (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER (ou.m^3/s)**	**SOER (ou.m^3/m^2/s)**	**OER (ou.m^3/s)**	**OER - Current Area (ou.m^3/s)**
ED3N-1	7,500	6,000	6,000	7,000	0.356	2,670	0.132	792	0.130	780	0.132	794	0.017	104	0.30	2,100	1,800	394	2,760,000	8.8	61,600	52,800
ED3N-2 & 3 ^^^	12,400	11,000	11,000	13,000	0.102	1,260	0.129	1,420	0.175	1,930	0.118	1,300	0.049	543	11.6	150,000	127,000	0.29	3,800	7.4	96,200	81,400
ED3N-2	7,000	5,500	5,500	6,500	0.169	1,180	0.120	660	0.148	811	0.145	797	0.066	365	20.1	131,000	111,000	0.21	1,350	n/a^^^		
ED3N-3	5,400	5,500	5,500	6,500	0.035	190	0.139	765	0.20	1,110	0.091	500	0.032	178	0.2	1,010	852	0.37	2,430			
ED3N-4	39,000	25,000	25,000	16,000	0.095	3,710	0.163	4,080	0.248	6,200	0.269	6,720	0.023	575	0.0604	966	1,510	0.41	6,600	0.7	11,200	17,500
ED3S	89,400	89,435	n/a		0.058	5,190	0.116	10,400	0.277	24,700	No previous measurements available as ED3S & ED3S-S are new sources									0.5	44,700	24,700
ED3S-S**	19,000	1,420			0.134	2,550	1.97	44,700	0.437	621										0.159	4,510	226
Active Tipping Face	2,000	6,000	6,000	40,000 *	7.59	15,200	9.52	14,300	8.16	49,000	7.51	45,100	4.28	25,700	3.04	122,000	18,200	8.36	334,000	7.3	292,000	43,800
Leachate Treatment Dam	5,000	5,000	5,000	2,000	0.186	930	0.243	1,220	0.27	1,350	0.276	1,380	0.026	129	0.323	647	1,620	0.46	920	3.6	7,200 #	18,000
Construction and Demolition Tip Face	900	900	500	900	n/a	n/a	n/a	n/a	n/a	n/a	0.326	294	n/a^	n/a	0.293	264	147	n/a	n/a	n/a	n/a	n/a
Storage Pond 7	n/a	n/a	n/a	1,200	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/m^^	n/a	n/m	n/m	n/m	85	102,000	n/m	n/m	n/m

n/a = not applicable
n/m = not measured
^ All odour emission rates represent the derived mean SOER values for each location
^^ As advised by Veolia
^^^ reported in the EA 2010 as a single emission source i.e. ED3N-2 & ED3N-3 as a single area
# represents mean result for different batches of leachate between 2007 and 2011
* as per AAQMP estimate
** Target SOER not obtained from the EA. Source of emission data is the *Woodlawn Bioreactor Facility Odour Modelling Study - Proposed addition of ED3S to leachate management system - May 2016: Table 2.1*

Based on the result in **Table 7.4**, the following comments are made:

- The total measurable odour emission rate from the Site found in the Audit was 26,200 ou.m^3/s, representing a substantial decrease of 94% since the 2017 IOA. The dominant contributor to this result is the reduction in OER for ED3S-S since the previous IOA, likely related to the characteristics prevailing in ED3S-S at the time of sampling. This is a good result and indicates that the treated leachate content in ED3S-S is of good quality and low in odour;
- The active tipping face is now contributing to approximately 43% of the Site's total measurable odour emissions, without consideration of fugitive landfill gas emissions (see **Section 7.2.1.2**). This increase is attributable to the reduction in pond sources, the sampled locations of the waste covered area in the Void and management practice associated with the active tipping ace (see **Section 7.2.1.6** for details);
- Overall, the LMS continues to operate under very low odour emission conditions and is unlikely to be contributing to any significant odour impact beyond the Site boundary;
- From a comparative viewpoint, the SOER results show close agreement between the Audit results and the EA 2010 value for all emission sources (see **Table 6.1**). This is a significant result as it shows that the SOER predictions in the EA 2010 are suitable for current and future operations at the Site. This is supported by the odour modelling study conducted in the Audit (see **Section 8**); and
- Like the previous IOAs, ED3N-2 & ED3N-3 have been reported both as separate emission sources and a single source (as per the EA 2010) as to determine the relative contribution of odour emission from each pond separately.

The following sections discuss the results from the odour emissions inventory and Audit in the context of the pond and non-pond sources (see **Sections 7.5.1 & 7.5.2** respectively).

7.5.1 Pond sources

All pond sources at the Site sampled in the Audit are considered area sources, including:

- ED3N Pond System: this includes ED3N-1, 2, 3 and 4;
- ED3S Pond System: this includes ED3S & ED3S-S; and
- LTD.

The following sections discuss each of the above pond sources.

7.5.1.1 ED3N Pond System

In the context of the odour emissions inventory for the Site, the Audit finds that at the current and above performance targets for leachate quality, leachate effluent stored in ED3N represents very low odour emissions since the IOAs began in 2011. The derived mean SOER's for ED3N-1, 2, 3 & 4 in the Audit is 0.356 ou.m^3/m^2/s, 0.169 ou.m^3/m^2/s, 0.035 ou.m^3/m^2/s, and 0.095 ou.m^3/m^2/s, respectively. At these values, the stored contents of ED3N continue to be a minor odour emission source at the Site.

On the above basis, the Audit finds that the leachate performance targets set by Veolia are appropriate in attenuating odour emissions from pond-related sources. It can be considered that any significant deviation of the leachate quality monitoring targets would be a reasonable indicator that there will be an increase in risk potential for odour emission generation from the ED3N Pond System. This risk potential is considered to be significantly mitigated with the commissioning of the LTP.

7.5.1.2 ED3S Pond System

7.5.1.2.1 ED3S

In the context of the odour emissions inventory for the Site, the Audit finds that at the current and above performance targets for stormwater quality stored in ED3S represents very low odour emissions since the IOAs began in 2011. The derived mean SOER for ED3S in the Audit is 0.058 ou.m^3/m^2/s. At this value, the stormwater stored in ED3S is of a quality that is conducive with low odour.

7.5.1.3 ED3S-S

The SOER input from the ED3S May 2016 Report used a SOER of 0.159 ou.m^3/m^2/s for the modelling of ED3S-S. The mean result derived from the Audit is 0.134 ou/m^3/m^2/s (see **Table 6.2**). This result is below the modelled value and unlikely to cause any adverse impact beyond the boundary of the Site. This is a positive outcome.

7.5.1.4 Leachate Treatment dam

The LTD was found to be very effective in treating the incoming leachate before storage in ED3N Pond System. The SOER derived in the Audit from this source is 0.186 ou.m^3/m^2/s, well below the EA 2010 value of 3.6 ou.m^3/m^2/s and almost identical to that found in the 2017 IOA. On this basis, Veolia should continue to work with Veolia Water in optimising the treatment process. The Audit endorses this continuation.

7.5.2 Non-pond sources

The activities within the Void were judged to be similar regarding process operations to that found in the 2016 IOA, except for the landform adopted for the active tipping face within the Void (see **Section 7.2.1.5** for details) . The Audit endorses the continued use of biofiltration cover material around high-risk areas prone to fugitive gas emission leaks, where required.

The Audit odour testing results indicate that the Void continues to remain the major contributor to odour emissions at the Site, through fugitive gas emissions, if gas extraction is not effectively maintained. The fugitive landfill gas emissions that arise due to wall effects and cracks in the capping of waste, particularly near landfill gas extraction wells and Void perimeter, are an on-going operational issue at the Site. A reduction in leachate extraction can also impact the effectiveness of the landfill gas extraction. Based on the significant in landfill gas capture, it appears that the Void was operating in a state with minimal fugitive gas emissions at the time of the Audit (see **Section 7.2.1.2.1**).

7.5.3 Active tipping face

For reasons discussed in **Section 7.2.1.6**, the mean SOER result of 7.6 ou.$m^3/m^2/s$) from the active tipping face as found in the Audit is not considered significant from an odour impact viewpoint, but demonstrates the importance of continued efforts to minimise the active tipping face as much as practically possible. Overall, the Audit finds that current practices at the Site in relation to the active tipping face are conducive to the minimisation of odour from this source.

8 ODOUR MODELLING STUDY

8.1 PREFACE

As part of the Audit's scope of work, TOU was requested to deliver a re-run of the site-specific odour dispersion model initially done in the EA 2010 with the current operational factors and odour audit emissions data. As previously mentioned in **Section 7.4**, the purpose of the re-run is to demonstrate compliance with the modelling-based, project-specific odour performance goal of 6 ou and *Condition 7 (F)* of the Audit requirements.

8.1.1 Relevant Modelling Background Information

To enable the undertaking of the modelling re-run, TOU was supplied the original odour dispersion model used in the EA 2010 developed by the former Heggies Pty Ltd, now operating under SLR Consulting. TOU updated the original CALMET meteorology for its initial assessment of the addition of the ED3S dam to the leachate management system (refer to *Veolia Australia & New Zealand Woodlawn Bioreactor Facility Odour Modelling Study – Proposed Addition of ED3S to Leachate Management System* dated May 2016). The preparation methodology for the meteorology has been reproduced in **Section 8.3**. For the CALPUFF odour dispersion modelling and under strict instructions, the ED3S study and subsequent studies involved the addition of new sources without modification to existing sources within the original EA odour model (**the Previous Model**). The original configuration and odour emission rates can be found in *Section 5* of the EA 2010 titled *Odour and Dust Impact Assessment (Rev 5) Report* dated 2 August 2010.

8.1.2 Scope of Works

The scope of the Audit required the update of the previous odour dispersion model with current operational factors and odour audit emissions data measured as part of the current IOA. This involved the modification and removal of existing odour sources from the original CALPUFF dispersion model to best represent the present operations during the Audit period.

The following section details the methodology and findings of the odour modelling study.

8.2 ODOUR DISPERSION MODELLING METHODOLOGY

8.2.1 Odour Emissions Testing Results Summary

The results of the odour emissions testing carried out for the Audit containing the source areas, SOERs and OERs are summarised in **Table 8.1.** The tabulated odour emission inventories for the EA and each of the annual odour audits are available in **Appendix F,** along with the individual sample results for the current and previous odour audits.

Table 8.1 – A summary of odour emissions data used in the modelling study

Location	Area (m^2)	SOER ($ou.m^3/m^2$ s)	OER ($ou,m^3/s$)	Comments
ED3N-1	7,500	0.356	2,670	Mean value of three samples from the Audit.
ED3N-2 & 3^	12,400	0.102	1,260	Mean value of six samples from the Audit.
ED3N-4	39,000	0.095	3,710	Mean value of three samples from the Audit.
ED3S	89,400	0.058	5,190	Mean value of two samples from the Audit.
ED3S-S	19,000	0.134	2,550	Mean value of three samples from the Audit.
Active Tipping Face	2,000	7.59	15,200	Mean value of three samples from the Audit.
Leachate Treatment Dam	5,000	0.186	930	Mean value of anoxic and aeration zone samples from the Audit.
Waste Covered Area	122,000	2.59	317,000	75^{th} percentile of twelve samples from the previous IOA and the Audit given the high variability of this source as described in **Section 2.3**.

^Modelled OER slightly higher than that report in **Table 8.1**

The exclusion for the modelling exercise is as follows:

- At the time of the Audit visit, ED1 coffer dam was empty. As such, it was not included as part of the modelling undertaken in the Audit. ED1 coffer dam will be included in the sampling and testing monitoring program in the next IOA; and

- The contribution of the spray evaporation system (as described in **Section 2.4.2.1**) and reported in **Table 6.4**. There is no evidence to suggest that the mechanical spray evaporation is a problematical activity from an odour viewpoint given the outcome of the LOM analysis undertaken in the Audit (see **Section 6.1.6**).

8.2.2 Odour Source and Emission Rate Configurations

The Previous Model area sources were extracted as shapefile polygons by Geographic Information System (**GIS**) techniques from the quality assurance (**QA**) file automatically generated by CALPUFF for the area sources. The location of each area source is mapped in **Figure 8.1**. Existing sources had their location and dimensions corrected and defunct sources were removed to best represent the present operations reflected in the latest iteration of odour emissions testing for the Audit. The result is illustrated in **Figure 8.2.** It should be noted that the Alterative Treatment Facility (**ATF**) did not proceed and was removed from the updated model.

With the use of GIS vector processing tools and field calculator, areas were derived and multiplied by their previously modelled SOER to obtain the OER for each source used in the previous modelling. The results, along with OERs from two volume sources have been collated for the previous modelling and are shown in **Table 8.2**. Included in the table are descriptions of the changes made from the Previous Model to the updated model for the Audit. Current source areas and emission rates used for the Audit are presented in **Table 8.3**.

Figure 8.1 – Layout of area sources in the Previous Model

Figure 8.2 – Layout of area sources for the updated model used in the Audit

Table 8.2 – The Previous Model source areas and emission rates					
Source ID	**Description**	**Area (m^2)**	**SOER ($ou.m^3/m^2$ s)**	**OER ($ou.m^3/s$)**	**Comments**
LDAM	Leachate Treatment Dam	3,640	3.60	13,100	Modified to LTD.
GW	Groundwater (aka ED3N-4)	35,400	0.300	10,600	Modified to ED3N-4
TL1	Treated leachate (aka ED3N-2 & 3)	9,960	3.60	35,800	Modified to ED3N-2-3.
UTL	Untreated leachate (aka ED3N-1)	6,440	5.00	32,200	Modified to ED3N-1.
COVW	Covered aged waste	63,500	0.300	19,000	Modified to WCA. Elevation RL740.
AGEDW	Treated leachate spray	58,300	3.60	210,000	Modified to LRA. Elevation RL740.
FW	Fresh waste	24,000	0.700	16,800	Modified to ATF. Elevation RL740.
WR3	Composted material in windrow	40,000	0.110	4,400	Deleted. AWT did not proceed.
WR2	Fresh waste in windrow	4,420	5.65	25,000	Deleted. AWT did not proceed.
WR4	Freshly turned waste in windrow	4,260	4.92	20,900	Deleted. AWT did not proceed.
WR4_2	Freshly turned waste in windrow	1,810	4.92	8,870	Deleted. AWT did not proceed.
WR5	Greenwaste storage	1,930	2.37	4,570	Deleted. AWT did not proceed.
WR5_2	Composted material in windrow	9,270	0.110	1,020	Deleted. AWT did not proceed.
SRC_1	MSW storage, sorting, processing	N/A	N/A	5.65	Deleted. AWT did not proceed.
SRC_2	Greenwaste storage, sorting, processing	N/A	N/A	2.37	Deleted. AWT did not proceed.
Original EA Total OER				402,000	Note: to three significant figures
ED3S-S	Leachate Evaporation Dam 3 South-South System – measured 2016	27,500	0.437	12,000	Area and SOER modified.
ED3S1	Leachate Evaporation Dam 3 South System – measured 2016	23,700	0.277	6,560	Area and SOER modified.
ED3S2	Leachate Evaporation Dam 3 South System – measured 2016	65,300	0.277	18,100	SOER modified.
ED2-A^	Heron Mine Dewatering	54,400	0.078	4,240	Measured 2017 for Heron.
ED2-B^	Heron Mine Dewatering	161,000	0.078	12,500	Measured 2017 for Heron.
Additional OER				53,400	Note: to three significant figures
The Previous Model Total OER				456,000	Note: to three significant figures

^ Heron Mine Dewatering dam is not part of the Site or the Void operations

Table 8.3 – Updated model source areas and emission rates					
Source ID	**Description**	**Area (m^2)**	**SOER ($ou.m^3/m^2 s$)**	**OER ($ou.m^3/s$)**	**Comment**
ATF	Active Tipping Face	2,000	7.59	15,200	Previously FW. Elevation RL740.
LRA	Leachate Recirculation Area (ceased)	20,000	0	0	Previously AGEDW. Leachate recirculation ceased (WIP 2019). Elevation RL740.
WCA	Waste Covered Area (fugitives)	122,000	2.59	317,000	Previously COVW. Elevation RL740.
ED2-A^	Heron Mine Dewatering	54,400	0.078	4,240	None.
ED2-B^	Heron Mine Dewatering	161,000	0.078	12,500	None.
ED3N-1	Leachate Evaporation Dam 3 North System	7,500	0.356	2,670	Previously UTL.
ED3N-2-3	Leachate Evaporation Dam 3 North System	14,500	0.102	1,480	Previously TL1.
ED3N-4	Leachate Evaporation Dam 3 North System	39,000	0.095	3,710	Previously GW.
ED3S1	Leachate Evaporation Dam 3 South System	24,200	0.058	1,400	None.
ED3S2	Leachate Evaporation Dam 3 South System	65,300	0.058	3,800	None.
ED3S-S	Leachate Evaporation Dam 3 South-South System	19,000	0.134	2,550	None.
LTD	Leachate Treatment Dam	5,000	0.186	930	Previously LDAM.
Updated model total OER				360,000	Note: to three significant figures

^ Heron Mine Dewatering dam is not part of the Site or the Void operations

8.3 ODOUR DISPERSION MODELLING METHODOLOGY

8.3.1 NSW Odour Criteria and Dispersion Model Guidelines

Regulatory authority guidelines for odorous impacts of gaseous process emissions are not designed to satisfy a 'zero odour impact criteria', but rather to minimise the nuisance effect to acceptable levels of these emissions to a large range of odour sensitive receptors within the local community.

The odour impact assessment for this project has been carried out in accordance with the methods outlined by the documents:

- NSW EPA, 2017, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*;
- NSW EPA, 2006, Technical Framework (and Notes): *Assessment and Management of Odour from Stationary Sources in NSW*; and
- Barclay & Scire, 2011, *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'*.

The documents specify that the odour modelling for Level 3 impact assessments, upon which this odour modelling study is conducted in the Audit, be based on the use of:

- The 99.0th percentile dispersion model predictions;
- 1-hour averaging times with built-in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time;
- Odour emission rates multiplied by the peak-to-mean ratios as outlined in **Table 8.4**;
- The far-field distance typically defined as greater than 10 times the largest source dimension, either height or width; and
- The appropriate odour impact assessment criterion (**IAC**), based on the population of the affected community near the development.

Table 8.4 – NSW EPA peak-to-mean factors			
Source type	**Pasquill-Gifford stability class**	**Near-field P/M60***	**Far-field P/M60***
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

*Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

Source: *NSW EPA, 2017, Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales – Table 6.1*

The IAC for complex mixtures of odours are designed to include receptors with a range of sensitivities. Therefore, a statistical approach is used to determine the acceptable ground level concentration of odour at the nearest sensitive receptor. This criterion is determined by the following equation:

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

Equation 8.1

where,

IAC = Impact Assessment Criteria (ou)

***p* =** population

Source: NSW EPA, 2017, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales – Equation 7.2*

Based on **Equation 8.1**, **Table 8.5** outlines the odour performance criteria for six different affected population density categories. It states that higher odour concentrations are permitted in lower population density applications.

Table 8.5 – Odour IAC under various population densities	
Population of affected community	**Odour performance criterion (ou)**
Urban Area (≥ ~2000)	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤ ~2)	7.0

Source: NSW EPA, 2017, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales – Table 7.5*

The original odour impact assessment contained in the EA 2010 had adopted the IAC of **6 ou** "*given the low number of sensitive receptor locations in the vicinity of the Woodlawn site*". TOU has maintained consistency with this approach as conditions have not significantly changed.

8.3.2 Odour Dispersion Model Selection

The odour dispersion modelling assessment was carried out using the CALPUFF System (Version 6.42). CALPUFF is a puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport. CALMET is a meteorological model that produces three-dimensional gridded wind and temperature fields to be fed into CALPUFF (Atmospheric Studies Group, 2011). The primary output from CALPUFF is hourly pollutant concentrations evaluated at gridded and/or discrete receptor locations. CALPOST/CALRANK processes the hourly pollutant concentration output to produce tables at each receptor and contour plots across the modelling domain. For further technical information about the CALPUFF modelling system refer to the document *CALPUFF Modeling System Version 6 User Instructions*.

The CALPUFF system can account for a variety of effects such as non-steady-state meteorological conditions, complex terrain, varying land uses, plume fumigation and low wind speed dispersion (Environment Protection Authority, 2017). CALPUFF is considered an appropriate dispersion model for impact assessment by NSW EPA in their document - *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* in one or more of the following applications:

- complex terrain, non-steady-state conditions;
- buoyant line plumes;
- coastal effects such as fumigation;

- high frequency of stable calm night-time conditions;
- high frequency of calm conditions; and
- inversion break-up fumigation conditions.

In the case of this odour modelling study in the Audit, CALPUFF was required to handle the complexity of surrounding terrain features. Under calm and very light winds, non-steady-state conditions such as accumulation of odour and/or downslope movement with drainage airflow would almost certainly occur.

For the odour modelling study in the Audit, the air contaminant was odour and ground-level concentrations in odour units (ou) have been projected.

8.3.3 Geophysical and Meteorological Configuration

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

8.3.4 Terrain configuration

Terrain elevations were sourced from 1 Second Shuttle Radar Topography Mission (**SRTM**) Derived Smoothed Digital Elevation Model (**DEM-S**). The SRTM data was treated with several processes including but not limited to removal of stripes, void filling, tree offset removal and adaptive smoothing. The DEM-S was used as input into TERREL processor to produce 20 kilometres (**km**) by 20 km grid at 0.15 km resolution. A map of the terrain is illustrated in **Figure 8.3.**

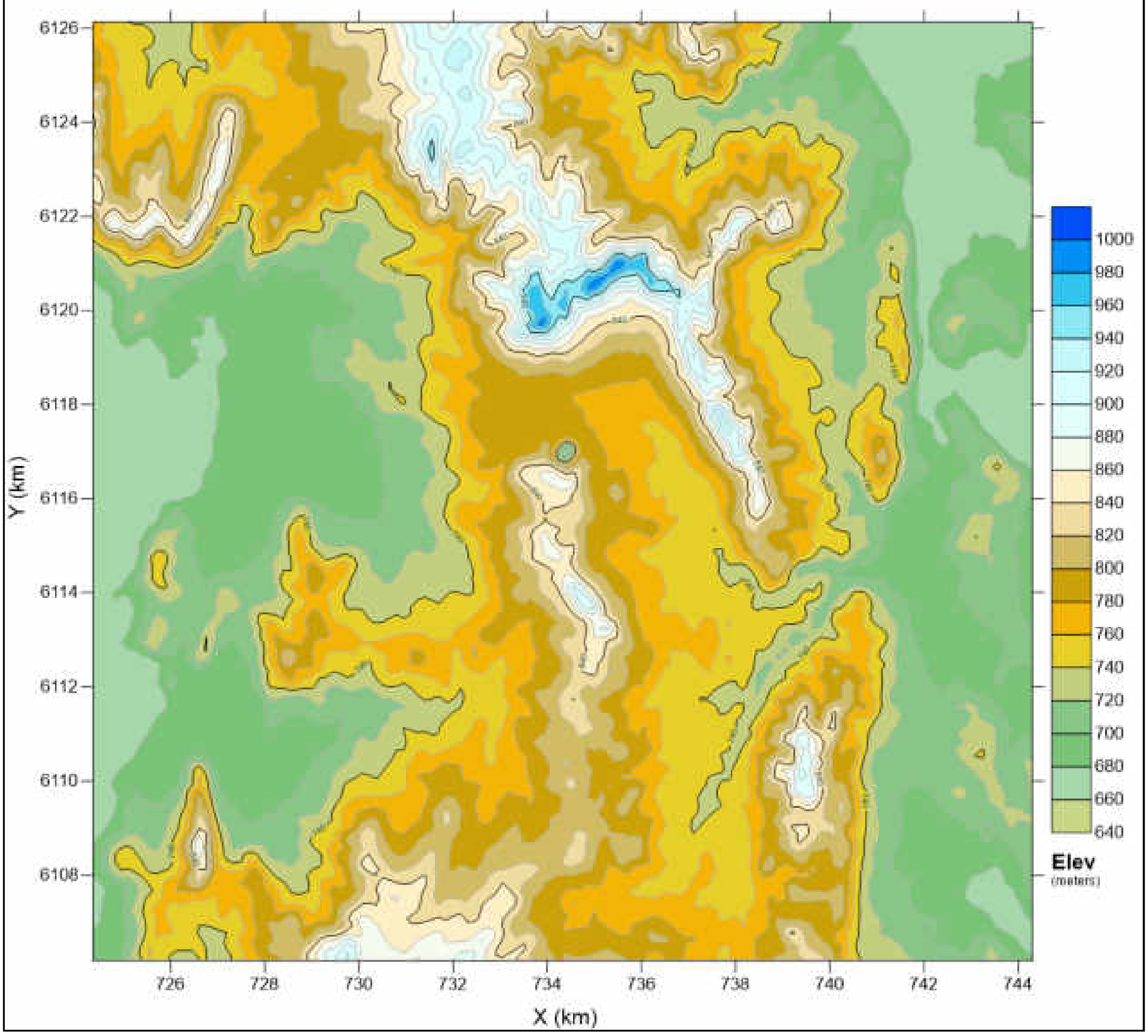


Figure 8.3 – Terrain map of Woodlawn and surrounds

8.3.5 Land use configuration

Land use was sourced from the United States Geological Survey (**USGS**) Global Land Cover Characteristics Data Base for the Australia-Pacific Region. The data was used as input into CTGPROC processor to produce a 20 km by 20 km grid at 0.15 km resolution. A map of the land use is illustrated in **Figure 8.4**.

8.3.6 Geophysical configuration

The geophysical data file was created using the MAKEGEO processor. Land use data from CTGPROC and terrain data from TERREL was used as input to produce a 20 km by 20 km geophysical grid at 0.15 km resolution.

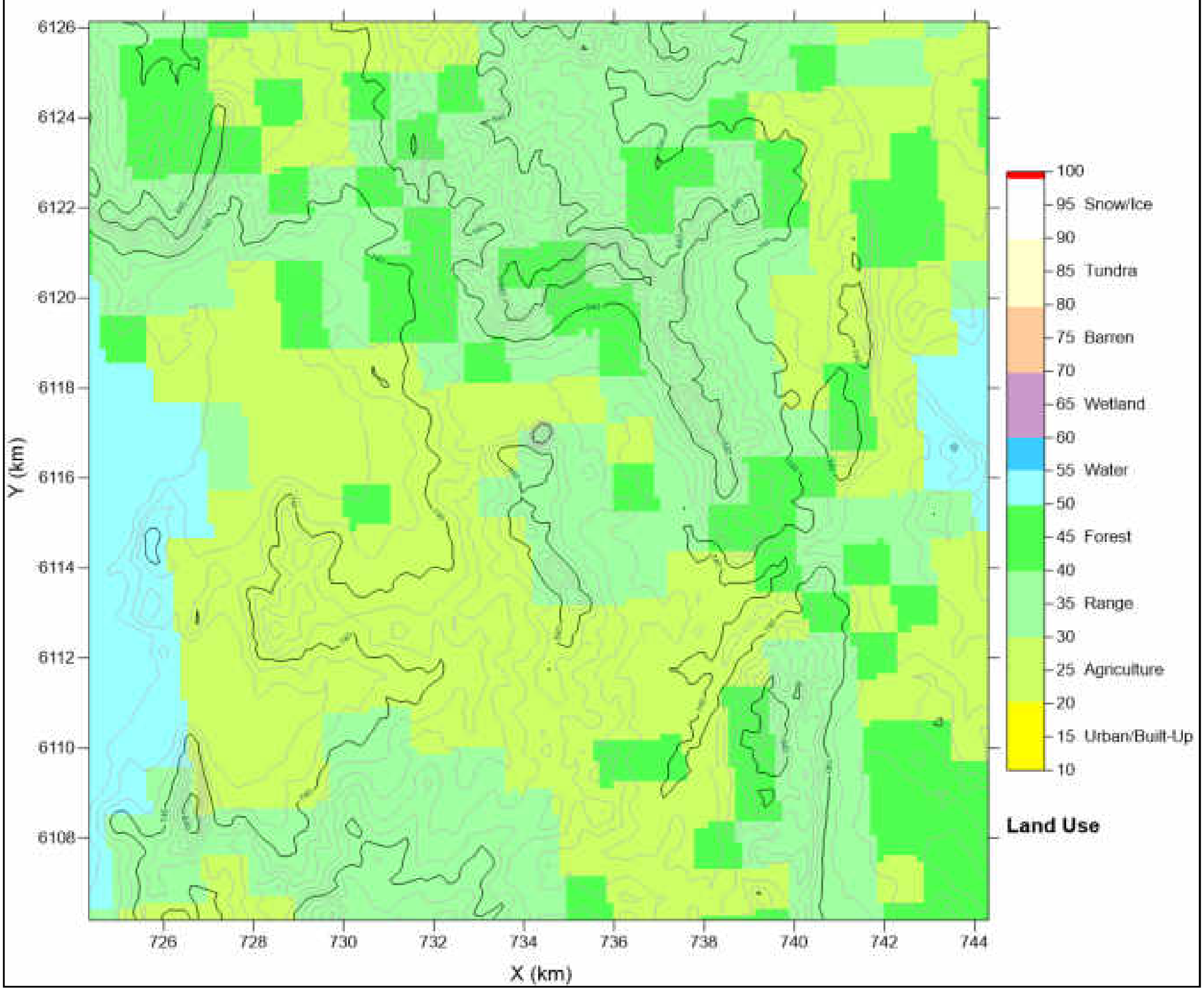


Figure 8.4 – Land use map of Woodlawn and surrounds

8.3.7 Meteorological configuration

8.3.7.1 Input data

One-hour average observed meteorological surface data for a representative year (2015) was sourced from Goulburn Airport that is maintained by Bureau of Meteorology (**BOM**). The location of Goulburn Airport surface station and other metadata are available in **Appendix F**. The BOM data was formatted into generic format and was processed with SMERGE to produce a surface meteorological data file.

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

8.3.7.2 CALMET meteorological model configuration

CALMET was run using the hybrid option that uses geophysical data, surface station data from Bundaberg Airport and upper-air data from the TAPM 3D data tile. The data was used to initialise the diagnostic functions of the CALMET module to produce a full 3D meteorology data for input into CALPUFF. **Table 8.6** shows the key variable fields selected.

8.3.7.3 Meteorological data analysis

Observed 2015 BOM surface data was compared with longer-term climate (2011 – 2015) from Goulburn Airport to gauge how representative and suitable the year is for air quality dispersion modelling. For reference, meteorological data were also extracted from the CALMET model for the location directly near the Woodlawn site office. The annual windroses for Goulburn Airport show very good agreement with west to northwest winds dominating (**Figure 8.5**). The Woodlawn windroses (**Figure 8.6**) show bias to lighter winds and greater frequency of east to south-easterly winds, perhaps due influences from the nearby valley and ridgelines. A more conservative bias is expected relative to the observations at Goulburn Airport.

Both monthly average (**Figure 8.7**) and diurnal temperature (**Figure 8.8**) profiles for the long term and 2015 are in very good agreement. Diurnal mixing heights and stability class frequencies over the Woodlawn site are shown in **Figure 8.9** and **Figure 8.10**, respectively.

Table 8.6 – CALMET key variable fields											
Grid Configuration (WGS-84 UTM Zone 55S)											
134					**NX Cells**						
134					**NY Cells**						
0.15					**Cell Size (km)**						
724.277			6106.107		**SW Corner (km)**						
11					**Vertical Layers**						
ZFACE (m)	0	20	40	80	160	320	640	1000	1500	2000	2500	3000
LAYER	1	2	3	4	5	6	7	8	9	10	11	
MID-PT (m)	10	30	60	120	240	480	820	1250	1750	2250	2750	

Critical Wind Field Settings			
Value	**Found**	**Typical**	**Values**
TERRAD	4	None	Terrain scale (km) for terrain effects
IEXTRP	-4	4,-4	Similarity extrap. of wind (-4 ignore upper stn sfc)
ICALM	0	0	Do Not extrapolate calm winds
RMAX1	6	None	MAX radius of influence over land in layer 1 (km)
RMAX2	8	None	MAX radius of influence over land aloft (km)
R1	3	None	Distance (km) where OBS wt = IGF wt in layer 1
R2	4	None	Distance (km) where OBS wt = IGF wt aloft

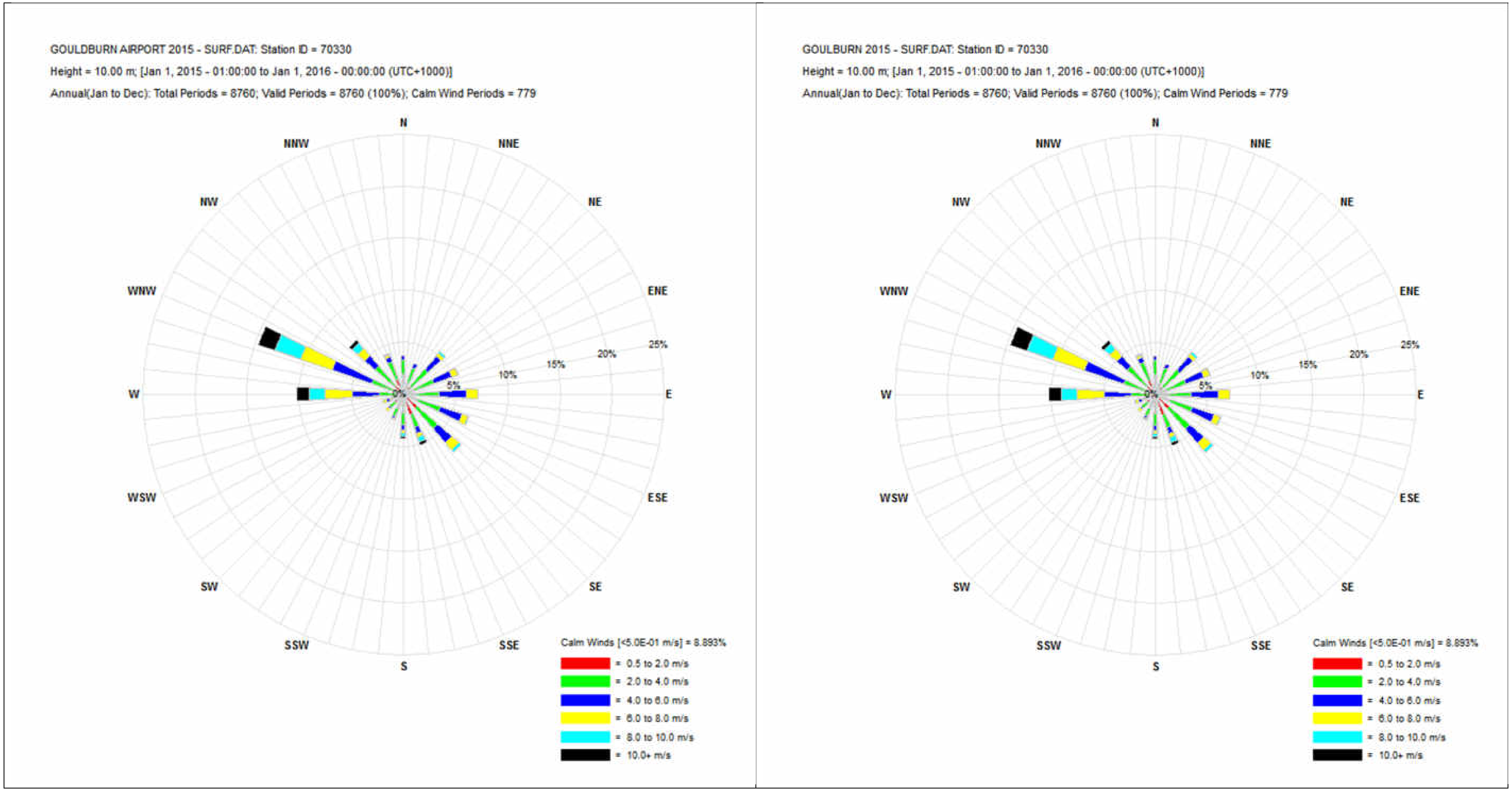


Figure 8.5 – Annual windroses for Goulburn Airport 5 years and 2015 only

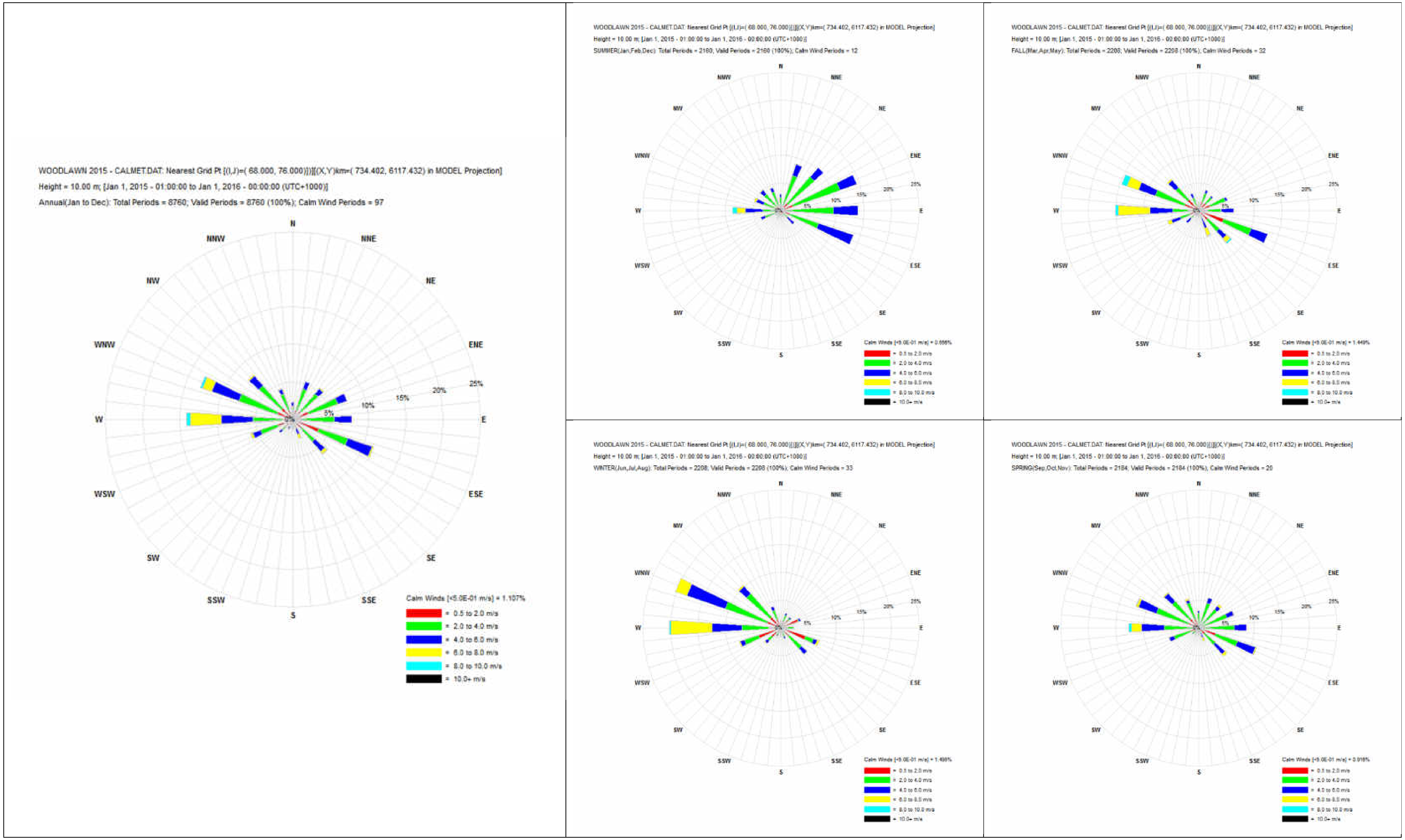


Figure 8.6 – Annual and seasonal windroses for Woodlawn 2015 (modelled)

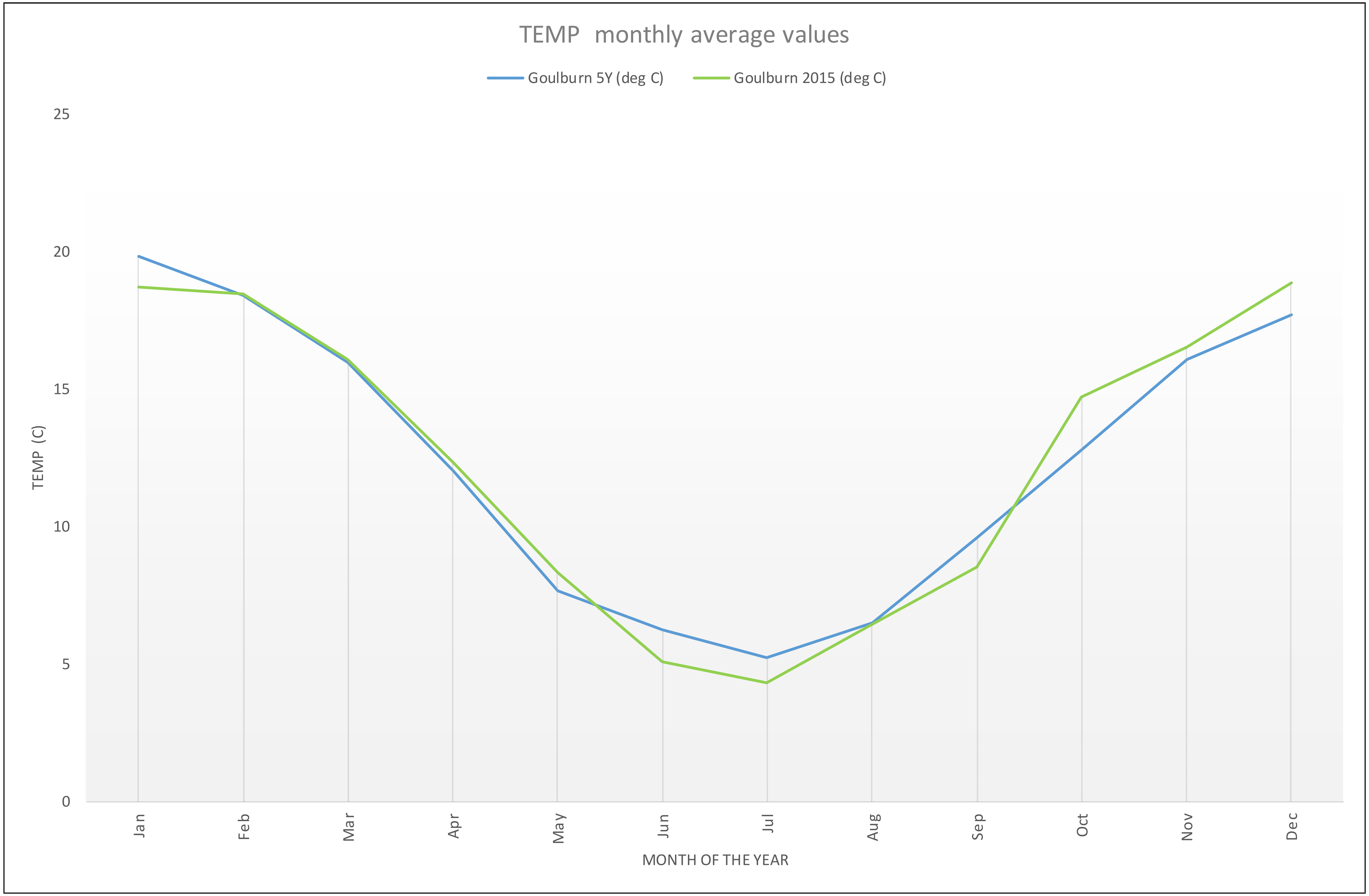


Figure 8.7 – Monthly average temperatures for Goulburn Airport 5 years and 2015 only

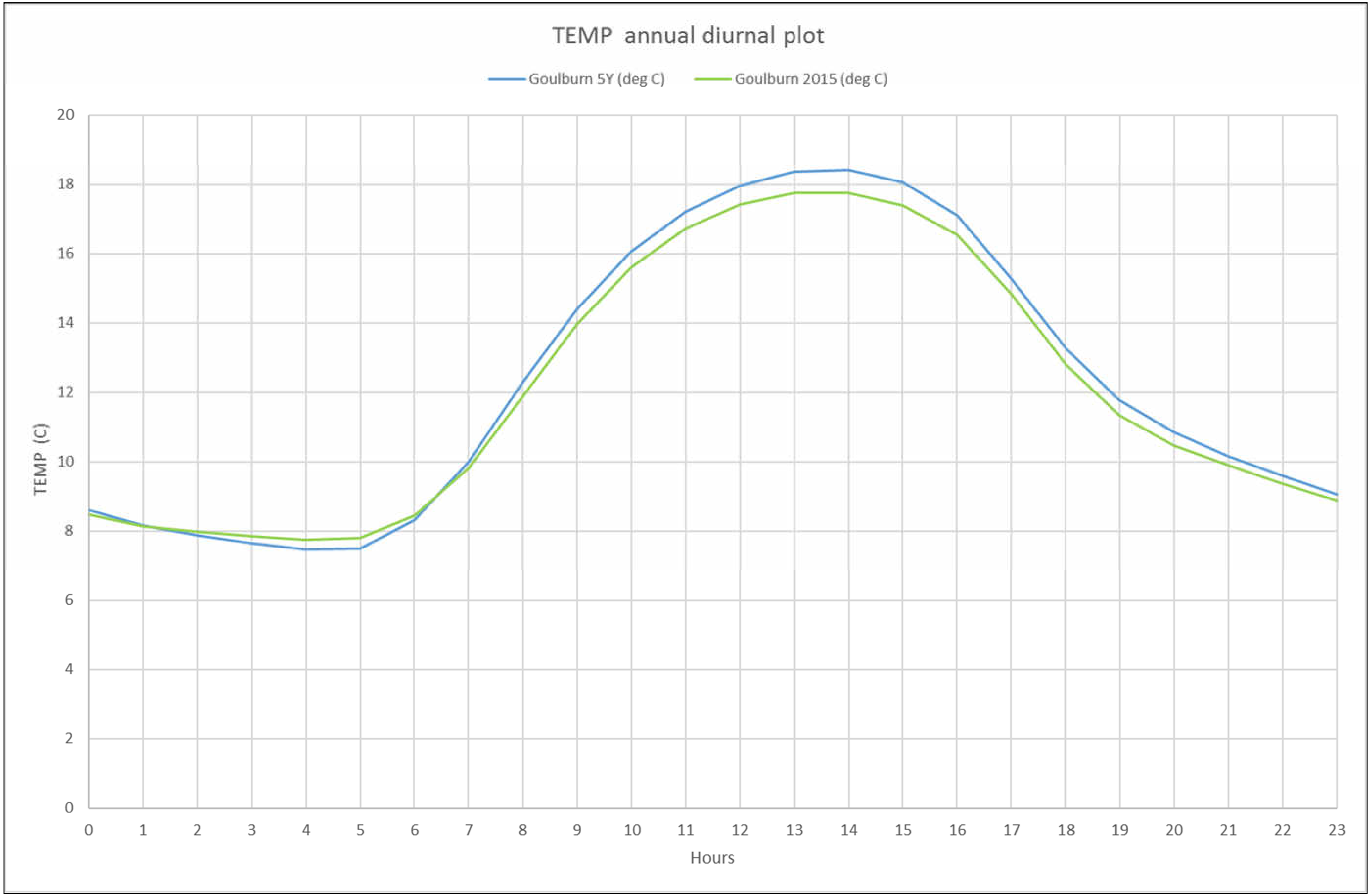


Figure 8.8 – Annual diurnal temperature for Goulburn Airport 5 years and 2015 only

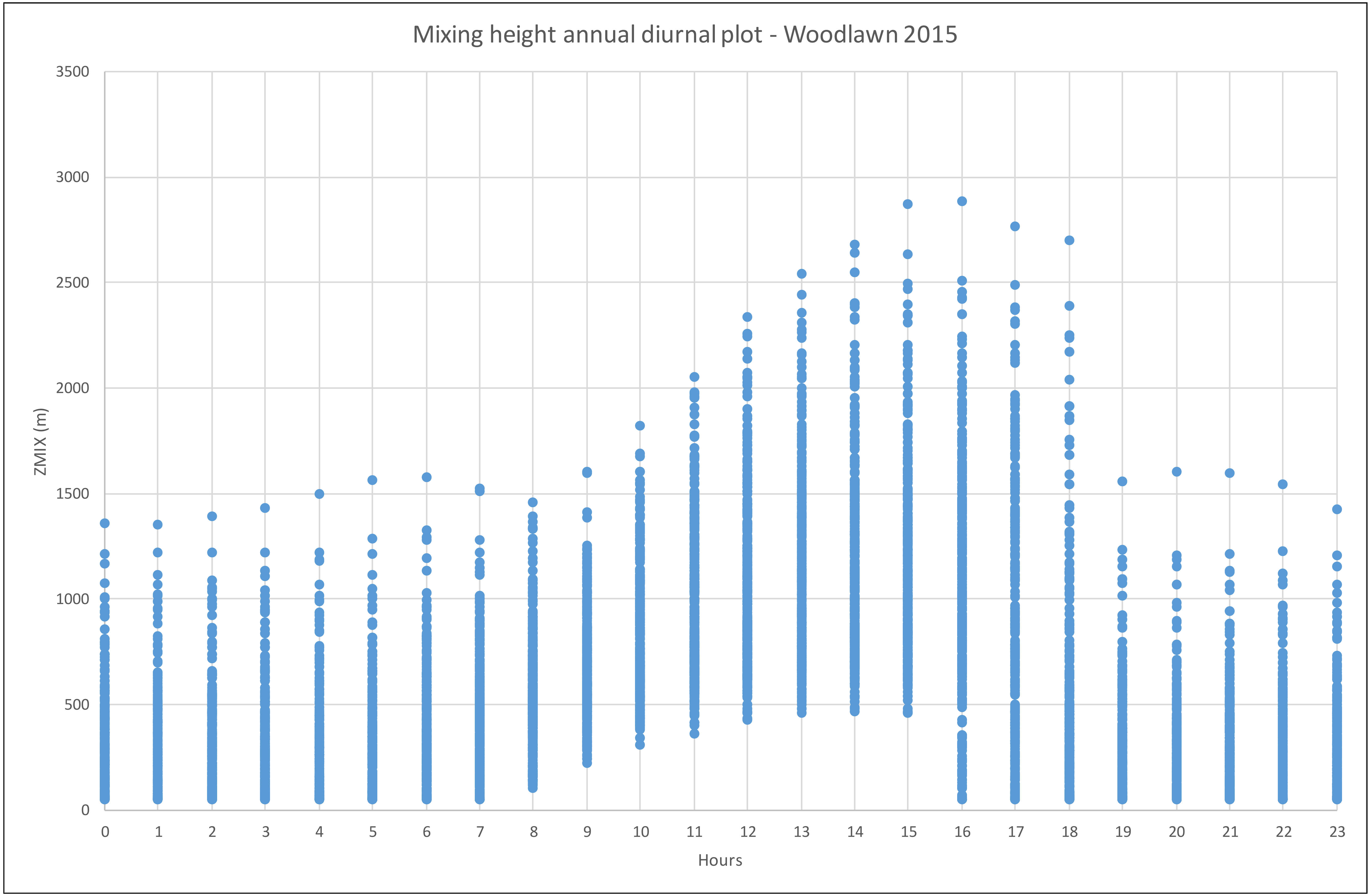


Figure 8.9 – Annual X-Y scatter plot diurnal mixing height for Woodlawn 2015 (modelled)

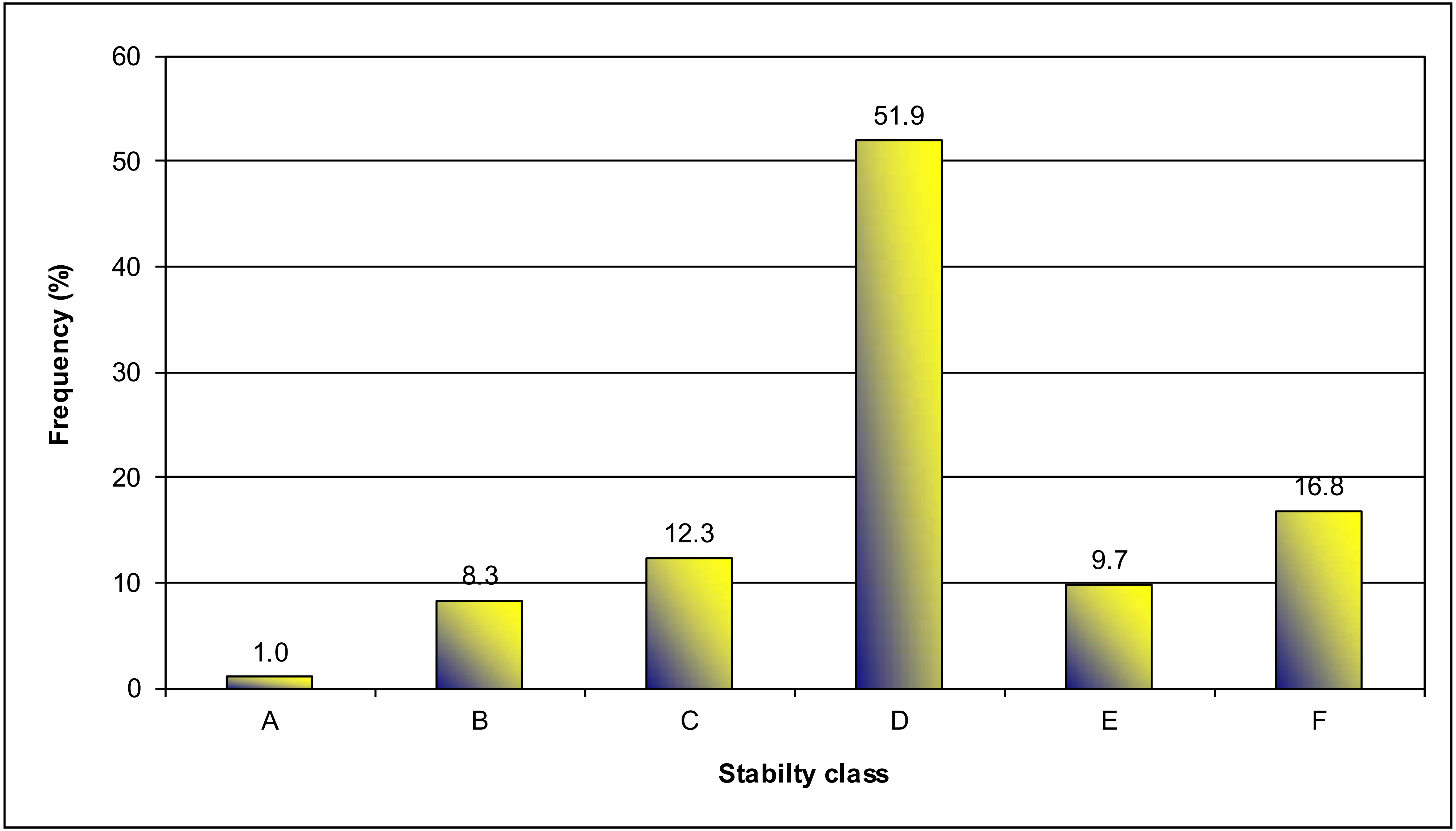


Figure 8.10 – Annual stability class frequency for Woodlawn 2015 (modelled)

8.3.8 CALPUFF Dispersion Model Configuration

8.3.8.1 Computational domain

The computational domain was set to the same parameters as the meteorological domain.

8.3.9 Receptor configuration

Three groups of arbitrary discrete receptors were configured over the modelling domain. A receptor grid was created with a fine resolution inner nest of 9.6 km by 9.6 km by 0.15 km spacing; and an outer nest of 19.35 km by 19.35 km by 0.45 km spacing. A sensitive receptor was placed over the location of the main dwelling at the Torokina property to the southwest of the Site operations. The discrete receptors over properties to the north and east of the Site have been removed from the updated model as they are project-related residences and not considered relevant to the Audit.

8.3.10 Source Configuration and Emission Rates

See **Appendix F** for full odour source and emission rate configurations including a sample CALPUFF list file.

8.3.11 CALPUFF Model Options

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

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

8.4 ODOUR EMISSIONS SCENARIO

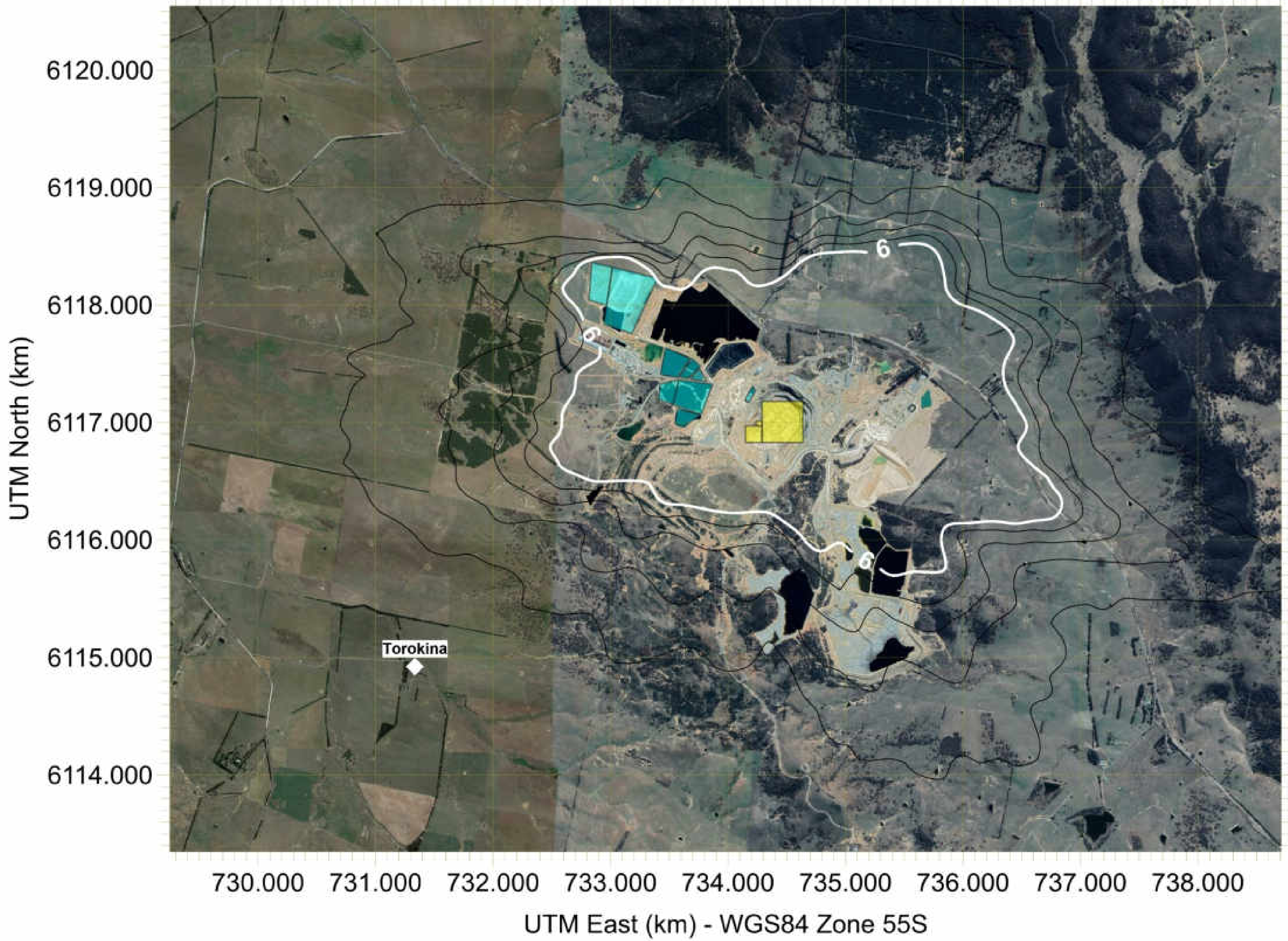
The odour emissions scenario used for the modelling was that measured during the Audit, except for the Waste Covered Area that used the dataset from both the previous IOA and the Audit, and Evaporation Dam 2 measured for Heron in 2017. This scenario represents TOU's best estimate of total odour emissions from normal operations for the Woodlawn Bioreactor during 2018. This scenario does not consider abnormal conditions or upset events (e.g. blockage of leachate/landfill gas extraction pipes that may result in an elevated level of fugitive landfill gas emissions than measured or projected in the model). The Audit has made commentary regarding on-going management and monitoring of fugitive gas emissions in **Section 9.2.1**.

8.5 ODOUR DISPERSION MODELLING RESULTS

The odour dispersion modelling results are visually shown in **Figure 8.11**, which illustrates the contour plot of the ground level odour IAC of 6.0 ou (99%, P/M60). The predicted odour concentration at the Torokina property is provided in **Table 8.7** below.

Table 8.7 – Sensitive receptor location and predicted odour impact result

Receptor	UTM East (km)	UTM North (km)	Elevation (m)	Ground level odour concentration (ou)
Torokina	731.336	6114.923	717.13	1.2



CALPUFF modelling for Veolia Woodlawn Odour Audit #7 Modelled by: S. Hayes 24/07/19 Checked by:	**Predicted odour impact from Woodlawn operations**	Ground level odour concentration (ou, 99%, P/M60) 1 ou contour interval CALMET (Hybrid) 2015 meteorology Odour Audit #7 (2018) measured emissions included

Figure 8.11 – Predicted odour impact from the Site operations

8.6 MODELLING STUDY FINDINGS

The Audit undertook a re-run of the odour dispersion modelling study of the Site to demonstrate compliance with the modelling-based, project-specific odour performance goal of 6 ou and in satisfaction of *Condition 7 (F)* of the Audit requirements. The re-run of the odour dispersion model reflects current operational factors and emissions data as determined in the Audit. This involved the modification and removal of existing odour sources from the original CALPUFF dispersion model to best represent the present operations during the Audit period i.e. calendar year 2018.

The odour emissions scenario used for the modelling was that measured during the Audit. This scenario represents TOU's best estimate of total odour emissions from normal operational conditions for the Site as of the Audit. This scenario does not consider abnormal conditions or upset events (e.g. blockage of leachate/landfill gas extraction pipes that may result in an elevated level of fugitive landfill gas emissions than measured or projected in the model). The Audit has made commentary regarding on-going management and monitoring of fugitive gas emissions in **Section 9.2.1**.

The modelling output demonstrates that the ground level concentration at the nearest sensitive receptor (i.e. the Torokina property dwelling) is predicted to be well below the NSW EPA odour IAC of 6.0 ou (99%, P/M60). Therefore, it can be concluded that adverse odour impacts are unlikely from the Site under normal operational conditions.

8.6.1 Modelling Study Concluding Remark

The modelling outcome outlined in the Audit is consistent with the previous IOA findings, where compliance was deemed likely given that the majority of the SOER and corresponding OER results were within the ranges used in the EA 2010 (see **Table 7.4**). Moreover, the Audit finds that Veolia continues to actively undertake measures to minimise odour emissions from the Site, including participation in a community consultation process designed to provide the necessary odour impact feedback. This feedback will continue to be important in the management of odour complaints/issues, particularly as a means of managing the increased number of complaints as observed in **Section 7.4.1**. The Audit recommends that this continue in the future as a means of determining compliance or otherwise with the project-specific goal.

9 AUDIT RECOMMENDATIONS

9.1 CONDITION 7 (G & H)

The following section is designed to address the following Audit requirement:

- *Outline all reasonable and feasible measures (including cost/benefit analysis, if required) that may be required to improve odour control at the site; and*
- *Recommend and prioritise (mandatory and non-mandatory) recommendations for their implementations.*

Based on the findings from this Audit, the following mandatory and non-mandatory measures have been recommended. In addition to these measures, Veolia should continue the current community liaison program (including the Woodlawn Community Liaison Committee and the Tarago and District Progress Association Inc.) to notify affected/nearby residents of works and address concerns. Veolia should also continue to log and monitor odour complaints in the current odour complaints register.

The Audit team understands that the odour diary project is currently suspended given the active engagement between Veolia and the affected community.

9.2 MANDATORY RECOMMENDATIONS

The mandatory recommendations in this Audit revolve around the leachate management system and the continuation of odour mitigation from the Void. These have been discussed in the following sections.

9.2.1 Odour mitigation from the Void

Fugitive landfill gas emissions

Veolia should continue to improve landfill gas capture from the Bioreactor. This continuation is underway with Veolia completing its WIP 2019, which outlines a comprehensive plan that is being implemented to increase gas capture. It also seeks to address current areas of concern and the potential solution outcomes that can be implemented. This is an active (and effective) management approach that will result in a continual improvement in gas capture efficiency and ultimately reduce odour/landfill gas emissions from the Void. The Audit endorses this strategy as the primary measure to reduce odour emissions from the Void and recommends that Veolia continues the implementation of the gas systems detailed in the WIP 2019, including:

- the planned infrastructure instalments within each waste lift;
- the continuous improvement to leachate extraction, treatment performance, capacity and efficiency. This supported by the implementation of the long-term

leachate solution in the form of the LTP that is the process-proving phase of operation;

- the continuous improvement in the waste tipping profile, covering and expansion and optimisation of the landfill gas infrastructure;
- the continuous monitoring of leachate and gas extraction;
- Remediation actions in the event of equipment failure and process upset in the Void;
- The implementation of operational management programs including:
  - Leachate management;
  - Pumps and pumping solutions; and
  - The expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction.

It should be noted that the WIP 2019 is a live document that will be continually updated. Therefore, it will continue to remain a part of the IOA.

9.2.2 Leachate management system

Continue to adequately maintain and manage the upgraded LMS to ensure it is operating in an optimum state and meeting the leachate quality monitoring targets as outlined in the *Leachate Treatment Operation Manual* and recommended by Veolia Water. Moreover, continue the implementations planned in the WIP 2019. Both the manual and WIP 2019 should be considered as a 'live' document to reflect any variation in quality and operational demands and identifications of new constraints and/or issues. This should continue to attenuate the potential for significant odour generation from the leachate stored in ED3N & ED3S Pond Systems both now and in the future.

The Audit finds that the LTP will provide additional leachate treatment capacity at the Site. It is also understood that treated leachate flowing to ED1 coffer dam from the LTP is of a very high quality. The inclusive of additional leachate treatment capacity will have a significant effect on the minimisation of odour from the Void and LMS. At the time of the Audit visit, ED1 coffer dam was empty. ED1 coffer dam will be included in the sampling and testing monitoring program in the next IOA.

9.2.3 Active Tipping Face

Veolia should continue to develop strategies for the minimising of the exposed active tipping face surface area. It should also proceed and continue with the details in the WIP 2019.

9.3 NON-MANDATORY RECOMMENDATIONS

The non-mandatory recommendations in this Audit revolve around odour mitigation strategies for the Void, odour complaints, and fugitive gas emissions from the Void. This has been discussed in the following sections.

9.3.1 Odour mitigation strategies for the Void

Fugitive gas emissions

It is understood from the previous IOA that Veolia had engaged a university body to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Site – the Audit was not made aware of the outcome from this study. If this study did not proceed, it is recommended that a landfill gas survey is undertaken to enhance understanding of the potential fugitive emission release from the Void. The landfill gas survey can include the isolation flux hood and the measurement of CH_4/H_2S as indicators of fugitive gas emission. If this is performed across a large area of the Void, it is possible that more accurate quantification of potential fugitive emission gas release can be obtained.

9.3.2 Refine investigation of odour issues in the community

From a qualitative viewpoint, the increase in odour complaint is unclear to the Audit given the significant improvement in landfill gas extraction in the Void and expansion and improvement in the leachate management system through optimisation of surface water catchments, landfill gas infrastructure design, active tipping practices and increased leachate treatment capacity via the commissioning of the LTP.

Given this outcome, the Audit recommends that Veolia continue its active engagement with the community through its existing odour complaints and response management strategy. The handling and management of odour complaints will be reassessed in the next IOA to evaluate the need for additional forms of community engagement, given that the number of complaints remains historically low. As such, the refinement in community engagement remains as a non-mandatory recommendation in the Audit to ensure this matter is provided with the opportunity of continuous improvement. Specifically, Veolia should consider refining its investigation of odour issues in the community, particularly surrounding the most common complainants, as to assess the extent to which odour is present in the community. Such an investigation could include: potential odour transport pathways; undertaking of field odour surveys; assess the topography of surrounding land; analysis of climatic data; and a detailed review of odour complaint data.

9.3.3 IMF and Waste Transport Activities

Based on TOU observations, the Audit suggests that Veolia review the following aspects relating to the use of the IMF and waste transport activities to further improve its odour performance from minor and transient odour sources:

- The coverage of sprays at the wash bay and its ability to thoroughly clean a recently emptied truck. This will minimise transient levels of odour that may be detectable and associated with truck movement in the community.
- The washing practice associated with the sealed containers; and
- The maintenance of the sealed containers.

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REPORT SIGNATURE PAGE

The Odour Unit Pty Ltd
P: +61 2 9209 4420
E: info@odourunit.com.au
W: www.odourunit.com.au
ABN: 53 091 165 061

Signed by:

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Senior Engineer & Consultant

Steven Hayes B.Sc., CAQP
Senior Atmospheric Scientist & Consultant

Approved by:

Terry Schulz B. Eng (Chem.), CAQP
Managing Director

Veolia Australia & New Zealand

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #7

July 2019

Appendices

APPENDIX A:

RECORD OF CORRESPONDENCE WITH NSW EPA & DPE

Michael Assal

Subject: FW: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

From: Michael Assal
Sent: Thursday, 14 February 2019 6:21 PM
[redacted]
Subject: RE: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

Thanks for the timely feedback, [redacted]. It is appreciated.

Yes, we can confirm that both the re-run of the site-specific model and the odour emission potential from the mechanical evaporators are included as part of the scope of works for Odour Audit #7.

Given that we have received feedback on the submitted proposal from both the NSW EPA & DPE, Odour Audit #7 will now proceed as planned unless otherwise notified.

Regards,

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Senior Engineer & Consultant

The Odour Unit Pty Ltd
Level 3, 12/56 Church Avenue
MASCOT NSW 2020

T: +61 2 9209 4420 **T(D):** +61 2 9209 4394
F: +61 2 9209 4421 **M:** +61 430 097 202
W: http://www.odourunit.com.au

[redacted]
Sent: Thursday, 14 February 2019 5:58 PM
To: Michael Assal <massal@odourunit.com.au>; [redacted]
Subject: RE: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

Hi Michael,

Thank you for your email. Veolia advised the EPA on 18 January 2019 that a re-run of the site-specific odour model using emissions data collected during the audit has been proposed to be added to the scope of work in Audit #7. Can you please confirm that this will be included?

Also, given the importance of the mechanical evaporation of treated leachate to the Bioreactor's water balance, we are very keen to understand the emissions resulting from that practice and any recommendations that you may have for minimising potential impacts from that activity.

Please give me a call if you would like to discuss.

Regards

[redacted]
Unit Head, Waste Compliance
Waste & Resource Recovery Branch, NSW Environment Protection Authority
[redacted]
[redacted] www.epa.nsw.gov.au @NSW_EPA EPA YouTube
Report pollution and environmental incidents 131 555
Please send official electronic correspondence to waste.operations@epa.nsw.gov.au

---

From: Michael Assal <massal@odourunit.com.au>
Sent: Friday, 8 February 2019 5:20 PM
[redacted] EPA WARR Waste Operations Mailbox
<waste.operations@epa.nsw.gov.au>
Subject: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation
Importance: High

[redacted]

RE: Woodlawn Bioreactor Facility Odour Audit #7

Relevant background

We, The Odour Unit (**TOU**), have been engaged by Veolia Environmental Services (**Veolia**) to conduct the seventh (7^{th}) independent odour audit (**the Odour Audit**) at the Woodlawn Bioreactor Facility, Tarago, NSW (**the Woodlawn Facility**). In accordance with the project approval requirements outlined in *Condition 7* of *Schedule 4* in the *Specific Environmental Conditions - Landfill sites* (DA 10_0012), which states that we need to *Consult with the Environment Protection Authority (EPA) and the Department of Planning & Environment (DPE),* please regard this email as our formal notification for consultation with the relevant regulator departments for the Odour Audit.

The Odour Audit Proposal

Please find **attached** our proposal as addressed and issued to Veolia for the undertaking of the Odour Audit at the Woodlawn Facility. The attached proposal details our scope of works, the audit team, deliverables, timeframe and other details relating to the undertaking of the Odour Audit.

Consultation Timing

As you will gather from the attached proposal, we have scheduled the fieldwork component of the Odour Audit between **19 February 2019 and 21 February 2019**. As such, it will be appreciated if we can receive any advice or feedback by **Thursday**, **14 February 2019**.

We look forward to hearing from you soon. Please do not hesitate to contact us if you have any enquiries.

Regards,

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Senior Engineer & Consultant

THE ODOUR UNIT

The Odour Unit Pty Ltd
Level 3, 12/56 Church Avenue
MASCOT NSW 2020
T: +61 2 9209 4420 **T(D):** +61 2 9209 4394
F: +61 2 9209 4421 **M:** +61 430 097 202
W: http://www.odourunit.com.au

Michael Assal

Subject: FW: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

From: Michael Assal
Sent: Monday, 11 February 2019 3:28 PM
[redacted]
Subject: RE: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

Thank you for the swift response, [redacted].

We acknowledge your feedback and can confirm that the odour audit will cover the analysis of odour complaints as required below. I will communicate this advice to our client.

Regards,

Michael Assal MEngSc, B. Eng (Hon)/B.Sc, AMIChemE, MIEAust, CAQP
Senior Engineer & Consultant

The Odour Unit Pty Ltd
Level 3, 12/56 Church Avenue
MASCOT NSW 2020

T: +61 2 9209 4420 **T(D):** +61 2 9209 4394
F: +61 2 9209 4421 **M:** +61 430 097 202
W: http://www.odourunit.com.au

[redacted]
Sent: Monday, 11 February 2019 2:49 PM
To: Michael Assal <massal@odourunit.com.au>
Subject: Veolia Woodlawn Bioreactor Odour Audit #7 (DA 10_0012) - Consultation

To Michael

In relation to the independent odour audit (the Odour Audit) at the Woodlawn Bioreactor Facility, Tarago, NSW (the Woodlawn Facility) the Department provides the following advice and/or feedback.

The Odour Audit needs to ensure that it addresses all the requirements outlined in Schedule 4 Condition 7.

Furthermore, the audit should consider the number of complaints that were received in relation to odour and compare it to previous years (see below).

The environmental parameters associated for these complaints should also be assessed, for example:

- what were the prevailing winds when the complaint was made;

- was the complaint due to a system breakdown at Woodlawn or the Intermodal;
- was there a leachate incident that lead to an increase in complaints; and
- did the biroreactor process a certain type or waste/high processing capacity at the time the complaint was made.

An analysis of whether the leachate treatment plant has led to a reduction in complaints should also be considered.

Consideration should also be given as to which residents are making the complaints and what operational changes Veolia Environmental Services can make to reduce the odour impacts to those residents.

Previous odour complaints are as follows:
For 2016/2017 a total of 36 complaints were received
2015/2016 a total of 88 complaints were received
2014/2015 a total of 63 complaints were received

Should you require any further clarification in relation to above, please contact me on the details below.

Kind regards,

[redacted]
Senior Compliance Officer
Planning Services
Level 2, 84 Crown Street Wollongong NSW 2500
[redacted]

NSW GOVERNMENT | Planning & Environment

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THE ODOUR UNIT

APPENDIX B:

ODOUR CONCENTRATION LABORATORY TESTING RESULT SHEETS

THE ODOUR UNIT PTY LTD

Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	Isolation flux hood	Sampling Team	TOU

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	February 2019	TOU Project #	N1806L.07
Order number	7100143001	Project Manager	M. Assal
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT V04.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: *r* = 0.101 (January 2018) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: *A* = 0.212 (January 2018) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced, except in full.

Date: Monday, 11 March 2019

Panel Roster Number: SYD20190221_014

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20190221_014

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
Sample #1 - ED3S-S	SC19089	20.02.2019 1055 hrs	21.02.2019 0905 hrs	4	8	--	--	332	332	0.205
Sample #2 – ED3S-S	SC19090	20.02.2019 1056 hrs	21.02.2019 0956 hrs	4	8	--	--	152	152	0.094
Sample #3 – ED3S-S	SC19091	20.02.2019 1115 hrs	21.02.2019 1031 hrs	4	8	--	--	166	166	0.10
Sample #4 – ED3S	SC19092	20.02.2019 1212 hrs	21.02.2019 1109 hrs	4	8	--	--	140	140	0.086
Sample #5 – ED3S	SC19093	20.02.2019 1208 hrs	21.02.2019 1141 hrs	4	8	--	--	49	49	0.030
Sample #6 – ED3N-4	SC19094	20.02.2019 1401 hrs	21.02.2019 1209 hrs	4	8	--	--	139	139	0.076

Samples Received in Laboratory – From: TOU Date: 21 February 2019 Time: 0745 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Sample Measurement Results
Panel Roster Number: SYD20190221_014

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
Sample #7 – ED3N-3	SC19099	20.02.2019 1356 hrs	21.02.2019 1548 hrs	4	8	--	--	59	59	0.032
Sample #8 – ED3N-3	SC19100	20.02.2019 1505 hrs	21.02.2019 1616 hrs	4	8	--	--	70	70	0.038
Sample #9 – ED3N-3	SC19101	20.02.2019 1410 hrs	21.02.2019 1651 hrs	4	8	--	--	64	64	0.035
Sample #10 – ED3N-2	SC19102	20.02.2019 1436 hrs	21.02.2019 1720 hrs	4	8	--	--	181	181	0.10
Sample #11 – ED3N-4	SC19103	20.02.2019 1529 hrs	21.02.2019 1748 hrs	4	8	--	--	166	166	0.10
Sample #12 – ED3N-4	SC19104	20.02.2019 1530 hrs	21.02.2019 1815 hrs	4	8	--	--	181	181	0.11

Samples Received in Laboratory – From: TOU Date: 22 February 2019 Time: 0745 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20190221_014	51,400	$20 \leq \chi \leq 80$	724	71	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC19089 pungent, ammoniacal, earthy
SC19090 pungent, ammoniacal, earthy
SC19091 pungent, ammoniacal, earthy
SC19092 musty
SC19093 musty
SC19094 pungent, ammoniacal, earthy
SC19099 pungent, ammoniacal, earthy
SC19100 pungent, ammoniacal, earthy
SC19101 pungent, ammoniacal, earthy
SC19102 pungent, ammoniacal, earthy
SC19103 pungent, ammoniacal, earthy
SC19104 pungent, ammoniacal, earthy

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

END OF DOCUMENT

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	Isolation flux hood	Sampling Team	TOU

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	February 2019	TOU Project #	N1806L.07
Order number	7100143001	Project Manager	M. Assal
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
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Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT V04.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $r = 0.101$ (January 2018) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $A = 0.212$ (January 2018) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

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Date: Monday, 11 March 2019

Panel Roster Number: SYD20190222_015

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20190222_015

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
Sample #13 – ED3N-2	SC19105	21.02.2019 0917 hrs	22.02.2019 0902 hrs	4	8	--	--	279	279	0.18
Sample #14 – ED3N-2	SC19106	21.02.2019 0910 hrs	22.02.2019 0936 hrs	4	8	--	--	362	362	0.23
Sample #15 – ED3N-1	SC19107	21.02.2019 0920 hrs	22.02.2019 1019 hrs	4	8	--	--	470	470	0.3
Sample #16 – ED3N-1	SC19108	21.02.2019 1010 hrs	22.02.2019 1044 hrs	4	8	--	--	724	724	0.46
Sample #17 – ED3N-1	SC19109	21.02.2019 0954 hrs	22.02.2019 1121 hrs	4	8	--	--	512	512	0.32
Sample #18 – Leachate Treatment Dam (Aerated Zone)	SC19110	21.02.2019 1231 hrs	22.02.2019 1144 hrs	4	8	--	--	332	332	0.19
Sample #19 – Leachate Treatment Dam (Anoxic Zone)	SC19111	21.02.2019 1240 hrs	22.02.2019 1205 hrs	4	8	--	--	306	306	0.18
Sample #20 – Active tipping face (less than one day old)	SC19112	21.02.2019 1540 hrs	22.02.2019 1307 hrs	4	8	--	--	23,200	23,200	11.4

Samples Received in Laboratory – From: TOU Date: 22 February 2019 Time: 0800 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Sample Measurement Results
Panel Roster Number: SYD20190222_015

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
Sample #21 – Active tipping face (less than one day old)	SC19113	21.02.2019 1540 hrs	22.02.2019 1328 hrs	4	8	--	--	11,600	11,600	5.7
Sample #22 – Active tipping face (less than one day old)	SC19114	21.02.2019 1540 hrs	22.02.2019 1349 hrs	4	8	--	--	11,600	11,600	5.7
Sample #23 – Waste Covered Area (P13-P14, Void Perimeter, 150 mm)	SC19115	21.02.2019 1632 hrs	22.02.2019 1438 hrs	4	8	--	--	2,440	2,440	1.3
Sample #24 – Waste Covered Area (M14-N14, 150 mm)	SC19116	21.02.2019 1624 hrs	22.02.2019 1509 hrs	4	8	--	--	724	724	0.36
Sample #25 – Waste Covered Area (N11-N12, 150 mm)	SC19117	21.02.2019 1624 hrs	22.02.2019 1536 hrs	4	8	--	--	861	861	0.43
Sample #26 – Waste Covered Area (J17-J18, 300 mm)	SC19118	21.02.2019 1721 hrs	22.02.2019 1604 hrs	4	8	--	--	724	724	0.43

Samples Received in Laboratory – From: TOU Date: 22 February 2019 Time: 0800 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Sample Measurement Results
Panel Roster Number: SYD20190222_015

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
Sample #27 – Waste Covered Area (I10-I11, 300 mm)	SC19119	21.02.2019 1721 hrs	22.02.2019 1639 hrs	4	8	--	--	724	724	0.4
Sample #28 – Waste Covered Area (F13-F14, 300 mm)	SC19120	21.02.2019 1740 hrs	22.02.2019 1807 hrs	4	8	40 : 1	40 : 1	46,300	1,898,000	26.3

Samples Received in Laboratory – From: TOU Date: 22 February 2019 Time: 0800 hrs

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20190222_015	51,400	$20 \leq \chi \leq 80$	724	71	Yes

Comments Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC19105	pineapple, musty
SC19106	pineapple, musty
SC19107	rotten egg, earthy
SC19108	rotten egg, earthy
SC19109	rotten egg, earthy
SC19110	pungent, ammonical, earthy
SC19111	pungent, ammonical, earthy
SC19112	putrid, garbage, bin juice
SC19113	putrid, garbage, bin juice
SC19114	putrid, garbage, bin juice
SC19115	bin juice, garbage, earthy, dirt
SC19116	earthy, dirt
SC19117	earthy, dirt
SC19118	earthy, dirt
SC19119	earthy, dirt
SC19120	putrid, pineapple

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

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THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	Liquid odour method	Sampling Team	TOU

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	February 2019	TOU Project #	N1806L.07
Order number	7100143001	Project Manager	M. Assal
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT V04.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $r = 0.101$ (January 2018) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $A = 0.212$ (January 2018) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

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Date: Tuesday, 12 March 2019

Panel Roster Number: SYD20190225_016

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20190225_016

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)[1]
LOM Sample #1 – ED3S-S	SC19121	25.02.2019 1140 hrs	25.02.2019 1349 hrs	4	8	--	--	470	470	--
LOM Sample #2 – ED3S-S	SC19122	25.02.2019 1235 hrs	25.02.2019 1423 hrs	4	8	--	--	215	215	--
LOM Sample #1A – ED3S-S	SC19123	25.02.2019 1305 hrs	25.02.2019 1529 hrs	4	8	--	--	215	215	--
LOM Sample #2A – ED3S-S	SC19124	25.02.2019 1355 hrs	25.02.2019 1612 hrs	4	8	--	--	395	395	--

Samples Received in Laboratory – From: Sample preparation at TOU laboratory Date: 25 February 2019 Time: Refer to Sampling Date & Time

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20190225_016	51,400	$20 \le \chi \le 80$	724	71	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC19121 earthy, musty
SC19122 earthy, musty
SC19123 earthy, musty
SC19124 earthy, musty

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
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THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	Liquid Odour Method (**LOM**)	Sampling Team	TOU

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	February 2019	TOU Project #	N1806L.07
Order number	7100143001	Project Manager	M. Assal
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT V04.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $r = 0.101$ (January 2018) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS4323.3:2001. ODORMAT V04: $A = 0.212$ (January 2018) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

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Date: Tuesday, 12 March 2019

Panel Roster Number: SYD20190228_019

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20190228_019

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate (ou.m^3/m^2/s)[1]
LOM Sample #15 – ED3N-1	SC19137	28.02.2019 0930 hrs	28.02.2019 1056 hrs	4	8	--	--	279	279	--
LOM Sample #16 – ED3N-1	SC19138	28.02.2019 0940 hrs	28.02.2019 1129 hrs	4	8	--	--	181	181	--
LOM Sample #3 – ED3S-S	SC19139	28.02.2019 0950 hrs	28.02.2019 1210 hrs	4	8	--	--	512	512	--
LOM Sample #17 – ED3N-1	SC19140	28.02.2019 1010 hrs	28.02.2019 1324 hrs	4	8	--	--	197	197	--
LOM Sample #13 – ED3N-2	SC19141	28.02.2019 1015 hrs	28.02.2019 1358 hrs	4	8	--	--	166	166	--
LOM Sample #14 – ED3N-2	SC19142	28.02.2019 1220 hrs	28.02.2019 1429 hrs	4	8	--	--	166	166	--

Samples Received in Laboratory – From: Sample preparation at TOU laboratory Date: 28 February 2019 Time: Refer to Sampling Date & Time

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20190228_019	51,400	$20 \leq \chi \leq 80$	724	71	Yes

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC19137 dirty socks, earthy, musty
SC19138 dirty socks, earthy, musty
SC19139 earthy, musty, ammoniacal
SC19140 earthy, musty
SC19141 dirty socks, earthy, musty
SC19142 earthy, musty

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

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THE ODOUR UNIT PTY LTD

Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	Veolia Environmental Services	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	Liquid Odour Method (**LOM**)	Sampling Team	TOU

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	February 2019	TOU Project #	N1806L.07
Order number	7100143001	Project Manager	M. Assal
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
ODORMAT V04.

Instrumental Precision — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: r = 0.101 (January 2018) Compliance – Yes

Instrumental Accuracy — The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: A = 0.212 (January 2018) Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

Traceability — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

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This report shall not be reproduced, except in full.

Date: Tuesday, 12 March 2019 — Panel Roster Number: SYD20190304_021

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20190304_021

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate (ou.m³/m²/s)[1]
LOM Sample #6 – ED3N-4	SC19156	04.03.2019 0940 hrs	04.03.2019 1108 hrs	4	8	--	--	91	91	--
LOM Sample #7 – ED3N-3	SC19157	04.03.2019 0946 hrs	04.03.2019 1142 hrs	4	8	--	--	91	91	--
LOM Sample #8 – ED3N-3	SC19158	04.03.2019 0955 hrs	04.03.2019 1216 hrs	4	8	--	--	64	64	--
LOM Sample #9 – ED3N-3	SC19159	04.03.2019 1020 hrs	04.03.2019 1328 hrs	4	8	--	--	14	14	--
LOM Sample #10 – ED3N-2	SC19160	04.03.2019 1025 hrs	04.03.2019 1400 hrs	4	8	--	--	54	54	--
LOM Sample #11 – ED3N-4	SC19161	04.03.2019 1027 hrs	04.03.2019 1434 hrs	4	8	--	--	49	49	--
LOM Sample #12 – ED3N-4	SC19162	04.03.2019 1030 hrs	04.03.2019 1504 hrs	4	8	--	--	27	27	--

Samples Received in Laboratory – From: Sample preparation at TOU laboratory Date: 4 March 2019 Time: Refer to Sampling Date & Time

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20190304_021	51,400	$20 \leq \chi \leq 80$	724	71	Yes

Comments Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC19156 earthy, musty
SC19157 earthy, musty
SC19158 earthy, musty
SC19159 earthy, musty
SC19160 earthy, musty, ammoniacal
SC19161 earthy, musty
SC19162 earthy, musty

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
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APPENDIX C:

ODOUR EMISSIONS WORKSHEET

THE ODOUR UNIT PTY LTD
Surface Odour Emission Rate for Isolation Flux Hood
Calculation Sheet

Client: Veolia (Australia & New Zealand)
Sampling Site: Woodlawn Bioreactor Facility
Project Number: N1806L - Audit #7

Sample Location	TOU Sample Number	Odour Concentration (ou)	Nominal Air Temperature (°C)	Measured Internal Flux Hood Odour Temperature (°C)	Emission Factor Nominal Air Temperature	Emission Factor measured air temperature	Temperature Correction Factor	Enclosed surface area (m^2)	Flux chamber sweep air flow rate - Q (L/min)	Flux chamber sweep air flow rate - Q (m^3/min)	Odour Emission Rate at Source (Not corrected for temperature) (ou.m^3/m^2/min)	Odour Emission Rate at Source (Corrected for temperature) (ou.m^3/m^2/min)	Specific Odour Emission Rate (ou.m^3/m^2/s)	Odour character
Sample #1 - ED3S-S	SC19089	332	15.3	20.6	1.220	1.307	0.933	0.126	5	0.005	13.17	12.30	0.205	pungent, ammoniacal, earthy
Sample #2 – ED3S-S	SC19090	152	15.3	20.6	1.220	1.307	0.933	0.126	5	0.005	6.03	5.63	0.094	pungent, ammoniacal, earthy
Sample #3 – ED3S-S	SC19091	166	15.3	20.6	1.220	1.307	0.933	0.126	5	0.005	6.59	6.15	0.102	pungent, ammoniacal, earthy
Sample #4 – ED3S	SC19092	140	18.1	23.8	1.265	1.363	0.929	0.126	5	0.005	5.56	5.16	0.086	musty
Sample #5 – ED3S	SC19093	49	18.1	23.8	1.265	1.363	0.929	0.126	5	0.005	1.94	1.81	0.030	musty
Sample #6 – ED3N-4	SC19094	139	20.2	34.9	1.300	1.574	0.826	0.126	5	0.005	5.52	4.56	0.076	pungent, ammoniacal, earthy
Sample #7 – ED3N-3	SC19099	59	20.2	34.9	1.300	1.574	0.826	0.126	5	0.005	2.34	1.93	0.032	pungent, ammoniacal, earthy
Sample #8 – ED3N-3	SC19100	70	20.2	34.9	1.300	1.574	0.826	0.126	5	0.005	2.78	2.29	0.038	pungent, ammoniacal, earthy
Sample #9 – ED3N-3	SC19101	64	20.2	34.9	1.300	1.574	0.826	0.126	5	0.005	2.54	2.10	0.035	pungent, ammoniacal, earthy
Sample #10 – ED3N-2	SC19102	181	20.2	31.3	1.300	1.502	0.866	0.126	5	0.005	7.18	6.22	0.104	pungent, ammoniacal, earthy
Sample #11 – ED3N-4	SC19103	166	22.7	29.9	1.343	1.475	0.911	0.126	5	0.005	6.59	6.00	0.100	pungent, ammoniacal, earthy
Sample #12 - ED3N-4	SC19104	181	22.7	29.9	1.343	1.475	0.911	0.126	5	0.005	7.18	6.54	0.109	pungent, ammoniacal, earthy
Sample #13 – ED3N-2	SC19105	279	14.9	18.8	1.214	1.277	0.951	0.126	5	0.005	11.07	11	0.18	pineapple, musty
Sample #14 – ED3N-2	SC19106	362	14.9	18.8	1.214	1.277	0.951	0.126	5	0.005	14.37	13.65	0.23	pineapple, musty
Sample #15 – ED3N-1	SC19107	470	14.9	18.8	1.214	1.277	0.951	0.126	5	0.005	18.65	17.73	0.3	rotten egg, earthy
Sample #16 – ED3N-1	SC19108	724	16.0	20.0	1.231	1.297	0.949	0.126	5	0.005	28.73	27.27	0.46	rotten egg, earthy
Sample #17 – ED3N-1	SC19109	512	16.0	20.5	1.231	1.305	0.943	0.126	5	0.005	20.32	19.16	0.32	rotten egg, earthy
Sample #18 – Leachate Treatment Dam (Aerated Zone)	SC19110	332	20.0	29.7	1.297	1.471	0.882	0.126	5	0.005	13.17	11.61	0.19	pungent, ammoniacal, earthy
Sample #19 – Leachate Treatment Dam (Anoxic Zone)	SC19111	306	20.0	29.7	1.297	1.471	0.882	0.126	5	0.005	12.14	10.70	0.18	pungent, ammoniacal, earthy
Sample #20 – Active tipping face (less than one day old)	SC19112	23,200	25.2	48.3	1.388	1.874	0.741	0.126	5	0.005	920.63	681.82	11.4	putrid, garbage, bin juice
Sample #21 – Active tipping face (less than one day old)	SC19113	11,600	25.2	48.3	1.388	1.874	0.741	0.126	5	0.005	460.32	340.91	5.7	putrid, garbage, bin juice
Sample #22 – Active tipping face (less than one day old)	SC19114	11,600	25.2	48.3	1.388	1.874	0.741	0.126	5	0.005	460.32	340.91	5.7	putrid, garbage, bin juice
Sample #23 – Waste Covered Area (P13-P14, Void Perimeter, 150 mm)	SC19115	2,440	24.5	43.2	1.375	1.753	0.784	0.126	5	0.005	96.83	75.93	1.3	bin juice, garbage, earthy, dirt
Sample #24 – Waste Covered Area (M14-N14, 150 mm)	SC19116	724	23.7	45.2	1.361	1.800	0.756	0.126	5	0.005	28.73	21.72	0.36	earthy, dirt
Sample #25 – Waste Covered Area (N11-N12, 150 mm)	SC19117	861	23.7	45.8	1.361	1.814	0.750	0.126	5	0.005	34.17	25.63	0.43	earthy, dirt
Sample #26 – Waste Covered Area (J17-J18, 300 mm)	SC19118	724	23.7	32.6	1.361	1.528	0.891	0.126	5	0.005	28.73	25.59	0.43	earthy, dirt
Sample #27 – Waste Covered Area (I10-I11, 300 mm)	SC19119	724	22.5	36.5	1.340	1.607	0.834	0.126	5	0.005	28.73	23.95	0.40	earthy, dirt
Sample #28 – Waste Covered Area (F13-F14, 300 mm)	SC19120	46,300	22.5	34.2	1.340	1.560	0.859	0.126	5	0.005	1837.30	1578.06	26.3	putrid, pineapple

Liquid Odour Measurement Emission Results (Mechanical Evaporators)

Liquid Odour Measurement - Calculation (25L N_2 with 413 µL sample)	TOU Sample Number	Odour Concentration (ou)	Volume of Liquid (mL)	Volume of dry N_2 (L)	Odour Concentration (ou/m^3)	Calculated Liquid Odour Concentration (ou/mL)	Mechanical Evaporation Rate (L/min) @ 20% efficiency	Odour Emission Rate (ou.m^3/min)	Odour Emission Rate (ou.m^3/s)	Mechanical Evaporation Rate (L/min) @ 30% efficiency	Odour Emission Rate (ou.m^3/min)	Odour Emission Rate (ou.m^3/s)	Odour Character
LOM Sample #15 – ED3N-1	SC19137	279	0.413	25	279	16.9	70	1,180,000	19,700	105	1,770,000	29,500	dirty socks, earthy, musty
LOM Sample #16 – ED3N-1	SC19138	181	0.413	25	181	11	70	770,000	12,800	105	1,160,000	19,300	dirty socks, earthy, musty
LOM Sample #17 – ED3N-1	SC19140	197	0.413	25	197	11.9	70	833,000	13,900	105	1,250,000	20,800	earthy, musty,
LOM Sample #10 – ED3N-2	SC19160	54	0.413	25	54	3.27	70	229,000	3,820	105	343,000	5,720	earthy, musty, ammoniacal
LOM Sample #13 – ED3N-2	SC19141	166	0.413	25	166	10	70	700,000	11,700	105	1,050,000	17,500	dirty socks, earthy, musty
LOM Sample #14 – ED3N-2	SC19142	166	0.413	25	166	10	70	700,000	11,700	105	1,050,000	17,500	earthy, musty
LOM Sample #7 – ED3N-3	SC19157	91	0.413	25	91	5.51	70	386,000	6,430	105	579,000	9,650	earthy, musty
LOM Sample #8 – ED3N-3	SC19158	64	0.413	25	64	3.87	70	271,000	4,520	105	406,000	6,770	earthy, musty
LOM Sample #9 – ED3N-3	SC19159	14	0.413	25	14	0.847	70	59,300	988	105	88,900	1,480	earthy, musty
LOM Sample #6 – ED3N-4	SC19156	91	0.413	25	91	5.51	70	386,000	6,430	105	579,000	9,650	earthy, musty
LOM Sample #11 – ED3N-4	SC19161	49	0.413	25	49	2.97	70	208,000	3,470	105	312,000	5,200	earthy, musty
LOM Sample #12 – ED3N-4	SC19162	27	0.413	25	27	1.63	70	114,000	1,900	105	171,000	2,850	earthy, musty

Mechanical evaporation rate is based on 20 % / 30% evaporation efficiency per evaporator

Liquid Odour Measurement Emission Results (Natural Evaporation)

Liquid Odour Measurement - Calculation (25L N_2 with 413 µL sample)	TOU Sample Number	Odour Concentration (ou)	Volume of Liquid (mL)	Volume of dry N_2 (L)	Odour Concentration (ou/m^3)	Calculated Liquid Odour Concentration (ou/mL)	Current Area (m^2)	Natural evaporation rate (mm/month)	Natural evaporation rate (L/s)	Odour emission rate (ou.m^3/s)
LOM Sample #1 – ED3S-S	SC19121	470	0.413	25	470	28.5	19,000	92.67	0.670	19,100
LOM Sample #2 – ED3S-S	SC19122	215	0.413	25	215	13	19,000	92.67	0.670	8,710
LOM Sample #1A – ED3S-S	SC19123	215	0.413	25	215	13	19,000	92.67	0.670	8,710
LOM Sample #2A – ED3S-S	SC19124	395	0.413	25	395	23.9	19,000	92.67	0.670	16,000
LOM Sample #3 – ED3S-S	SC19139	512	0.413	25	512	31	19,000	92.67	0.670	20,800
LOM Sample #15 – ED3N-1	SC19137	279	0.413	25	279	16.9	7,500	92.67	0.264	4,470
LOM Sample #16 – ED3N-1	SC19138	181	0.413	25	181	11	7,500	92.67	0.264	2,910
LOM Sample #17 – ED3N-1	SC19140	197	0.413	25	197	11.9	7,500	92.67	0.264	3,150
LOM Sample #10 – ED3N-2	SC19160	54	0.413	25	54	3.27	7,000	92.67	0.247	807
LOM Sample #13 – ED3N-2	SC19141	166	0.413	25	166	10	7,000	92.67	0.247	2,470
LOM Sample #14 – ED3N-2	SC19142	166	0.413	25	166	10	7,000	92.67	0.247	2,470
LOM Sample #7 – ED3N-3	SC19157	91	0.413	25	91	5.51	5,400	92.67	0.190	1,050
LOM Sample #8 – ED3N-3	SC19158	64	0.413	25	64	3.87	5,400	92.67	0.190	737
LOM Sample #9 – ED3N-3	SC19159	14	0.413	25	14	0.847	5,400	92.67	0.190	161
LOM Sample #6 – ED3N-4	SC19156	91	0.413	25	91	5.51	39,000	92.67	1.375	7,580
LOM Sample #11 – ED3N-4	SC19161	49	0.413	25	49	2.97	39,000	92.67	1.375	4,080
LOM Sample #12 – ED3N-4	SC19162	27	0.413	25	27	1.63	39,000	92.67	1.375	2,240

The natural evaporation rate is based on the mean evaporation rate recorded between May 2007 to June 2012 i.e. 92.67 mm/month

APPENDIX D:

TECHNICAL DOCUMENTATION RELEVANT TO THE AUDIT

THE ODOUR UNIT

ODOUR COMPLAINTS REGISTER:

9 FEBRUARY 2018 – 30 APRIL 2019

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
3/04/2019	8:38:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was “a stinking garbage smell present at his house”.	30 minutes	The site is experiencing record levels of gas capture, with all seven engines operating. The focus over the previous months has been the ongoing development of the Woodlawn Infrastructure Plan and installation of new gas extraction systems around the bioreactor. The result has been a positive outcome for the operations team and our ongoing compliance commitment. The Leachate Treatment Plant is in the process-proving phase and is currently treating leachate around 100m3 of raw leachate per day. The existing treatment plant is still operating at capacity. The odour audit was conducted at the end of February; Veolia is awaiting the outcomes from the independent auditors.
24/03/2019	8:32:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was “a very potent landfill smell”.	Not specified	The site is experiencing record levels of gas capture, with all seven engines operating. The focus over the previous months has been the ongoing development of the Woodlawn Infrastructure Plan and installation of new gas extraction systems around the bioreactor. The result has been a positive outcome for the operations team and our ongoing compliance commitment. The Leachate Treatment Plant is in the process-proving phase and is currently treating leachate around 100m3 of raw leachate per day. The existing treatment plant is still operating at capacity. The odour audit was conducted at the end of February; Veolia is awaiting the outcomes from the independent auditors.
24/03/2019	8:04:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was “a strong pungent odour present at his house and he had to close all the windows”.	Not specified	The site is experiencing record levels of gas capture, with all seven engines operating. The focus over the previous months has been the ongoing development of the Woodlawn Infrastructure Plan and installation of new gas extraction systems around the bioreactor. The result has been a positive outcome for the operations team and our ongoing compliance commitment. The Leachate Treatment Plant is in the process-proving phase and is currently treating leachate around 100m3 of raw leachate per day. The existing treatment plant is still operating at capacity. The odour audit was conducted at the end of February; Veolia is awaiting the outcomes from the independent auditors.
18/02/2019	8:59:00 PM	Letter	Willandra Lane, Tarago	The complainant reported to community feedback line that she “detected a slight odour.”	Not specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia’s water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void’s wall and waste mass. The next Independent Odour Audit has been scheduled and is on the 19th Feb. 2019, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
18/02/2019	11:00:00 AM	Letter	King Street, Tarago	The complainant reported to the community feedback line that he "detected a sweet, sickly smell on Sunday morning and this morning."	Not specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. The next Independent Odour Audit has been scheduled and is on the 19th Feb. 2019, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
8/02/2019	8:29:00 PM	Letter	Tarago	The complainant reported to community feedback line that she "Detected an odour at her house which was around for about 30 mins."	30 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. The next Independent Odour Audit has been scheduled and is on the 19th Feb. 2019, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
4/02/2019	7:30:00 AM	Letter	Willandra Lane, Tarago	The complainant reported to community feedback line that she had to "close her house up due to the rubbish smell."	Detected at time of call.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. The next Independent Odour Audit is scheduled to begin this month, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
25/01/2019	7:52:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was "a foul odour present at her house from about 6:30am."	1 hour 30 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. The next Independent Odour Audit is scheduled to begin next month, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

VEOLIA

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
23/01/2019	8:42:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was an "offensive rotten garbage odour and he had to shut the windows to his house to stop the odour coming in."	7 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. The next Independent Odour Audit is scheduled to begin next month, which will outline the current performance of the site. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
30/12/2018	9:58:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that she"experienced a slight rotten garbage smell this morning, when the air was still, but it has gone now."	Not Specified, however noted that it was a short period of time	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the mid commissioning phase and is currently treating leachate at small quantities. The existing treatment plant is still operating at capacity. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
20/12/2018	9:49:00 AM	Letter	Goulburn Street, Tarago	The complainant reported to the Environmental line through EPA that they smelt a"metallic stench coming from the landfill, the strength of the odour was 4/6."	Not Specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
3/11/2018	9:56:00 PM	Letter	Willandra Lane, Tarago	The complainant reported to the Environmental line through EPA that "she had the windows to her house open as it was a warm night and at approximately 21:50 a strong smell of waste/refuse wafted in. She said she had to close the windows to stop the smell coming into her house."	Detected at time of call.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
1/11/2018	8:09:00 PM	Letter	Willandra Lane, Tarago	The complainant reported to the community feedback line that she was experiencing odour at her residence when she called. Marie could not describe the type of odour when asked, however stated that it was similar to what she had detected before.	Detected at time of call.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
26/10/2018	1:16:00 PM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA "he detected a very strong rotting garbage odour when he came out of his house at 6:20am that morning. He said its strength was a 4/5."	Not Specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
9/10/2018	8:40:00 AM	Letter	Stewart Street, Tarago	The complainant reported to the community feedback line that there was a "sweet and sour smell coming through her house this morning"	25 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
9/10/2018	7:59:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was a "strong rotting garbage smell from approximately 7:15 am this morning."	45 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. The Leachate Treatment Plant is in the commissioning phase. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
3/10/2018	7:59:00 PM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that there was an "awful rotting rubbish smell detected this evening."	Not Specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target and is scheduled for commissioning by the end of the week. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
2/10/2018	6:00:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was a "strong putrid smell of rotting rubbish coming from the Woodlawn Bio Reactor."	Not Specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target and is scheduled for commissioning by the end of the week. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
1/10/2018	7:20:00 PM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that there was a "strong putrid smell of rotting rubbish coming from the Woodlawn Bio Reactor and made him feel like he wanted to spew up his dinner and could be smelt inside his house."	20 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target and is scheduled for commissioning by the end of the week. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
22/09/2018	10:01:00 AM	Letter	Mulwaree Street, Tarago	The complainant reported to the Environmental line through EPA that a "garbage/rubbish odour in the air is coming from the Veolia Woodlawn Landfill from 09:30am in the morning."	30 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

VEOLIA

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
17/09/2018	8:13:00 PM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line "there is currently a really awful rotting rubbish smell in the air at Tarago. There is no wind, in fact it is quite still. The smell is distinctively rotting rubbish but a little different than what I have experienced before. It has a kind of sweetness if I can describe it like that, but definitely not pleasant at all."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
17/09/2018	8:32:00 AM	Letter	Willandra Lane, Tarago	The complainant reported to the Environmental line through EPA of a "strong putrid rubbish odour, first noticed it at 8:25am this morning when she opened the door to her house."	5 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
14/09/2018	7:11:00 PM	Letter	King Street, Tarago	The complainant reported to the Environmental line through EPA that he "smelt a decomposing garbage smell from about 6:45pm and it was the worst it has ever been. He said that it was enough to make you feel sick."	30 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
10/09/2018	8:39:00 PM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that the "smell was unbearable and sickening, and he was unable to leave the house due to the smell of stagnant water, rubbish and leachate".	1 hour	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
10/09/2018	7:15:00 PM	Letter	King Street, Tarago	The complainant reported to the community feedback line that he "detected a smell at his residence and it lasted for about half an hour and also noticed this smell in the morning."	30 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
10/09/2018	9:10:00 AM	Letter	Mulwaree Street, Tarago	The complainant reported to the Environmental line through EPA that a "strong rubbish odour was present when she opened the back door of her house at 8:00am this morning."	1 hour	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
30/08/2018	6:00:00 PM	Letter	Mulwaree Street, Tarago	The complainant reported to the Environmental line through EPA that there was a "strong rubbish odour."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
28/08/2018	8:28:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "It is a horrible rubbish and chemical smell and he first noticed the odour at approx. 6:30am and it was still continuing at the time of his call."	2 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
5/08/2018	9:12:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that the odour "was a foul waste type odour and it started at 21:50 on Saturday 4/8/18 and was still present at the time of his call on 5/8/18 at 09:12."	12 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
12/07/2018	8:50:00 PM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "the odour was an issue at 8.50 pm 12/7/2018"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
12/07/2018	8:56:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that Rotten garbage smell rating 7/10 and would like to have other options – maybe email instead. Want to be contacted regarding this.	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
12/07/2018	6:30:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "a stench of odour from the Woodlawn Bio Reactor, Tarago".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
10/07/2018	8:49:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that the smell last night was 7/10 and this morning was 8/10.	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
10/07/2018	6:30:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "this odour has been occurring every day and caller is sick of the odours".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
9/07/2018	7:00:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "the smell began at 7 am Monday 9/7/2018, rated as 4/6 and stated that the odour triggered an asthmatic attack on the complainant's spouse. Spouse sought medical attention on Tuesday 10/7/2018 because asthmatic attack could not settle."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
4/07/2018	6:27:00 PM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that "It stinks. I cannot explain it, it just stinks. He said the odour started at 18:00".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
3/07/2018	9:30:00 AM	Call	Cullulla Road, Tarago	Complainant contacted the Community feedback line and complained that the trucks exiting the Crisps Creek Intermodal Facility are slow going up the hill towards the Bioreactor which makes him late for work, and that some drivers don't wait for him to pass before exiting out of the slip lane.	Not specified.	Veolia has advised contractors to give way to vehicles when exiting the Crisps Creek Intermodal Facility.
3/07/2018	8:46:00 AM	Letter	Goulburn Street, Tarago	The complainant reported to the Environmental line through EPA that "he is affected by a strong offensive odour coming from Woodlawn landfill starting from 8:30am. He rated the odour at 5/6 and said the wind condition is calm".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
3/07/2018	8:45:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line "the smell is very bad, 10/10; it is a very foggy morning".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
22/06/2018	9:20:00 AM	Letter	Leahys Lane, Tarago	The complainant reported to the Environmental line through EPA a "sour milk and rotten garbage smell, first noticed the odour at about 6:30am, there was no wind at this time".	3 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
21/06/2018	7:10:00 PM	Letter	Leahys Lane, Tarago	The complainant reported to the Environmental line through EPA a "sour milk and rotten garbage smell, first noticed the odour at about 7pm"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
21/06/2018	10:05:00 AM	Letter	Rosebery Street, Tarago	The complainant reported to the Environmental line through EPA that his partner "first noticed the odour at about 5:30 am on their way to work, he went outside about 10am for a break and felt so nauseous from the odour he had to go inside again.".	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
28/05/2018	10:15:00 AM	Letter	Willandra Lane, Tarago	The complainant reported to the community feedback line that it "Smells like rubbish, usual tip smell we get coming into the house, the smell was about a 5 on a scale of 1-5. It feels as if nothing is changing and it is getting worse. Not fair, I feel money throwing at Goulburn Council is not enough to get rid of the smell".	15 minutes	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
26/05/2018	9:00:00 AM	Letter	Rosebury Street, Tarago	The complainant reported to the Environmental line through EPA that he experienced a "strong pungent odour suspected of coming from the Woodlawn Bioreactor, first noticed the odour when I went outside the house at 8:45am. He said it was a waste type odour and it was a cold morning with only a slight breeze."	Not specified	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
22/05/2018	9:45:00 PM	Letter	Tarago	The complainant reported to the community feedback line that he "smelt an odour in town last night on the way home, the smell was about a 2 as per the ranking in the odour diaries"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also used to manage any fugitive gas between the void's wall and waste mass. We are constantly reviewing our tipping sequence in an attempt to further improve gas collection.
19/04/2018	9:30:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that it " smelt like rotten garbage, same as before, as I was leaving my house"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. We have also engaged the University of Canberra to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor.

Woodlawn Bioreactor Complaints Register

VEOLIA

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
19/04/2018	9:00:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that it "smells like rotten garbage at my house"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. We have also engaged the University of Canberra to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor.
5/04/2018	7:57:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that she "Left home about 8:10am and smelt it when I came out my back door, it smelt like rotten garbage and it usually does not smell past mid-morning and does not stick around"	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. We have also engaged the University of Canberra to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour complaint.
29/03/2018	11:46:00 AM	Letter	Cullulla Road Tarago	The complainant reported to the community feedback line that she "First smelt faint odour at 7:15am at Cullulla road, Tarago and again at 7:25am at corner of King/Mulwaree st but stronger. Smell was an absolute stench at 8:55am at the corner of Collector / Tarago road. Smell was tolerable when she arrived back home at 9:10am"	2 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.
29/03/2018	8:40:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that she "went outside and the smell is particularly strong, worse than earlier in the week."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.

Woodlawn Bioreactor Complaints Register

VEOLIA

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
27/03/2018	7:26:00 AM	Letter	Cullulla Road Tarago	The complainant reported to the community feedback line that she "First detected the smell at 7:26am at the corner of King/Mulwaree st (bus depot), was a faint odour- smelt of rubbish/gas. The strongest odour was at 8:55am at the corner of Collector and Tarago road- Had to spray bus with glen40 as kids felt ill, odour was stronger than first smelt at 9:10am"	2 hours	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.
27/03/2018	10:02:00 AM	Letter	Goulburn Street, Tarago	The complainant reported to the EPA that they "first noticed the odour last night at about 8pm and closed up the house at that time, so couldn't say how long the odour lasted however they said it was still present at 7.30am this morning when they first went outside. They said the strength of the odour varied between 4/6 (strong) – 6/6 (overpowering)."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.
27/03/2018	9:49:00 AM	Letter	Mulwaree Street, Tarago	The complainant reported to the EPA that "she first noticed the odour when she went outside this morning at about 8.30-9am. She said the odour is affecting the whole town. She said the odour is overpowering and rated its strength as a 6/6."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.
27/03/2018	8:54:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the community feedback line that she was experiencing a "slight smell wafting over her property that seems to be getting stronger."	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Construction for the new Leachate Treatment Plant is on target. A bio-filter is also now used to manage any fugitive gas between the void's wall and waste mass. We are also reviewing our tipping sequence in an attempt to further improve gas collection. The gas extraction system was operating at an efficient state and no power station or gas extraction related issues occurred during the lead up to the odour being detected by the complainants.

Woodlawn Bioreactor Complaints Register

Date	Complaint lodged	Response	Location	Description	Duration	Response/action taken to resolve the complaint
28/02/2018	8:25:00 AM	Letter	Braidwood Road, Tarago	The complainant reported to the EPA that she was experiencing a “strong rotting garbage smell coming from the Veolia Bioreactor on 28/2/18 at 08:00.”	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia’s water division. Construction for the new Leachate Treatment Plant is on target. Following a heavy storm event (25/2/2018, greater than 80mm) Veolia is currently in the process of managing excess storm water in the Void. A bio-filter is also now used to manage any fugitive gas between the void’s wall and waste mass. We have also engaged the University of Canberra to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor, this assessment is expected to start in March 2018. We are also reviewing our tipping sequence in an attempt to further improve gas collection. We also advise that compared to this time last year gas collection has increased significantly which is an outcome of all the improvements we have implemented to date.
8/02/2018	8:47:00 PM	Letter	Rosebury Street, Tarago	The complainant reported to the EPA that he was experiencing a “strong stench/odour and it smells like rotten rubbish.”	Not specified.	Veolia continues to address the challenges of water management within the Bioreactor and is attempting to address this with the development and implementation of a longer term treatment solution being advanced by Veolia’s water division. Veolia has commenced the civil work on the new Leachate Treatment Plant. Veolia Woodlawn have implemented a contoured waste profile that allows for better control of storm water flows on the waste surface to minimise the ability for surface storm water to enter the waste. Due to leachate levels within the waste mass a new perforated well design has been implemented. This has been installed to maximise the opportunity for gas collection when compared with that of solid wells. This approach is proving successful as gas collection and power generation has increased substantially when compared with this time last year. A bio-filter trial has also been undertaken in an attempt to manage any fugitive gas between the void’s wall and waste mass. This has shown to demonstrate some positive results and subsequently is now part of our normal operations. We have also engaged the University of Canberra to undertake a study on fugitive gas emissions/odour and its behaviour to further improve gas collection at the Woodlawn Bioreactor this assessment is expected to start in March 2018.

EMISSIONS TESTING REPORT: WOODLAWN BIOGAS POWER STATION (R006204):

8 OCTOBER 2018

Ektimo

Address (Head Office)
7 Redland Drive
MITCHAM VIC 3132

Office Locations
VIC NSW WA QLD

Postal Address
52 Cooper Road
COCKBURN CENTRAL WA 6164

Freecall: 1300 364 005
www.ektimo.com.au
ABN: 86 600 381 413

Report Number R006204

Emission Testing Report
Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Biogas Power Station, Tarago

Document Information

Client Name:	Veolia Environmental Services (Australia) Pty Ltd
Report Number:	R006204
Date of Issue:	8 October 2018
Attention:	Sureka Withanage
Address:	619 Collector Rd Tarago NSW 2580
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
Preliminary Report	-	-	-	-	-
Draft Report	R006204[DRAFT]	15/08/2018	JWe	RCo	ADa
Draft Report	R006204[DRAFT2]	6/09/2018	JWe	RCo	ADa
Final Report	R006204	8/10/2018	JWe	RCo	ADa
Amend Report	-	-	-	-	-

Template Version: 020718

Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

Report Authorisation

Ryan Collins **Client Manager**	NATA Accredited Laboratory No. 14601	**Aaron Davis** **Ektimo Signatory**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

Ektimo was engaged by Veolia Environmental Services (Australia) Pty Ltd to perform emission testing.

Results from this emission monitoring program indicate that Veolia Environmental Services (Australia) Pty Ltd was compliant with requirements of set out by the NSW EPA in their environmental protection licence 11436 during the sampling period.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA Point 8 - Generator Exhaust	25 July 2018	Hydrogen sulphide, sulfuric acid mist and sulfur trioxide (as SO_3), carbon dioxide, carbon monoxide, nitrogen oxides, oxygen, sulfur dioxide, volatile organic compounds (VOC's), destruction efficiency, C_1-C_4 hydrocarbons
EPA Point 5 - LFG Supply		Carbon dioxide, oxygen, volatile organic compounds (VOC's), C_1-C_4 hydrocarbons, siloxanes
LFG Supply Line (Before Chiller)		Siloxanes

* Flow rate, velocity, temperature and moisture were determined unless otherwise stated.

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

2 LICENCE COMPARISON

The following licence comparison table shows that all analytes highlighted in green are compliant with the licence limit set by the NSW EPA as per licence 11436 (last amended on 08/11/2017).

EPA No.	Location Description	Pollutant	Units	Licence Limit	Detected Values
8	Engine 1 Exhaust Stack	Hydrogen Sulfide	mg/m^3	5	<0.01
		Sulfuric acid mist and sulfur trioxide (as SO_3)	mg/m^3	100	2.4
		Nitrogen Oxides	mg/m^3 @ 7% O2	450	420
		Volatile organic compound destruction efficiency	%	>98	98.8

3 SAMPLING PLANE COMPLIANCE

Ektimo assessed the engine exhaust stack sampling plane criteria and selection of sampling points outlined in NSW TM-1 (Australian Standard 4323.1 -1995). In this method, the selection of sampling plane position calls for an Ideal sampling plane to be located in a straight, preferably vertical section of stack or duct away from any flow obstructions which may cause a disturbance or other instability to the gas flow. This position will be found to exist at 7-8 hydraulic diameters downstream and 2-3 hydraulic diameters upstream from a flow disturbance. In the case of the EPA point 8 engine exhaust stack, the sampling plane is located 4 hydraulic diameters downstream of a junction and 2 hydraulic diameters from the exit. See table 1 for details.

TABLE 1

CRITERIA FOR SELECTION OF SAMPLING PLANES

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (*D*)	Minimum distance downstream from disturbance, diameters (*D*)
Bend, connection, junction, direction change	>2*D*	>6*D*
Louvre, butterfly damper (partially closed or closed)	>3*D*	>6*D*
Axial fan	>3*D*	>8*D* (see Note)
Centrifugal fan	>3*D*	>6*D*

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

In addition the following criteria must be met.

a) The gas velocity is basically in the same direction at all points along each sampling traverse.

b) The gas velocity at all sampling points is greater than 3 m/s.

c) The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane

d) The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.

e) The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1

f) The gas temperature at the sampling plane should preferably be above the dewpoint.

If the criteria of items (a) to (f) cannot be achieved a new sampling position shall be selected. The EPA point 8 engine exhaust stack meets all criteria of (a) to (f) and is suitable, therefore a new sampling position is not required, although an increased number of sampling points shall be used in accordance with clause 4.2 (non-ideal sampling positions) of AS 4323.1-1995.

Clause 4.2 proposes that if the criteria of table 1 cannot be met then a greater number of points shall be used in order to retain as much accuracy as is practicable, by applying the appropriate sampling point factors from *table 2*. The product of both the upstream and downstream factors multiplied by the total number of sampling points from *table 3* should then be raised to the next even number of sampling points for each sampling traverse.

TABLE 2

SAMPLING POINT FACTORS

Non-ideal situation	Sampling point factors
Sampling plane downstream from disturbance:	
Diameters less than Table 1	
0	1.00
1	1.05
2	1.10
3	1.15
4 or more	1.20
Sampling plane upstream from disturbance:	
Diameters less than Table 1	
0	1.00
0.5	1.05
1.0	1.10
1.5 or more	1.15

TABLE 3

MINIMUM NUMBER OF SAMPLING POINTS FOR CIRCULAR SAMPLING PLANES

Sampling plane diameter m		Minimum number of sampling traverses	Minimum number of access holes	Minimum number of sampling points per radius	Minimum total number of sampling points
>0.20	≤0.35	2	2	1	4
>0.35	≤0.70	2	2	2	8
>0.70	≤1.50	2	2	3	12
>1.50	≤2.50	2	4	4	16
>2.50	≤4.00	2	4	6	24
>4.00	≤6.00	3	6	5	30
>6.00		3	6	6	36

By example, the EPA point 8 engine exhaust stack has a sampling plane diameter of 350mm. If an ideal sampling plane was available the total number of sampling points would equate to 4. For this location, we have used a sampling point factor of 1.10 which yields a total number of sampling points of 8.

4 RESULTS

4.1 EPA Point 8 – (Engine 2 Exhaust Stack)

Date	25/07/2018	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R006204	**Stack ID**	EPA Point 8 - (Engine 2 Exhaust Stack)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		180723

Sampling Plane Details	
Sampling plane dimensions	350 mm
Sampling plane area	0.0962 m²
Sampling port size, number	4" Flange (x2)
Access & height of ports	Elevated work platform 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	9.4	
Gas molecular weight, g/g mole	29.1 (wet)	30.3 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.35 (dry)
% Oxygen correction & Factor	7 %	1.11
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1235 & 1359	
Temperature, °C	455	
Temperature, K	728	
Velocity at sampling plane, m/s	48	
Volumetric flow rate, discharge, m³/s	4.6	
Volumetric flow rate, discharge, m³/hour	16000	
Volumetric flow rate (wet STP), m³/s	1.6	
Volumetric flow rate (wet STP), m³/hour	5600	
Volumetric flow rate (dry STP), m³/s	1.4	
Volumetric flow rate (dry STP), m³/hour	5100	
Mass flow rate (wet basis), kg/hour	7300	

Gas Analyser Results	Average			Minimum			Maximum		
Sampling time	1301 - 1401			1301 - 1401			1301 - 1401		
Combustion Gases	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	380	420	32	350	390	30	410	460	35
Carbon monoxide	1000		86	1000		84	1100		89
	Concentration %			Concentration %			Concentration %		
Carbon dioxide	11.4			11.3			11.5		
Oxygen	8.4			8.3			8.4		

Hydrogen Sulfide	Results	
Sampling time	1243-1343	
	Concentration mg/m³	Mass Rate g/min
Hydrogen Sulfide	<0.01	<0.001

Isokinetic Results	Results	
Sampling time	1244-1354	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	100	8.6
Sulfur trioxide and/or Sulfuric acid (as SO3)	2.4	0.2
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	106	
Velocity difference, %	3	

Date	25/07/2018	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R006204	**Stack ID**	EPA Point 8 - (Engine 2 Exhaust Stack)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		180723

Total VOCs (as n-Propane)	Results	
	Concentration mg/m³	Mass Rate g/min
Total*	7.9	0.67

*Total excluding methane

VOC's C_1-C_4	Results		
Sampling time	1213-1224		
	Concentration mg/m³	Concentration %	Mass Rate g/min
Methane	450	0.069	38
Ethane	<1		<0.1
Ethylene	5		0.42
Acetylene	<1		<0.1
Propane	<2		<0.2
Propylene	<2		<0.2
Cyclopropane	<2		<0.2
Isobutane	<3		<0.2
n-Butane	<3		<0.2
Propadiene	<2		<0.2
1-Butene	<3		<0.2
Propyne	<2		<0.2
trans-2-Butene	<3		<0.2
1,3-Butadiene	<2		<0.2
cis-2-Butene	<3		<0.2

VOC (speciated)	Results	
Sampling time	1155-1255	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-trimethylbenzene, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Acetone, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Testing Parameter	Total Hydrocarbons (g/min)		
	LFG Inlet	Stack Outlet	Destruction Efficiency %
EPA Point 8 (Engine 2) Stack	57	0.67	98.8

4.2 EPA Point 5 – (LFG Supply)

Date	25/07/2018	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R006204	**Stack ID**	EPA Point 5 - (LFG Supply)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		180723

Sampling Plane Details	
Sampling plane dimensions	370 mm
Sampling plane area	0.108 m²
Sampling port size, number	1" BSP (x1)
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Change in diameter 2.2 D
Upstream disturbance	Connection 1.3 D
No. traverses & points sampled	1 1

Stack Parameters		
Moisture content, %v/v	<0.4	
Gas molecular weight, g/g mole	28.5 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1155 & 1300	
Temperature, °C	5	
Temperature, K	278	
Velocity at sampling plane, m/s	8.4	
Volumetric flow rate, discharge, m³/S	0.91	
Volumetric flow rate, discharge, m³/hour	3300	
Volumetric flow rate (wet STP), m³/S	0.94	
Volumetric flow rate (wet STP), m³/hour	3400	
Volumetric flow rate (dry STP), m³/S	0.94	
Volumetric flow rate (dry STP), m³/hour	3400	
Mass flow rate (wet basis), kg/hour	4300	
Velocity difference, %	<1	

Gas Analyser Results	Average	Minimum	Maximum
Sampling time	1156 - 1255	1156 - 1255	1156 - 1255
	Concentration %	Concentration %	Concentration %
Carbon dioxide	37	36.3	37.5
Oxygen	3.4	3.4	3.6

Siloxanes	Results	
Sampling time	1210-1220	
	Concentration mg/m³	Mass Rate g/min
Decamethylcyclopentasiloxane	0.34	0.019
Decamethyltetrasiloxane	0.034	0.0019
Dodecamethylcyclohexasiloxane	0.16	0.0088
Hexamethylcyclotrisiloxane	0.3	0.017
Hexamethyldisiloxane	<0.005	<0.0003
Octamethylcyclotetrasiloxane	0.17	0.0094
Octamethyltrisiloxane	0.025	0.0014
Pentamethyldisiloxane	<0.005	<0.0003
Tetradecamethylcycloheptasiloxane	0.012	0.00068

Date	25/07/2018	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R006204	**Stack ID**	EPA Point 5 - (LFG Supply)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		180723

Total VOCs (as n-Propane)	Results	
	Concentration mg/m³	Mass Rate g/min
Total*	1000	57

*Total excluding methane

VOC's C_1-C_4	Results		
Sampling time	1210-1220		
	Concentration mg/m³	Concentration %	Mass Rate g/min
Methane	370000	51	21000
Ethane	4.9		0.27
Ethylene	6.6		0.37
Acetylene	<1		<0.07
Propane	35		2
Propylene	<2		<0.1
Cyclopropane	17		0.95
Isobutane	<3		<0.1
n-Butane	65		3.7
Propadiene	56		3.1
1-Butene	<3		<0.1
Propyne	<2		<0.1
trans-2-Butene	<3		<0.1
1,3-Butadiene	<2		<0.1
cis-2-Butene	<3		<0.1

VOC (speciated)	Results	
Sampling time	1159-1259	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.009
Ethanol	410	23
Isopropanol	81	4.5
1,2-Dichloroethane	1.6	0.091
Butanol	150	8.6
Toluene	48	2.7
Tetrachloroethene	2.1	0.12
Ethylbenzene	20	1.1
m + p-Xylene	41	2.3
Styrene	2.2	0.13
o-Xylene	15	0.86
Isopropylbenzene	1.4	0.079
Propylbenzene	2.4	0.14
1,3,5-trimethylbenzene	3.7	0.21
1,2,4-trimethylbenzene	9.9	0.56
1,2,3-trimethylbenzene	1.9	0.11
n-Hexane	23	1.3
Methyl ethyl ketone	84	4.7
Ethyl acetate	100	5.9
Cyclohexane	4.3	0.24
2-Methylhexane	4.4	0.25
3-Methylhexane	4.3	0.24
Heptane	8.2	0.46
Propyl acetate	36	2
Methylcyclohexane	7.4	0.42
MIBK	4	0.22
2-Hexanone	0.56	0.031
Octane	7	0.39
Butyl acetate	23	1.3
alpha-Pinene	44	2.5
beta-Pinene	22	1.2
3-Carene	2.4	0.13
D-Limonene	150	8.3
Undecane	5.7	0.32
Dodecane	1.2	0.07

(1) Unless otherwise reported, the following target compounds were found to be below detection:
1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, Benzene, Carbon tetrachloride, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-trichloroethane, Chlorobenzene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, tert-Butylbenzene, Acetone, Pentane, Acrylonitrile, 2,3-Dimethylpentane, Isopropyl acetate, Ethyl acrylate, Methyl methacrylate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, Decane, Tridecane, Tetradecane

4.3 LFG Supply Line (Before Chiller)

Date	25/07/2018	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R006204	**Stack ID**	LFG Supply Line (Before Chiller)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Please refer to client records.		

Sampling Plane Details	
Sampling plane dimensions	370 mm
Sampling plane area	0.108 m²
Sampling port size, number	1" BSP (x1)
Access & height of ports	Ground level 1.5 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Valve 1 D
Upstream disturbance	Valve 1 D
No. traverses & points sampled	1 1

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

Siloxanes	Results
Sampling time	1146-1156
	Concentration mg/m³
Decamethylcyclopentasiloxane	0.39
Decamethyltetrasiloxane	0.037
Dodecamethylcyclohexasiloxane	0.19
Hexamethylcyclotrisiloxane	0.49
Hexamethyldisiloxane	<0.005
Octamethylcyclotetrasiloxane	0.23
Octamethyltrisiloxane	0.027
Pentamethyldisiloxane	<0.005
Tetradecamethylcycloheptasiloxane	0.019

5 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Veolia Environmental Services (Australia) Pty Ltd for complete process conditions.

6 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Method Detection Limit	Uncertainty*	NATA Accredited	
					Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	NA	-	✓	NA
Flow rate, temperature and velocity	NSW TM-2	NA	Location specific	8%, 2%, 7%	✓	NA
Moisture content	NSW TM-22	NSW TM-22	0.1%	8%	✓	✓
Carbon dioxide	NSW TM-24	NSW TM-24	0.1%	13%	✓	✓
Carbon monoxide	NSW TM-32	NSW TM-32	0.003 g/m³	12%	✓	✓
Nitrogen oxides (NO_X)	NSW TM-11	NSW TM-11	0.004 g/m³	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	0.1%	13%	✓	✓
Hydrogen sulfide	NSW TM-5	NSW TM-5	0.8 mg/m³	not specified	✓	✓†
Sulfur dioxide	NSW TM-4	NSW TM-4	0.06 mg/m³	12%	✓	✓†
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo 344	0.3 mg/m³	19%	✓	✓†
Sulfuric acid mist (including sulfur trioxide)	NSW TM-3	Ektimo 235	0.02 mg/m³	16%	✓	✓†
Siloxanes	N/A	Ektimo inhouse	not specified	not specified	×†	×†

180613

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis performed by Ektimo, NATA accreditation number 14601.
Laboratory analytical results were reported on 27 July 2018 in report number R006204-H2S.
Laboratory analytical results were reported on 30 July 2018 in report number R006204_C1-C4.
Laboratory analytical results were reported on 1 August 2018 in report number R006204-SOx.
Laboratory analytical results were reported on 6 August 2018 in report number R006204_SVOC.
Laboratory analytical results were reported on 13 August 2018 in report number R006204_Siloxanes.

7 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate; the sampling reproducibility, analytical method, accuracy, precision and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

8 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry

EVAPORATION DATA SUPPLIED BY VEOLIA:

MAY 2007 TO JUNE 2012

Evaporation	2006 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	2006 Sep	Oct	Nov	Dec	2007 Jan	Feb	Mar	Apr	May	Jun
1	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.60	6.80	5.00	3.00	1.50	1.41
2	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	2.20	2.60	4.80	3.60	2.40	1.04
3	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	2.60	5.00	3.80	3.80	3.19	1.16
4	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.00	6.40	7.60	2.80	4.52	1.30
5	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.80	7.40	6.60	3.00	2.68	0.69
6	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	8.20	3.60	4.60	2.52	1.00
7	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.60	7.00	5.00	2.40	2.43	0.67
8	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	5.80	4.60	3.60	1.40	1.87	0.83
9	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.60	6.80	5.00	2.40	1.37	0.48
10	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.40	5.20	4.80	2.00	1.41	0.73
11	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.60	3.60	5.40	3.20	1.48	1.24
12	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	11.40	2.20	7.00	3.60	1.74	0.77
13	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	13.40	3.80	3.60	2.60	2.19	1.23
14	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	4.40	2.80	3.00	1.51	1.02
15	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.80	5.80	4.80	3.60	2.03	0.43
16	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	6.20	6.20	4.00	2.09	0.64
17	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.80	3.80	4.60	2.80	1.47	0.84
18	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	5.60	2.40	3.40	1.49	0.75
19	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	6.00	1.60	2.00	3.80	0.72	0.63
20	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.60	3.60	0.20	2.20	1.53	0.43
21	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	11.00	6.80	2.20	2.60	2.14	1.13
22	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.40	7.40	3.40	2.60	2.21	1.12
23	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.60	5.60	4.40	2.60	1.69	1.35
24	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	9.40	5.20	4.80	1.80	1.59	1.11
25	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	7.20	4.60	4.00	0.60	1.81	1.16
26	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.00	4.20	2.60	1.20	1.75	0.57
27	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	12.40	3.60	2.80	2.40	1.56	0.27
28	6.40	5.40	4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	10.60	3.00	2.80	1.40	2.20	0.42
29	8.20		4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.80		4.20	1.40	1.75	0.79
30	8.20		4.10	2.60	1.70	1.10	1.20	1.90	2.80	3.90	5.00	6.20	8.00		3.00	1.80	2.65	1.27
31	8.20		4.10		1.70		1.20	1.90		3.90		6.20	10.00		3.40		1.24	
Total Month	**203.8**	**151.2**	**127.1**	**78**	**52.7**	**33**	**37.2**	**58.9**	**84**	**120.9**	**150**	**192.2**	**246.8**	**141**	**126.4**	**79.6**	**60.68**	**26.47**
Accumulated Year	**204**	**355**	**482.1**	**560.1**	**612.8**	**645.8**	**683**	**741.9**	**825.9**	**946.8**	**1096.8**	**1289**	**246.8**	**387.8**	**514.2**	**593.8**	**654.48**	**681**

Evaporation data recorded from the Goulburn Tafe W

Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
						2008												2009	
1.21	1.13	4.17	4.49	2.73	2.82	7.058	4.079	4.42	3.876	2.082	1.889	2.563	2.158	1.339	3.822	8.25	5.487	6.915	7.353
0.82	1.27	2.87	5.04	4.66	2.286	7.126	2.908	4.566	3.485	1.918	0.485	1.146	0.953	2.667	4.838	2.408	7.579	8.11	6.754
1.21	2.29	3.26	5.41	4.31	5.675	7.446	4.000	4.257	5.316	1.977	0.828	1.139	1.469	2.828	6.486	3.711	6.729	6.339	6.712
1.75	0.94	2.94	8.39	1.49	4.147	2.006	4.788	4.536	2.663	2.314	0.46	1.32	1.967	1.616	6.588	3.963	6.955	5.254	5.055
1.18	1.59	2.46	5.05	3.30	4.956	7.4	1.496	4.274	3.13	2.225	0.771	0.847	1.659	1.006	1.318	5.035	5.046	6.369	4.618
0.72	1.67	1.44	5.48	2.40	1.109	6.6	1.512	4.457	3.239	2.423	0.76	1.387	1.263	1.288	2.328	3.928	5.442	8.86	6.982
1.06	1.65	1.87	5.68	4.5	4.2	6.883	4.498	5.111	2.656	2.177	1.026	1.22	1.656	1.162	3.205	6.31	7.507	8.46	7.344
1.02	1.71	1.38	3.90	2.097	3.395	6.251	3.381	3.829	2.231	2.323	1.351	1.312	1.147	2.65	3.387	3.199	6.765	8.21	8.81
0.70	2.11	1.61	3.89	2.106	4.31	6.6	2.689	4.053	1.712	2.209	0.5	1.227	1.663	2.508	4.196	3.801	6.172	3.146	8.3
0.90	2.39	2.04	3.91	2.929	6.974	5.175	2.861	4.623	1.81	2.056	1.211	0.51	1.35	3.038	4.017	5.71	6.895	4.802	2.73
1.19	3.15	2.55	4.12	4.648	3.645	6.945	4.415	4.768	2.685	2.026	0.588	0.875	0.664	2.896	4.264	5.541	3.662	4.78	1.038
1.44	3.09	1.69	4.89	5.543	1.426	7.747	4.853	4.954	3.052	1.296	0.865	1.079	1.452	3.56	3.963	5.464	1.874	4.981	4.292
1.09	2.27	2.29	3.87	5.421	5.00	5.179	3	4.862	2.614	1.532	1.672	1.215	1.511	4.341	4.769	6.244	0.951	4.415	1.801
1.02	1.69	3.53	4.15	6.033	4.40	7.447	1.161	4.992	2.11	1.757	1.089	1.621	1.801	5.149	4.463	6.274	4.303	6.69	3.05
0.86	1.02	4.08	4.78	6.794	5.362	1.344	3.54	4.861	2.854	1.874	1.572	2.064	1.693	2.177	1.793	6.243	3.726	9	2.4
1.06	1.08	3.46	6.31	6.455	5.385	6.369	5.299	5.892	2.901	1.997	1.141	1.281	1.726	4.05	3.63	6.192	5.567	9.69	2.225
1.04	1.87	3.82	7.67	5.901	0.933	4.194	5.042	4.894	2.611	1.468	0.794	1.247	1.834	2.663	4.097	4.685	6.225	7.435	3.11
1.34	0.82	2.25	4.52	6.297	4.659	4.4	4.186	4.841	1.902	1.245	1.042	1.28	2.186	2.098	4.755	5.378	3.919	6.079	2.313
1.30	0.95	3.21	4.95	5.31	4.40	2.054	4.73	5.056	2.09	1.432	1.056	1.051	1.361	3.326	4.845	3.55	4.689	6.418	3.187
1.52	0.78	4.30	5.30	6.444	2.116	1.72	4.48	2.672	1.27	1.881	0.842	1.652	2.009	4.809	5.672	2.603	5.48	7.43	5.529
1.49	0.94	1.92	5.45	6.425	1.79	3.779	5.237	4.843	1.596	1.602	0.297	1.258	2.209	5.661	4.572	3.418	4.656	7.28	3.265
1.15	1.14	3.13	7.20	6.425	5.306	2.357	2.445	1.335	2.494	1.74	1.192	1.394	2.44	4.423	3.561	5.702	5.765	7.637	4.303
0.78	0.88	3.23	6.92	0.573	2.921	4.681	5.397	1.763	1.229	1.673	1.271	1.551	1.138	4.422	3.28	2.389	6.683	5.991	3.535
1.51	1.16	3.62	4.15	1.268	4.309	5.547	6.058	3.212	2.211	1.193	1.118	1.17	1.594	2.527	3.602	2.16	3.337	6.481	4.391
1.60	1.70	4.87	1.97	2.786	4.859	6.208	5.649	1.777	1.685	1.456	1.126	1.146	2.284	2.461	4.178	5.332	1.37	7.481	6.763
1.99	2.03	4.68	1.29	5.691	5.20	4.636	4.078	0.872	1.569	1.499	1.623	1.547	2.553	3.68	5.96	4.286	6.181	4.449	5.653
1.86	2.98	3.07	2.36	4.37	6.216	6.022	5.26	2.734	3.338	1.253	1.242	1.2	2.669	4.221	5.949	3.299	7.006	6.364	5.124
1.30	3.73	3.92	4.32	6.6	3.844	6.413	3.85	3.058	2.642	1.484	1.607	0.866	2.212	5.675	8	5.683	4.365	4.688	4.802
1.73	4.86	5.73	4.75	5.35	6.515	5.972	0.894	2.139	1.338	1.37	1.198	1.235	1.744	6.15	5.297	3.178	5.461	6.868	
1.18	3.51	3.62	5.87	3.106	6.941	6.752		3.646	2.208	1.425	1.927	1.503	1.283	3.495	1.819	5.458	7.121	7.29	
1.56	3.98		5.56		7.736	6.868		3.861		1.726		1.703	2.13		5.019		6.405	7.182	
38.56	**60.372**	**92.97**	**151.606**	**131.946**	**132.835**	**169.179**	**111.786**	**121.158**	**74.517**	**54.633**	**32.543**	**40.609**	**53.778**	**97.886**	**133.673**	**139.394**	**163.323**	**205.09**	**131.44**
719.5	**779.88**	**872.8**	**1024.45**	**1156.4**	**1289.23**	**169**	**280.965**	**402.123**	**476.64**	**531.273**	**563.816**	**604.425**	**658.203**	**756.089**	**889.762**	**1029.16**	**1192.48**	**205**	**336.533**

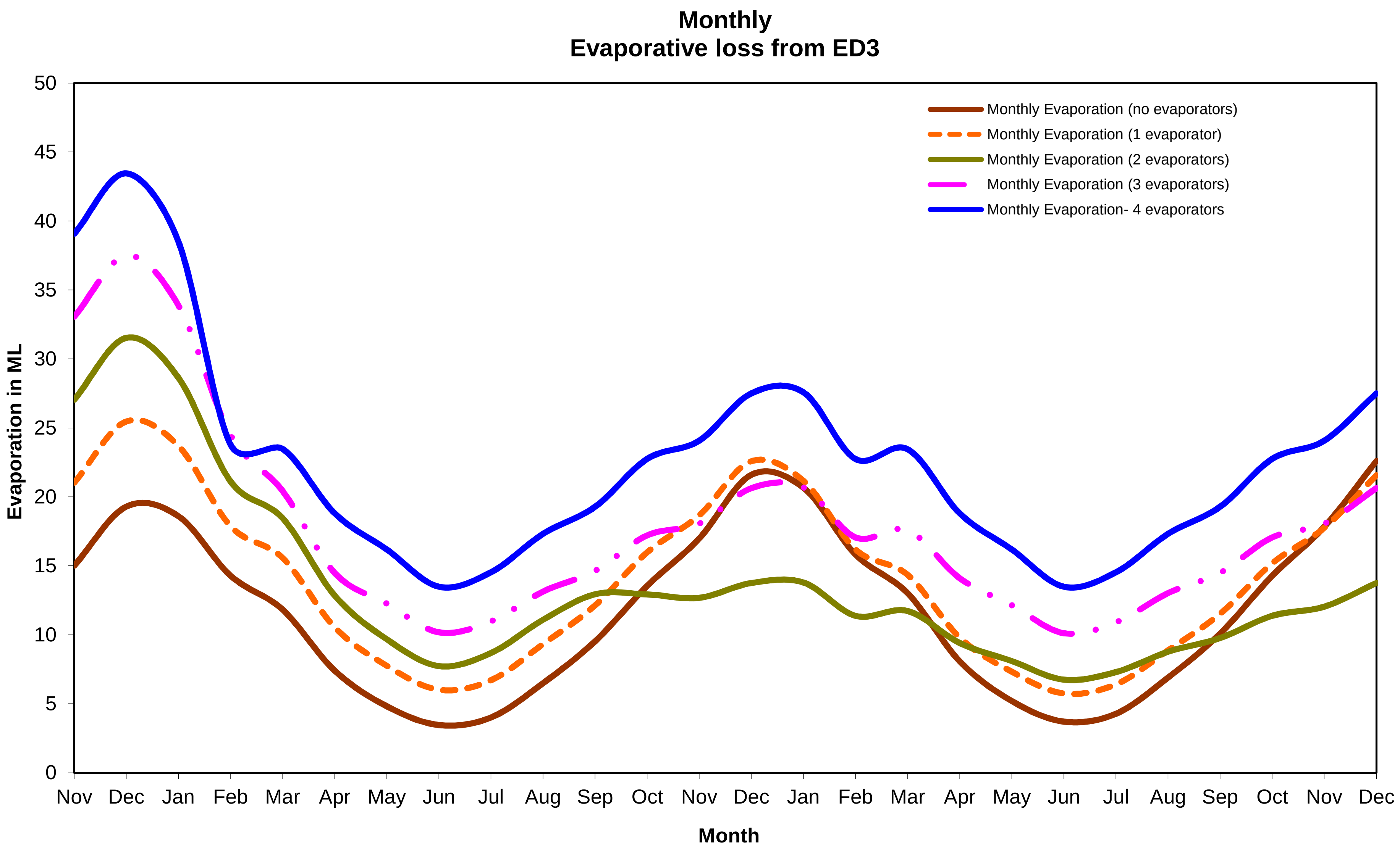
eather Station

Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2010 Jan	Feb	Mar	Apr	May	Jun
6.917	2.423	1.755	1.077	1.847	1.551	1.984	4.057	4.662	2.028	3.998	5.099	3.148	2.332	1.695	0.878
4.472	1.71	2.372	0.801	1.384	1.814	2.912	6.426	5.645	5.513	6.6	6.074	1.88	3.354	1.916	1.125
3.878	1.453	1.88	0.787	1.089	1.202	2.841	1.895	5.112	5.577	4.735	5.207	2.762	2.975	2.831	1.087
3.498	3.908	2.072	0.56	1.165	2.058	1.365	0.766	7.929	7.173	4.158	3.146	3.891	2.655	1.683	0.855
5.725	2.928	2.129	0.701	1.104	1.529	2.454	1.152	5.29	6.583	4.044	3.664	4.055	2.152	2.958	0.907
4.923	3.621	1.981	1.211	1.493	1.623	3.174	2.186	1.641	6.23	5.176	2.508	1.321	3.063	1.433	1.303
4.612	2.546	2.117	1.313	0.921	1.996	3.339	2.677	2.032	6.638	7.148	2.434	3.007	1.81	2.05	1.055
4.945	2.97	2.058	0.786	1.202	2.192	1.115	1.318	4.208	7.695	3.889	1.551	1.534	1.5	1.903	1.346
2.91	3.12	1.763	1.105	0.611	2.206	2.108	3.38	5.156	7.358	5.272	1.77	3.112	3.291	1.955	1.332
3.338	3.284	2.182	0.895	0.771	1.865	1.68	2.502	6.205	4.17	7.378	5.177	3.092	2.66	1.906	0.827
3.617	1.841	1.215	1.285	0.927	1.887	2.787	2.709	6.607	6.303	7.771	4.201	2.743	3.463	2.485	1.431
4.376	2.073	1.848	1.049	0.982	1.502	3.644	2.501	6.865	6.729	7.485	6.063	3.919	3.058	3.087	1.381
3.763	2.514	1.946	0.691	2.192	1.643	5.067	1.654	6.934	7.03	9.3	4.934	2.812	3.207	1.911	1.201
1.961	0.469	2.119	1.578	1.559	2.055	6.87	3.239	4.736	6.693	5.012	0.81	3.277	2.865	2.033	1.074
3.811	1.969	1.581	1.521	0.818	1.996	2.964	2.22	6.605	3.489	2.788	0.918	2.577	3.386	1.734	1.141
4.779	4.187	1.602	1.015	1.049	2.365	3.78	2.346	5.514	6.185	3.759	3.496	3.634	2.66	1.728	1.179
4.66	3.699	1.789	0.784	1.013	3.062	3.287	3.11	7.546	8	3.442	4.03	4.26	2.696	1.379	1.443
4.282	2.983	1.842	1.059	1.434	2.581	3.727	3.306	5.807	11.73	6.841	5.162	4.197	2.758	0.917	0.864
4.783	2.608	1.432	1.027	1.474	2.222	2.763	3.298	5.604	1.331	4.313	4.24	4.181	2.507	1.724	1.379
3.871	1.738	1.076	1.456	1.814	2.725	3.061	4.18	6.838	6.966	6.507	3.96	3.73	2.511	1.701	0.776
4.548	1.094	1.284	1.107	2.203	2.918	3.498	5.517	8	3.649	7.994	4.726	4.999	2.921	0.885	1.32
4.535	1.638	1.287	0.589	2.459	1.673	3.687	5.776	4.833	7.337	7.766	6.52	4.999	2.688	1.165	1.185
4.201	1.488	0.719	1.161	2.013	2.523	2.501	4.272	6.697	6.719	9.95	6.017	3.975	2.918	1.664	0.491
5.067	1.991	1.288	0.863	0.761	2.127	1.283	5.039	0.884	7.524	9.65	5.734	4.213	3.392	1.157	1.154
6.118	1.73	1.478	0.824	1.547	1.984	3.13	5.359	1.841	8.85	4.516	4.929	3.705	1.498	0.839	0.983
5.434	1.438	1.413	1.087	1.784	2.257	4.556	1.522	6.292	0.754	6.134	4.726	4.034	2.387	0.64	1.076
3.611	1.52	0.777	0.838	0.859	2.071	1.988	1.903	5.591	0.895	7.369	4.487	4.923	2.272	0.491	0.995
2.982	1.68	1.037	1.244	1.546	3.473	1.579	2.641	4.326	3.024	6.039	4.945	4.015	1.531	0.891	1.21
3.861	1.917	0.689	0.798	1.562	4.048	2.576	4.087	8.2	4.501	3.961		4.129	2.867	1.166	1.24
4.352	1.667	0.843	0.898	1.621	1.767	3.663	2.571	3.657	6.765	6.124		1.592	2.643	0.628	1.417
2.855		0.777		1.283	2.321		5.037		6.318	3.125		0.785		0.27	
132.69	**68.21**	**48.35**	**30.11**	**42.49**	**67.24**	**89.38**	**98.65**	**161.26**	**179.76**	**182.24**	**116.53**	**104.50**	**80.02**	**48.83**	**33.66**
469.218	**537.425**	**585.776**	**615.886**	**658.373**	**725.609**	**814.992**	**913.638**	**1074.895**	**1254.652**	**182**	**298.77**	**403.27**	**483.29**	**532.12**	**565.77**

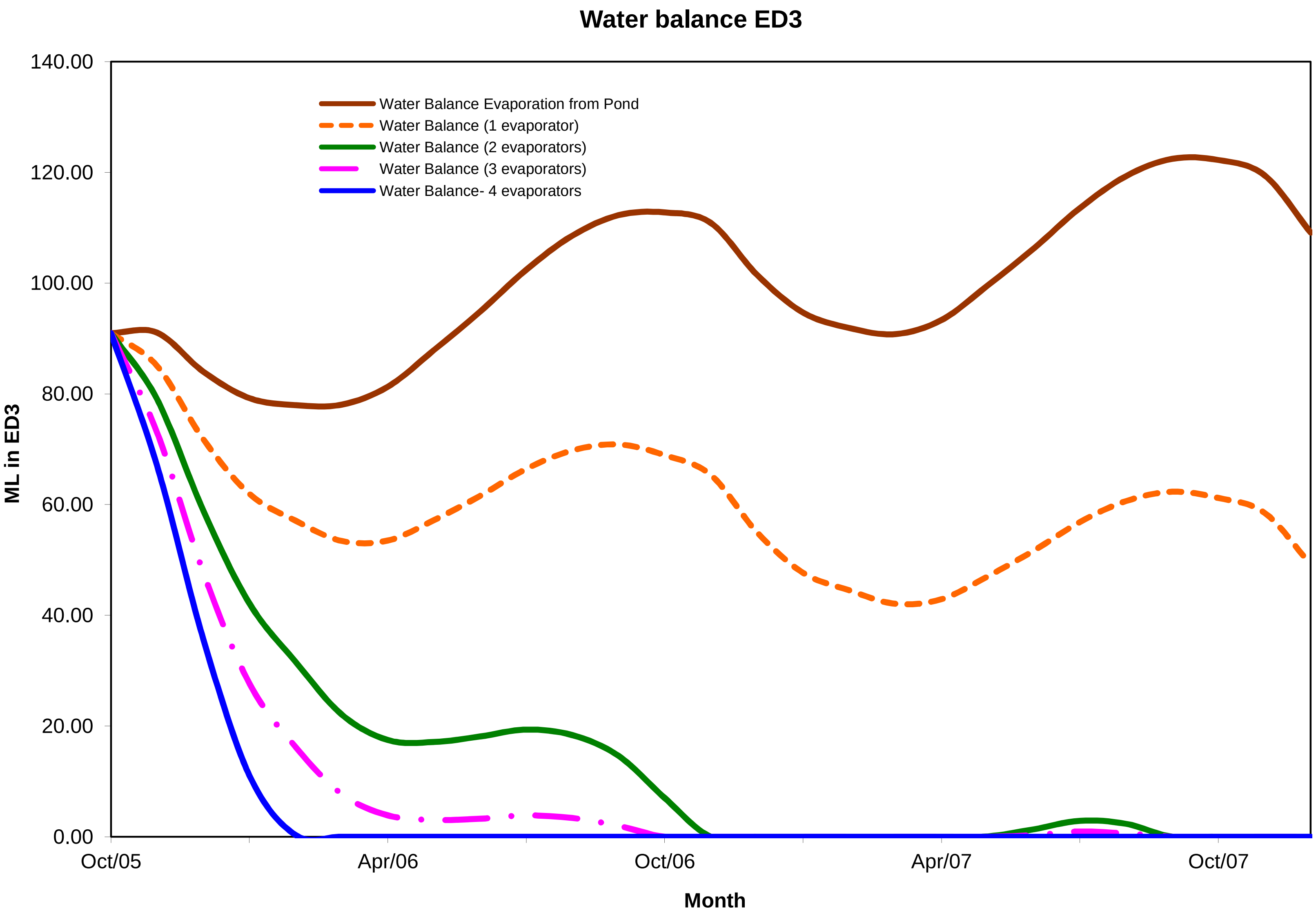
						2011							
Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1.268	1.296	2.57	3.375	4.13	1.186	7.051	7.012	2.274	1.106	1.672	0.987	1.048	1.254
1.044	1.432	3.342	2.595	1.913	1.338	7.866	9.26	4.678	3.107	1.878	1.056	0.911	2.284
0.452	1.033	0.811	2.4	2.259	3.215	3.502	5.421	3.477	3.304	0.655	1.016	1.027	1.942
1.215	1.468	1.109	1.091	4.22	2.258	0.963	3.908	5.296	3.294	1.914	1.53	1.616	3.34
1.111	1.031	0.862	2.602	1.355	3.228	2.593	2.614	5.187	3.215	2.064	0.861	1.293	3.226
1.077	1.714	1.645	4.097	1.948	4.476	5.333	6.545	3.419	1.963	2.11	1.51	1.004	3.188
0.573	1.737	1.99	3.927	2.165	3.351	3.727	1.692	3.268	1.802	1.676	1.527	0.864	1.604
1.348	1.679	2.243	3.864	4.228	5.486	3.458	4.228	4.416	2.223	2.087	1.093	1.247	1.912
1.326	1.577	2.275	3.793	4.414	4.11	4.247	3.948	4.142	3.183	2.375	0.862	1.228	0.946
0.814	1.94	1.779	2.713	3.68	1.728	2.307	3.324	3.978	3.395	1.6	1.092	1.16	1.769
0.855	0.94	2.288	2.238	3.89	4.773	2.736	4.659	1.385	1.308	2.051	1.078	1.079	1.23
0.7	0.917	1.423	2.36	5.513	5.854	1.677	2.874	1.6	2.148	1.193	1.34	1.41	0.462
1.493	0.976	1.389	3.446	5.371	5.957	4.233	2.073	3.28	1.747	1.684	0.956	1.458	1.427
0.631	2.024	1.307	1.812	6.154	5.745	3.408	1.502	4.49	1.923	1.434	0.744	0.815	1.582
1.03	1.39	0.437	3.58	3.953	4.113	3.981	4.138	0.749	2.724	1.743	0.804	1.333	1.771
1.381	1.588	1.027	1.264	1.957	6.395	5.885	3.005	2.157	2.568	1.959	0.557	1.19	1.495
1.225	1.2	3.789	2.281	4.89	3.684	6.391	1.15	2.357	2.236	1.344	0.813	0.589	1.994
1.302	1.883	2.998	3.349	4.525	5.331	7.255	3.479	1.534	2.029	1.467	1.074	1.178	0.561
1.433	1.683	2.743	3.847	6.084	3.731	5.497	2.893	0.69	2.608	1.735	1.222	0.831	0.867
0.826	1.684	2.645	3.02	2.109	3.686	4.004	3.746	1.547	2.338	1.71	1.208	0.475	0.819
1.377	1.882	2.91	3.964	5.642	2.636	4.759	4.729	1.814	1.341	1.56	1.517	1.369	0.957
1.379	1.539	3.202	4.17	6.288	5.074	6.263	4.947	0.758	2.355	1.738	0.914	0.853	1.532
1.336	2.092	2.737	4.903	5.996	5.285	4.855	4.657	3.055	2.246	1.803	0.864	0.721	1.235
1.201	1.533	2.271	3.476	4.515	6.343	6.291	4.763	2.44	2.209	0.854	1.412	1.208	1.695
1.573	1.865	3.718	2.227	5.96	2.143	5.118	4.651	2.026	2.329	1.129	1.207	0.621	2.437
1.431	1.816	2.922	2.794	5.9	5.442	6.436	4.057	3.047	1.251	1.797	1.25	0.674	3.024
1.326	1.186	4.061	4.945	4.33	3.951	7.204	5.033	2.824	1.474	1.694	1.653	1.431	3.163
1.452	1.803	3.858	4.318	5.672	3.478	6.509	2.284	2.365	1.764	1.191	1.369	1.506	2.636
0.515	2.243	3.876	3.221	1.734	5.219	5.086	[redacted]	3.328	1.206	1.303	0.969	2.089	2.91
0.838	2.186	3.174	4.233	1.189	6.065	5.724	[redacted]	2.678	1.313	1.275	0.918	2.003	2.894
0.86	1.966	[redacted]	4.17	[redacted]	6.422	6.781	[redacted]	3.709	[redacted]	0.946	[redacted]	2.083	1.518
34.39	**49.30**	**71.40**	**100.08**	**121.98**	**131.70**	**151.14**	**112.592**	**87.968**	**65.709**	**49.641**	**33.403**	**36.314**	**57.674**
600.17	**649.47**	**720.87**	**820.94**	**942.93**	**1074.63**	**151.14**	**263.732**	**351.7**	**417.409**	**467.05**	**500.453**	**536.767**	**594.441**

				2012									
Sep	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2.471	2.435	4.777	2.325	5.891	5.284	0.9	3.54	1.227	1.373	1.384			
2.241	1.588	4.316	4.913	6.209	2.501	1.154	2.845	2.177	0.793	0.822			
2.59	1.69	3.187	3.823	6.572	0.926	0.938	2.605	1.285	0.278	1.289			
3.132	3.258	2.896	5.667	7.179	1.351	0.919	3.164	2.134	0.594	1.277			
3.208	3.717	5.035	2.502	3.869	5.308	1.289	2.861	1.909	1.126				
2.879	2.781	6.021	4.276	5.369	6.111	4.487	2.241	1.845	0.44				
3.472	1.184	5.481	2.521	4.112	3.608	2.485	3.182	1.434	1.351				
2.624	1.667	4.105	4.129	6.458	1.226	1.009	3.775	1.077	1.279				
2.148	2.349	3.484	1.996	2.415	1.754	1.291	3.02	2.012	1.112				
1.354	2.354	4.679	5.002	6.068	2.106	3.155	2.901	2.752	1.18				
2.113	3.671	3.949	4.417	5.436	4.055	4.215	2.367	3.317	1.241				
1.992	2.976	4.623	3.436	3.858	2.691	3.676	2.476	2.556	0.629				
3.06	3.96	5.283	2.506	5.435	3.405	1.858	2.471	2.095	0.589				
2.947	3.783	4.932	2.187	6.049	3.371	3.285	2.797	1.384	1.253				
3.867	2.61	7.31	4.185	2.996	4.062	2.97	1.622	1.75	1.101				
3.495	3.47	6.555	5.44	2.083	4.704	4.013	2.658	1.504	1.735				
4.641	4.797	1.852	2.785	4.367	5.012	3.449	2.979	1.687	0.388				
4.808	4.456	4.183	5.786	5.552	3.774	2.386	1.349	1.343	1.027				
5.481	4.215	5.886	3.902	6.141	3.874	3.566	1.094	1.883	1.354				
5.343	4.925	7.084	1.302	6.487	4.644	2.513	2.241	1.763	1.264				
2.999	5.604	2.288	4.018	4.825	2.77	3.803	2.089	0.999	1.125				
3.491	5.794	4.966	2.69	4.856	4.255	4.005	1.749	1.613	1.895				
4.132	4.353	1.416	4.248	4.142	3.313	1.574	1.236	2.124	0.979				
5.552	5.458	2.959	5.868	3.036	4.821	3.37	2.224	2.66	1.068				
0.677	6.477	1.808	6.049	4.872	5.508	3.169	1.13	1.581	1.355				
1.441	0.997	0.889	6.216	2.176	5.785	2.475	0.934	1.061	1.264				
2.871	1.547	4.708	2.701	3.709	2.374	3.162	1.885	0.925	0.88				
3.301	2.761	4.889	4.081	2.485	2.673	1.564	1.73	1.416	0.587				
1.057	4.003	5.752	4.757	4.831	1.274	1.226	2.061	0.983	1.278				
1.649	2.008	5.654	6.255	5.77		3.304	1.868	1.428	1.283				
	4.498		3.977	2.548		3.262		1.146					
91.036	**105.386**	**130.967**	**123.96**	**145.796**	**102.54**	**80.472**	**69.094**	**53.07**	**31.821**	**4.772**	**0**	**0**	**0**
685.477	**790.863**	**921.83**	**1045.79**	**145.796**	**248.336**	**328.808**	**397.902**	**450.972**	**482.793**	**487.565**	**487.565**	**487.565**	**487.565**

Nov	Dec
0	0
487.565	487.565



Monthly
Evaporative loss from ED3
Monthly Evaporation (no evaporators)
Monthly Evaporation (1 evaporator)
Monthly Evaporation (2 evaporators)
Monthly Evaporation (3 evaporators)
Monthly Evaporation- 4 evaporators
Evaporation in ML
0
5
10
15
20
25
30
35
40
45
50
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Water balance ED3
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
ML in ED3
Oct/05
Apr/06
Oct/06
Apr/07
Oct/07
Month
Water Balance Evaporation from Pond
Water Balance (1 evaporator)
Water Balance (2 evaporators)
Water Balance (3 evaporators)
Water Balance- 4 evaporators

	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
	30	31	31	28	31	30	31	30	31	31	30	31	30	31	31	28	31	30	31	30	31	31	30	31	30	31
	58.7	46.1	59.8	51.2	55.6	49.3	47.5	37.9	52.4	47.6	65.2	61.9	58.7	46.1	59.8	51.2	55.6	49.3	47.5	37.9	52.4	47.6	65.2	61.9	58.7	46.1
	5	6.2	6.3	5.5	4.1	2.6	1.6	1.1	1.2	1.9	2.8	3.8	5	6.2	6.3	5.5	4.1	2.6	1.6	1.1	1.2	1.9	2.8	3.8	5	6.2
Average Monthly Pan Evaporation (mm- total)	0.1725	0.22165	0.2232	0.1778	0.1488	0.093	0.0589	0.0405	0.04495	0.06975	0.099	0.13795	0.1725	0.22165	0.2232	0.1778	0.1488	0.093	0.0589	0.0405	0.04495	0.06975	0.099	0.13795	0.1725	0.22165
Estimated monthly evaporation (M3) attributed to 1 evaporator (350 l/min)	6019	6875	6895	5686	5862	4701	4046	3371	3632	4330	4820	5687	6019	6875	6895	5686	5862	4701	4046	3371	3632	4330	4820	5687	6019	6875
Estimated monthly evaporation (M3) attributed to 2 evaporators (350 l/min)	12037	13751	13789	11372	11725	9402	8093	6742	7264	8659	9640	11375	12037	13751	13789	11372	11725	9402	8093	6742	7264	8659	9640	11375	12037	13751
Estimated monthly evaporation (M3) attributed to 3 evaporators (350 l/min)	18056	20626	20684	17058	17587	14103	12139	10113	10895	12989	14460	17062	18056	20626	20684	17058	17587	14103	12139	10113	10895	12989	14460	17062	18056	20626
Estimated monthly evaporation (M3) attributed to 4 evaporator(s) (350 l/min)	24075	27502	27578	22744	23449	18804	16186	13484	14527	17318	19280	22750	24075	27502	27578	22744	23449	18804	16186	13484	14527	17318	19280	22750	24075	27502
Estimated Evaporation (M3) attributed to surface evaporation (no evaporator)	15006.3	19291.2	18596.0	14286.3	11827.1	7397.5	4816.0	3457.6	4001.9	6488.1	9529.3	13544.4	16982.3	21601.0	20657.1	15814.9	13016.6	8081.2	5197.2	3706.7	4272.1	6895.5	10083.4	14273.9	17829.0	22594.3
Estimated Evaporation (M3) attributed to surface evaporation (1 evaporator)	15006.3	18586.8	16798.5	12188.2	9715.6	5845.2	3705.0	2647.1	3070.1	4994.2	7313.1	10292.7	12643.1	15705.6	14263.7	10500.7	8482.3	5096.7	3274.3	2374.8	2773.1	4542.8	6698.9	9492.6	11738.3	14684.1
Estimated Evaporation (M3) attributed to surface evaporation (2 evaporator)	15006.3	17777.3	14847.0	9755.6	6725.4	3443.3	1581.8	988.8	1414.3	2427.2	3296.7	1550.3	643.3	0.0	0.0	0.0	0.0	0.0	0.0	1.5	32.2	107.1	123.3	0.0	0.0	0.0
Estimated Evaporation (M3) attributed to surface evaporation (3 evaporator)	15006.3	16861.3	13193.4	7424.1	2837.6	382.6	121.3	65.6	78.0	143.4	178.4	144.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	35.5	30.9	0.0	0.0	0.0
Estimated Evaporation (M3) attributed to surface evaporation (4 evaporator(s))	15006.3	15950.5	10922.7	1049.4	25.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evaporator evaporation as % of Surface Evaporation (1 evaporator)	40.1%	35.6%	37.1%	39.8%	49.6%	63.5%	84.0%	97.5%	90.8%	66.7%	50.6%	42.0%	35.4%	31.8%	33.4%	36.0%	45.0%	58.2%	77.9%	90.9%	85.0%	62.8%	47.8%	39.8%	33.8%	30.4%
Evaporator evaporation as % of Surface Evaporation (2 evaporators)	80.2%	71.3%	74.2%	79.6%	99.1%	127.1%	168.0%	195.0%	181.5%	133.5%	101.2%	84.0%	70.9%	63.7%	66.8%	71.9%	90.1%	116.3%	155.7%	181.9%	170.0%	125.6%	95.6%	79.7%	67.5%	60.9%
Evaporator evaporation as % of Surface Evaporation (3 evaporator(s))	120.3%	106.9%	111.2%	119.4%	148.7%	190.6%	252.1%	292.5%	272.3%	200.2%	151.7%	126.0%	106.3%	95.5%	100.1%	107.9%	135.1%	174.5%	233.6%	272.8%	255.0%	188.4%	143.4%	119.5%	101.3%	91.3%
Evaporator evaporation as % of Surface Evaporation (4 evaporator(s))	160.4%	142.6%	148.3%	159.2%	198.3%	254.2%	336.1%	390.0%	363.0%	266.9%	202.3%	168.0%	141.8%	127.3%	133.5%	143.8%	180.1%	232.7%	311.4%	363.8%	340.0%	251.2%	191.2%	159.4%	135.0%	121.7%
Evaporation from Pond	15006.33158	19291.2246	18595.96903	14286.305	11827.0785	7397.5361	4815.98473	3457.57676	4001.9273	6488.09051	9529.31306	13544.40844	16982.28	21600.97867	20657.05538	15814.9363	13016.6113	8081.18995	5197.22556	3706.71156	4272.10208	6895.50571	10083.4006	14273.9441	17829.0205	22594.3205
Incident Rainfall	10081.5	7243.5	8819.25	8027.25	6913.5	5626.5	6435	5395.5	6575.25	7656	8217	9050.25	10081.5	7243.5	8819.25	8027.25	6913.5	5626.5	6435	5395.5	6575.25	7656	8217	9050.25	10081.5	7243.5
Water Pumped In	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

	Initial Volume stored in ED3																										
Progressive Water Balance (no evaporators)	90976	91051	84003	79226	77967	78054	81283	87902	94840	102413	108581	112268	112774	110874	101516	94678	91891	90787	93333	99571	106259	113562	119323	122457	122233	119485	109135
Progressive RL of dam	789.09	789.09	789.02	788.96	788.95	788.95	788.99	789.06	789.13	789.21	789.27	789.31	789.31	789.29	789.20	789.13	789.10	789.09	789.11	789.18	789.25	789.32	789.38	789.41	789.41	789.38	789.27
Progressive Water Balance (1 evaporator)	90976	85032	71813	61939	57093	53428	53509	57192	61569	66443	69775	70859	68929	65349	55011	47672	44513	42082	42911	47025	51674	56845	60628	62327	61197	58521	49205
Progressive RL of dam	789.09	789.03	788.87	788.73	788.67	788.62	788.62	788.67	788.73	788.79	788.84	788.85	788.83	788.78	788.64	788.55	788.50	788.46	788.48	788.54	788.60	788.67	788.72	788.74	788.73	788.69	788.57
Progressive Water Balance (2 evaporators)	90976	79013	58919	42151	31618	22091	17471	17108	18114	19355	18358	14622	7005	0	0	0	0	0	0	68	1346	2885	2339	0	0	0	0
Progressive RL of dam	789.09	788.96	788.70	788.46	788.26	788.07	787.81	787.75	787.93	788.02	787.98	787.28	785.83	784.50	784.50	784.50	784.50	784.50	784.50	784.51	784.76	785.05	784.94	784.50	784.50	784.50	784.50
Progressive Water Balance (3 evaporators)	90976	72995	47751	27693	16238	7727	3868	3042	3259	3861	3385	1963	0	0	0	0	0	0	0	0	282	955	587	0	0	0	0
Progressive RL of dam	789.09	788.88	788.55	788.18	787.58	785.97	785.23	785.08	785.12	785.23	785.14	784.87	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.55	784.68	784.61	784.50	784.50	784.50	784.50
Progressive Water Balance- 4 evaporators	90976	66976	35767	11085	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Progressive RL of dam	789.09	788.80	788.34	786.60	784.56	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50	784.50

	1/11/2005	1/12/2005	1/01/2006	1/02/2006	1/03/2006	1/04/2006	1/05/2006	1/06/2006	1/07/2006	1/08/2006	1/09/2006	1/10/2006	1/11/2006	1/12/2006	1/01/2007	1/02/2007	1/03/2007	1/04/2007	1/05/2007	1/06/2007	1/07/2007	1/08/2007	1/09/2007	1/10/2007	1/11/2007	1/12/2007
Monthly Evaporation (no evaporators)	15.006	19.291	18.596	14.286	11.827	7.398	4.816	3.458	4.002	6.488	9.529	13.544	16.982	21.601	20.657	15.815	13.017	8.081	5.197	3.707	4.272	6.896	10.083	14.274	17.829	22.594
Monthly Evaporation (1 evaporator)	21.025	25.462	23.693	17.874	15.578	10.546	7.752	6.018	6.702	9.324	12.133	15.980	18.662	22.581	21.158	16.187	14.345	9.798	7.321	5.746	6.405	8.872	11.519	15.180	17.757	21.560
Monthly Evaporation (2 evaporators)	27.044	31.528	28.636	21.127	18.450	12.845	9.675	7.731	8.678	11.086	12.937	12.925	12.681	13.751	13.789	11.372	11.725	9.402	8.093	6.744	7.296	8.766	9.763	11.375	12.037	13.751
Monthly Evaporation (3 evaporators)	33.063	37.487	33.877	24.482	20.425	14.485	12.261	10.179	10.973	13.132	14.638	17.207	18.056	20.626	20.684	17.058	17.587	14.103	12.139	10.113	10.902	13.024	14.491	17.062	18.056	20.626
Monthly Evaporation- 4 evaporators	39.081	43.452	38.501	23.793	23.475	18.804	16.186	13.484	14.527	17.318	19.280	22.750	24.075	27.502	27.578	22.744	23.449	18.804	16.186	13.484	14.527	17.318	19.280	22.750	24.075	27.502

Net pan evaporation (inches/month)	Percentage of volume pumped by evaporator	Net pan evaporation (inches/month)	Percentage of volume pumped by evaporator
1.5	20	7.0	40
2.0	28	7.5	41
2.5	29	8.0	42
3.0	30	8.5	43
3.5	32	9.0	44
4.0	34	9.5	45
4.5	35	10	46
5.0	36	10.5	47
5.5	37	11	48
6.0	38	11.5	49
6.5	39	12	50
7.0	40	12+	up to 85

Net pan evaporation	Percentage of volume pumped by evaporator (from manufacturer specifications)			
1.5	20%	38.1	21.8%	21.8%
2	28%	50.8	24.4%	24.4%
2.5	29%	63.5	26.7%	26.7%
3	30%	76.2	28.7%	28.7%
3.5	32%	88.9	30.5%	30.5%
4	34%	101.6	32.2%	32.2%
4.5	35%	114.3	33.8%	33.8%
5	36%	127	35.2%	35.2%
5.5	37%	139.7	36.6%	36.6%
6	38%	152.4	37.9%	37.9%
6.5	39%	165.1	39.1%	39.1%
7	40%	177.8	40.3%	40.3%
7.5	41%	190.5	41.4%	41.4%
8	42%	203.2	42.5%	42.5%
8.5	43%	215.9	43.5%	43.5%
9	44%	228.6	44.6%	44.6%
9.5	45%	241.3	45.5%	45.5%
10	46%	254	46.5%	46.5%
10.5	47%	266.7	47.4%	47.4%
11	48%	279.4	48.3%	48.3%
11.5	49%	292.1	49.1%	49.1%
12	50%	304.8	50.0%	50.0%
12+	up to 86			

MONTHLY WASTE TONNAGE DATE:

DECEMBER 2017 – FEBRUARY 2019

	Waste input (t)
12/2017	63,249.71
01/2018	60,705.36 `
02/2018	53,747.14
03/2018	57,442.19
04/2018	57,360.10
05/2018	61,876.88
06/2018	55,749.86
07/2018	58,235.78
08/2018	59,671.26
09/2018	50,816.27
10/2018	63,986.12
11/2018	64,410.24
12/2018	62,570.97
01/2019	62,489.32
02/2019	60,140.68

THE ODOUR UNIT

APPENDIX E

LIQUID ODOUR MEASUREMENT METHODOLOGY

Methodology

The Liquid Odour Method (**LOM**) is comprised of the following components:

- Evaporation of a known amount of liquid in a known volume of dry nitrogen contained in a Nalophan odour sample bag;
- Determination of the odour concentration of the gaseous sample by Dynamic Dilution Olfactometry following AS4323.3:2001; and
- Calculation of the odour concentration in the liquid from the gaseous odour concentration (ou/m^3) and the volume of liquid evaporated to produce the gaseous sample.

Procedure

Liquid Sample Storage

The liquid samples analysed from the Woodlawn Bioreactor Facility were collected from stored leachate in lagoons ED3N-1, ED3N-2, ED3N-3, ED3N-4 and ED3S-S. These were refrigerated prior to testing. A liquid sample was extracted immediately from the refrigerated sample bottle and not allowed to warm to room temperature. This is the general procedure when carrying out the liquid odour measurement method for aqueous samples.

Liquid Sample Size

The volume of liquid is determined by the requirement to produce a gaseous sample with a relative humidity of less than 100%. This equates to less than 2.3% v/v water at 20º C, or for a 25 L sample, 413 µL of aqueous sample. The method development work carried out to date has shown that 413 µL of liquid sample in 25 L dry nitrogen will evaporate in approximately 30 mins. The nominal liquid sample size required for the Liquid Odour method can be specified as 340-413 µL, which provides a gaseous sample with 80-100% RH. For the liquids samples collected at the Woodlawn Bioreactor Facility, 413 µL of liquid sample was used in 25 L dry nitrogen.

Table D1 details a range of liquid volumes and approximate evaporation times observed from the method development work carried out to date.

Table D1 - Liquid sample volumes, evaporation and equilibration time

Volume µL (% saturation)	Approximate evaporation time (in 25 L dry nitrogen)	Recommended equilibration time (in 25 L dry nitrogen)
280 µL (60%)	20-30 min	60 min
340 µL (80%)	30-40 min	60 min
413 µL (100%)	40-60 min	60 min

Sample Equilibration and Ageing

The development work to date has shown that condensate derived odour samples are not stable and degrade significantly over time. However, the degradation appears insignificant in the first 2-4 hours after preparation of the gaseous samples. Therefore, samples must be tested within that time period after preparation. For samples prepared at 100% saturation or below, the equilibration time can be standardised to 1 hour.

Sample Preparation and Odour Testing Procedure

The gaseous sample for odour testing is prepared as follows:

1. Dispense 25 L of dry nitrogen into a conditioned Nalophan bag.

2. Place a piece of clear packaging tape (approximately 100 mm long) onto the wall of the bag half way between the ends. Ensure that the a least a 1 cm^2 section of tape completely adheres to the bag with no air bubbles trapped between the tape and bag that could allow a leak of gas to the edge of the tape.

3. Remove the liquid sample from cold storage.

4. Rinse the microlitre syringe (5 x) with the liquid sample.

5. Draw up the required volume of liquid sample (see **Liquid Sample Size** and **Table D1**) and record the exact volume in the syringe.

6. Inject the liquid through the tape and wall of the bag at the point where the tape has completely adhered to the bag. Tap the syringe to displace residual drop that adheres to the needle and withdraw the syringe from the bag.

7. Place the second piece of packaging tape over the first piece such that the puncture hole is sealed. Ensure no air bubbles are trapped between the layers of tape such that a leak could occur.

8. Vigorously shake the bag to disperse the liquid droplets inside the bag (to aid in the evaporation rate).

9. Store the bag in the laboratory for the prescribed equilibration time (see **Sample Equilibration and Ageing** and **Table D1**) to allow all the liquid to evaporate.

10. At the completion of the equilibration time, carry out the measurement of odour concentration using AS4323.3:2001.

Calculation of Liquid Odour Concentration

The odour concentration from a liquid (ou per mL) is calculated from the gaseous sample odour concentration, the volume of liquid used to prepare the gaseous sample and the volume of dry nitrogen:

$$[odour]_{liquid} = \frac{\left(\frac{OU}{m^3} \times \frac{litres_{Nitrogen}}{1000}\right)}{mL_{liquid}}$$

An example of the calculation is presented in **Table D2**.

Table D2 – Example calculation of liquid odour concentration for ED3N-4		
Parameter	**Value**	**Unit**
Volume of liquid from ED3N-4	0.413	mL
Volume of dry N_2	25	L
Measured odour concentration	91^	ou
Calculated liquid odour concentration	= (91 x 25/1000)/0.413 = 5.51	ou.m^3/mL

^ TOU Sample Number SC19156 – see **Table 6.4** in Main Report

Calculation of Odour Emission Rates from Evaporation of Liquids

A primary driver for the development of a liquid odour measurement is the requirement to predict odour emission rates from liquids area sources (such as storage ponds) as well as condensates. In particular, evaporation of condensates or other odorous refinery waters in cooling towers has been implicated as a significant contributor to refinery odour. With a measurement of the odour from liquids now available, the estimation of emission rates can be considered.

An example is presented below for treated leachate stored in ED3N-4 (SC19156) which returned a measured odour concentration of 5.51 ou.m^3/mL (see **Table D2**) with an evaporation rate of 1.375 L/s (based on on-site evaporation data collected by Veolia between May 2007 and June 2012):

Odour concentration = 5.51 ou.m^3/mL

Ambient pond evaporation rate = 1.375 L/sec

Odour emission rate = 5.51 ou.m^3/mL x 1,375 mL/sec
= 7,580 ou.m^3/sec (see **Table 6.4** in Main Report)

THE ODOUR UNIT

APPENDIX F:

MODELLING INPUT, OUTPUT & CONFIGURATION INFORMATION

Australian Government
Bureau of Meteorology

Basic Climatological Station Metadata

Current status

Metadata compiled: 26 NOV 2015

Station: GOULBURN AIRPORT AWS

Bureau of Meteorology station number: 070330
Bureau of Meteorology district name: Sthn Tablelands Gburn-Monaro
State: NSW

World Meteorological Organization number: 95716
Identification: YGLB

Network Classification: National Benchmark Network for Agrometeorology
Station purpose: Synoptic, Aeronautical
Automatic Weather Station: Almos

Current Station Location				
Latitude	**Decimal**	-34.8085	**Hour Min Sec**	34°48'31"S
Longitude	**Decimal**	149.7312	**Hour Min Sec**	149°43'52"E
Station Height	640 m	**Barometer Height**	640.8 m	
Method of station geographic positioning			GPS	

Year opened: 1988
Status: Open

Station summary

No summary for this site has been written as yet.

Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

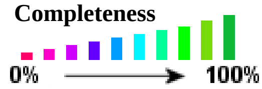
Basic Climatological Station Metadata

Current status

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Observation summary

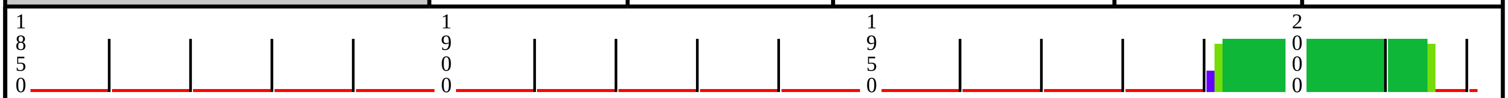
The table below indicates the approximate completeness of the record for individual element types within the Australian Data Archive for Meteorology. For elements not listed see the note below.



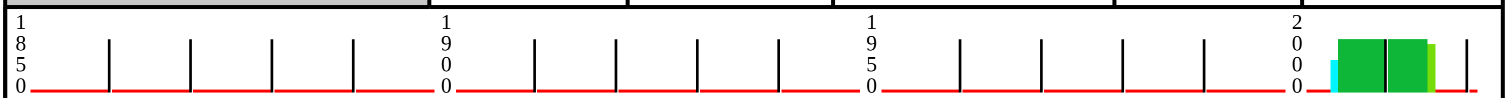
DAILY DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	SINGLE DAYS MISSED	FULL MONTHS MISSED
MAXIMUM AIR TEMPERATURE	JUL 1990	OCT 2015	95.9	372	0
MAXIMUM WIND GUST SPEED	JUN 2003	OCT 2015	98.8	53	0
WIND RUN ABOVE 10 FEET	JUN 2003	OCT 2015	98.7	57	0
RAINFALL	JUN 1994	NOV 2015	94	N/A	N/A

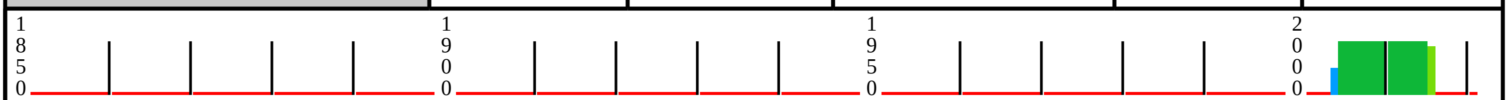
MAXIMUM AIR TEMPERATURE



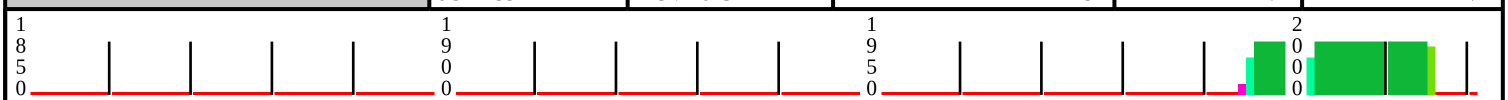
MAXIMUM WIND GUST SPEED



WIND RUN ABOVE 10 FEET



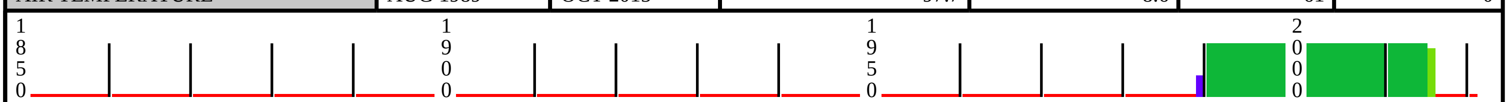
RAINFALL



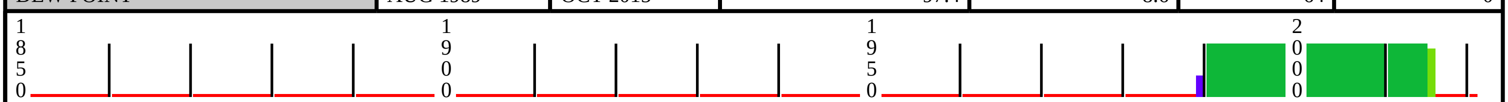
HOURLY DATA HOLDINGS - from 1 to 24 observations per day

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
AIR TEMPERATURE	AUG 1989	OCT 2015	97.7	8.6	61	0
DEW POINT	AUG 1989	OCT 2015	97.4	8.6	64	0
MEAN SEA LEVEL PRESSURE	SEP 1995	OCT 2015	98.4	8.9	42	0
TOTAL CLOUD AMOUNT	AUG 1995	OCT 2015	8.3	5.4	111	217
WIND SPEED	AUG 1989	OCT 2015	97.7	8.6	59	0

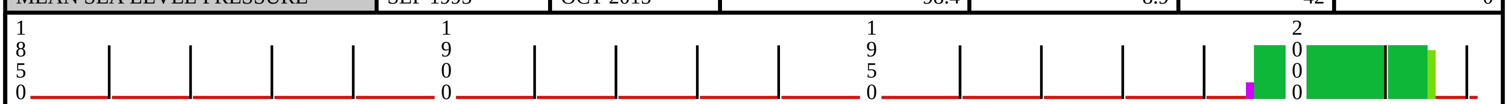
AIR TEMPERATURE



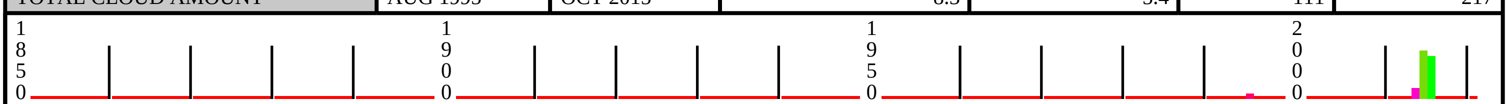
DEW POINT



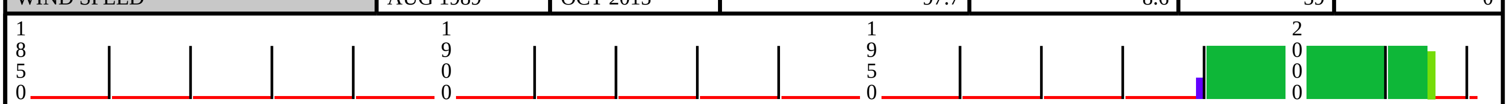
MEAN SEA LEVEL PRESSURE



TOTAL CLOUD AMOUNT



WIND SPEED



Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Basic Climatological Station Metadata

Current status

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS	**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:** Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:** 26 NOV 2015

THERE ARE NO RAINFALL INTENSITY DATA HOLDINGS

ONE-MINUTE DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
ALL ELEMENTS	SEP 2010	NOV 2015	99.1	1427.4	N/A	0

HALF-HOURLY DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
ALL ELEMENTS	JAN 1989	NOV 2015	72.1	34.6	N/A	2

THERE ARE NO UPPER-AIR EDT DATA HOLDINGS

Holdings calculated up to 01 Nov 2015

The % complete figure is the completeness of observations averaged over all months of record, for the given station and observation type, taking gaps into account. For hourly holdings, the completeness is relative to the maximum number of daily observations for the site each month, and is therefore an estimate. For daily holdings, the completeness figure shown is exact.

The single days missed figure is the total number of days for which no observation was received, not including full missed months. The full months missed figure is the total of full month gaps over the period of record. Where an element is not included assumptions can generally be made about availability, and the list to use has been suggested below.

Unlisted element	Listed element to use
Minimum air temperature	Maximum air temperature
Wet bulb temperature	Dew point
Soil temperature at 20, 50 & 100cm	10cm soil temperature
Relative humidity	Dew point
Minimum temp. of water in evaporimeter	Evaporimeter - max water temp
Visual observations eg. weather, visibility	Total cloud amount
Sea related observations	Sea state

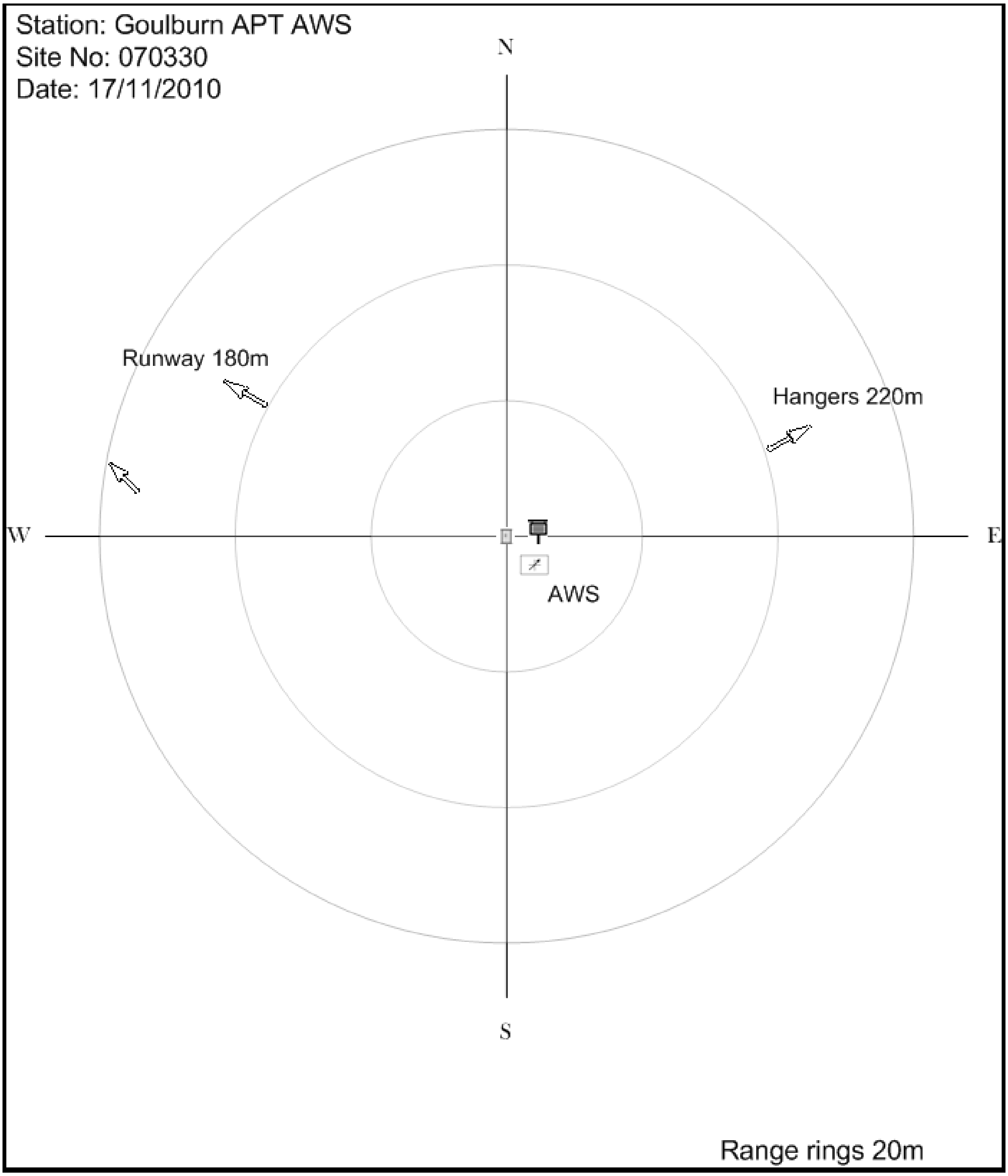
Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Australian Government
Bureau of Meteorology

Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS		**Location:**	GOULBURN AIRPORT AWS		**State:**	NSW
Bureau No.:	070330	**WMO No.:** 95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:** 149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:**	26 NOV 2015

Instrument Location and Surrounding Features
17/11/2010(most recent)



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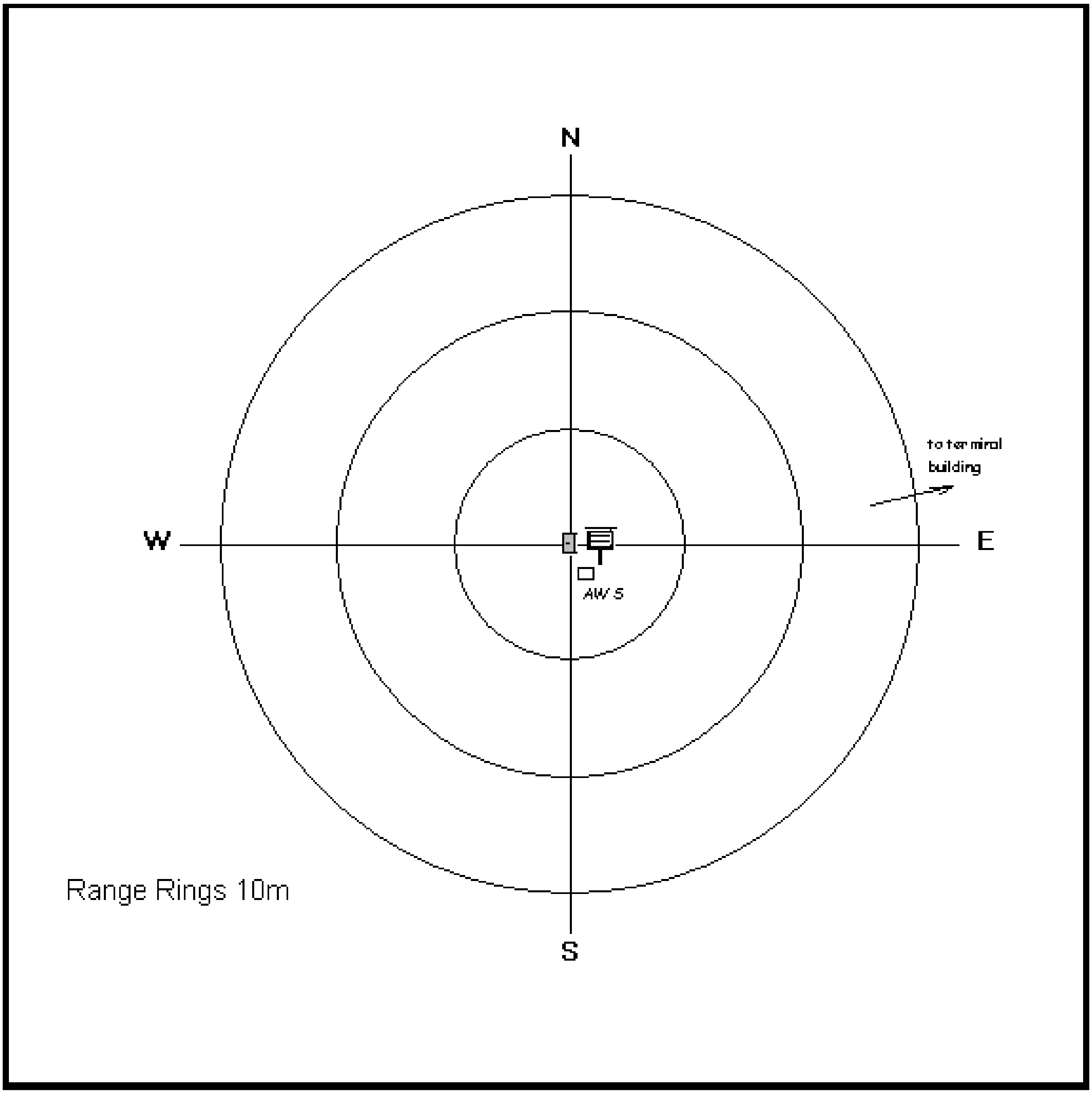
Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS		**Location:**	GOULBURN AIRPORT AWS		**State:**	NSW
Bureau No.:	070330	**WMO No.:** 95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:** 149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:**	26 NOV 2015

Instrument Location and Surrounding Features
26/03/2007



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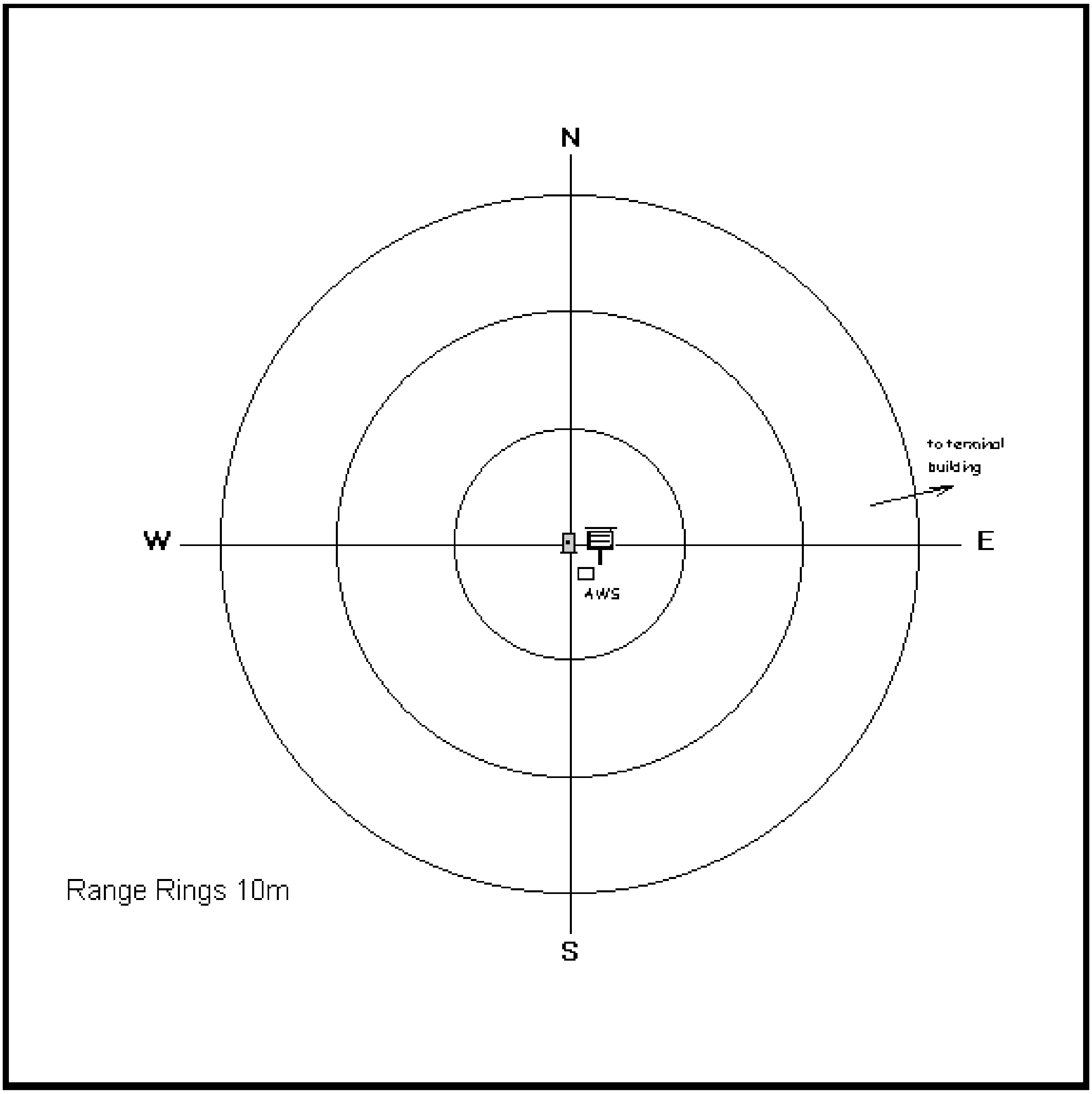
Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS		**Location:**	GOULBURN AIRPORT AWS		**State:**	NSW
Bureau No.:	070330	**WMO No.:** 95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:** 149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:**	26 NOV 2015

Instrument Location and Surrounding Features
13/11/2002



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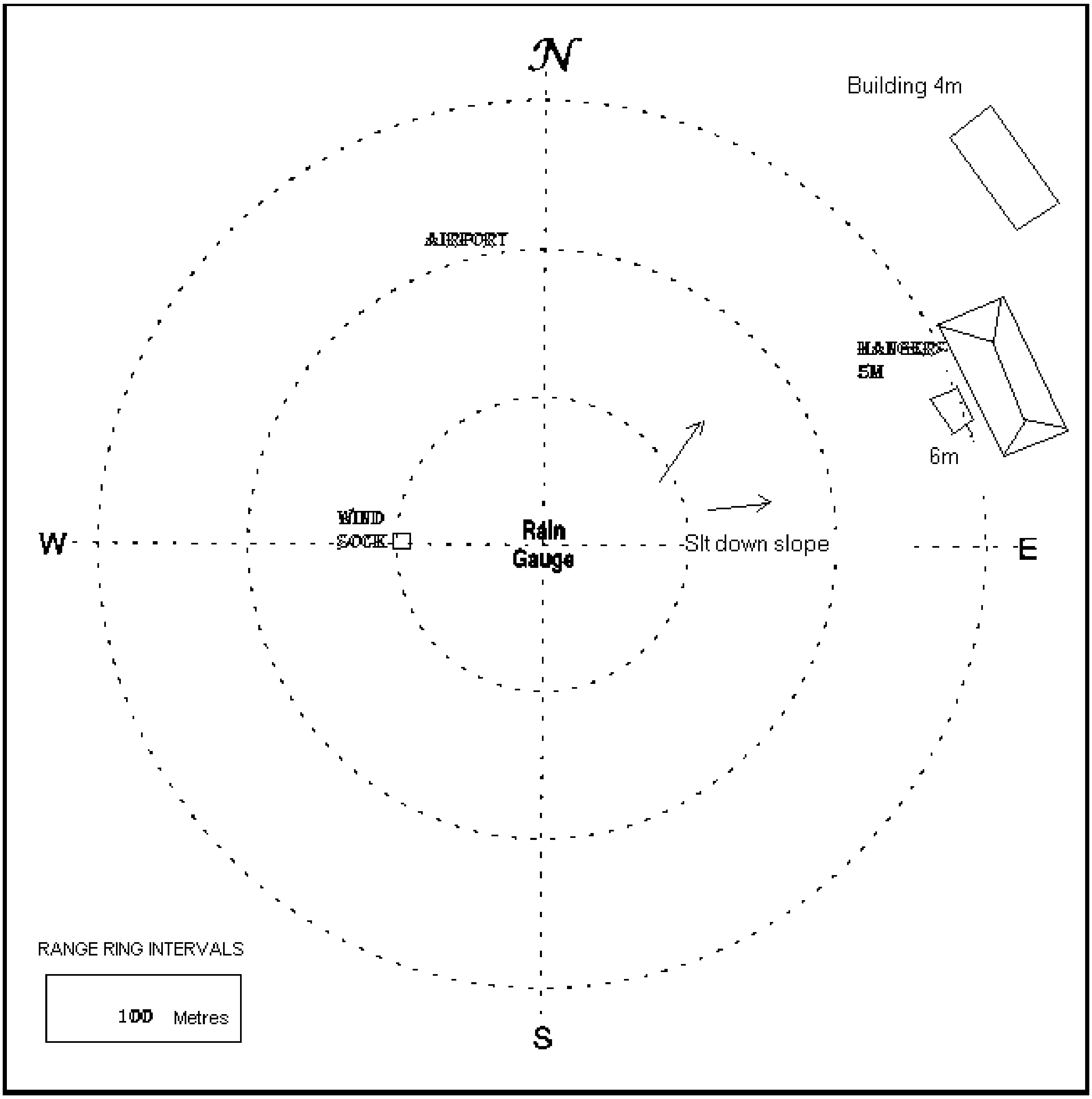
Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Instrument Location and Surrounding Features
27/03/2001



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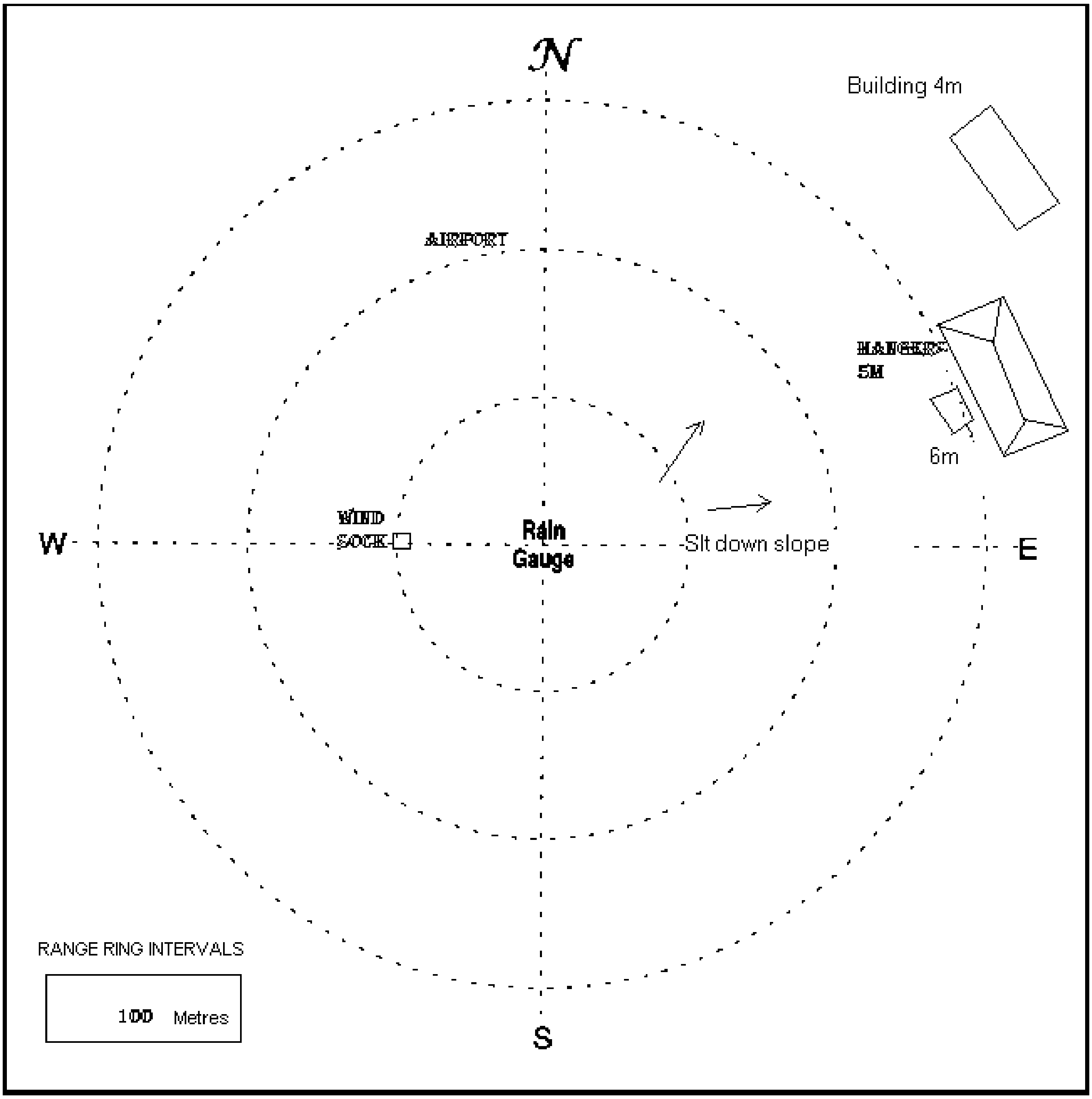
Australian Government
Bureau of Meteorology

Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS	**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:** Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:** 26 NOV 2015

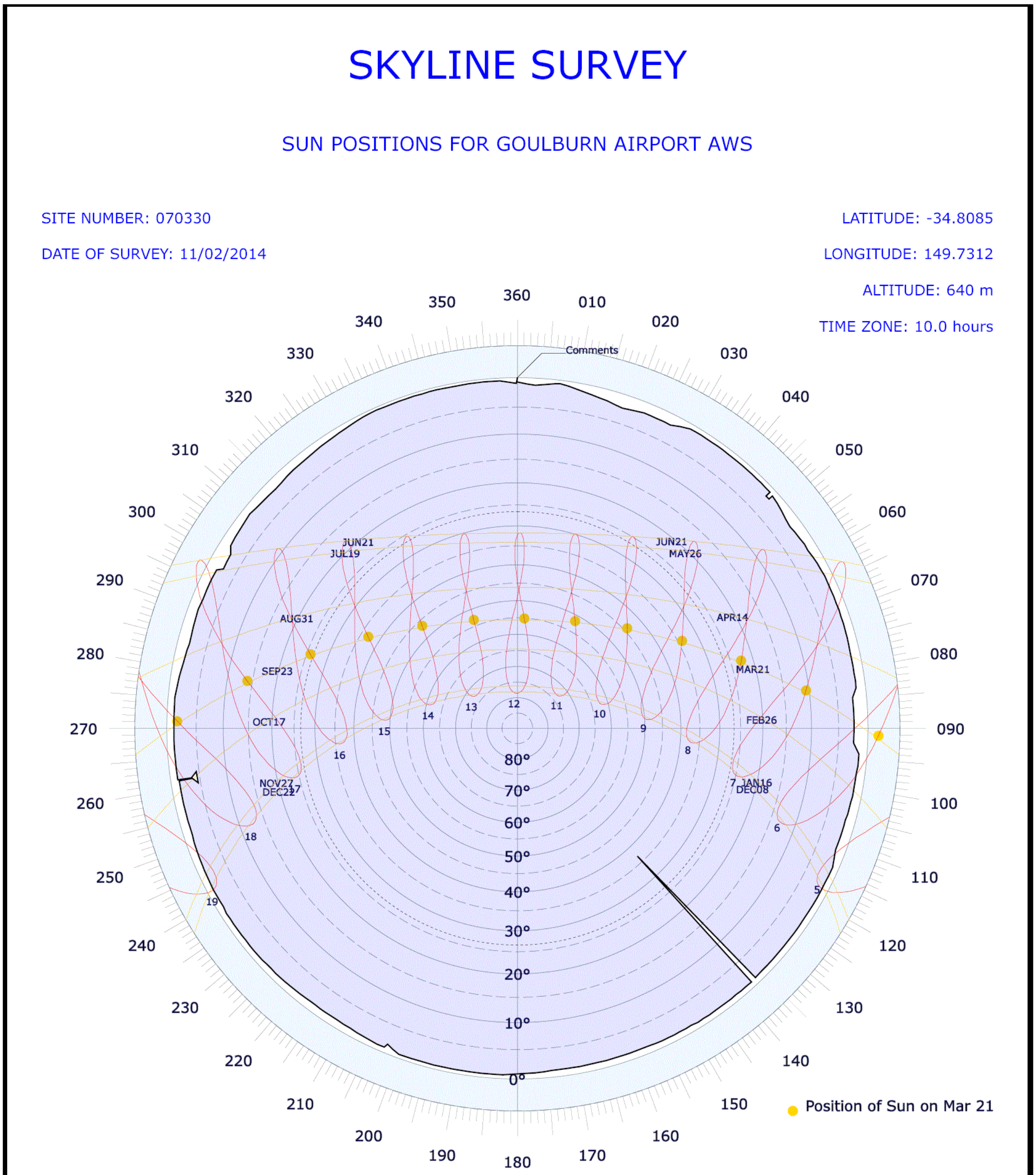
Instrument Location and Surrounding Features
09/03/1998



Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Skyline Diagram
11/02/2014(most recent)

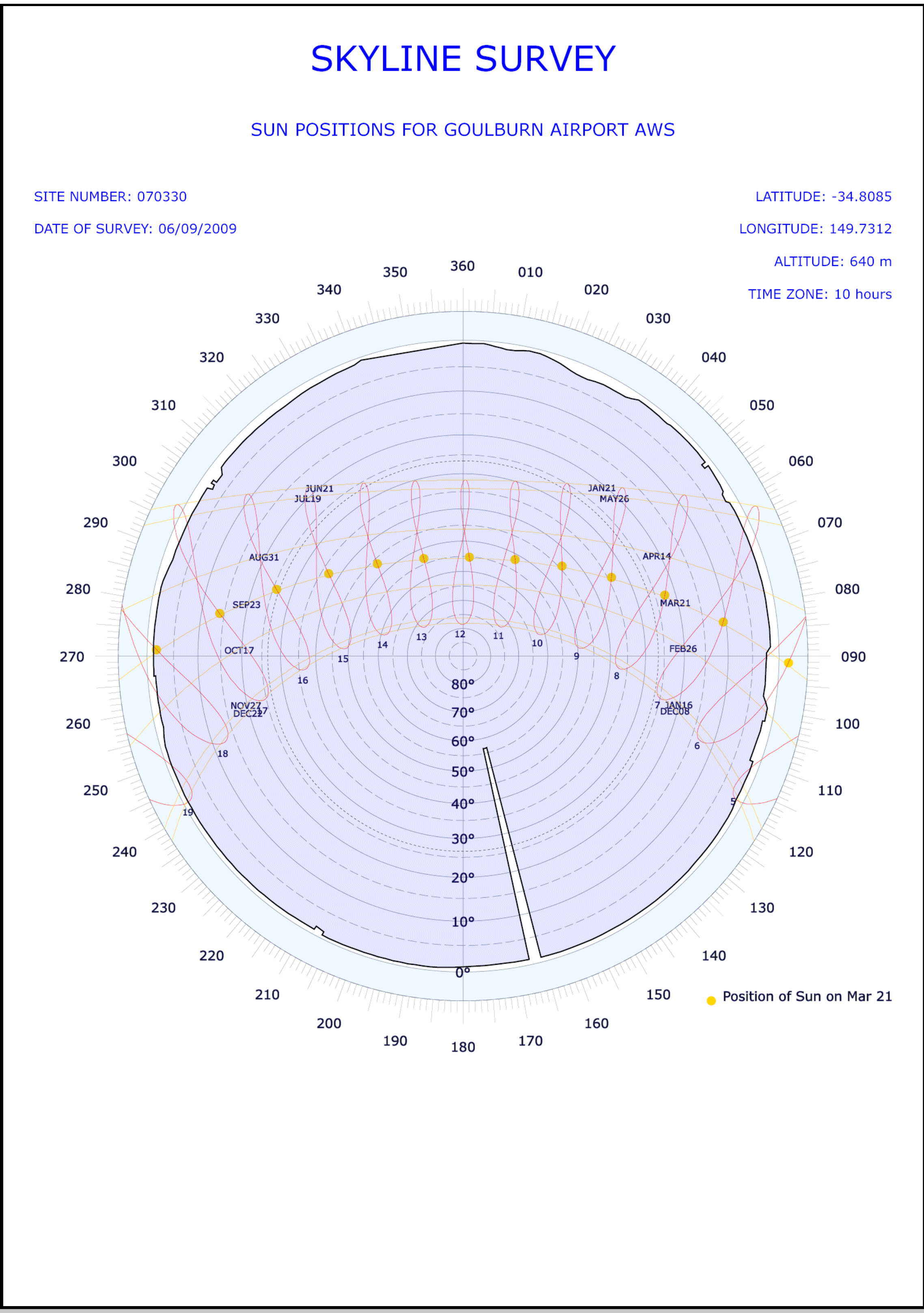


Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS		**Location:**	GOULBURN AIRPORT AWS		**State:**	NSW
Bureau No.:	070330	**WMO No.:** 95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:** 149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:**	26 NOV 2015

Skyline Diagram
06/09/2009



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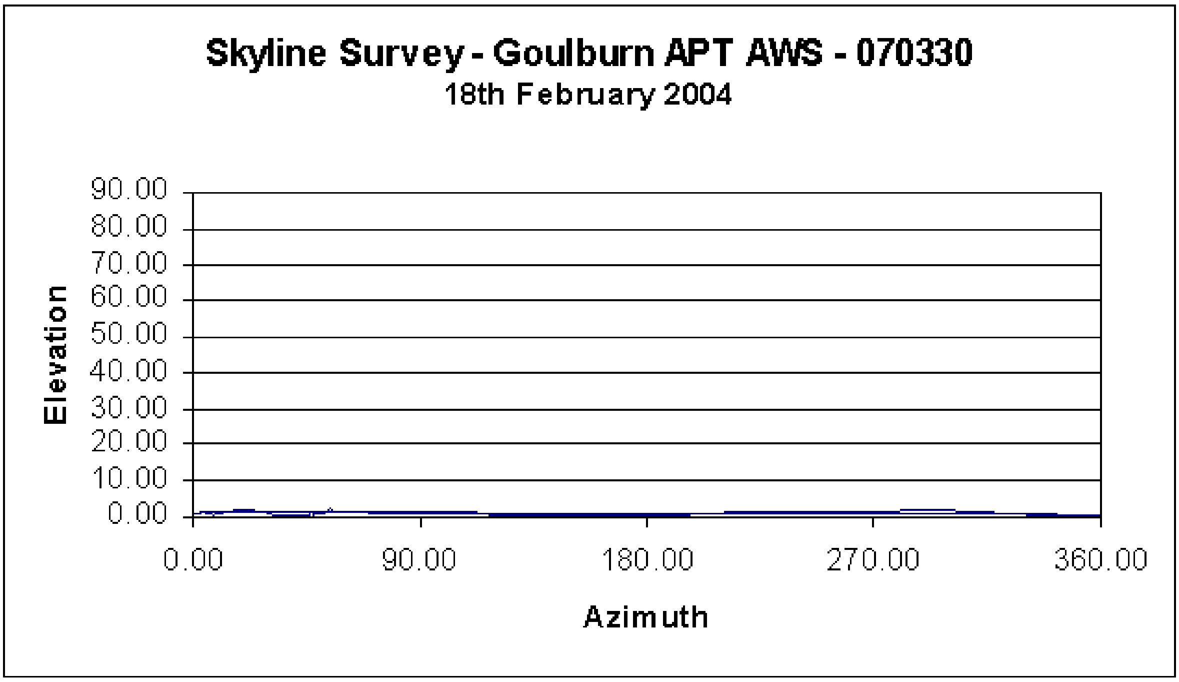
Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Skyline Diagram
24/02/2004



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Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Station Observation Program Summary (Surface Observations) from 01/11/1988 to 13/09/2010

Current Observation	**Continuous**	**Half Hourly**	**Hourly**
Surface Observations	-	Y	Y

Current Observation	Program Type	12 AM	3 AM	6 AM	9 AM	12 PM	3 PM	6 AM	9 AM
Surface Observation	PERFORMED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	REPORTED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	SEASONAL	-	-	-	-	-	-	-	-

Station Observation Program Summary (Surface Observations) 26 NOV 2015 (most recent)

Current Observation	**Continuous**	**Half Hourly**	**Hourly**
Surface Observations	Y	Y	Y

Current Observation	Program Type	12 AM	3 AM	6 AM	9 AM	12 PM	3 PM	6 AM	9 AM
Surface Observation	PERFORMED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	REPORTED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	SEASONAL	-	-	-	-	-	-	-	-

Extended Climatological Station Metadata
All History

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS	**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:** 07 Nov 1988	**Current Status:** Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:** 640.8 m	**Metadata compiled:** 26 NOV 2015

Station Equipment History

Equipment Install/Remove

Cloud Height

31/OCT/2013 INSTALL Ceilometer (Type Vaisala CL31 S/N - J3510003) Surface Observations

River Height (No Electronic History)

Wind Run (No Electronic History)

Spectral Radiation (No Electronic History)

Sea Surface Temperature (No Electronic History)

Sea Water Temperature (No Electronic History)

Evaporation (No Electronic History)

Minimum Temperature (No Electronic History)

Soil Temperature 50cm (No Electronic History)

Sub Surface Temperature (No Electronic History)

Electrical Conductivity (No Electronic History)

Maximum Temperature (No Electronic History)

Soil Temperature 20cm (No Electronic History)

Solar Radiation (No Electronic History)

Soil Temperature 5cm (No Electronic History)

Oxygen Content (No Electronic History)

Sea Water Level (No Electronic History)

Surface Inclination (No Electronic History)

Terrestial Minimum Temperature (No Electronic History)

Visibility (No Electronic History)

Solar Radiation (Direct) (No Electronic History)

Magnetic Bearing (No Electronic History)

Wind Direction

10/SEP/2004 INSTALL Anemometer (Type Synchrotac Cups - Type 732 S/N - 80261) Surface Observations
01/NOV/1988 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - WS - 74105 WD - 74066) Surface Observations
01/NOV/1988 INSTALL Mast Anemometer (Type Pivot, Standard 8m S/N - NONE) Infrastructure
15/FEB/2005 REPLACE Anemometer (Now Synchrotac Cups - Type 732 S/N - D100) Surface Observations
10/SEP/2004 REPLACE Anemometer (Now Synchrotac Vane - Type 706 S/N - 80309) Surface Observations
15/FEB/2005 REPLACE Anemometer (Now Synchrotac Vane - Type 706 S/N - D100) Surface Observations

Air Temperature

01/NOV/1988 INSTALL Humidity Probe (Type Rotronics S/N - 713201/9) Surface Observations
23/FEB/2012 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 11666-005) Surface Observations
19/FEB/2010 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 39220-007) Surface Observations
03/APR/2012 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 49513-003) Surface Observations
25/NOV/2002 REPLACE Humidity Probe (Now Vaisala HMP45D S/N - X4150011) Surface Observations
01/NOV/1988 INSTALL Temperature Probe - Dry Bulb (Type Rosemount S/N - NONE) Surface Observations
23/FEB/2012 REPLACE Temperature Probe - Dry Bulb (Now WIKA TR40 S/N - 107822-1) Surface Observations
01/NOV/1988 INSTALL Thermometer, Mercury, Dry Bulb (Type Dobbie S/N - M1803) Surface Observations

Wet Bulb Temperature (No Electronic History)

Lightning (No Electronic History)

Turbidity (No Electronic History)

Total Column Ozone Amount (No Electronic History)

Station:	GOULBURN AIRPORT AWS			Location:	GOULBURN AIRPORT AWS			State:	NSW
Bureau No.:	070330	WMO No.:	95716	Aviation ID:	YGLB	Opened:	07 Nov 1988	Current Status:	Still open
Latitude:	-34.8085	Longitude:	149.7312	Elevation:	640 m	Barometer Elev:	640.8 m	Metadata compiled:	26 NOV 2015

Station Equipment History (continued)

Equipment Install/Remove(Continued)

Pressure

01/MAY/1995 INSTALL Barometer (Type Vaisala PA11A S/N - 601091) Surface Observations
23/SEP/2002 REPLACE Barometer (Now Vaisala PA11A S/N - 458199) Surface Observations
31/MAR/2011 REPLACE Barometer (Now Vaisala PTB220B S/N - D3540108) Surface Observations

Humidity

01/NOV/1988 INSTALL Humidity Probe (Type Rotronics S/N - 713201/9) Surface Observations
23/FEB/2012 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 11666-005) Surface Observations
19/FEB/2010 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 39220-007) Surface Observations
03/APR/2012 REPLACE Humidity Probe (Now Rotronics MP101A-T4-W4W S/N - 49513-003) Surface Observations
25/NOV/2002 REPLACE Humidity Probe (Now Vaisala HMP45D S/N - X4150011) Surface Observations

Sunshine Hours (No Electronic History)

Pressure Trend (No Electronic History)

Snow Height (No Electronic History)

Wind Speed

10/SEP/2004 INSTALL Anemometer (Type Synchrotac Cups - Type 732 S/N - 80261) Surface Observations
01/NOV/1988 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - WS - 74105 WD - 74066) Surface Observations
01/NOV/1988 INSTALL Mast Anemometer (Type Pivot, Standard 8m S/N - NONE) Infrastructure
15/FEB/2005 REPLACE Anemometer (Now Synchrotac Cups - Type 732 S/N - D100) Surface Observations
10/SEP/2004 REPLACE Anemometer (Now Synchrotac Vane - Type 706 S/N - 80309) Surface Observations
15/FEB/2005 REPLACE Anemometer (Now Synchrotac Vane - Type 706 S/N - D100) Surface Observations

Rainfall

01/NOV/1988 INSTALL Raingauge (Type Rimco 7499 TBRG S/N - 66837) Surface Observations
31/JUL/2006 REPLACE Raingauge (Now Rimco 7499 TBRG S/N - 84619) Surface Observations
01/AUG/2006 REPLACE Raingauge (Now Rimco 7499 TBRG S/N - 84625) Surface Observations

Soil Temperature 100cm (No Electronic History)

Soil Temperature 10cm (No Electronic History)

Solar Radiation (Long Wave) (No Electronic History)

RF Reflectivity (No Electronic History)

The following table summarises information on field performance checks available electronically over the period indicated. The number of instances an instrument was found to fail field performance checks should only be used as a guide. A system of data quality flags is implemented by the Bureau of Meteorology to indicate the data quality of an observation as determined by a mutli-stage quality control process.

Available Date Range	Element	Fail Field Performance Check
14/NOV/2013 - 10/MAR/2015	Cloud Height	0
09/MAR/1998 - 18/NOV/2015	Wind Direction	6
09/MAR/1998 - 18/NOV/2015	Air Temperature	3
09/MAR/1998 - 10/MAR/2015	Pressure	0
09/MAR/1998 - 18/NOV/2015	Humidity	2
09/MAR/1998 - 18/NOV/2015	Wind Speed	6
09/MAR/1998 - 18/NOV/2015	Rainfall	4

Station Detail Changes

09/MAY/2006 CLASSIFICATION Category D (TAF D)

Station:	GOULBURN AIRPORT AWS			**Location:**	GOULBURN AIRPORT AWS			**State:**	NSW
Bureau No.:	070330	**WMO No.:**	95716	**Aviation ID:**	YGLB	**Opened:**	07 Nov 1988	**Current Status:**	Still open
Latitude:	-34.8085	**Longitude:**	149.7312	**Elevation:**	640 m	**Barometer Elev:**	640.8 m	**Metadata compiled:**	26 NOV 2015

Station Equipment History (continued)

Station Detail Changes(Continued)

01/NOV/1988 CLASSIFICATION Mesonet (FME)
05/OCT/2001 CLASSIFICATION National Benchmark Network for Agrometeorology (NBNA)
10/JAN/2011 CLASSIFICATION Standard (ASOSSTD)
10/JUN/2014 CLASSIFICATION Standard Aviation or Defence (AVSTD)
28/JUN/2011 OBJECT Document/AWS SITE AUDIT
14/NOV/2013 OBJECT Document/CEILOMETER STATUS
24/FEB/2004 OBJECT Document/Goulburn APT AWS Skyline points
06/SEP/2009 OBJECT Document/SKYLINE DATA
11/FEB/2014 OBJECT Document/SKYLINE DATA
07/NOV/1988 STATION - (nondb seeding) Opened
07/NOV/1988 STATION - (nondb seeding) aero_ht Changed to 652.6
07/NOV/1988 STATION - (nondb seeding) bar_ht Changed to 640.8
07/NOV/1988 STATION - (nondb seeding) bar_ht_deriv Changed to MAP 1:25 000
07/NOV/1988 STATION - (nondb seeding) stn_ht Changed to 640
07/NOV/1988 STATION - (nondb seeding) stn_ht_deriv Changed to MAP 1:25 000
07/NOV/1988 STATION - (nondb seeding) wmo_num Changed to 95716
07/NOV/1988 STATION aviation_id Changed to YGLB
07/NOV/1988 STATION latitude Changed to -34.80854
07/NOV/1988 STATION latlon_deriv Changed to GPS
07/NOV/1988 STATION latlon_error Changed to 4
07/NOV/1988 STATION longitude Changed to 149.73118
09/MAR/1998 STATION lu_0_100m Changed to Airport
09/MAR/1998 STATION lu_100m_1km Changed to Airport
09/MAR/1998 STATION lu_1km_10km Changed to Open farmland, grassland or tundra
07/NOV/1988 STATION name Changed to GOULBURN AIRPORT AWS
09/MAR/1998 STATION soil_type Changed to red soil
09/MAR/1998 STATION surface_type Changed to fully covered by grass

System Changes

01/NOV/1988 SYSTEM Infrastructure Commenced
01/NOV/1988 SYSTEM Surface Observations Commenced

Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Notes on these metadata

The following notes have been compiled to assist with interpreting the metadata provided in this document. These notes are subject to change as the network evolves. Changes in station-specific metadata occur more frequently, both as recent changes are recorded and historical information is transferred from paper file to electronic database.

Reliability of the metadata

The Commonwealth Bureau of Meteorology maintains information on more than 20,000 stations which have operated since observations began in the mid 1800s. The amount of information available for each of these sites and its associated uncertainty are influenced by a number of factors including the type and purpose of the station and the time over which it operated.

Early information about stations was held only on paper file. In 1998 a corporate electronic database was established to help maintain information about the network and its components. The number of parameters recorded about a station is now much greater than before this database was established. The national database has also helped improve consistency in the metadata through the implementation of predefined fields. As a result, and through the refinement of operating procedures, station metadata recorded since 1998 are of a higher overall standard than previously, although occasional omissions and errors are still possible.

The Bureau is part way through a task of entering historical information held on paper file into the corporate database. **Until this process is completed there will remain large gaps in the information contained in these metadata documents and considerable caution should be used when deriving conclusions from the metadata.** As an example, two consecutive entries about a rain gauge dated 50 years apart may appear in the equipment metadata. This may either mean that nothing happened to that instrument over the 50 years, or that information for the intervening period has yet to be entered into the database. Similarly, if no information was available about instruments at a site when it was first established, fields which were required to have a value present may have used the earliest information available as a best-guess estimate. Sometimes this was the metadata current when the database was established in 1998. In some instances there may be gaps in metadata relevant to the post 1998 period.

For the above reasons it is recommended that all metadata prior to 1998 be considered as indicative only, and used with caution, unless it has been quality controlled. The Bureau of Meteorology should be contacted if further information or confirmation of the data is required. Depending on the nature of the inquiry there may be a fee associated with this request. Contact details are provided in the telephone book for each capital city or the Bureau's web site at:
http://www.bom.gov.au

The following pages contain explanatory notes for selected terms found in this document.

Station Number

The Bureau of Meteorology station number uniquely specifies a station and is not intended to change over time time, although on very rare occasions a station number may change or be deleted from the record (usually to correct an error). Generally a new station number is established if an existing station changes in a way that would affect the climate data record for that site (measured in terms of air temperature and precipitation). Significant station moves are an example of this.

Some stations also possess a World Meteorological Organization (WMO) station number. The WMO number is different to the Bureau of Meteorology number. It also uniquely specifies a station at any given time but can be reassigned to another station if the new station takes priority in the global reporting network. Only selected stations will have a WMO number. Significant stations may maintain their WMO number for many decades.

Notes on these metadata

Network Classification

SUPPORTING the BASIC CLIMATE SERVICE
Global Climate Observing System (GCOS)
GCOS Upper Air Network (GUAN)
GCOS Surface Network (GSN)
National Climate Network {not yet assigned}
Reference Climate Stations (RCS)
Regional Basic Climatological Network (RBCN)
CLIMAT Stations (CLC)
CLIMAT TEMP Stations (CLT)
SUPPORTING the NATIONAL WEATHER WATCH SYSTEM
WMO Global Observing System (GOS)
GOS Upper Air Network
GOS Satellite Network
Global Atmospheric Watch
Background Atmospheric Pollution Monitoring Network (BAPMON)
Basic Ozone Network
Basic Solar and Terrestrial Radiation Network
Regional Basic Synoptic Network (RBSN)
WMO Global Oceanic Observing System (GOOS)
SUPPORTING the BASIC WEATHER SERVICE (BWS)
BWS Land Network
Significant Land Locations
Capital City Mesonets
National Benchmark Network for Agrometeorology (NBNA)
BWS Marine Network
Significant Coastal Loactions
Open Ocean Network
BWS Upper Air Network
Major Significant Locations
BWS Remote Sensing Network
Weather Watch Radar Network
Fire Weather Wind Mesonets
High Resolution Satellite
SUPPORTING the BASIC HYDROLOGICAL SERVICE
Regional Flood Warning Network
Water Resources Assessment Network
Global Hydrological Network
Global Terrestrial Observing System (GTOS)
World Hydrological Cycle Observing System (WHYCOS)
National Hydrological Network

Networks of stations are defined for a variety of purposes (as defined in above table).

Network Classification Continued....

Stations may be included in several different networks, which may change over time. The table on the previous page lists current network classifications related to the scientific purpose of the network. Some of these networks - the GCOS network for instance - are components of a global network. Entries in the database for some networks may not be complete, thus not properly representing the status of the network. The composition of the network will usually change over time. While several of the networks have international significance, other network classifications have been developed to aid operational management.

Station Purpose

The station purpose can be classified according to the observation program listed below. Parameters in brackets list some of the various different configurations which occur.

- Synoptic [Seasonal, River Height, Climatological, Telegraphic Rain, Aeronautical, Upper Air]
- Climatological [Seasonal, Telegraphic Rain]
- Aeronautical
- Rainfall [River Height]
- River Height
- Telegraphic Rain [Non-Telegraphic River Height, Telegraphic River Height]
- Non-Telegraphic Rain [Telegraphic River Height]
- Evaporation [Rainfall, River Height, Telegraphic River Height, Non-Telegraphic River Height, Telegraphic Rain, Non-Telegraphic Rain]
- Pluviograph [Rainfall, Telegraphic Rain, Non-Telegraphic Rain, River Height, Telegraphic River Height, Non-Telegraphic River Height]
- Radiation
- Lightning Flash Counter
- Public Information
- Local Conditions
- Radar Site
- Unclassified
- No Routine Observations

Note: Telegraphic observations are those which are sent by some electronic means be it a phone or telegram to the responsible Bureau office. It is a term which is historically linked to analogue non automatic data transmission.

Station Observation Program Summary

Surface Observations

The following terms are used to describe the frequency of surface observations at a site. Historical observation programs will typically be missing for many sites until the database is backfilled with information.

Set a)
- Continuous Program
  - More than half hourly observations sent (eg an automatic weather station {AWS} which continuously transmits 10 minute observations). This will automatically include half hourly and hourly observations programs.
- Half hourly observations
  - Half hourly observations sent. This will automatically include hourly observations.
- Hourly observations
  - Hourly observations sent only. Stations report on non-synoptic hours (ie. 0100, 0200, 0400, 0500, etc)

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Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by email on climatedata@bom.gov.au

Surface observations continued....

Set b)
- Performed
  - Observations performed, instruments read and observations recorded
- Reported
  - Observations performed, instruments read and reported real time
- Seasonal
  - The program may only be performed during a defined season (such as Fire Weather observations) or the routine program may increase in reporting frequency and/or parameters. The program dates are currently modified at the start and end of each season for stations performing seasonal observations. Historically this was not always the case.

Current Station Equipment Summary

Equipment listed in this metadata product is catalogued under one of systems listed below, appropriate to its application. The "Infrastructure" category has been included since it contains information about the mast height of an anemometer (if present).

- Flood Warning
- Infrastructure
- Radiation
- Rainfall Intensity
- Surface Observations
- Upper Air
- Weather Watch {RADAR}

Station Equipment History

Equipment Install/Remove

One of four types of actions can be performed on an instrument in this listing:

Install - A new instrument is installed at the site. This can be either a completely new addition (eg the first barometer at the site), or the replacement of an existing instrument with a different type (eg replacing mercury barometer with electronic barometer)

Remove - An instrument can be removed either when it is no longer necessary to measure a particular element, or when the element is to be measured by an instrument of a different type (see under "Install" above)

Replace - This occurs when one instrument is replaced with another of the same type (eg Kew pattern mercury barometer replacing another Kew pattern mercury barometer)

Share - The same instrument is used for observations under two (or more) systems (eg a rain gauge may be used within both Surface Observations and Rainfall Intensity systems)

Unshare - The instrument is no longer shared between systems

Notes on these metadata

Calibration

During a site inspection an instrument will be calibrated as either being within or not within the specified tolerance in accuracy.

Where a quantative calibration result can be achieved by comparison to a transfer standard (eg barometer comparisons and tipping bucket rain gauge calibrations), the instrument will be recorded as being within or outside the required tolerance. Instruments (such as 203mm rain gauges, screens and evaporation pans) where quantitative calibrations cannot be derived should be regarded as meeting specifications when the instrument is in 'good working order'.

This product provides a summary table of the number of times an instrument was found to be out of calibration

Station Detail Changes

This set of metadata indicates when some aspect of the general information about a station has changed.

- STATION

Metadata which are categorised as pertaining to STATION are items of (textual) information describing a specific attribute of the station. A reference to (nondB seeding) indicates initial information of this field has been sourced from a previous database.

Station position

- Latitude and longitude

Derivation of station latitude and longitude, defined by the location of the rain gauge when it is present, has changed over time. Current practice is to locate or verify open and operational station latitude and longitude based on Global Positioning System equipment. Methods used to locate a station as described in this product (latlon_deriv) are as follows: GPS, MAP 1:10000, MAP 1:12500, MAP 1:25000, MAP 1:50000, MAP 1:100000, MAP 1:250000, SURVEY, and Unknown (which is more commonly represented by a null value). The field latlon_error should be used with caution as the method of determining this value has been interpreted in different ways over time.

- Height

Determination of heights for observing sites is by survey where possible. Otherwise height may be determined using a Digital Aneroid Barometer and a known surveyed point, or derived from map contours. The source of height is provided in the corresponding parameter with a suffix of "_deriv".

Heights which may appear in these metadata are:

- aero_ht
    - The official elevation of the aerodrome which normally corresponds to the altitude of the highest threshold of the runways at that airport;
- bar_ht
    - this represents the height of the mercury barometer cistern or the digital aneroid barometer above mean sea level (MSL);
- stn_ht
    - this normally represents the height of the rain gauge above MSL

Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Notes on these metadata

- Land Use

To assist the long term understanding of climate change it is important to be able to determine the differences over time which are attributed to variations in the climate. Since land use has an effect on the micro climate around the site, and changes in land use will therefore affect the climate record, it is important that the characteristics of the site are monitored. Soil types are recorded as they affect the land use and also add to the knowledge of the site details.

Defined Land use Types.

- Non-vegetated (barren, desert)
- Coastal or Island
- Forest
- Open farmland, grassland or tundra
- Small town, less than 1000 population
- Town 1000 to 10,000 population
- City area with buildings less than 10 metres (3 stories)
- City area with buildings greater than 10 metres (3 stories)
- Airport

The land use code is entered on the station inspection form in the ranges 0 to 100 m, 100 to 1 km and 1km to 10 km; ie:

- lu_0_100m: Land Use 0 to 100 metres from the enclosure
- lu_100m_1km: Land Use 100 metres to 1 kilometre
- lu_1km_10km: Land Use 1 kilometre to 10 kilometres

Defined Soil Type (At Enclosure).

- unable to determine
- sand
- black soil
- clay
- rock
- red soil
- other

Surface Type (At Enclosure).

- unable to determine
- fully covered by grass
- mostly covered by grass
- partly covered by grass
- bare ground
- sand
- concrete
- asphalt
- rock
- other

Source Name	Lower Left X Coord.	Lower Left Y Coord.	Upper Left X Coord.	Upper Left Y Coord.	Upper Right X Coord.	Upper Right Y Coord.	Lower Right X Coord.	Lower Right Y Coord.	Effect. Height	Base Elev.	Init. Sigma Z	ODOR
(12 chars.)	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(km)	(m)	(m)	(m)	(g/m**2/s)
ED2a	733.017	6118.322	732.968	6117.995	732.817	6118.044	732.842	6118.363	0	787.4	1	0.078
ED2b	733.4	6118.229	733.182	6117.756	732.945	6117.839	733.017	6118.322	0	787.4	1	0.078
ED3N-1	733.82	6117.347	733.684	6117.368	733.711	6117.42	733.759	6117.456	0	791.6	1	0.356
ED3N-2-3	733.767	6117.477	733.661	6117.371	733.582	6117.386	733.694	6117.544	0	791.2	1	0.102
ED3N-4	733.68	6117.544	733.57	6117.381	733.426	6117.407	733.469	6117.634	0	791.4	1	0.095
ED3Sa	733.533	6117.15	733.41	6117.196	733.423	6117.324	733.583	6117.362	0	792.9	1	0.058
ED3Sb	733.867	6117.322	733.775	6117.07	733.533	6117.15	733.583	6117.362	0	792.9	1	0.058
ED3S-S	733.769	6117.065	733.619	6116.964	733.549	6116.985	733.57	6117.119	0	790.8	1	0.134
LTD	734.236	6117.273	734.177	6117.171	734.143	6117.188	734.206	6117.304	0	793.0	1	0.186
ATF	734.29	6116.972	734.24	6116.972	734.24	6117.012	734.29	6117.012	0	740.0	1	7.59
LRA	734.29	6116.83	734.149	6116.83	734.149	6116.972	734.29	6116.972	0	740.0	1	0
WCA	734.639	6117.179	734.639	6116.83	734.29	6116.83	734.29	6117.179	0	740.0	1	2.59

```
*******************************************************************************************************************************

   ****  CONFIRMATION OF CONTROL DATA  ****


--------------  INPUT GROUP 1  ---------------

metrun  =  0
ibyr    =  2015
ibmo    =  1
ibdy    =  1
ibhr    =  0
ibsec   =  0
ibdathr =  201500100
ieyr    =  2016
iemo    =  1
iedy    =  1
iehr    =  0
iesec   =  0
iedathr =  201600100
nsecdt  =  3600
irlg    =  8760
iavg    =  1
xbtz    =  -10.0000000
abtz    = UTC+1000
nspec   =  1
nse     =  1
itest   =  1
metfm   =  1
mprffm  =  1
mrestart=  0
nrespd  =  0
avet    =  60.0000000
pgtime  =  60.0000000
ioutu   =  2

--------------  INPUT GROUP 2  ---------------

mgauss =  1
mctadj =  3
mctsg  =  0
mslug  =  0
mtrans =  1
mchem  =  0
maqchem =  0
mlwc   =  0
mwet   =  0
mdry   =  0
mtilt  =  0
mdisp  =  2
mdisp2 =  3
mturbvw =  3
mtauly =  0.00000000E+00
mtauadv=  0
mcturb =  1
mrough =  0
mtip   =  1
mbdw   =  1
mshear =  0
mrise  =  1
mrise_fl=  2
mtip_fl=  0
msplit =  0
mpartl =  1
mpartlba=  1
mtinv  =  0
mpdf   =  1
msgtibl=  0
mbcon  =  0
msource=  0
mfog   =  0
mreg   =  0

--------------  INPUT GROUP 3  ---------------

SPECIES: ODOR          j: 1  isplst(-,j) =   1  1  0  GROUP: ODOR

--------------  INPUT GROUP 4  ---------------

pmap    = UTM
datum   = WGS-84
daten   = 02-21-2003
utmhem  = S
iutmzn  =  55
nx      =  134
ny      =  134
nz      =  11
zface  =  0.00000000E+00 20.0000000 40.0000000 80.0000000 160.000000 320.000000 640.000000 1000.00000 1500.00000 2000.00000
2500.00000 3000.00000
dgridkm =  0.150000006
xorigkm =  724.276978
yorigkm =  6106.10693
iutmzn  =  55
ibcomp  =  1
jbcomp  =  1
iecomp  =  134
jecomp  =  134
lsamp   =  F
ibsamp  =  1
jbsamp  =  1
iesamp  =  134
jesamp  =  134
meshdn  =  1
```

```
--------------  INPUT GROUP 5  ---------------

icon    =  1
idry    =  0
iwet    =  0
it2d    =  0
irho    =  0
ivis    =  0
lcomprs =  T
icprt   =  0
idprt   =  0
iwprt   =  0
icfrq   =  1
idfrq   =  1
iwfrq   =  1
(note:  i_frq values converted to timesteps)
iprtu   =  5
imesg   =  2
imflx   =  0
imbal   =  0
inrise  =  0
iqaplot =  1
ipftrak =  0
ldebug  =  F
ipfdeb  =  1
npfdeb  =  1
nn1     =  1
nn2     =  10

GROUP: ODOR          j:   1  ioutop(-,j) =  0 1 0 0 0 0 0

--------------  INPUT GROUP 6  ---------------

        ------  Subgroup (6a)  ------

nhill  =  0
nctrec =  0
mhill  =  2
xhill2m=  1.00000000
zhill2m=  1.00000000
xctdmkm=  0.00000000E+00
yctdmkm=  0.00000000E+00

        ------  Subgroup (6b)  ------


        ------  Subgroup (6c)  ------


--------------  INPUT GROUP 7  ---------------

SPECIES: ODOR          j:   1  dryg(-,j) =    -999.00   -999.00   -999.00   -999.00   -999.00

--------------  INPUT GROUP 8  ---------------

SPECIES: ODOR          j:   1  dryp(-,j) =    -999.00   -999.00

--------------  INPUT GROUP 9  ---------------

rcutr   =  30.0000000
rgr     =  10.0000000
reactr  =  8.00000000
pconst  =  2.30000001E-08
bmin    =  1.00000001E-07
bmax    =  2.49999994E-06
qswmax  =  600.000000
dconst1 =  2.00000000
dconst2 =  0.666666687
dconst3 =  4.79999988E-04
dconst4 =  0.666666687
nint    =  9
iveg    =  1

--------------  INPUT GROUP 10  ---------------

SPECIES: ODOR          j:   1  wa(-,j) =  0.000E+00   0.000E+00

--------------  INPUT GROUP 11  ---------------

moz      =  1
bcko3m   =  80.0000000 80.0000000 80.0000000 80.0000000
         =  80.0000000 80.0000000 80.0000000 80.0000000
         =  80.0000000 80.0000000 80.0000000 80.0000000
mnh3     =  0
mavgnh3  =  1
bcknh3m  =  10.0000000 10.0000000 10.0000000 10.0000000
         =  10.0000000 10.0000000 10.0000000 10.0000000
         =  10.0000000 10.0000000 10.0000000 10.0000000
rnite1   =  0.200000003
rnite2   =  2.00000000
rnite3   =  2.00000000
mh2o2    =  1
bckh2o2m =  1.00000000 1.00000000 1.00000000 1.00000000
         =  1.00000000 1.00000000 1.00000000 1.00000000
         =  1.00000000 1.00000000 1.00000000 1.00000000
rh_isrp  =  50.0000000
so4_isrp =  4.00000005E-07
bckpmf   =  1.00000000 1.00000000 1.00000000 1.00000000
         =  1.00000000 1.00000000 1.00000000 1.00000000
         =  1.00000000 1.00000000 1.00000000 1.00000000
ofrac    =  0.150000006 0.150000006 0.200000003 0.200000003
         =  0.200000003 0.200000003 0.200000003 0.200000003
         =  0.200000003 0.200000003 0.200000003 0.150000006
vcnx     =  50.0000000 50.0000000 50.0000000 50.0000000
```

```
         =  50.0000000 50.0000000 50.0000000 50.0000000
         =  50.0000000 50.0000000 50.0000000 50.0000000

--------------  INPUT GROUP 12  ---------------

sytdep   =  550.000000
mhftsz   =  0
jsup     =  5
conk1    =  9.99999978E-03
conk2    =  0.100000001
iurb1    =  10
iurb2    =  19

anemht   =  10.0000000
isigmav  =  1
imixctdm =  0
ilanduin =  20
z0in     =  0.250000000
xlaiin   =  3.00000000
elevin   =  0.00000000E+00
xlatin   =  -999.000000
xlonin   =  -999.000000

xmxlen   =  1.00000000
mxnew    =  99
xsamlen  =  1.00000000
mxsam    =  99
ncount   =  2
sl2pf    =  10.0000000
wscalm   =  0.499994993
cdiv     =  0.00000000E+00 0.00000000E+00

tkcat    =  265.000000   top for class 1
tkcat    =  270.000000   top for class 2
tkcat    =  275.000000   top for class 3
tkcat    =  280.000000   top for class 4
tkcat    =  285.000000   top for class 5
tkcat    =  290.000000   top for class 6
tkcat    =  295.000000   top for class 7
tkcat    =  300.000000   top for class 8
tkcat    =  305.000000   top for class 9
tkcat    =  310.000000   top for class 10
tkcat    =  315.000000   top for class 11

wscat    =  1.53999996   top for class 1
wscat    =  3.08999991   top for class 2
wscat    =  5.13999987   top for class 3
wscat    =  8.22999954   top for class 4
wscat    =  10.8000002   top for class 5

Over LAND
svmin    =  0.200000003  for stability 1
svmin    =  0.200000003  for stability 2
svmin    =  0.200000003  for stability 3
svmin    =  0.200000003  for stability 4
svmin    =  0.200000003  for stability 5
svmin    =  0.200000003  for stability 6
swmin    =  0.200000003  for stability 1
swmin    =  0.119999997  for stability 2
swmin    =  7.99999982E-02  for stability 3
swmin    =  5.99999987E-02  for stability 4
swmin    =  2.99999993E-02  for stability 5
swmin    =  1.60000008E-02  for stability 6

Over WATER
svmin    =  0.200000003  for stability 1
svmin    =  0.200000003  for stability 2
svmin    =  0.200000003  for stability 3
svmin    =  0.200000003  for stability 4
svmin    =  0.200000003  for stability 5
svmin    =  0.200000003  for stability 6
swmin    =  0.200000003  for stability 1
swmin    =  0.119999997  for stability 2
swmin    =  7.99999982E-02  for stability 3
swmin    =  5.99999987E-02  for stability 4
swmin    =  2.99999993E-02  for stability 5
swmin    =  1.60000008E-02  for stability 6

symin    =  1.00000000
szmin    =  1.00000000
szcap_m  =  5000000.00
xminzi   =  50.0000000
xmaxzi   =  3000.00000

plx0     =  7.00000003E-02    for stability 1
plx0     =  7.00000003E-02    for stability 2
plx0     =  0.100000001    for stability 3
plx0     =  0.150000006    for stability 4
plx0     =  0.349999994    for stability 5
plx0     =  0.550000012    for stability 6

ptg0     =  1.99999996E-02    for stability 5
ptg0     =  3.50000001E-02    for stability 6

ppc      =  0.500000000    for stability 1
ppc      =  0.500000000    for stability 2
ppc      =  0.500000000    for stability 3
ppc      =  0.500000000    for stability 4
ppc      =  0.349999994    for stability 5
ppc      =  0.349999994    for stability 6
tbd      =  0.500000000
tibldist =  1.00000000 10.0000000 9.00000000
nlutibl  =  4
fclip    =  0.00000000E+00
nsplit   =  3
```

```
iresplit =  0 0 0 0
         =  0 0 0 0
         =  0 0 0 0
         =  0 0 0 0
         =  0 1 0 0
         =  0 0 0 0
zisplit  =  100.000000
roldmax  =  0.250000000
nsplith  =  5
sysplith =  1.00000000
shsplith =  2.00000000
cnsplith =  1.00000001E-07
epsslug  =  9.99999975E-05
epsarea  =  9.99999997E-07
dsrise   =  1.00000000
trajincl =  20.0000000
mdepbc   =  1
htminbc  =  500.000000
rsampbc  =  10.0000000

--------------  INPUT GROUP 13  ---------------

npt1     =  0
iptu     =  5   units =   OUV/s
      converted to g/s, odour_units*m3/s, or Bq/s
      by factor:  1.00000000
nspt1    =  0
npt2     =  0


--------------  INPUT GROUP 14  ---------------

nar1     =  12
iaru     =  5   units =   OUV/s/m^2
   converted to g/s/m^2, odour_units*m/s,
   or Bq/s/m^2  by factor:  1.00000000
nsar1    =  12
nar2     =  0

cnamar1  = ED2A            ED2B            ED3N-1          ED3N-2-3        ED3N-4          ED3SA           ED3SB
ED3S-S          LTD             ATF             LRA             WCA
htar1    =  0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
elar1    =  787.400024 787.400024 791.599976 791.200012 791.400024 792.900024 792.900024 790.799988 793.000000 740.000000 740.000000
740.000000
sz0ar1   =  1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000
1.00000000

area source: ED2A              number:  1
qar1     =  54278.4609
area1    =  54278.4609
[x,y]ar1grd  =  58.2670059 81.4322891
[x,y]ar1grd  =  57.9402657 79.2545547
[x,y]ar1grd  =  56.9335899 79.5800781
[x,y]ar1grd  =  57.1000137 81.7057266
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED2B              number:  2
qar1     =  160933.172
area1    =  160933.172
[x,y]ar1grd  =  60.8203087 80.8137970
[x,y]ar1grd  =  59.3668594 77.6595001
[x,y]ar1grd  =  57.7868614 78.2128906
[x,y]ar1grd  =  58.2670059 81.4322891
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3N-1            number:  3
qar1     =  7516.91992
area1    =  7516.91992
[x,y]ar1grd  =  63.6201973 74.9348907
[x,y]ar1grd  =  62.7136192 75.0748672
[x,y]ar1grd  =  62.8934708 75.4199219
[x,y]ar1grd  =  63.2132950 75.6608047
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3N-2-3          number:  4
qar1     =  14497.1621
area1    =  14497.1621
[x,y]ar1grd  =  63.2670059 75.8007812
[x,y]ar1grd  =  62.5602188 75.0943985
[x,y]ar1grd  =  62.0332832 75.1953125
[x,y]ar1grd  =  62.7799454 76.2467422
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
```

```
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3N-4            number:  5
qar1     =  39023.1406
area1    =  39023.1406
[x,y]ar1grd  =  62.6867638 76.2467422
[x,y]ar1grd  =  61.9535294 75.1595001
[x,y]ar1grd  =  60.9936485 75.3352814
[x,y]ar1grd  =  61.2801094 76.8457031
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3SA             number:  6
qar1     =  24216.1035
area1    =  24216.1035
[x,y]ar1grd  =  61.7069473 73.6197891
[x,y]ar1grd  =  60.8866348 73.9257812
[x,y]ar1grd  =  60.9733047 74.7818985
[x,y]ar1grd  =  62.0401993 75.0325470
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3SB             number:  7
qar1     =  65261.8359
area1    =  65261.8359
[x,y]ar1grd  =  63.9335098 74.7656250
[x,y]ar1grd  =  63.3203087 73.0859375
[x,y]ar1grd  =  61.7069473 73.6197891
[x,y]ar1grd  =  62.0401993 75.0325470
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ED3S-S            number:  8
qar1     =  19040.1641
area1    =  19040.1641
[x,y]ar1grd  =  63.2800255 73.0533829
[x,y]ar1grd  =  62.2802696 72.3795547
[x,y]ar1grd  =  61.8135567 72.5195312
[x,y]ar1grd  =  61.9535294 73.4147110
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: LTD               number:  9
qar1     =  4968.07617
area1    =  4968.07617
[x,y]ar1grd  =  66.3936310 74.4401016
[x,y]ar1grd  =  66.0001602 73.7597656
[x,y]ar1grd  =  65.7735138 73.8736954
[x,y]ar1grd  =  66.1934357 74.6484375
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

area source: ATF               number:  10
qar1     =  2001.46375
area1    =  2001.46375
[x,y]ar1grd  =  66.7533340 72.4348907
[x,y]ar1grd  =  66.4200821 72.4348907
[x,y]ar1grd  =  66.4200821 72.7018204
[x,y]ar1grd  =  66.7533340 72.7018204
ODOR        Emission Factor Type: HOUR24
Index  1  to  24  Emission Factor =  0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
2.29999995 2.29999995 1.89999998 1.89999998 0.00000000E+00 0.00000000E+00

area source: LRA               number:  11
qar1     =  20033.4199
area1    =  20033.4199
[x,y]ar1grd  =  66.7533340 71.4876251
[x,y]ar1grd  =  65.8133926 71.4876251
[x,y]ar1grd  =  65.8133926 72.4348907
[x,y]ar1grd  =  66.7533340 72.4348907
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
```

```
area source: WCA               number:  12
qar1     =  121842.938
area1    =  121842.938
[x,y]ar1grd  =  69.0799942 73.8151016
[x,y]ar1grd  =  69.0799942 71.4876251
[x,y]ar1grd  =  66.7533340 71.4876251
[x,y]ar1grd  =  66.7533340 73.8151016
ODOR        Emission Factor Type: WSP6_PGCLASS6
Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998

--------------  INPUT GROUP 15  ---------------

nln2     =  0
nlines   =  0
ilnu     =  5   units =   OUV/s
      converted to g/s, odour_units*m3/s, or Bq/s
      by factor:  1.00000000
nsln1    =  0
xl       =  0.00000000E+00
hbl      =  0.00000000E+00
wbl      =  0.00000000E+00
wml      =  0.00000000E+00
dxl      =  0.00000000E+00
fprimel  =  0.00000000E+00
mxnseg     =  7
nlrise   =  6


--------------  INPUT GROUP 16  ---------------

nvl1     =  0
ivlu     =  5   units =   OUV/s
      converted to g/s, odour_units*m3/s, or Bq/s
      by factor:  1.00000000
nsvl1    =  0
nvl2     =  0


--------------  INPUT GROUP 17  ---------------

nfl2     =  0

--------------  INPUT GROUP 18  ---------------

nrd1     =  0
nrd2     =  0
nsfrds   =  0


--------------  INPUT GROUP 20  ---------------

nrec     =  5549
nrgrp    =  3
xng          yng          zng          elevng        group
47.0572891 58.7695274 0.00000000E+00 717.130005 SENS
33.1534805 33.2877579 0.00000000E+00 698.020020 INNER
...
96.1535568 96.2858047 0.00000000E+00 739.859985 INNER
0.153401688 0.286458313 0.00000000E+00 679.840027 OUTER
...
129.153641 96.2858047 0.00000000E+00 694.260010 OUTER


------------------------------------------------------------------------------------------------------------------------------------
         INPUT FILES

Default Name     Unit No.     File Name and Path
------------     --------     ------------------
 CALPUFF.INP         1
 audit-7_calpuff.inp
(CALMET Domain: 1 )  MASTER
  CALMET.DAT       100
  ..\..\CALMET\2015\01_CALMET.DAT
    (----)         100
    ..\..\CALMET\2015\02_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\03_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\04_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\05_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\06_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\07_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\08_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\09_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\10_CALMET.DAT
```

```
    (----)         100
    ..\..\CALMET\2015\11_CALMET.DAT

    (----)         100
    ..\..\CALMET\2015\12_CALMET.DAT



-------------------------------------------------------------------------------------------------------------------------------------
         OUTPUT FILES

Default Name     Unit No.     File Name and Path
------------     --------     ------------------
 CALPUFF.LST         2
 AUDIT-7_CALPUFF.LST
    CONC.DAT         8
    AUDIT-7_CALPUFF.CON



SETNEST: Setup results for nested CALMET grids
----------------------------------------------

Properties of each CALMET domain grid

  Domain      =  1
  Origin(m)   =  724277.000 6106107.00
nx,ny,cell(m) =  134 134 150.000000
  Nest Factor =  1
Offset nx0,ny0=  0.00000000E+00 0.00000000E+00
Corner coordinates in outermost grid units:
  LL Corner   =  0.00000000E+00 0.00000000E+00
  UR Corner   =  134.000000 134.000000
Horizontal splitting parameters for domain:
  SYSPLITH(m) =  150.000000
SHSPLITH(m/s) =  8.33333358E-02

-------------------------------------------------------------------------------------------------------------------------------------

Completion of CALPUFF test mode run -- run terminating normally

-------------------------------------------------------------------------------------------------------------------------------------


 End of run -- Clock time: 15:39:30
                     Date: 07-23-2019

       Elapsed Clock Time:        2.0 (seconds)

                 CPU Time:        0.5 (seconds)
```

```
CALSUM -- Version: 7.0.0          Level: 150330
NFILES =  10

Names of input files:

    No.   1   Filename: ED2_calpuff.con
    No.   2   Filename: ED3N-1_calpuff.con
    No.   3   Filename: ED3N-2-3_calpuff.con
    No.   4   Filename: ED3N-4_calpuff.con
    No.   5   Filename: ED3S_calpuff.con
    No.   6   Filename: ED3S-S_calpuff.con
    No.   7   Filename: ATF_calpuff.con
    No.   8   Filename: LTD_calpuff.con
    No.   9   Filename: LRA_calpuff.con
    No.  10   Filename: WCA_calpuff.con

Name of output file:

       Output Filename: calpuff.con

Output file compressed? (LCOMPRO) =  T


Scaling factors (of form X(new) = X(old)*ASCALE + BSCALE) for each species

No. species (NSPEC) =      1
File:     1(ASCALE, BSCALE):
     7.80000E-02       0.00000E+00
File:     2(ASCALE, BSCALE):
     3.56000E-01       0.00000E+00
File:     3(ASCALE, BSCALE):
     1.02000E-01       0.00000E+00
File:     4(ASCALE, BSCALE):
     9.50000E-02       0.00000E+00
File:     5(ASCALE, BSCALE):
     5.80000E-02       0.00000E+00
File:     6(ASCALE, BSCALE):
     1.34000E-01       0.00000E+00
File:     7(ASCALE, BSCALE):
     7.59000E+00       0.00000E+00
File:     8(ASCALE, BSCALE):
     1.86000E-01       0.00000E+00
File:     9(ASCALE, BSCALE):
     0.00000E+00       0.00000E+00
File:    10(ASCALE, BSCALE):
     2.59000E+00       0.00000E+00

BSCALE is in grams/m**3

NOTE: When using BSCALE to add a constant background concentration
      this is normally done by apply BSCALE to one CALPUFF
      output file only, with SCALE=0 for the other files

Title lines on new output file:
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018
    S. Hayes 19/06/19

Title lines from file No.:  1
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED2
    S. Hayes 17/06/19

Title lines from file No.:  2
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED3N-1
    S. Hayes 17/06/19

Title lines from file No.:  3
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED3N-2-3
    S. Hayes 17/06/19

Title lines from file No.:  4
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED3N-4
    S. Hayes 17/06/19

Title lines from file No.:  5
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED3S
    S. Hayes 17/06/19

Title lines from file No.:  6
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ED3S-S
    S. Hayes 17/06/19

Title lines from file No.:  7
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - ATF
    S. Hayes 17/06/19

Title lines from file No.:  8
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - LTD
    S. Hayes 17/06/19

Title lines from file No.:  9
    Veolia Woodlawn Bioreactor
    SCN30 Audit #7 2018 - LRA
    S. Hayes 17/06/19

Title lines from file No.:  10
    Veolia Woodlawn Bioreactor
```

```
    SCN30 Audit #7 2018 - WCA
    S. Hayes 17/06/19

Data from header records of File #1
   CMODEL: CALPUFF
   VER:      7.2.1
   LEVEL:    150618
   IBYR:     2015
   IBJUL:    1
   IBHR:     0
   IBSEC:    0
   NSECDT:   3600
   XBTZ:     -10.0000000
   IRLG:     8760
   IAVG:     1
   PMAP:     UTM
   DATUM:    WGS-84
   NX:       134
   NY:       134
   DXKM:     0.150000006
   DYKM:     0.150000006
   IONE:     1
   XORIGKM:  724.277039
   YORIGKM:  6106.10742
   NSSTA:    1
   IBCOMP:   1
   IECOMP:   134
   JBCOMP:   1
   JECOMP:   134
   IBSAMP:   1
   IESAMP:   134
   JBSAMP:   1
   JESAMP:   134
   MESHDN:   1
   NREC:     5549
   NRGRP:    3
   NCTREC:   0
   LSGRID:   F
   NSPOUT:   1
   MSOURCE:  0
```

File	pt1	pt2	ar1	ar2	ln1	ln2	vl1	vl2	bcon	fl1	fl2	rd1	rd2
1	0	0	2	0	0	0	0	0	0	0	0	0	0
2	0	0	1	0	0	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	0	0	0
4	0	0	1	0	0	0	0	0	0	0	0	0	0
5	0	0	2	0	0	0	0	0	0	0	0	0	0
6	0	0	1	0	0	0	0	0	0	0	0	0	0
7	0	0	1	0	0	0	0	0	0	0	0	0	0
8	0	0	1	0	0	0	0	0	0	0	0	0	0
9	0	0	1	0	0	0	0	0	0	0	0	0	0
10	0	0	1	0	0	0	0	0	0	0	0	0	0

SPECIES: ODOR 1

UNITS: odour_units

TIMEHEAD Results for output file

Year	Julday	Hour	Second	Steps
2015	1	0	0	8760

TIMEHEAD Results for individual files

File	Year	Julday	Hour	Second	Steps	First	Last
1	2015	1	0	0	8760	1	8760
2	2015	1	0	0	8760	1	8760
3	2015	1	0	0	8760	1	8760
4	2015	1	0	0	8760	1	8760
5	2015	1	0	0	8760	1	8760
6	2015	1	0	0	8760	1	8760
7	2015	1	0	0	8760	1	8760
8	2015	1	0	0	8760	1	8760
9	2015	1	0	0	8760	1	8760
10	2015	1	0	0	8760	1	8760

```
Sources identified in all files processed
Source type  3
ED2A
ED2B
ED3N-1
ED3N-2-3
ED3N-4
ED3SA
ED3SB
ED3S-S
ATF
LTD
LRA
WCA

Number of periods expected :  8760
Number of periods processed:  8760
```