Veolia Australia & New Zealand

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #6

January 2018

Final Report

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0.3 Final Draft Report	11.04.2018	Amendments made. Final draft report issued.
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LIST OF DEFINITIONS & UNITS

AS4323.3:2001	Australian Standard 4323.3: 2001: Determination of odour concentration by dynamic olfactometry
AS4323.4:2009	Australian Standard 4323.4:2009. Stationary source emissions - Area source sampling - Flux chamber technique.
BWMS	Bioreactor Waste Management System
C & D	construction & demolition
$CaSO_4$	calcium sulphate
CH_4	methane
CO_2	carbon dioxide
DPI	Department of Planning & Infrastructure
EA 2010	Environmental Assessment Woodlawn Expansion Report (August 2010)
ED3N	Evaporation Dam 3 North
ED3S	Evaporation Dam 3 South
EPL	Environment Protection License
$Fe_2(SO_4)_3$	ferric sulphate
GC-FID	Gas Chromatography-Flame Ionisation Detector
GC-MS	Gas Chromatography-Mass Spectrometry
GC-SCD	Gas Chromatography-Sulphur Chemiluminescence
H_2S	hydrogen sulphide
H_2SO_4	sulphuric acid
ha	hectare
HRT	hydraulic retention time
IFH	Isolation Flux Hood
IMF	Crisps Creek Intermodal Facility
IOA	Independent Odour Audit

Jerome Analyser	Jerome ® 631-X H_2S Analyser
KOPs	knock-out pots
kW	kilowatts
L	litres
L/day	litres per day
L/min	litres per minute
L/s	litres per second
LAT	Leachate Treatment Dam
LMS	Leachate Management System
LOM	Liquid Odour Method
m	metres
m/s	metres/sec
m^2	square metres
m^3	cubic metres
MLP	Measurement Location Point
MSW	Municipal Solid Waste
mm	millimetres
MW	Megawatts
N_2	nitrogen gas
NATA	National Association of Testing Authorities
NGERS	National Greenhouse Emissions Reporting Scheme
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
RH	relative humidity
RL	reduced level
SO_3	sulphur trioxide
SOER	specific odour emission rate
Solid Waste Guidelines 2016	NSW EPA Environmental Guidelines: Solid Waste Landfills (2016)
the 2017 Emissions Testing Report	Emission Testing Report Veolia Environmental Services (Australia) Pty Ltd Woodlawn Biogas Power Station, Tarago: September 2017
the Audit	2017 Independent Odour Audit
the Biofilter Trial Report	Report for the biofiltration trial at Woodlawn Bioreactor: March 2017
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 Site	Woodlawn Bioreactor Facility, Collector Road, Tarago, NSW
tpa	tonnes per annum
TWL	Top Water Level
TOU	The Odour Unit Pty Ltd
US EPA	United States Environment Protection Agency
VENM	Virgin Excavated Natural Material
Veolia	Veolia Australia & New Zealand
VOC	Volatile Organic Compounds

WALTER	Woodlawn Aerated Leachate Treated Effluent Refiner
WIP	Woodlawn Infrastructure Plan
WIP 2012	Woodlawn Infrastructure Plan - Phase 1: April 2012
WIP 2018	Woodlawn Infrastructure Plan - Phase 4: March 2018
WIP post-2014	Woodlawn Infrastructure Plan - Phase 2: 2015-IP 2017
WIP 2017	Woodlawn Infrastructure Plan - Phase 3: March 2017

1 INTRODUCTION

In January 2018, Veolia Australia & New Zealand (hereafter referred to as **Veolia**) engaged The Odour Unit Pty Ltd (hereafter referred to as **TOU**) to carry out the sixth Independent Odour Audit (hereafter referred to as **the Audit**) of the Woodlawn Bioreactor Facility located at Collector Road, Tarago, NSW (hereafter referred to as **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 (hereafter referred to as **DPI**) seeking approval to increase the maximum throughput rate of the Woodlawn Bioreactor from 500,000 to 1.13 million tonnes per annum (hereafter referred to as **tpa**). Simultaneously, Veolia was also seeking to increase the maximum throughput rate of the nearby Crisps Creek Intermodal Facility (hereafter referred to as **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 sixth Independent Odour Audit (hereafter referred to as **IOA**) commissioned since the Woodlawn Waste Expansion project approval was granted.

1.3 COMPLIANCE WITH AUDIT OBJECTIVES

The Audit has been undertaken by TOU and endorsed by the Director-General of the DPI, and consists of the following:

- **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 2015 IOA. In the Audit, this included a review of:
    - Landfill gas capture and trend since the previous audit;
    - Report for the biofiltration trial at Woodlawn Bioreactor: March 2017 (hereafter referred to as **the Biofilter Trial Report**);
    - 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: September 2017 (hereafter referred to as **the 2017 Emissions Testing Report**)
    - Landfill gas inlet fuel quality testing for Generator No. 1;
    - Waste Infrastructure Plan – Phase 4: March 2018 (hereafter referred to as **WIP 2018**);
    - Recording of waste input flows; and
    - The stormwater catchment plan for the Void.
- **Reporting***:* a comprehensive summary of all aspects of the Audit, complying with the Audit objectives specified in **Section 1.2**.

1.3.1 Additional Work to Audit requirements

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

- Consideration and commentary on the IMF;
- Quantification of odour emissions between waste covered areas with and without a biofiltration cover; 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 (hereafter referred to as **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, which is supplemented by leachate recirculation, resulting in the production of landfill gas. The landfill gas, predominately rich in methane (hereafter referred to as **CH_4**) and carbon dioxide (hereafter referred to as **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 (hereafter referred to as **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 a mechanical biological treatment facility at the Site, which falls under a separate development consent and environment protection licence. These undertakings are not relevant to the Audit and thus have been excluded.

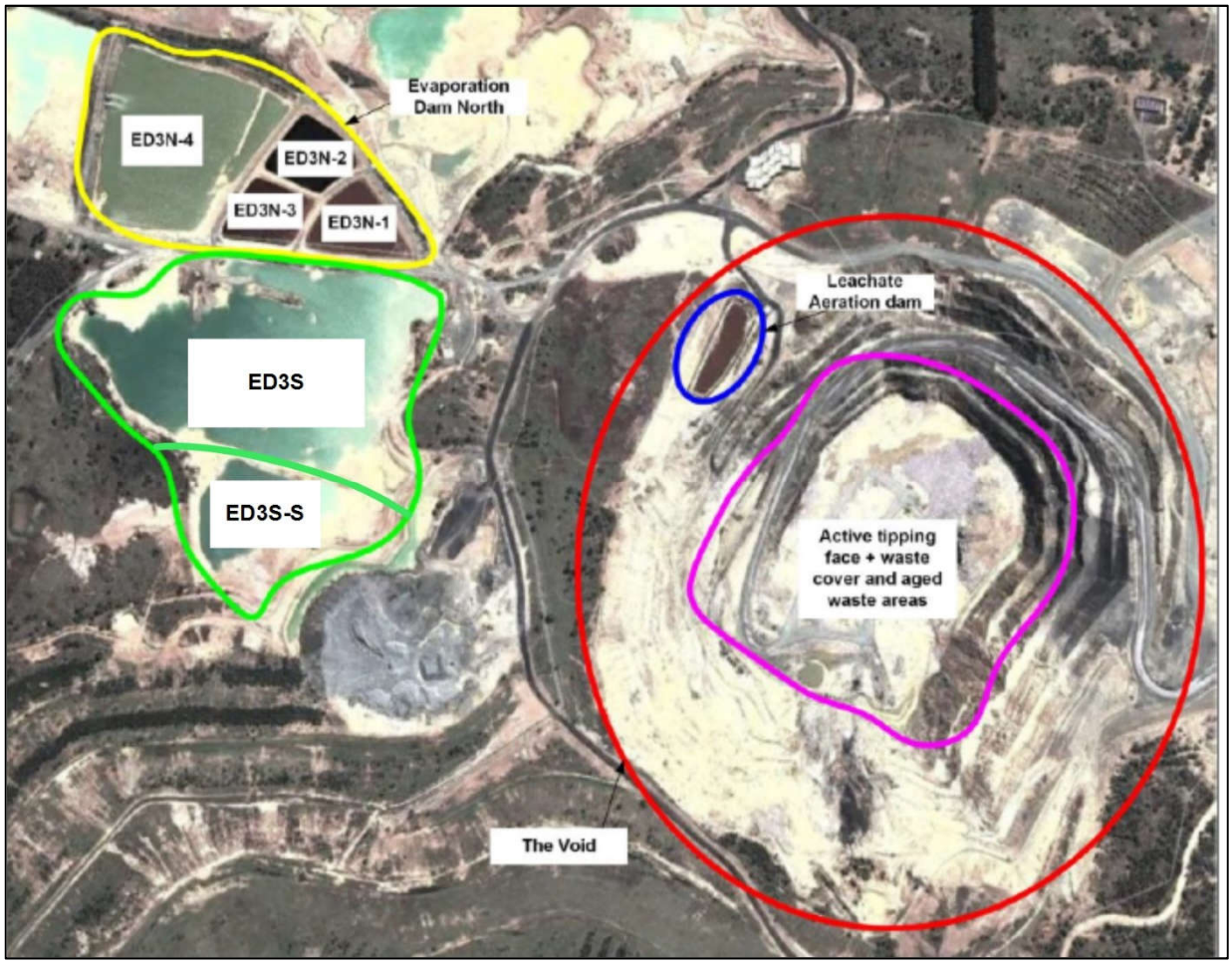


Figure 2.1 – An aerial view illustrating the layout of the Site as of the Audit (**Map source:** Google Earth ®)

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 (hereafter referred to as **BWMS**); and

2. The Leachate Management System (hereafter referred to as **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 (hereafter referred to as **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;
- Aged waste areas;
- A mobile tipping platform;
- A leachate recirculation system, which is currently in limited use as documented in the WIP 2018 (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 catchment management in the Void.

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 22 January 2018

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 area of exposed waste on a daily basis 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 was still well below the area size specified in the EA 2010 (further discussed in **Section 7.2.1.7**).

When required, it is understood by the Audit that the tipping process is supplemented by a hydrogen sulphide (hereafter referred to as **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 2018. Once a waste area is covered, leachate recirculation may be undertaken to optimise degradation rates and, in turn, encouraging the generation of landfill gas which is continuously extracted by the landfill gas infrastructure within the waste. However, 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 2018.

2.3.2 Leachate recirculation

The main principle of leachate recirculation within the Void is to move leachate from aged waste areas, especially those that are in a more advanced stage of anaerobic decomposition, to new waste areas to increase retained moisture levels and biological activity to enhance the waste decomposition process. This process has the effect of promoting higher and faster volumes of landfill gas generation within the Bioreactor, particularly when additional inoculum and moisture is required.

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, there is only one reinjection infrastructure being maintained in the Bioreactor. The reinjection point is at the eastern wall of the Void.

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 have been extensively described in the WIP 2018 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 during 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 2018) 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 (hereafter referred to as **ED3N**), also known as evaporation lagoon 1-4;
- Evaporation Dam 3 South (hereafter referred to as **E3DS**), used for stormwater run-off;
- Evaporation Dam 3 South-South (hereafter referred to as **ED3S-S**), also known as evaporation lagoon 5; and
- Leachate Treatment Dam (hereafter referred to as **LTD**).

Each of these listed features is described in **Section 2.4.2** to **Section 2.4.4**, respectively. Storage Pond 7, a previous feature of the LMS, no longer exists (see **Section 2.4.5** for details). Moreover, as of the Audit, Stormwater Pond 3 is still in use but is understood to be in the planning stage for its decommissioning which is expected to commence in the second-half of 2018 (see **Section 2.4.7** for details). Further details on the LMS have been previously documented and can be found in *Chapter 8* of the *EA 2010*.

2.4.1 Volume reduction of treated leachate

It is a condition of the Site's Environmental Protection Licence (hereafter referred to as **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 3.6 hectares (hereafter referred to as **ha**), at top water level (hereafter referred to as **TWL**), and is divided into four discrete lagoons, namely:

1. **ED3N–1:** receives treated leachate from the leachate treatment dam. The pond surface area, as of the Audit, is approximately 0.6 ha;

2. **ED3N–2***:* receives treated leachate from the LTD. The pond surface area, as of the Audit, is approximately 0.55 ha;

3. **ED3N–3**: receives treated leachate from the LTD. The pond surface area, as of the Audit, is approximately 0.55 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 2.5 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.**

2.4.2.1 Mechanical evaporation system

The mechanical evaporation system at the Site is currently active as to manage the growing need for volume reduction in the ponds to retrieve storage capacity. The mechanical evaporation system is operated as per Veolia's *Mechanical Evaporator Operation Protocol* document, which was made available and reviewed as part of the previous 2016 IOA. A photo showing the operation of the evaporators as occurred during the Audit is shown in **Photo 2.1**.

The mechanical evaporation system at the Site consists of five Turbomist ® evaporation pump units, each designed to spray 350 litres per minute (hereafter referred to as **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.

2.4.2.1.1 Operation of mechanical evaporation system

The evaporator units are automated and controlled by on-site sensors that are programmed to operate the evaporator units under the following conditions:

- Favourable wind directions (i.e. when wind direction favours air movement back over the dam);

- Ambient relative humidity (hereafter referred to as **RH**) levels are less than 75%; and
- Wind speed is more than 0.2 metres per second (hereafter referred to as **m/s**).

Photo 2.1 – The operation of the mechanical evaporation system at the Site as occurred on 22 January 2018

Information provided by Veolia from previous audits indicate that approximately 20% to 30% of the pumped water is evaporated, depending upon ambient temperature and RH conditions. The evaporator units can be relocated to different areas within the ED3N pond system. As will be discussed in **Section 7.2.1.5,** mechanical evaporation of treated leachate stored in ED3N is assessed to be of suitable quality from an odour viewpoint.

2.4.3 Evaporation Dam 3 South (ED3S)

ED3S pond system currently consists of predominately stormwater runoff which is managed as acid mine drainage. At TWL, ED3S can cover a total surface area of approximately 118 ha. ED3S is divided into two discrete lagoons to provide supplementary reserve capacity for the storage of treated leachate from the LTD, namely:

1. **ED3S:** continues to receive stormwater runoff which is managed as acid mine drainage. It also receives stormwater water run-off from Stormwater Pond 3 (see

Section 2.4.7). The pond surface area at TWL is 89.4 ha. A photo of ED3S as occurred during the Audit is shown in **Photo 2.2**; and

2. **ED3S–S***:* receives treated leachate from the LTD. The pond surface area at TWL is 28.3 ha. At the time of the Audit, ED3S was at approximately 93% volume storage capacity, equivalent to a water surface area of approximately 26 ha. A photo of ED3S-S as occurred during the Audit is shown in **Photo 2.3**.

Photo 2.2 – ED3S as occurred on 23 January 2018

Photo 2.3 – ED3S-S as occurred on 23 January 2018

2.4.4 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 2.4** shows the LTD as occurred during the Audit and **Figure 2.3** illustrates the current continuous treatment configuration for the LTD.

The LTD has a hydraulic retention time (hereafter referred to as **HRT**) of 33 days and is capable of the continuous treatment of approximately 259,000 litres per day (hereafter referred to as **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 (hereafter referred to as **$Fe_2(SO_4)_3$**) 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 (hereafter referred to as **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.

Photo 2.4 – The LTD as occurred on 23 January 2018

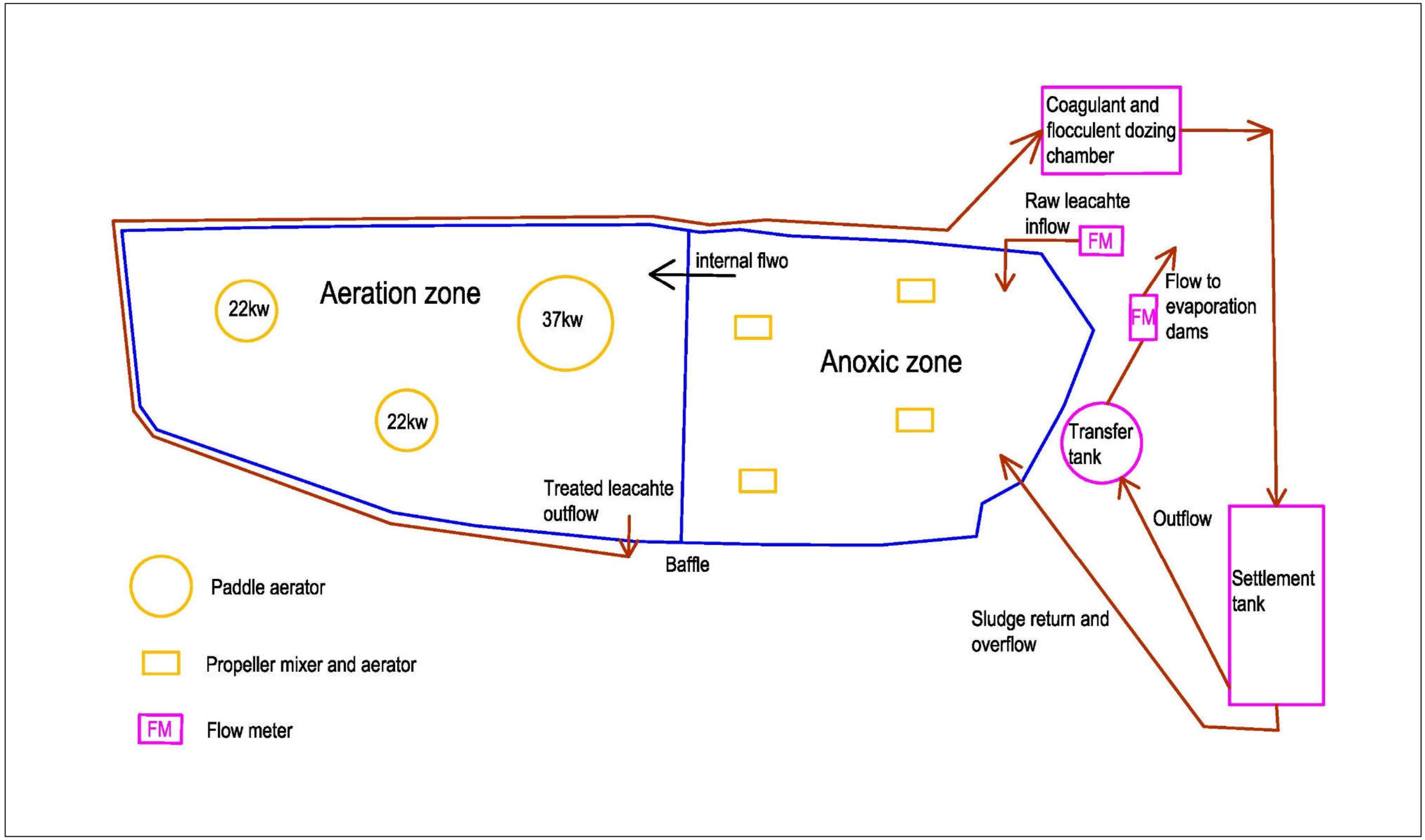


Figure 2.3 – A flow schematic of the current continuous treatment configuration for the LTD at the Site (**Source:** Veolia)

2.4.5 Storage Pond 7 (inside the Void)

At the time of the Audit, Storage Pond 7 remains decommissioned (previously located in the Void). As a result, it has been excluded as a valid odour emission source for the Audit.

2.4.6 Stormwater Infrastructure in the Void

According to the WIP 2018, the surface water in the Void will be managed in four sub-catchments as shown in **Figure 2.4**. 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.

2.4.7 Function of Stormwater Pond 3

Stormwater Pond 3 is located on the western side of the Bioreactor at reduced level (**RL**) 725 (see **Figure 2.2**). It can store approximately 7,700 m^3 of liquid including 0.5 m freeboard. According to the information provided in the WIP 2018, within Stormwater Pond 3 are three 120 L/s pumps, equivalent to a total water transfer rate of 360 Ls/, operated on separate float switches. Water is pumped from Stormwater Pond 3 via a single transfer tank to ED3S for storage. All surface water is collected or transferred to Stormwater Pond 3. Any stormwater that is collected from the covered landfill surface is drained to temporary stage ponds within the Void and transferred to Stormwater Pond 3.

As previously mentioned in **Section 2.4**, Stormwater Pond 3 is understood to be in the planning stage for its decommissioning which is expected to commence in the second-half of 2018. As such, its function and existence will be re-assessed in the next audit for the Site.

2.4.7.1 Management of contaminated surface water

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 come into contact with waste or leachate, the water will be managed as leachate through the established treatment pathways of the LMS.

2.4.7.2 Management of high rainfall events

According to the WIP 2018, Stormwater Pond 3 has been designed to handle a short duration event of high-intensity rainfall equivalent to 15 mm/hour over three hours. This is based on the pond capacity, pumping capacity and calculated inflow rates.

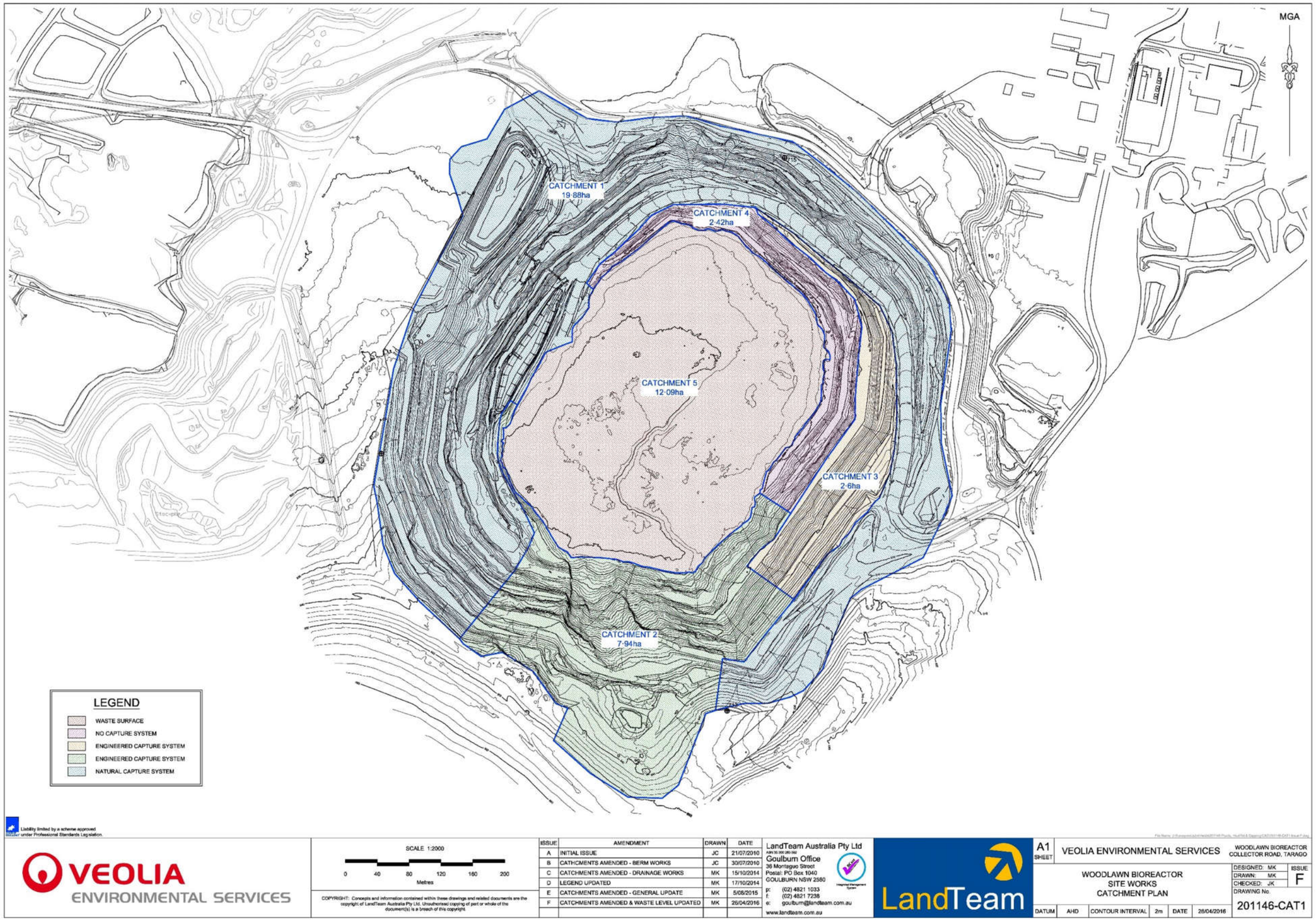


Figure 2.4 – Surface water management strategy in the Void as outlined in the WIP 2018

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 the 2015 IOA by the audit team is used as a basis for the sampling program in the Audit.

3.1 SAMPLING SCOPE

The Audit involved the collection of a total of twenty-nine (29) gas samples, namely:

- Twenty-four (24) gas samples for odour concentration measurement; and
- Five liquid (5) samples for odour concentration measurement testing using an in-house NATA-accredited Liquid Odour Concentration Determination Method (see **Section 4.2 & Appendix D** 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 7.2.1.5** 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 Audit did encounter intermittent and light wet weather conditions between 22 and 24 January 2018. 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 7.2.1.9** 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 22 January 2017 and 24 January 2017		
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 (2) + Liquid odour measurement (1)	3
ED3N - 2	Area source (2) + Liquid odour measurement (1)	3
ED3N - 3	Area source (2) + Liquid odour measurement (1)	3
ED3N - 4	Area source (2) + Liquid odour measurement (1)	3
ED3S Pond System		
ED3S	Area Source	2
ED3S-S	Area source (3) + Liquid odour measurement (1)	4
TOTAL		**29**

^ see **Section 4** for details

4 SAMPLING METHODOLOGY

The sampling methodologies described in this section is 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 the settling pond and wastewater dam surface area. This was undertaken using an isolation flux hood (hereafter referred to as **IFH**). All sampling using the IFH was carried out according to the method described in the United States Environment Protection Agency (hereafter referred to as **US EPA**) technical report '*EPA/600/8-86/008*', from which Australian Standard 4323.4:2009 (hereafter referred to as **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 metres (hereafter referred to as **m**), a chamber surface area of 0.126 square metres (hereafter referred to as **m^2**) and a chamber volume of 30 litres (hereafter referred to as **L**), equivalent to 0.03 cubic metres (hereafter referred to as **m^3**), when the skirt of the hood is inserted into the liquid or solid surface by the specified 25 millimetres (hereafter referred to as **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.

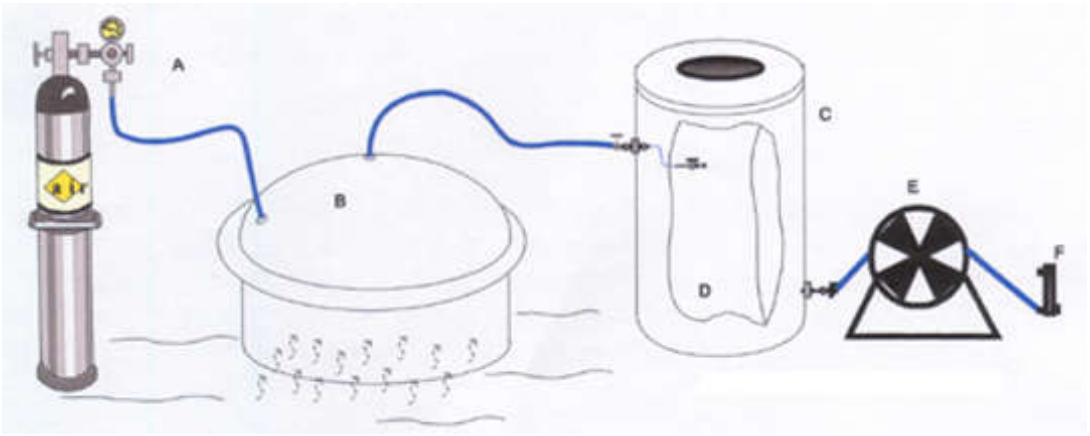
The US EPA method followed by TOU may be summarised as follows (and as described in the schematic of the sampling equipment shown in **Figure 4.1**):

- 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 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.

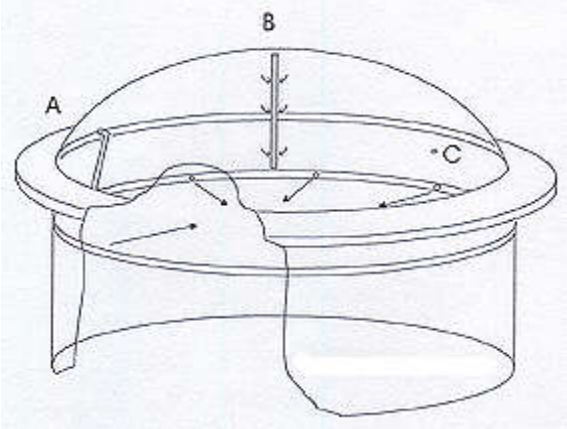


Source: Odotech - Odoflux Isolation Flux Hood Manual

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

.

Photo 4.1 – An example of IFH sampling on a solid surface in the Void as occurred on 24 January 2018

Photo 4.2 – An example of IFH sampling on a liquid surface (ED3S) as occurred on 23 January 2018

4.2 LIQUID ODOUR METHOD

4.2.1 Overview

The Liquid Odour Method (hereafter referred to as **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 D** 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*' (hereafter referred to as **AS4323.3:2001**) 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 Australian Standard AS4323.3:2001. 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 AS4323.3:2001.

The results obtained give an odour measurement measured regarding odour units (hereafter referred to as **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 4323.3:2001. This process is defined within AS4323.3:2001. The odour units can be subsequently multiplied by an emission rate or volumetric flow to obtain an Odour

Emission Rate (hereafter referred to as **OER**) or a specific odour emission rate (hereafter referred to as **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 AS4323.3:2001.

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 AS4323.3:2001. 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 95^{th} percentile confidence interval, where A must be less than 0.217 to comply with the accuracy criterion as mentioned in the Standard.

The Odormat™ V02 was last calibrated in August-October 2017 and complied with all requirements set out in the AS4323.3:2001 (see **Appendix A** – Result sheets: *Repeatability and Accuracy*). The calibration gas used was 51.5 parts per million (hereafter referred to as **ppm**), by volume, n-butanol in nitrogen gas (hereafter referred to as **N_2**).

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. Moreover, the odour emission results obtained from the Audit in relation to the efficacy of application of a biofiltration cover around the Void perimeter and the application of virgin excavated natural material (**VENM**) are presented in **Table 6.1**;

- **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 2016; and

- **Table 6.3** 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 22 January 2018 and 24 January 2018 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 #22 - Active Tip Face (1 of 3) - Fresh Waste (< 1 day old)	SC18092	10,600	7.05	garbage, bin juice	1.0 – 7.3*	7.3 (wet fresh waste emission adopted)
Sample #23 - Active Tip Face (2 of 3) - Fresh Waste (< 1 day old)	SC18087	17,400	11.5	garbage, bin juice		
Sample #24 - Active Tip Face (3 of 3) - Fresh Waste (< 1 day old)	SC18094	15,000	10.0	garbage, bin juice		
Aged Waste	n/m**				0.5	
Waste Covered Area (VENM Cover)						
Sample #20 - Waste Covered Area (150 mm depth capped cover between O16 and O17)	SC18090	1,720	1.15	earthy, garbage	0.1 - 0.2* (covered) 7.5 – 23.9*** (fugitive emissions)	0.2 (covered) 23.9*** (fugitive emissions)
Sample #19 - Waste Covered Area (150 mm depth capped cover between N10 and N11)	SC18089	3,760	2.54	pineapple, putrid, rotten		
Sample #21 - Waste Covered Area (150 mm depth capped cover between L16 and M16)	SC18091	4,100	2.73	pineapple, putrid, rotten		
Sample #16 - Waste Covered Area (300 mm depth capped cover between E15 and E16)	SC18086	362	0.251	dirt, rotten		
Sample #17 - Waste Covered Area (300 mm depth capped cover between H10 and H11)	SC18087	17,900	12.4	pineapple, putrid, rotten		
Waste Covered Area (Biofiltration cover around Void of perimeter)						
Sample #18 - Waste Covered Area (Void perimeter with biocover)	SC18088	790	0.51	dirt, earthy	7.5 – 23.9***	23.9***

* 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 22 January 2018 and 24 January 2018 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 #11 - Leachate Aeration Dam (1 of 2) - Aerobic Zone	SC18081	431	0.243	pungent, ammoniacal earthy, dirty socks	0.1 - 7.4*	3.6
Sample #12 - Leachate Aeration Dam (2 of 2) - Anoxic Zone	SC18082	431	0.243	pungent, ammoniacal earthy, dirty socks		
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

Table 6.1 (continued) - The Audit odour emission testings results obtained between 22 January 2018 and 24 January 2018 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 #3 - ED3N-1 (1 of 2)	SC18073	235	0.149	musty, earthy	2.1 – 8.8	8.8
Sample #4 – ED3N-1 (2 of 2)	SC18074	181	0.115	musty, earthy		
Sample #5 – ED3N-2 (1 of 2)	SC18075	181	0.115	musty, earthy	0.1 – 7.4	0.2*
Sample #6 - ED3N-2 (2 of 2)	SC18076	197	0.125	musty, earthy		
Sample #7 – ED3N-3 (1 of 2)	SC18077	181	0.115	musty, earthy		
Sample #8 - ED3N-3 (2 of 2)	SC18078	256	0.162	musty, earthy		
Sample #9 - ED3N-4 (1 of 2)	SC18079	152	0.096	musty, earthy	0.1 – 0.7	0.7**
Sample #10 – ED3N-4 (2 of 2)	SC18080	362	0.229	musty, earthy		
ED3S-S Pond System						
Sample #13 - ED3S-S (1 of 3)	SC18083	197	0.130	pungent, ammoniacal earthy	0.159***	
Sample #14 - ED3S-S (2 of 3)	SC18084	3,440	2.27	rotten egg, pungent, ammoniacal		
Sample #15 - ED3S-S (3 of 3)	SC18085	5,310	3.50	rotten egg, pungent, ammoniacal		
ED3S Pond System						
Sample #1 - ED3S (1 of 2)	SC18071	181	0.116	musty, earthy	0.0 - 0.5	0.5
Sample #2 - ED3S (2 of 2)	SC18072	181	0.116	musty, earthy		

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

^ as specified in *EA 2010*
^^ no longer exists - see **Section 2.4.5** for details
^^^ represents the sub-optimal pond contents that has 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 – LOM derived odour emission rates for mechanical and natural evaporation methods: 22 January 2018 and 24 January 2018						
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 #1 - ED3N-4	SC18095	304	18.4	70 / 105	21,500 / 32,200	107,500 / 161,000
LOM Sample #2 - ED3N-3	SC18096	166	10.0		11,700 / 17,500	58,500 / 87,500
LOM Sample #3 - ED3S-S	SC18097	235	14.2		16,600 / 24,800	83,000 / 124,000
LOM Sample #4 - ED3N-2	SC18098	215	13.0		15,200 / 22,800	76,000 / 114,000
LOM Sample #5 - ED3N-1	SC18099	166	10.0		11,700 / 17,500	58,500 / 87,500
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 - ED3N-4	SC18095	304	18.4	25,000	0.882	16,200
LOM Sample #2 - ED3N-3	SC18096	166	10.0	5,500	0.194	1,940
LOM Sample #3 - ED3S-S	SC18097	235	14.2	1,420	0.050	711
LOM Sample #4 - ED3N-2	SC18098	215	13.0	5,500	0.194	2,520
LOM Sample #5 - ED3N-1	SC18099	166	10.0	6,000	0.212	2,120

^ 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.

6.1 COMMENTS ON RESULTS

The following sections comment on the results presented in **Table 6.1**, **Table 6.2**, and **Table 6.3**.

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 (SC18087, SC18092 & SC18094) in the Audit is 9.52 ou.$m^3/m^2/s$, representing a moderate change since the previous 2016 IOA (from 8.16 ou.$m^3/m^2/s$). The odour character of the active tipping face samples collected in the Audit reported as 'garbage, bin juice', representing a similar finding from previous IOAs;

- The Waste Covered Area samples (SC18086 – SC18087 & SC18089 – SC18091) 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 0.51 ou.$m^3/m^2/s$ with a 'dirt, earthy' odour character. This result supports the use of biofilter cover as an effective strategy for managing fugitive gas emissions from the Void, 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 (hereafter referred to as **the Biofilter Trial Report**).

- **Void Covered Surface Types 2 & 3:** Areas covered with 150 mm and 300 mm of VENM to evaluate the covers efficacy 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 0.251 $m^3/m^2/s$ and 2.73 $m^3/m^2/s$, with a recorded outlier of 12.4 $ou.m^3/m^2/s$ (SC18087). This variability is likely due to the condition of the cover at the time of sampling and should be followed-up by Veolia to better understand the potential factors contributing to this result (see **Figure 6.1** for relevant sampled locations);

    - The measured SOER results for the waste covered areas including SC18087 & SC18089 – SC18091 can be considered as potential fugitive gas emission pathways given the elevated results when compared with the biofilter covered areas (i.e. SC18088) and the recorded odour character (pineapple, putrid, rotten). Notwithstanding these elevated results, they are well below 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; and

    - The waste covered area sample (SC18086), representing a 300 mm depth capped cover located between E15 and E16 (see **Figure 6.1**) that is not categorised as a potential fugitive emission pathway based on the SOER result, was close to the EA target of 0.2 $ou.m^3/m^2/s$. This also is a good result.

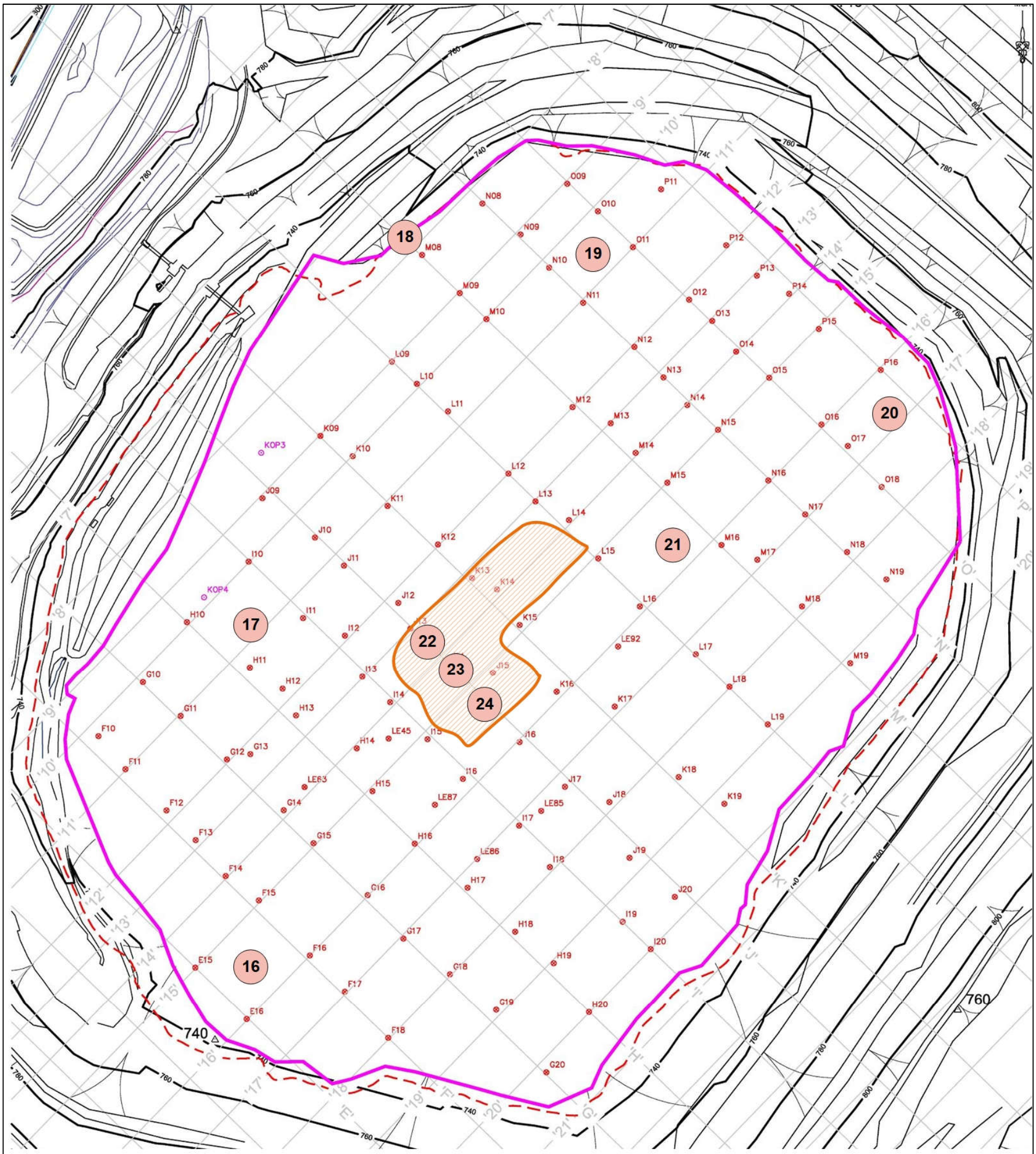


Image reproduced from the Woodlawn Bioreactor Landfill Monitoring Bore Locations (**Drawing 16700-218**) which was supplied by Veolia (Australia & New Zealand)

Legend

Sample location and number

Active tipping face as found during the Audt

Figure 6.1 - Nominal sampling locations within the Void: 22 January 2018 – 24 January 2018

Photo 6.1 – Conditions prevailing in the Void during the Audit on 22 January 2018

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:

- The leachate recirculation system continues to operate as a direct injection system that does not have suitable access points for sampling. 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. The reinjection point is at the eastern wall of the Void. On this basis, the recirculation is not considered a major odour emission source under the current operation at the Site;

- 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. SC18073 – SC18080) were found to be below the EA 2010 SOER model inputs for each dam. The very low SOER values for all ponds (0.096 – 0.229 ou.$m^3/m^2/s$) is consistent with the previous IOA results of 0.119 - 0.259 ou.$m^3/m^2/s$). 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 all measured results (i.e. 0.116 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;

- 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 (hereafter referred to as 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 1.97 ou/$m^3/m^2/s$ (see **Table 6.2**). While this result is higher than that modelled, it is characterised by an emission rate which is unlikely to cause any adverse impact beyond the boundary of the Site; and

- Veolia should investigate the cause behind the higher than desirable emission from ED3S-S.

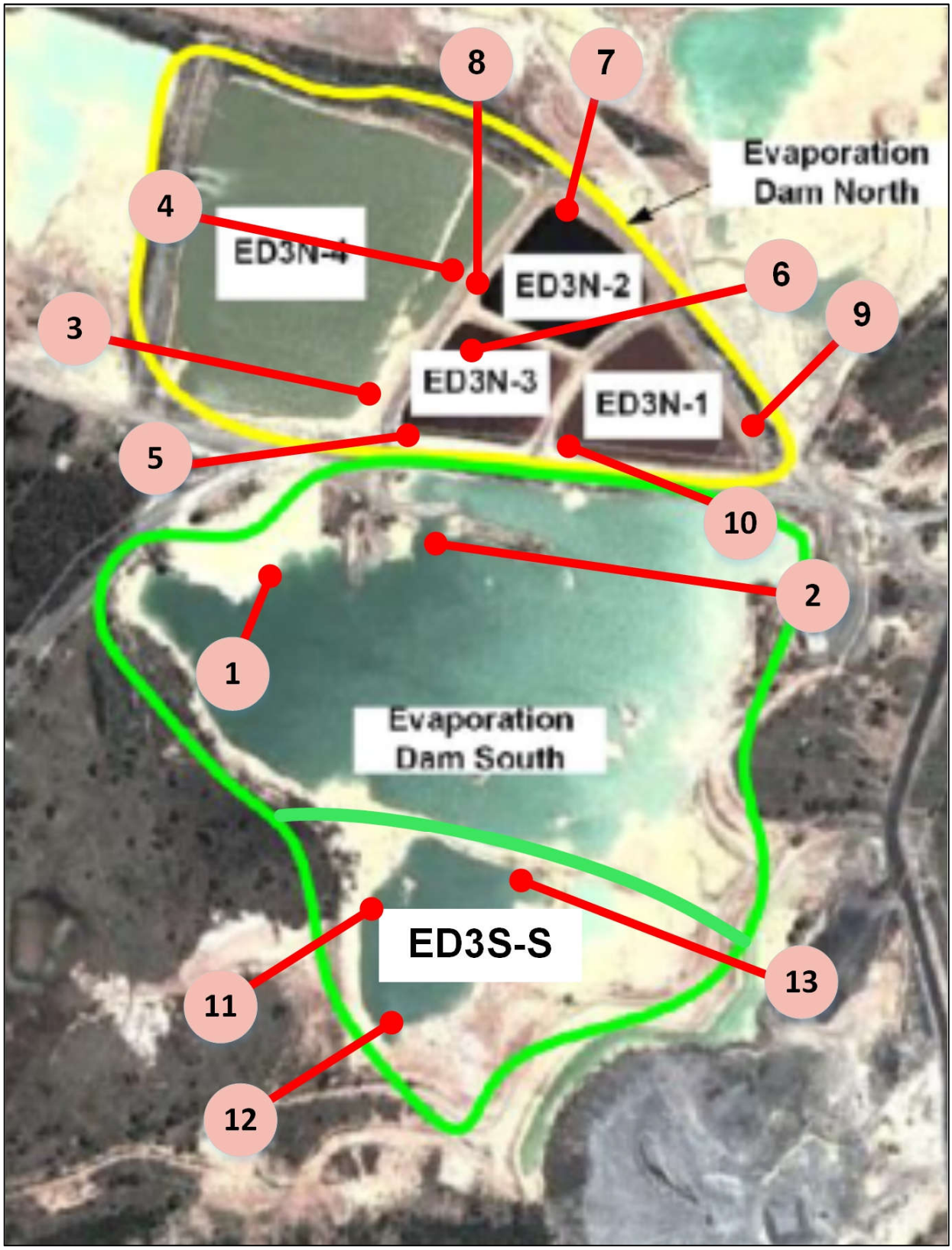


Figure 6.2 – Pond sources nominal sampling locations: 22 January 2018 – 24 January 2018

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 0.243 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 0.27 ou.$m^3/m^2/s$; and

- Three aerators and two mixers 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 23 January 2018

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 2017 Emissions Testing Report (see **Appendix C**).

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;

- The collected liquid samples were a grab sample from ED3N-1, ED3N-2, ED3N-3, ED3N-4 and ED3S-S; and

- All collected liquid samples analysed via the liquod odour measurement method were found to be low in odour, with only a 'musty' odour detectable - a good indicator of adequately treated leachate from an odour viewpoint - despite the apparent high OERs. Nevertheless, these 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 7.2.1.5**.

7 AUDIT DISCUSSION

7.1 PREVIOUS AUDIT RECOMMENDATIONS

Table 7.1 & **Table 7.2** outline the mandatory and non-mandatory recommendations documented in the 2016 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 2018 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 2018 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;
    - The expansion of wells in the Void for improved/minimisation of leachate recirculation and landfill gas extraction; and
    - De-sludging of the LTD and Stormwater Pond 3;
- Specific management techniques for:

- H_2S management;
- Covering of waste;
- The design, location and implementation of the biofiltration cover on the waste surface;
- 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 (hereafter referred to as **WIP**), with the latest details provided in the WIP 2018. 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 2018 available for review in the Audit. The relevant components of the WIP 2018 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 2016 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 2016 IOA are summarised in **Table 7.2** and include Veolia's response since that time.

Table 7.1 – 2016 IOA Mandatory Recommendations		
No.	**2016 Independent Audit Recommendations**	**Veolia Response**
1	*Fugitive landfill gas emissions* *Veolia should continue to improve landfill gas capture from the Bioreactor. This continuation is underway with Veolia completing its WIP 2017, 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 considered to be 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 2017, including the proposed leachate and gas extraction expansion around the Void. The landfill gas capture efficiency should continue to be monitored and recorded, and the surface of the Void monitored to determine the effectiveness of capture within specific areas of the Void.* *It should be noted that the WIP 2017 is a live document that will be continual 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 2018, an updated plan for the current and future operations at the Site. Similar to previous versions of the WIP, the WIP 2018 outlines the operational issues and plans to: ▪ improve and optimise leachate flow, treatment and recirculation; ▪ 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 2018 document is 'live' and designed around both a proactive and reactive approach in addressing infrastructure and operational issues. The WIP 2018 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.
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 2017. Both the manual and WIP 2017 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 clear from the on-site observations, odour emissions data collected during the Audit, and the WIP 2018 that Veolia continues to actively manage and improve the LMS. This is also evident in Veolia's proposed long-term leachate management solution where an Membrane Bioreactor (herafter referred to as **MBR**) Treatment Plant is planned to further improvement the quality of treated leachate. At the time of the Audit, the MBR Treatment Plant was in the construction phase.

Table 7.1 continued – 2016 IOA Mandatory Recommendations		
No.	**2016 Independent Audit Recommendations**	**Veolia Response**
3	*Active tipping face* *Investigation feasible options for managing odour emissions from the active tipping face. Veolia should also continue to develop strategies for the minimising the exposed active tipping face surface area at all times.*	**Waste cover management** Based on the WIP 2018, 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. In accordance with the Solid Waste Guidelines 2016, daily cover is applied to the waste each day before the close of business. VENM soil is used as daily cover material, where a minimum cover depth of 150 mm applied. Intermediate cover is applied to areas that have not been landfilled for more than 90 days. VENM soil is used as intermediate cover material, where a minimum cover depth of 300 mm applied. **Improvement in waste tipping practices** Veolia have modified the waste tipping profile as to form a pyramid shape when finished. From a centreline ridge along the north-south orientation, there is a fall on either side of the ridge towards the eastern and western ends of the Void. From a centreline ridge along the east-west orientation, there is a fall on either side of the ridge towards the northern and southern ends of the Void. Through this new profile design, the gravity and slope gradients drive the surface water flow into the designed area rather than staying on the surface at any low spot, thereby reducing the possibility of surface water being contaminated or penetrate into the waste and ultimately will minimise the leachate generation. The landfill gas pipework laid out on the surface also follows the gradient which simplifies condensate management and removal in the landfill gas collection system and provides in-line leachate draining to designated spots.

Table 7.2 - 2016 IOA Non-mandatory recommendations		
No.	**2016 IOA Non-Mandatory Recommendation**	**Veolia Response**
1	*Odour mitigation strategies for the Void - Fugitive gas emissions* *Further, investigate if the garbage character detectable downwind as found in the Audit is attributable to a single source or other sources (such as fugitive gas emissions from ageing to aged waste). A suggested problem definition for this investigation could be framed around determining if the odour character of fugitive landfill gas emissions from the Void and/or the active tipping face are similar in characteristic i.e. are both sources being detected downwind as garbage or is this solely attributable to the active tipping face operations in the Void. A study that investigates this matter may be beneficial as it could assist with contextualising the FAOA survey results and odour complaints.*	Odour complaints have dropped since the previous IOA (see **Section 7.4.1**) From a qualitative viewpoint, this reduction in odour complaints appears to correspond with the following factors: ▪ Significant improve in landfill gas extraction in the Void; and ▪ Improved leachate management through optimisation of surface water catchments, landfill gas infrastructure design and active tipping practices.
2	*Refine investigation of odour issues in the community* *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 dropped since the previous IOA (see **Section 7.4.1**) From a qualitative viewpoint, this reduction in odour complaints appears to correspond with the following factors: ▪ The significant improvement in landfill gas extraction in the Void; and ▪ The improvement in leachate management through optimisation of surface water catchments, landfill gas infrastructure design and active tipping practices. Given this outcome, and given the reduction in activity of community engagement via the deployment of the odour diaries as advised by Veolia (see **Section 7.4.1** for further details), Veolia has refined its investigation of odour issues in the community by active engagement through its existing odour complaints and response management strategy. The status quo regarding the efficacy of the odour diaries and community engagement strategy will be followed-up and reassessed in the next IOA.

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 7.2.1.2)**;
3. Improvement of landfill gas extraction from the Bioreactor (see **Section 7.2.1.3**);
4. Adequate combustion of landfill gas (see **Section 7.2.1.4**);
5. Improve evaporation capability (see **Section 7.2.1.5**);
6. The implementation of alternative capping material in the form of a biofilter medium, particularly in know high-risk areas such as the Void perimeter where shrinkage effects are pronounced (see **Section 7.2.1.6**);
7. Using the minimal active tipping face as practically possible (see **Section 7.2.1.7**);
8. Water cart to control dust (see **Section 7.2.1.8**);
9. Transportation of waste in sealed containers until unloading at the Bioreactor (see **Section 7.2.1.9**); and
10. The minimisation of leachate generation during stormwater events through improved surface catchment management (see **Section 7.2.1.11**).

7.2.1.1 Leachate recirculation method

To maximise the recirculation potential of the waste, 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.

7.2.1.1.1 Leachate recirculation operational status

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. The reinjection point is at the eastern wall of the Void.

Based on the current leachate recirculation operational status as documented the Audit, no further action is required by Veolia on this matter other than that documented in the WIP 2018.

7.2.1.2 Optimisation and continuous treatment of excess leachate from the Void

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 2.4.4** 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.

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.

7.2.1.3 Improvement of landfill gas extraction from the Bioreactor

Landfill gas extraction at this Site is an on-going operational process. The WIP 2018 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.

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.

7.2.1.3.1 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 March 2017 and December 2017 and compares this result to that obtained in the 2016 IOA. As can be derived from the results in **Table 7.3**, the monthly averaged landfill gas extraction over the period between March 2017 and December 2017 was approximately 1,839,132 m^3 (gas to generators plus flared). In comparison to the gas extraction result obtained from the previous period in the 2016 IOA (i.e. 1,086,927 m^3),

this represents a relative increase of approximately 69% in total gas extraction volume (equivalent to 752,205 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 2016 IOA & the Audit	
Summary table	**Values**
2016 IOA landfill gas extraction (m^3/month)	1,086,927
The Audit landfill gas extraction (m^3/month)	1,839,132
% improvement/decline	**69.2%**

The landfill gas trend between 5 March 2017 and 31 December 2017 is shown in **Figure 7.1**.

7.2.1.3.1.1 Fugitive landfill gas emissions

As noted in the previous 2016 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 2018 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 7.2.1.6** 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 undertaking of a study by a university body to gain an improved understanding of fugitive gas emissions/odour and its behaviour to further improve landfill gas collection at the Site.

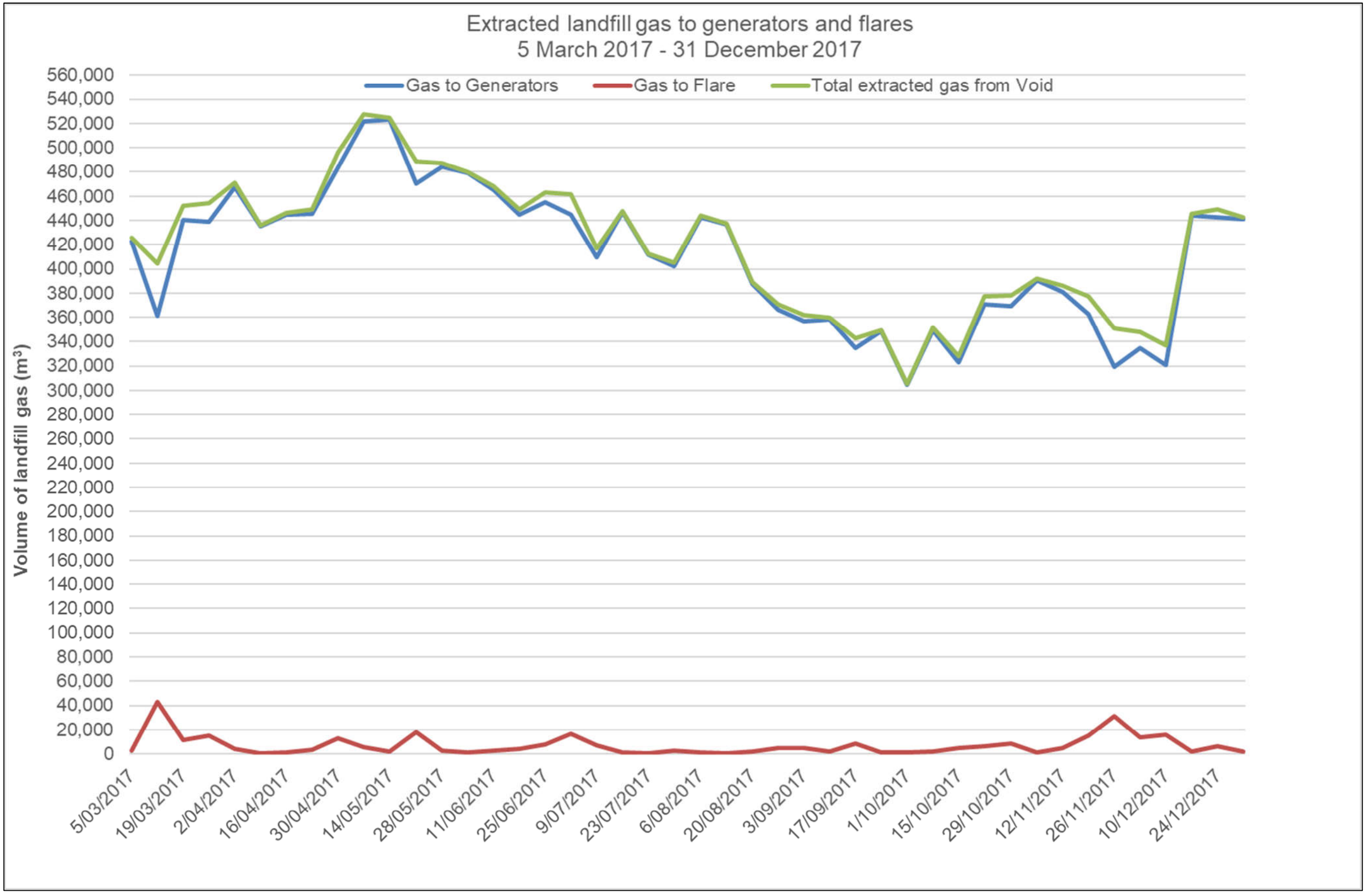


Figure 7.1 – Landfill gas trend between 5 March 2017 and 31 December 2017

7.2.1.4 Landfill gas combustion exhaust quality

According to the 2017 Emissions Testing Report (see **Appendix C**), all combusted gas emissions analysed on NSW EPA Point 8 - Generator No. 1 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 (hereafter referred to as **kW**).

Given the outcomes reported in the 2017 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.

7.2.1.5 Improve evaporation capability

Veolia has had the capacity to 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**).

7.2.1.5.1 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 2016 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.

Specifically, all samples collected and tested from the ED3N Pond system (i.e. SC18073 – SC18080) were found to be below the EA 2010 SOER model inputs for each dam. The very low SOER values for all ponds (0.096 – 0.229 $ou.m^3/m^2/s$) is consistent with the previous IOA results of 0.119 - 0.259 $ou.m^3/m^2/s$). 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. 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.

7.2.1.5.2 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 1.97 $ou/m^3/m^2/s$ (see **Table 6.2**). While this result is higher than that modelled, it is characterised by an emission rate which is unlikely to cause any adverse impact beyond the boundary of

the Site. This finding is supported by 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. Nevertheless, the Audit hypothesises the following reasons for this elevated result:

- The condition of the pond surface at the time of sampling and sampled location. Specifically, two out of the three sampled locations show an elevated result, with sample SC18083 returning a value of 0.13 ou.$m^3/m^2/s$. This suggests it is not the entire pond surface and at localised regions around ED3S-S, inferring that some sub-optimal quality leachate has mixed with the ED3S-S. Veolia should investigate this matter as a matter of priority; and

- The pH was measured at 8.3, with an estimated H_2S value of between 1 ppm and 3 ppm, based on a known rule of thumb by the audit team where 1 ppm of H_2S is typically 2,000 ou. Direct measurement was not possible due to an equipment malfunction of the Jerome H_2S analyser. Given the low concentration emitted and pH of the ED3S-S, it appears that there is still very marginal presence sulphide on the ED3S-S water column resulting in the liberating of H_2S due to vapour pressure effects. Again, Veolia should investigate this matter as a matter of priority.

7.2.1.5.3 Status of evaporation capability from an odour viewpoint

The results derived using the LOM testing is summarised in **Table 6.3** 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 a 'musty' character suggesting that there is no original untreated leachate character and favourable treatment of the stored effluent in the ED3N & ED3S Pond Systems. The exception is the SOER results for ED3S-S (see **Section 7.2.1.5.2**) which showed slightly elevated results (1.97 ou.$m^3/m^2/s$) from the desired value of 0.159 ou.$m^3/m^2/s$. Veolia should investigate the cause behind this as it is likely related to the leachate treatment process conditions.

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 8.2.2**).

7.2.1.6 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 2018.

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.

Photo 7.1 – Biofilter cover material applied on Void perimeter as occurred on 24 January 2018

7.2.1.7 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 1,500 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 22 January 2018

The SOER value determined during this Audit was approximately 9.52 ou.$m^3/m^2/s$. This represents an exceedance of the SOER value used in the EA 2010 modelling of 7.3 ou.$m^3/m^2/s$. Based on these results, it appears that the active tipping face can be a contributing source to downwind odour emissions from the Void under the appropriate meteorological conditions. 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 7.2.1.3**;

- 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 exposed waste surface area will result in a proportional reduction in emissions from the active tipping face, and vice versa; and

- The SOER result used in the EA 2010 assumed a SOER of 7.3 ou.$m^3/m^2/s$ with an active tipping face of 40,000 m^2 (compared with the current operational area of up to 1,500 m^2). As will be shown in **Table 7.4**, the resultant OER derived in the Audit (14,300 ou.$m^3/m^2/s$) is significantly less than that used in the EA 2010 (292,000 ou.$m^3/m^2/s$).

Given the above points, the elevated SOER result is not considered significant from an odour impact viewpoint. However, this simple analysis demonstrates the importance of continued efforts to minimise the active tipping face as much as practically possible. 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.

7.2.1.8 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. An example of this practice is shown in **Photo 7.3**. On the above basis, no further action is required by Veolia for this component of the Site's operations.

Photo 7.3 – Water carting in progress as found on 22 January 2018

7.2.1.9 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. A photo of a truck utilising the truck wash bay on 24 January 2018 is shown in **Photo 7.4**. 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.

Photo 7.4 – The use of the wash bay as found on 24 January 2018

On the above basis, no further action is required by Veolia for this component of the Site's operations.

7.2.1.10 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 the 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 7.5** & **Photo 7.6.**

No further actions are required by Veolia for this component of the Site's operations.

Photo 7.5 - The IMF facing south-west as found during the Audit inspection visit on 24 January 2018

Photo 7.6 - The IMF facing south-east as found during the Audit inspection visit on 24 January 2018

7.2.1.11 The minimisation of leachate generation during stormwater events

As indicated in **Section 2.4.6,** the WIP 2018, the surface water in the Void will be managed in four sub-catchments as shown in **Figure 2.4.** 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.

7.2.1.11.1 Management of high rainfall events

As previously mentioned in **Section 2.4.7.2**, the WIP 2018, Stormwater Pond 3 has been designed to handle a short duration event of high-intensity rainfall equivalent to 15 mm/hour over three hours. This is based on the pond capacity, pumping capacity and calculated inflow rates. This will further reduce the amount of leachate generation from surface water contact with waste under a high rainfall event.

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 includes:

- 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 C.** 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 (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 letters 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 7.4.1.1**).

The above points have been discussed in the following sections.

7.4.1 Odour diary entries analysis

The Odour Diary project is a joint initiative between TOU and Veolia in early-2014 and was complete and issued to the community in May/June 2014. The purpose of the Odour Diary is to collect real-time data on ambient odour levels at residential properties. While not being an Audit requirement, the odour diaries are relevant to the discussion of the Audit as it provides a better understanding on the nature and likely source of odours that are emitted beyond the Site boundary and experienced by the community. The Odour Diary is also an alternate and a direct communication channel between Veolia and the community in a standardised feedback format. This information will be assessed, and a formal response provided to the community.

No odour diary entries were made available to the Audit. As previously mentioned in **Table 7.2**, odour complaints have dropped since the previous IOA. From a qualitative viewpoint, this reduction in odour complaints appears to correspond with the following factors: the significant improvement in landfill gas extraction in the Void; and improved leachate management through optimisation of surface water catchments, landfill gas infrastructure design and active tipping practices. Given this outcome and given the reduction in activity of community engagement via the deployment of the odour diaries as advised by Veolia, Veolia has refined its investigation of odour issues in the community by active engagement through its existing odour complaints and response management strategy. The status quo regarding the efficacy of the odour diaries and community engagement strategy will be followed-up and reassessed in the next IOA.

7.4.1.1 Compliance with the project-specific odour performance goal of 6 ou

Similar to previous IOAs, the Audit did not have access to the site-specific odour dispersion model used in the EA 2010 and did not carry out modelling, using the odour emission rates determined in the Audit. It is, therefore, unable to determine whether compliance with the 6 ou criterion is being achieved, based on the approach used in odour dispersion modelling, whereby the modelled emission rates prevail over an entire year. Following the substantial improvement in measured odour emissions for both

pond and non-pond sources over previous audits, a re-run of the existing dispersion model to quantitatively check compliance should perhaps be undertaken. The Audit results suggest that compliance is likely to be achieved given that the majority of the SOER and corresponding OER results in this Audit are within the ranges used in the EA 2010 (see **Table 7.4** for further details). This view is supported by the observed reduction in odour complaints between the February 2017 and February 2018 period (see **Section 7.4.2**).

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. The Audit recommends that this continue in the future as a means of determining compliance or otherwise with the project-specific goal.

7.4.2 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 8 February 2017.

The odour complaints analysis indicated the following:

- Since the previous 2016 IOA, over the period of 27 March 2017 and 8 February 2018, there were 20 logged odour complaints, equivalent to a 78% decrease in logged complaints. This is a positive result and reflects 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 2017 and 8 February 2018. All responses can be found in **Appendix C**.

Notwithstanding the reduction in odour complaints, the Audit recommends that Veolia maintain the deployment of the odour diaries as a contingency measure in the event of an increase in odour complaints. Moreover, given the reduction in activity of community engagement via the deployment of the odour diaries as advised by Veolia, the status quo regarding the efficacy of the odour diaries and community engagement strategy will be followed-up and reassessed in the next IOA. 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 8.3.2** for more details).

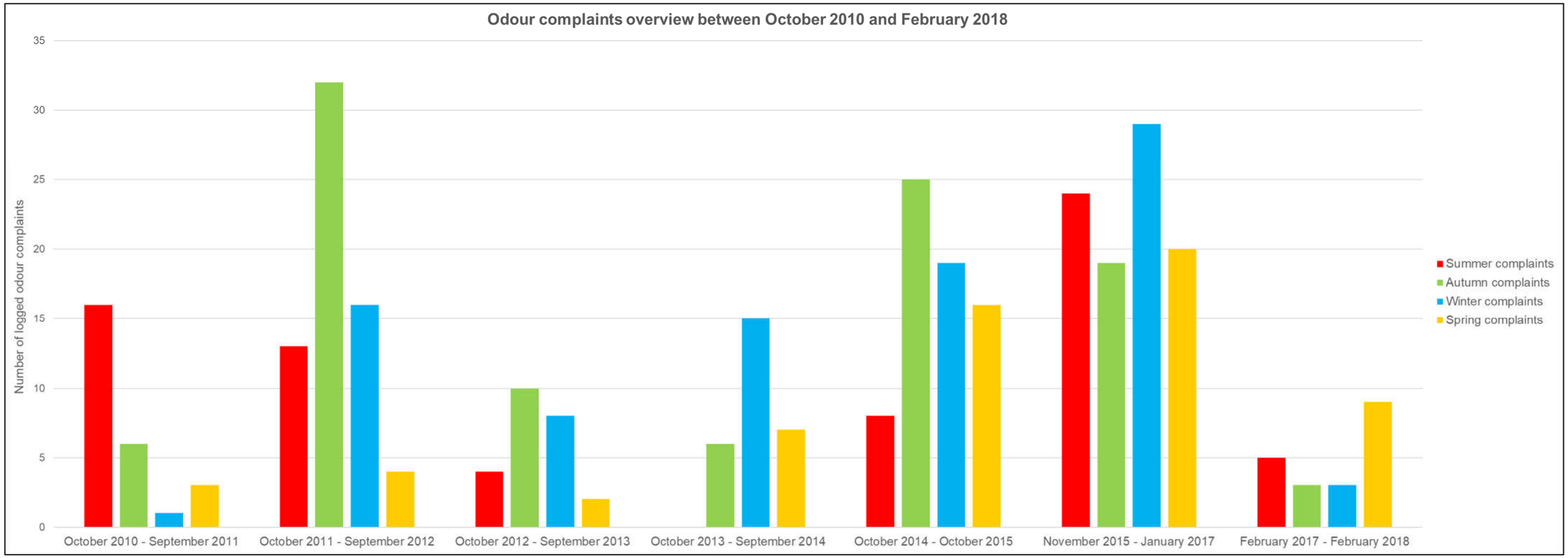


Figure 7.2 - Number of logged odour complaints between October 2010 and February 2018

7.5 ODOUR EMISSIONS INVENTORY DISCUSSION

As per 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		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 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 ($ou.m^3/s$)
ED3N-1	6,000	6,000	6,000	7,000	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 ^^^	11,000	11,000	11,000	13,000	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	5,500	5,500	5,500	6,500	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	5,500	5,500	5,500	6,500	0.139	765	0.20	1,110	0.091	500	0.032	178	0.2	1,010	852	0.37	2,430			
ED3N-4	25,000	25,000	25,000	16,000	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	89,435	89,435	n/a		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**	1,420	1,420			1.97	44,700	0.437	621										0.159	4,510	226
Active Tipping Face	1,500	6,000	6,000	40,000 *	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	0.243	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	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/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
** 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 76,900 ou.m^3/s, representing a decrease of 7,660 ou.m^3/s. This represents more than a 10% decrease since the 2016 IOA. The dominant source is ED3S-S (44,700 ou.m^3/s, or 58%), due to the very large area size of this odour source (22,700 m^2);
- The active tipping face is now contributing to approximately 19% of the Site's total measurable odour emissions, without consideration of fugitive landfill gas emissions (see **Section 7.2.1.3**). This reduction is attributable to the reduction in the active tipping face area (see **Section 7.2.1.7**);
- 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. As previously mentioned in **Section 7.4.1.1 and 7.2.1.5.2**, the exception is active tipping face and ED3S-S where there was an exceedance of the EA 2010 emissions; and
- Similarly, to the previous 2012 IOA, 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;
- Stormwater Pond 3; 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 0.132 ou.$m^3/m^2/s$, 0.12 ou.$m^3/m^2/s$, 0.139 ou.$m^3/m^2/s$, and 0.163 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.

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 0.116 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 1.97 ou/$m^3/m^2/s$ (see **Table 6.2**). While this result is higher than that modelled in the ED3S May 2016 Report, it is characterised by an emission rate which is unlikely to cause any adverse impact beyond the boundary of the Site. This finding is supported by 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 (refer to **Section 7.2.1.5.2** for further details).

On the above basis, the Audit finds that 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.

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 0.243 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 2016 IOA. On this basis, Veolia should continue to work with Veolia Water in optimising the treatment process. The Audit endorses this continuation.

7.5.1.5 Storage Pond 7

Storage Pond 7 remains non-existent (previously located in the Void) and is therefore not a valid odour emission source in the Audit. The Audit understands that Veolia has no intention of recommissioning this pond system in the future. The WALTER system is a fully enclosed system with no exposed area. On this basis, it is not considered a significant odour emission source at the Site.

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. The Audit odour testing results indicate that the Void continues to remain a potentially 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. Since the previous 2015 IOA, Veolia has adopted the use of biofiltration-based organic medium (a non-mandatory recommendation in the 2013 IOA and discussed in **Section 7.2.1.6**) in known problematically areas including the leachate extraction sump surface areas and Void perimeter. As can be shown in the 2016 IOA and the Audit, this has proven to be successful when the medium material is maintained in an optimum manner such as the controlling of medium moisture and depth. Veolia should continue the implementation of the bio-cover material, alongside with improving gas capture, as a means of reducing fugitive gas emissions from the Void surface given that this is judged to be the major contributor to odour emissions from the Site (see **Section 7.2.1.3**).

7.5.2.1.1 Active tipping face

For reasons discussed in **Section 7.2.1.7**, the elevated SOER result (9.52 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 AUDIT RECOMMENDATIONS

8.1 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 is not aware of the status regarding the odour diary project.

8.2 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.

8.2.1 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 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:
    - 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 2018 is a live document that will be continually updated. Therefore, it will continue to remain a part of the IOA.

8.2.2 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 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.

8.2.3 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.

8.2.4 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.

8.3 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.

8.3.1 Odour mitigation strategies for the Void

Fugitive gas emissions

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.

8.3.2 Refine investigation of odour issues in the community

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.

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18. Department of Environment and Conservation NSW, *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January* 2007.

19. AS/NZS 4323.3, *Stationary source emissions – Determination of odour concentration by dynamic olfactometry,* 2001.

20. Klenbusch, M. R. (1986), *EPA/600/8-8E/008 Measurement Of Gaseous Emission Rates From Land Surfaces Using An Emission Isolation Flux Chamber User's Guide,* U.S. Environmental Protection Agency, Las Vegas NV.

REPORT SIGNATURE PAGE

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

Veolia Australia & New Zealand

Woodlawn Bioreactor Expansion Project

Independent Odour Audit #6

January 2018

Appendices

APPENDIX A:

ODOUR CONCENTRATION LABORATORY TESTING RESULT SHEETS

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

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Internet: www.odourunit.com.au
ABN: 53 091 165 061

NATA

Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Veolia Australia & New Zealand	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	AS4323.3 / AS4323.4	Sampling Team	TOU (M. Assal, S. Munro)

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	January 2018	TOU Project #	N1806L
Order number	Refer to correspondence	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 Standard '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. Accredited for compliance with ISO/IEC 17025 – Testing. This report shall not be reproduced, except in full. 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 between 22ºC and 25ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $r = 0.1366$ (Aug - Oct 2017) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $A = 0.2128$ (Aug - Oct 2017) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (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.

Date: Thursday, 15 February 2018

Panel Roster Number: SYD20180124_010

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20180124_010

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 ($ou.m^3/m^2/s$)
Sample #1 - ED3S (1 of 2)	SC18071	23.01.2018 0939 hrs	24.01.2018 1029 hrs	4	8	--	--	181	181	0.116
Sample #2 - ED3S (2 of 2)	SC18072	23.01.2018 0939 hrs	24.01.2018 1101 hrs	4	8	--	--	181	181	0.116
Sample #3 - ED3N-1 (1 of 2)	SC18073	23.01.2018 1032 hrs	24.01.2018 1134 hrs	4	8	--	--	235	235	0.149
Sample #4 – ED3N-1 (2 of 2)	SC18074	23.01.2018 1032 hrs	24.01.2018 1203 hrs	4	8	--	--	181	181	0.115
Sample #5 – ED3N-2 (1 of 2)	SC18075	23.01.2018 1116 hrs	24.01.2018 1307 hrs	4	8	--	--	181	181	0.115
Sample #6 - ED3N-2 (2 of 2)	SC18076	23.01.2018 1116 hrs	24.01.2018 1339 hrs	4	8	--	--	197	197	0.125

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 Sample Measurement Results
Panel Roster Number: SYD20180124_010

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 ($ou.m^3/m^2/s$)
Sample #7 – ED3N-3 (1 of 2)	SC18077	23.01.2018 1254 hrs	24.01.2018 1412 hrs	4	8	--	--	181	181	0.115
Sample #8 - ED3N-3 (2 of 2)	SC18078	23.01.2018 1311 hrs	24.01.2018 1440 hrs	4	8	--	--	256	256	0.162
Sample #9 - ED3N-4 (1 of 2)	SC18079	23.01.2018 1346 hrs	24.01.2018 1514 hrs	4	8	--	--	152	152	0.096
Sample #10 – ED3N-4 (2 of 2)	SC18080	23.01.2018 1351 hrs	24.01.2018 1549 hrs	4	8	--	--	362	362	0.229
Sample #11 - Leachate Aeration Dam (1 of 2) - Aerobic Zone	SC18081	23.01.2018 1543 hrs	24.01.2018 1649 hrs	4	8	--	--	431	431	0.243
Sample #12 - Leachate Aeration Dam (2 of 2) - Anoxic Zone	SC18082	23.01.2018 1550 hrs	24.01.2018 1717 hrs	4	8	--	--	431	431	0.243

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	SYD20180124_010	51,500	$20 \leq \chi \leq 80$	724	71	Yes

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

SC18071	musty, earthy	SC18077	musty, earthy
SC18072	musty, earthy	SC18078	musty, earthy
SC18073	musty, earthy	SC18079	musty, earthy
SC18074	musty, earthy	SC18080	musty, earthy
SC18075	musty, earthy	SC18081	pungent, ammoniacal earthy, dirty socks
SC18076	musty, earthy	SC18082	pungent, ammoniacal earthy, dirty socks

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. 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.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd. Any attachments to this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.

END OF DOCUMENT

THE ODOUR UNIT PTY LTD

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Internet: www.odourunit.com.au
ABN: 53 091 165 061

NATA

Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Veolia Australia & New Zealand	Telephone	(02) 8588 1320
Contact	A. Du	Facsimile	--
Sampling Site	Woodlawn Bioreactor Facility	Email	ark.du@veolia.com
Sampling Method	AS4323.3 / AS4323.4	Sampling Team	TOU (M. Assal, S. Munro)

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	January 2018	TOU Project #	N1806L
Order number	Refer to correspondence	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 Standard '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. Accredited for compliance with ISO/IEC 17025 – Testing. This report shall not be reproduced, except in full. 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 between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $r = 0.1366$ (Aug - Oct 2017) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $A = 0.2128$ (Aug - Oct 2017) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (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.

Date: Thursday, 15 February 2018

Panel Roster Number: SYD20180125_011

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20180125_011

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 ($ou.m^3/m^2/s$)
Sample #13 - ED3S-S (1 of 3)	SC18083	24.01.2018 0902 hrs	25.01.2018 1041 hrs	4	8	--	--	197	197	0.13
Sample #14 - ED3S-S (2 of 3)	SC18084	24.01.2018 0908 hrs	25.01.2018 1116 hrs	4	8	--	--	3,440	3,440	2.27
Sample #15 - ED3S-S (3 of 3)	SC18085	24.01.2018 0939 hrs	25.01.2018 1144 hrs	4	8	--	--	5,310	5,310	3.5
Sample #16 - Waste Covered Area (300 mm depth capped cover between E15 and E16)	SC18086	24.01.2018 1122 hrs	25.01.2018 1223 hrs	4	8	--	--	362	362	0.25
Sample #17 - Waste Covered Area (300 mm depth capped cover between H10 and H11)	SC18087	24.01.2018 1125 hrs	25.01.2018 1326 hrs	4	8	--	--	17,900	17,900	12.4
Sample #18 - Waste Covered Area (Void perimeter with biocover)	SC18088	24.01.2018 1155 hrs	25.01.2018 1405 hrs	4	8	--	--	790	790	0.51

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 Sample Measurement Results
Panel Roster Number: SYD20180125_011

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 ($ou.m^3/m^2/s$)
Sample #19 - Waste Covered Area (150 mm depth capped cover between N10 and N11)	SC18089	24.01.2018 1219 hrs	25.01.2018 1436 hrs	4	8	--	--	3,760	3,760	2.54
Sample #20 - Waste Covered Area (150 mm depth capped cover between O16 and O17)	SC18090	24.01.2018 1237 hrs	25.01.2018 1518 hrs	4	8	--	--	1,720	1,720	1.15
Sample #21 - Waste Covered Area (150 mm depth capped cover between L16 and M16)	SC18091	24.01.2018 1242 hrs	25.01.2018 1549 hrs	4	8	--	--	4,100	4,100	2.73

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

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THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20180125_011

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 ($ou.m^3/m^2/s$)
Sample #22 - Active Tip Face (1 of 3) - Fresh Waste (< 1 day old)	SC18092	24.01.2018 1420 hrs	25.01.2018 1611 hrs	4	8	--	--	10,600	10,600	7.05
Sample #23 - Active Tip Face (2 of 3) - Fresh Waste (< 1 day old)	SC18093	24.01.2018 1426 hrs	25.01.2018 1640 hrs	4	8	--	--	17,400	17,400	11.5
Sample #24 - Active Tip Face (3 of 3) - Fresh Waste (< 1 day old)	SC18094	24.01.2018 1443 hrs	25.01.2018 1709 hrs	4	8	--	--	15,000	15,000	10.0

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).
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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	SYD20180125_011	51,500	$20 \leq \chi \leq 80$	724	71	Yes

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

SC18083	pungent, ammoniacal earthy	SC18089	pineapple, putrid, rotten
SC18084	rotten egg, pungent, ammoniacal	SC18090	earthy, garbage
SC18085	rotten egg, pungent, ammoniacal	SC18091	pineapple, putrid, rotten
SC18086	dirt, rotten	SC18092	garbage, bin juice
SC18087	pineapple, putrid, rotten	SC18093	garbage, bin juice
SC18088	dirt, earthy	SC18094	garbage, bin juice

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END OF DOCUMENT

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NATA

Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Veolia Australia & New Zealand	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 (M. Assal, S. Munro)

Order details:

Order requested by	A. Du	Order accepted by	M. Assal
Date of order	January 2018	TOU Project #	N1806L
Order number	Refer to correspondence	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 Standard '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. Accredited for compliance with ISO/IEC 17025 – Testing. This report shall not be reproduced, except in full. 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 between 22ºC and 25ºC.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $r = 0.1366$ (Aug - Oct 2017) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V02: $A = 0.2128$ (Aug - Oct 2017) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (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.

Date: Thursday, 15 February 2018

Panel Roster Number: SYD20180201_012

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20180201_012

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 ($ou.m^3/m^2/s$)
LOM Sample #1 - ED3N-4	SC18095	01.02.2018 0930 hrs	01.02.2018 1105 hrs	4	8	--	--	304	304	--
LOM Sample #2 - ED3N-3	SC18096	01.02.2018 0935 hrs	01.02.2018 1149 hrs	4	8	--	--	166	166	--
LOM Sample #3 - ED3S-S	SC18097	01.02.2018 1130 hrs	01.02.2018 1306 hrs	4	8	--	--	235	235	--
LOM Sample #4 - ED3N-2	SC18098	01.02.2018 1200 hrs	01.02.2018 1341 hrs	4	8	--	--	215	215	--
LOM Sample #5 - ED3N-1	SC18099	01.02.2018 1330 hrs	01.02.2018 1458 hrs	4	8	--	--	166	166	--

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	SYD20180201_012	51,500	$20 \leq \chi \leq 80$	861	60	Yes

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

SC18095	musty
SC18096	musty
SC18097	musty
SC18098	musty
SC18099	musty

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. 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.

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APPENDIX B:

ODOUR EMISSIONS WORKSHEET

THE ODOUR UNIT

VEOLIA

Odour Emissions Inventory Audit

Client: Veolia (Australia & New Zealand)
Sampling Site: Woodlawn Bioreactor Facility
Project Number: N1806L - Woodlawn Audit #6

Sample Location	TOU Sample Number	Odour Concentration (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Odour character
Evaporation Dam 3 South (ED3S) System				
Sample #1 - ED3S (1 of 2)	SC18071	181	0.116	musty, earthy
Sample #2 - ED3S (2 of 2)	SC18072	181	0.116	musty, earthy
Evaporation Dam 3 North (ED3N) System				
Sample #3 - ED3N-1 (1 of 2)	SC18073	235	0.149	musty, earthy
Sample #4 – ED3N-1 (2 of 2)	SC18074	181	0.115	musty, earthy
Sample #5 – ED3N-2 (1 of 2)	SC18075	181	0.115	musty, earthy
Sample #6 - ED3N-2 (2 of 2)	SC18076	197	0.125	musty, earthy
Sample #7 – ED3N-3 (1 of 2)	SC18077	181	0.115	musty, earthy
Sample #8 - ED3N-3 (2 of 2)	SC18078	256	0.162	musty, earthy
Sample #9 - ED3N-4 (1 of 2)	SC18079	152	0.096	musty, earthy
Sample #10 – ED3N-4 (2 of 2)	SC18080	362	0.229	musty, earthy
Evaporation Dam 3 South-South (ED3S-S) System				
Sample #13 - ED3S-S (1 of 3)	SC18083	197	0.130	pungent, ammoniacal earthy
Sample #14 - ED3S-S (2 of 3)	SC18084	3,440	2.27	rotten egg, pungent, ammoniacal
Sample #15 - ED3S-S (3 of 3)	SC18085	5,310	3.50	rotten egg, pungent, ammoniacal
Leachate Aeration Dam				
Sample #11 - Leachate Aeration Dam (1 of 2) - Aerobic Zone	SC18081	431	0.243	pungent, ammoniacal earthy, dirty socks
Sample #12 - Leachate Aeration Dam (2 of 2) - Anoxic Zone	SC18082	431	0.243	pungent, ammoniacal earthy, dirty socks
Active Tipping Area				
Sample #22 - Active Tip Face (1 of 3) - Fresh Waste (< 1 day old)	SC18092	10,600	7.05	garbage, bin juice
Sample #23 - Active Tip Face (2 of 3) - Fresh Waste (< 1 day old)	SC18087	17,400	11.5	garbage, bin juice
Sample #24 - Active Tip Face (3 of 3) - Fresh Waste (< 1 day old)	SC18094	15,000	10.0	garbage, bin juice
Waste Covered Area				
Sample #16 - Waste Covered Area (300 mm depth capped cover between E15 and E16)	SC18086	362	0.251	dirt, rotten
Sample #17 - Waste Covered Area (300 mm depth capped cover between H10 and H11)	SC18087	17,900	12.4	pineapple, putrid, rotten
Sample #18 - Waste Covered Area (Void perimeter with biocover)	SC18088	790	0.51	dirt, earthy
Sample #20 - Waste Covered Area (150 mm depth capped cover between O16 and O17)	SC18090	1,720	1.15	earthy, garbage
Sample #19 - Waste Covered Area (150 mm depth capped cover between N10 and N11)	SC18089	3,760	2.54	pineapple, putrid, rotten
Sample #21 - Waste Covered Area (150 mm depth capped cover between L16 and M16)	SC18091	4,100	2.73	pineapple, putrid, rotten

THE ODOUR UNIT

VEOLIA

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 #1 - ED3N-4	SC18095	304	0.413	25	304	18.4	70	1,290,000	21,500	105	1,930,000	32,200	musty
LOM Sample #2 - ED3N-3	SC18096	166	0.413	25	166	10.0	70	700,000	11,700	105	1,050,000	17,500	musty
LOM Sample #3 - ED3S-S	SC18097	235	0.413	25	235	14.2	70	994,000	16,600	105	1,490,000	24,800	musty
LOM Sample #4 - ED3N-2	SC18098	215	0.413	25	215	13.0	70	910,000	15,200	105	1,370,000	22,800	musty
LOM Sample #5 - ED3N-1	SC18099	166	0.413	25	166	10.0	70	700,000	11,700	105	1,050,000	17,500	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 - ED3N-4	SC18095	304	0.413	25	304	18.4	25,000	92.67	0.882	16,200
LOM Sample #2 - ED3N-3	SC18096	166	0.413	25	166	10	5,500	92.67	0.194	1,940
LOM Sample #3 - ED3S-S	SC18097	235	0.413	25	235	14.2	1,420	92.67	0.050	711
LOM Sample #4 - ED3N-2	SC18098	215	0.413	25	215	13	5,500	92.67	0.194	2,520
LOM Sample #5 - ED3N-1	SC18099	166	0.413	25	166	10	6,000	92.67	0.212	2,120

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 C:

TECHNICAL DOCUMENTATION RELEVANT TO THE AUDIT

ODOUR COMPLAINTS REGISTER:

8 JANUARY 2017 – 8 FEBRUARY 2018

Woodlawn Bioreactor Complaints Register

VEOLIA

Date	Complaint lodged	Response	Name (private)	Location	Location (private)	Description	Description (private)	Duration	Response/action taken to resolve the complaint
8/02/2018	8:47:00 PM	Letter	Wayne Olive	Rosebury Street, Tarago	6 Rosebury Street, Tarago	The complainant reported to the EPA that he was experiencing a "strong stench/odour and it smells like rotten rubbish."	Wayne Olive 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.
18/01/2018	8:27:00 AM	Letter	Sue Maas	Braidwood Road, Tarago	2011 Braidwood Road, Tarago	The complainant reported to the EPA that "a foul rotting rubbish smell is coming from the Woodlawn Bioreactor. She noticed the smell when she went outside of her house at approx 8am and said she had not detected any odours recently, but this morning's odour was particularly bad and said it was a 10 out of 10 for strength and intensity."	Sue Maas reported to the EPA that "a foul rotting rubbish smell is coming from the Woodlawn Bioreactor. She noticed the smell when she went outside of her house at approx 8am and said she had not detected any odours recently, but this morning's odour was particularly bad and said it was a 10 out of 10 for strength and intensity."	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 have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
13/12/2017	8:55:00 AM	Letter	Unknown	King Street, Tarago	King Street, Tarago	The Complainant reported to the EPA that he first "noticed an odour of rotting garbage when he went outside at approx. 8am and was still present at the time of his call at 8.55am. He said the strength was strong = 4/6"	The unknown Complainant reported to the EPA that he first "noticed an odour of rotting garbage when he went outside at approx. 8am and was still present at the time of his call at 8.55am. He said the strength was strong = 4/6"	55 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. Veolia have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
13/12/2017	8:39:00 AM	Letter	Wayne Olive	Rosebery Street, Tarago	6 Rosebery Street, Tarago	The complainant reported to the EPA that "there was a bad odour at the residence from approx 8am, this is an ongoing issue and he is concerned about the impact the odours are having on the quality of water in his water tank."	Wayne Olive reported to the EPA that "there was a bad odour at the residence from approx 8am, this is an ongoing issue and he is concerned about the impact the odours are having on the quality of water in his water tank."	39 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. Veolia have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
3/12/2017	9:14:00 PM	Letter	Wayne Olive	Rosebery Street, Tarago	6 Rosebery Street, Tarago	The complainant reported to the EPA that "there was a bad odour at the residence from approx 9pm, the smell was so strong that he vomited up his dinner. He advised that the smell was a rubbish smell."	Wayne Olive reported to the EPA that "there was a bad odour at the residence from approx 9pm, the smell was so strong that he vomited up his dinner. He advised that the smell was a rubbish smell."	14 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. Veolia have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
28/10/2017	8:45:00 AM	Letter	Wayne Olive	Rosebery Street, Tarago	6 Rosebery Street, Tarago	The complainant reported to the EPA that there was "a bad odour at his residence that smelt like "a dump/tip smell" from about 8:15am that morning".	Wayne Olive reported to the EPA that there was "a bad odour at his residence that smelt like "a dump/tip smell" from about 8:15am that 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. Veolia have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
8/10/2017	6:25:00 PM	Letter	Jeremy Johnson	Roseview Road Tarago	82 Roseview Road Tarago	The complainant reported to the EPA that "the odour was quite bad at his property from 15:00hrs that day, but that the issue was an ongoing one"	Jeremy Johnson reported to the EPA that "the odour was quite bad at his property from 15:00hrs that day, but that the issue was an ongoing one"	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. Veolia have provided the final supporting information to the Department of Planning and looking forward to the approval process being finalized, so construction can begin. 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.
21/09/2017	8:38:00 AM	Letter	Unknown	Tarago	Tarago	The complainant reported to the EPA that there was an odour of "rotting food waste started at around 8:15am today. The weather is dry and calm, with a slight westerly breeze. The odour strength is around 4-5/6, quite strong today. This is an ongoing issue at the site."	The unknown complainant reported to the EPA that there was an odour of "rotting food waste started at around 8:15am today. The weather is dry and calm, with a slight westerly breeze. The odour strength is around 4-5/6, quite strong today. This is an ongoing issue at the site."	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 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.
19/09/2017	9:30:00 PM	Letter	Sue Maas	Braidwood Road, Tarago	2011 Braidwood Road, Tarago	The complainant reported to the EPA that "Excessive rotting rubbish smell coming from the Veolia Woodlawn Bio Reactor, Collector Road, Tarago. Odour started on 19/7/17 at 21:30 and was ongoing overnight."	Sue Maas reported to the EPA that there was "Excessive rotting rubbish smell coming from the Veolia Woodlawn Bio Reactor, Collector Road, Tarago. Odour started on 19/7/17 at 21:30 and was ongoing overnight."	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 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.
18/09/2017	4:00:00 PM	Letter	Unknown	Rosebery Street, Tarago	Roseberry Street, Tarago	The complainant reported to the EPA that "There is a nauseating odour coming from Veolia. The odour started on 18/09/17 at 16:00."	The unknown Complainant reported to the EPA that "There is a nauseating odour coming from Veolia. The odour started on 18/09/17 at 16:00."	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. 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.
17/09/2017	7:15:00 AM	Letter	Wayne Olive	Roseview Road, Tarago	Roseview Road, Tarago	The complainant reported to the EPA that "The smell of rotting garbage from the Veolia Tarago Landfill was extreme on 17/9/17 from 07:15. This has been an ongoing issue for a long time with many complaints made by local residents over that time and no resolution to the odour issue. The odour started overnight."	Wayne Olive reported to the EPA that "The smell of rotting garbage from the Veolia Tarago Landfill was extreme on 17/9/17 from 07:15. This has been an ongoing issue for a long time with many complaints made by local residents over that time and no resolution to the odour issue. The odour started overnight."	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 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.
10/09/2017	7:40:00 AM	Letter	Wayne Olive	Roseview Road, Tarago	Roseview Road, Tarago	The complainant reported to the EPA that "the smell from the Veolia Woodlawn Landfill, Collector Road, Tarago, has been extreme since the early hours of the morning and is still present now at 07:48."	The unknown complainant reported to the EPA that "the smell from the Veolia Woodlawn Landfill, Collector Road, Tarago, has been extreme since the early hours of the morning and is still present now at 07:48."	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 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.
10/09/2017	7:30:00 AM	Letter	Sue Maas	Braidwood Road, Tarago	2011 Braidwood Road, Tarago	The complainant reported to the EPA that there was an "extremely pungent odour in the air coming from the Veolia Woodlawn Landfill, Collector Road, Tarago."	Sue Maas reported to the EPA that there was an "extremely pungent odour in the air coming from the Veolia Woodlawn Landfill, Collector Road, 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. 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.
2/09/2017	8:50:00 AM	Letter	Sue Maas	Braidwood Road, Tarago	2011 Braidwood Road, Tarago	The complainant reported to the EPA that a "strong garbage smell in the air from Veolia Woodlawn Bioreactor Facility."	Sue Maas reported to the EPA that a "strong garbage smell in the air from Veolia Woodlawn Bioreactor Facility."	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 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.
23/08/2017	11:17:00 AM	Letter	Graham Hawke	Braidwood Road, Tarago	1702 Braidwood Road, Tarago	The complainant reported that "This stench has been phenomenal all over winter. It is blood shocking. Last night we went to a windfarm meeting and walking out of there it nearly knocked you arse over head. That's how bad it was. And people were complaining about it. Let's do something about it for Christ's sake."	Graham Hawke reported to the EPA that "This stench has been phenomenal all over winter. It is blood shocking. Last night we went to a windfarm meeting and walking out of there it nearly knocked you arse over head. That's how bad it was. And people were complaining about it. Let's do something about it for Christ's sake."	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 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.
23/08/2017	9:11:00 AM	Letter	Graham Hawke	Braidwood Road, Tarago	1702 Braidwood Road, Tarago	The complainant reported "You promised this stench would be eliminated within about 12 months. It is getting worse. Every day and every morning this winter it is phenomenal. Let's do something about it. Close them down. You haven't heard from me in a long, long while. I'm sick of it. I've had a gutful of it."	Graham Hawke reported to the EPA "You promised this stench would be eliminated within about 12 months. It is getting worse. Every day and every morning this winter it is phenomenal. Let's do something about it. Close them down. You haven't heard from me in a long, long while. I'm sick of it. I've had a gutful of it."	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 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.
23/06/2017	9:00:00 AM	Letter	Helen Betz	Coghill Road, Tarago	68 Coghill Road, Tarago	The complainant reported that the smell this morning is really bad.	Helen Betz reported that the smell this morning is really bad.	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 Woodlawn are well underway with the implementation of 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. In addition to the aforementioned AECOM Pty Ltd were engaged to model stormwater ingress and their recommendations have been implemented to minimise the potential for stormwater ingress into the void. Due to leachate levels within the waste mass a new perforated well design has been implemented and is being installed to maximise the opportunity for gas collection 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 (Power Generation increase ~86% and Gas Capture Increase ~91%). 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 provide a proposal to further understand fugitive gas emissions/odour and its behaviour.
21/05/2017	10:00:00 PM	Letter	Barbara Fairfax	Taylors Creek Road, Tarago	1163 Taylors Creek Rd, Tarago	The complainant reported that the odour made her eyes water and smelt absolutely putrid.	Barbara Fairfax reported that the odour made her eyes water and smelt absolutely putrid.	90 mins	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 Woodlawn are well underway with the implementation of 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. In addition to the aforementioned AECOM Pty Ltd were engaged to model stormwater ingress and their recommendations have been implemented to minimise the potential for stormwater ingress into the void. Due to leachate levels within the waste mass a new perforated well design has been implemented and is being installed to maximise the opportunity for gas collection 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 (Power Generation increase ~86% and Gas Capture Increase ~91%). 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 provide a proposal to further understand fugitive gas emissions/odour and its behaviour.
28/03/2017	10:14:00 AM	Letter	Barbara Fairfax	Taylors Creek Road, Tarago	1163 Taylors Creek Rd, Tarago	The complainant reported that there was very bad odour this morning.	Barbara Fairfax reported that there was very bad odour this morning.	30 mins	Veolia continues to address the challenges of water management within the Bioreactor as we have previously outlined the development and implementation of a longer term treatment solution being advanced by Veolia's water division is integral to the ability for Veolia to manage leachate within the waste mass. Run Energy Pty Ltd has also been engaged to provide expert consultative and operational advice on system improvements to facilitate improved performance of the gas capture network. Due to leachate levels within the waste mass a new perforated well design has been implemented and is well underway in its installation to maximise the opportunity for gas collection compared with that of solid wells. This system is proving to be successful as gas capture has increased significantly since the commencement of its implementation. The extraction rate around this period in 2016 was in the vicinity of 1300m3/hr whereby currently we are extracting approximately 2800m3/hr. A bio-filter trial has also commenced in an attempt to manage any fugitive gas between the void's wall and waste mass which is proving to be successful at controlling fugitive gas as outlined in the Bio-filter report that is to be submitted to the EPA shortly. Veolia Woodlawn has made a decision that in an attempt to control the potential for leachate to surface. That is gas wells that extend deeper into the waste mass will be capped and a new well installed in its position to reduce the potential for leachate to migrate further up the waste mass under pressure from within the saturated waste mass. This was determined as the source of the current leachate visible on the surface as seen in the image. The pressure at depth was so great that on Sunday the 26th March the pressure has ejected leachate and gas from deep in the waste and subsequently has forced its way through the waste that was surrounding the particular well resulting in the leachate overwhelming the pumping system. The Woodlawn team attended the site on Sunday to check the pumping system and implement a program of actions to remove such liquid. This liquid is being pumped directly to the leachate treatment dam. Veolia expects that now the eruption to the surface has been controlled and stopped, the liquid is estimated to be removed by the 7th April 2017.
27/03/2017	8:30:00 AM	Letter	Maree Alaimo	Willandra Lane, Tarago	101 Willandra lane, Tarago	The complainant reported that the odour was so bad that they had to close all the windows and doors.	Maree Alaimo reported that the odour was so bad that she had to close all the windows and doors.	Not specified	Veolia continues to address the challenges of water management within the Bioreactor as we have previously outlined the development and implementation of a longer term treatment solution being advanced by Veolia's water division is integral to the ability for Veolia to manage leachate within the waste mass. Run Energy Pty Ltd has also been engaged to provide expert consultative and operational advice on system improvements to facilitate improved performance of the gas capture network. Due to leachate levels within the waste mass a new perforated well design has been implemented and is well underway in its installation to maximise the opportunity for gas collection compared with that of solid wells. This system is proving to be successful as gas capture has increased significantly since the commencement of its implementation. The extraction rate around this period in 2016 was in the vicinity of 1300m3/hr whereby currently we are extracting approximately 2800m3/hr. A bio-filter trial has also commenced in an attempt to manage any fugitive gas between the void's wall and waste mass which is proving to be successful at controlling fugitive gas as outlined in the Bio-filter report that is to be submitted to the EPA shortly. Veolia Woodlawn has made a decision that in an attempt to control the potential for leachate to surface. That is gas wells that extend deeper into the waste mass will be capped and a new well installed in its position to reduce the potential for leachate to migrate further up the waste mass under pressure from within the saturated waste mass. This was determined as the source of the current leachate visible on the surface as seen in the image. The pressure at depth was so great that on Sunday the 26th March the pressure has ejected leachate and gas from deep in the waste and subsequently has forced its way through the waste that was surrounding the particular well resulting in the leachate overwhelming the pumping system. The Woodlawn team attended the site on Sunday to check the pumping system and implement a program of actions to remove such liquid. This liquid is being pumped directly to the leachate treatment dam. Veolia expects that now the eruption to the surface has been controlled and stopped, the liquid is estimated to be removed by the 7th April 2017.
30/01/2017	11:10:00 PM	Letter	Graham Hawke	Braidwood Road, Tarago	1702 Braidwood Road, Tarago	The complainant reported that "the stench from Woodlawn is coming through my house again".	Mr. Hawke reported to the EPA that the "the stench from Woodlawn is coming through my house again".	Not specified	Veolia continues to address the challenges of water management within the Bioreactor as we have previously outlined to the community and EPA executives in April 2016 as a key requirement to improve gas capture. Key to this strategy is the recent consent modification approval allowing the use of an additional storage dam within the ED3 South dam system and the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Run Energy Pty Ltd has also been engaged to provide expert consultative and operational advice on system improvements to facilitate improved performance of the gas capture network. Veolia Woodlawn are well underway with its implementation of 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. In addition to the aforementioned AECOM Pty Ltd have been engaged to model stormwater ingress and have developed a strategy to minimise surface water from entering the void that is being enacted. Due to leachate levels within the waste mass a new perforated well design has been implemented and is being installed to maximise the opportunity for gas collection compared with that of solid wells. A bio-filter trial has also commenced in an attempt to manage any fugitive gas between the void's wall and waste mass.
9/01/2017	7:30:00 AM	Letter	Philip Tubman	Roseview Road, Tarago	Roseview Road (not specified)	The Complainant reported that they "couldn't go outside as the smell was so bad".	Mr Tubman said "couldn't go outside as the smell was so bad"	Not specified	Veolia continues to address the challenges of water management within the Bioreactor as we have previously outlined to the community and EPA executives in April 2016 as a key requirement to improve gas capture. Key to this strategy is the recent consent modification approval allowing the use of an additional storage dam within the ED3 South dam system and the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Run Energy Pty Ltd has also been engaged to provide expert consultative and operational advice on system improvements to facilitate improved performance of the gas capture network. Veolia Woodlawn have commenced the implementation of 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. In addition to the aforementioned AECOM Pty Ltd have been engaged to model stormwater ingress and have developed a strategy to minimise surface water from entering the void. Due to leachate levels within the waste mass a new perforated well design has been implemented and is being installed to maximise the opportunity for gas collection compared with that of solid wells. A bio-filter trial has also been presented for approval by the EPA in an attempt to manage any fugitive gas between the void's wall and waste mass. Currently research is being undertaken with regards to the opportunity to use a geo-synthetic cover material as another means of control.
8/01/2017	11:30:00 PM	Letter	Graham Hawke	Braidwood Road, Tarago	1706 Braidwood Road, Tarago	The Complainant reported that "the stench from Woodlawn has been coming through my house again tonight".	Graham Hawke reporting that "the stench from Woodlawn has been coming through my house again tonight".	Not specified	Veolia continues to address the challenges of water management within the Bioreactor as we have previously outlined to the community and EPA executives in April 2016 as a key requirement to improve gas capture. Key to this strategy is the recent consent modification approval allowing the use of an additional storage dam within the ED3 South dam system and the development and implementation of a longer term treatment solution being advanced by Veolia's water division. Run Energy Pty Ltd has also been engaged to provide expert consultative and operational advice on system improvements to facilitate improved performance of the gas capture network. Veolia Woodlawn have commenced the implementation of 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. In addition to the aforementioned AECOM Pty Ltd have been engaged to model stormwater ingress and have developed a strategy to minimise surface water from entering the void. Due to leachate levels within the waste mass a new perforated well design has been implemented and is being installed to maximise the opportunity for gas collection compared with that of solid wells. A bio-filter trial has also been presented for approval by the EPA in an attempt to manage any fugitive gas between the void's wall and waste mass. Currently research is being undertaken with regards to the opportunity to use a geo-synthetic cover material as another means of control.

RECEIVED WASTE TONNAGE -

JANUARY 2017 – DECEMBER 2017

Veolia Woodlawn received waste tonnage between January 2017 and December 2017	
Date	**waste received (t)**
2017-01	62,781
2017-02	61,466
2017-03	68,155
2017-04	63,083
2017-05	78,395
2017-06	74,308
2017-07	61,356
2017-08	72,438
2017-09	66,293
2017-10	68,101
2017-11	77,575
2017-12	78,849
Total	832,798

EVAPORATION DATA SUPPLIED BY VEOLIA:

MAY 2007 TO JUNE 2012

Evaporation	2006								2006				2007					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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

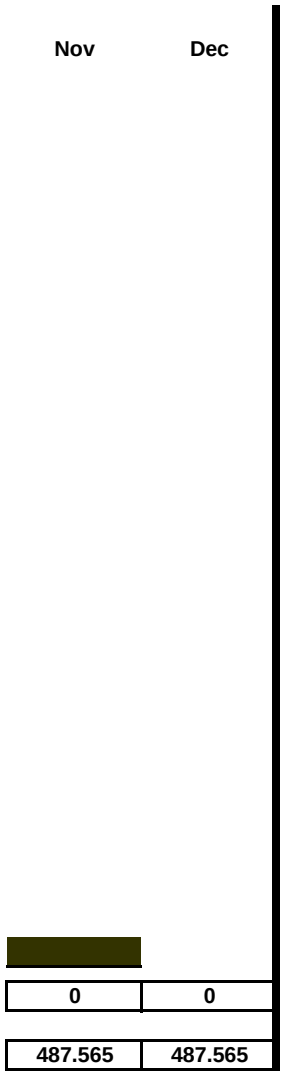
						2008												2009	
Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1.21	1.13	4.17	4.49	2.73	2.82	7.058	4.079	4.42	3.876	2.082	1.889	2.563	2.158	1.339	3.822	8.25	5.487	6.915	7.353
0.82	1.27	2.87	5.04	4.66	2.286	7.126	2.908	4.566	3.485	1.918	0.485	1.146	0.953	2.667	4.838	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	[redacted]
1.18	3.51	3.62	5.87	3.106	6.941	6.752	[redacted]	3.646	2.208	1.425	1.927	1.503	1.283	3.495	1.819	5.458	7.121	7.29	[redacted]
1.56	3.98	[redacted]	5.56	[redacted]	7.736	6.868	[redacted]	3.861	[redacted]	1.726	[redacted]	1.703	2.13	[redacted]	5.019	[redacted]	6.405	7.182	[redacted]
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**

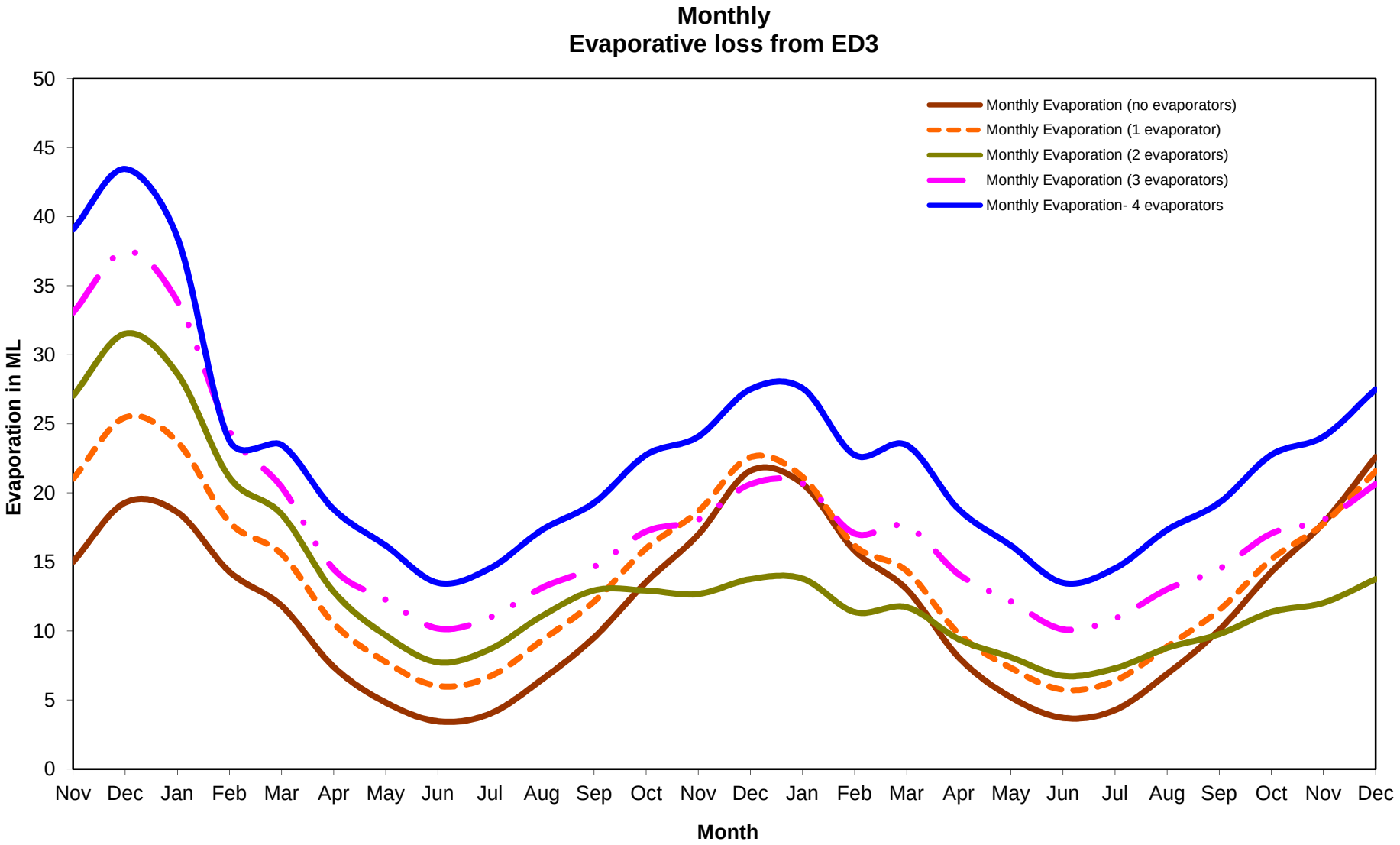
eather Station

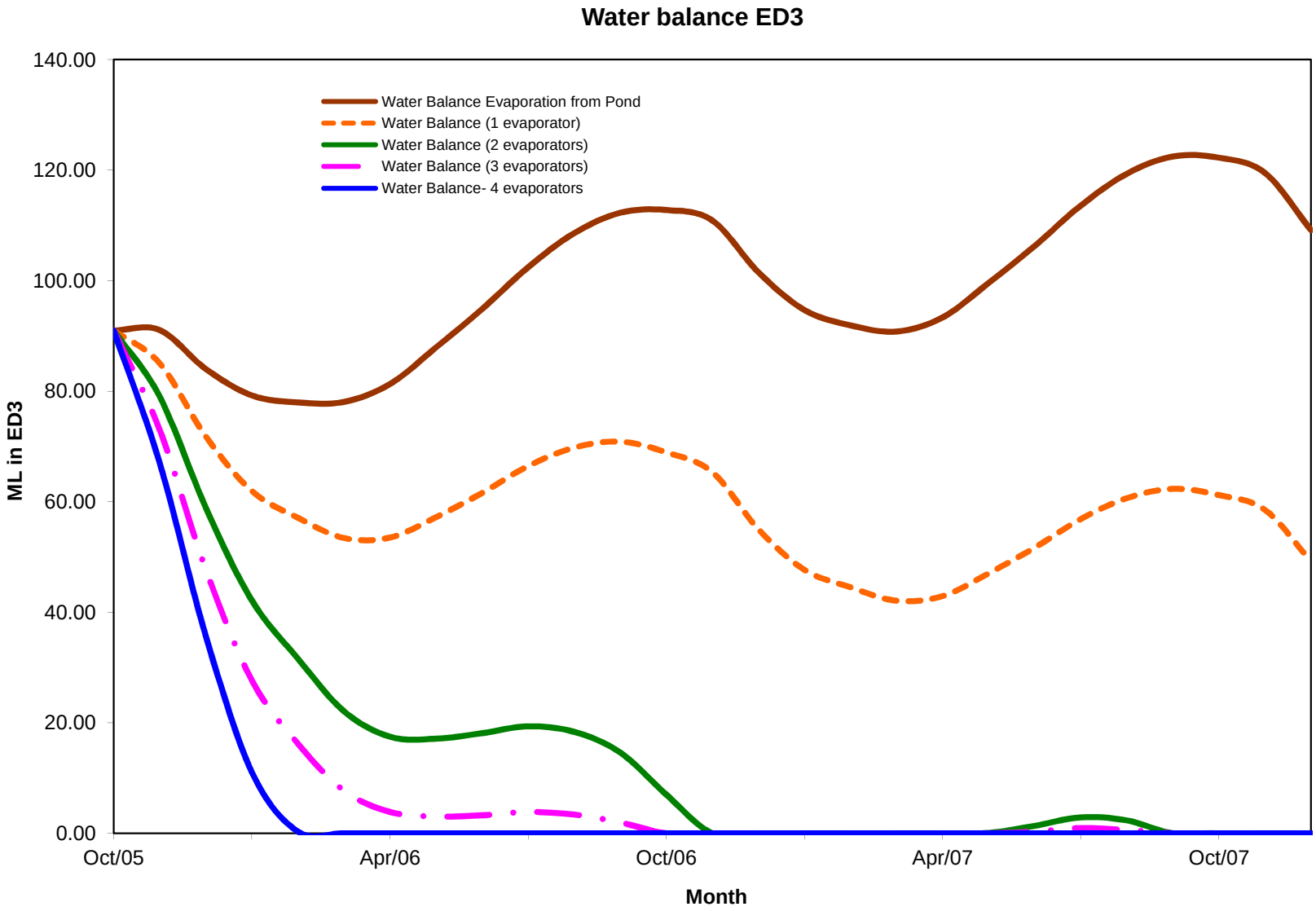
										2010					
Mar	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
6.917	2.423	1.755	1.077	1.847	1.551	1.984	4.057	4.662	2.028	3.998	5.099	3.148	2.332	1.695	0.878
4.472	1.71	2.372	0.801	1.384	1.814	2.912	6.426	5.645	5.513	6.6	6.074	1.88	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	[redacted]	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	[redacted]	1.592	2.643	0.628	1.417
2.855	[redacted]	0.777	[redacted]	1.283	2.321	[redacted]	5.037	[redacted]	6.318	3.125	[redacted]	0.785	[redacted]	0.27	[redacted]
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	[redacted]	3.304	1.868	1.428	1.283				
[redacted]	4.498	[redacted]	3.977	2.548	[redacted]	3.262	[redacted]	1.146	[redacted]			[redacted]	
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
Water Balance Evaporation from Pond
Water Balance (1 evaporator)
Water Balance (2 evaporators)
Water Balance (3 evaporators)
Water Balance- 4 evaporators
Oct/05
Apr/06
Oct/06
Apr/07
Oct/07
Month

	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
	1.9	1.5	1.9	1.8	1.8	1.6	1.5	1.3	1.7	1.5	2.2	2.0	1.9	1.5	1.9	1.8	1.8	1.6	1.5	1.3	1.7	1.5	2.2	2.0	1.9	1.5
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	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	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	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	789.02	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			

EKTIMO EMISSIONS TESTING REPORT: WOODLAWN BIOGAS POWER STATION (R004721):

15 SEPTEMBER 2017

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Report Number R004721

Emission Testing Report
Veolia Environmental Services (Australia) Pty Ltd
Woodlawn Biogas Power Station, Tarago

Document Information

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Report Number:	R004721
Date of Issue:	15 September 2017
Attention:	Amila Wijedasa
Address:	619 Collector Rd Tarago NSW 2580
Testing Laboratory:	Ektimo (ETC) ABN 74 474 273 172

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
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Aaron Davis
Ektimo Signatory

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025. 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	1 August 2017	Hydrogen sulfide, 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	1 August 2017	Carbon dioxide, oxygen, volatile organic compounds (VOC's), C_1-C_4 hydrocarbons, siloxanes

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

The sampling methodologies chosen by Ektimo are those recommended by the NSW Office of Environment and Heritage (as specified in the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January 2007*).

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 below the licence limit set by the NSW EPA as per licence 11436 (last amended on 29/03/2017).

EPA No.	Location Description	Pollutant	Units	Licence Limit	Detected Values
8	Engine 1 Exhaust Stack	Hydrogen Sulfide	mg/m^3	5	0.0074
		Sulfuric acid mist and sulfur trioxide (as SO_3)	mg/m^3	100	4.3
		Nitrogen Oxides	mg/m^3 @ 7% O2	450	360
		Volatile organic compound destruction efficiency	%	>98	99.3

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 2.5 hydraulic diameters downstream of a junction and 1 hydraulic diameters from a change in diameter. 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 1.26 which yields an increasing number of sampling points to 8.

4 RESULTS

4.1 EPA Point 8 – Generator Exhaust

Date	1-08-2017	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R004721	**Stack ID**	EPA Point 8 - (Engine 1 Exhaust Stack)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		

Sampling Plane Details		
Sampling plane dimensions	350 mm	
Sampling plane area	0.0962 m²	
Sampling port size, number	2" BSP (x2)	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Change in diameter	1 D
Upstream disturbance	Junction	2.5 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 or non-compliant due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	8.8	
Gas molecular weight, g/g mole	29.2 (wet)	30.3 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.35 (dry)
% Oxygen correction & Factor	7 %	1.08
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1220 & 1340	
Temperature, °C	460	
Temperature, K	733	
Velocity at sampling plane, m/s	50	
Volumetric flow rate, discharge, m³/s	4.8	
Volumetric flow rate, discharge, m³/hour	17000	
Volumetric flow rate (wet STP), m³/s	1.8	
Volumetric flow rate (wet STP), m³/hour	6500	
Volumetric flow rate (dry STP), m³/s	1.7	
Volumetric flow rate (dry STP), m³/hour	5900	
Mass flow rate (wet basis), kg/hour	8500	
Velocity difference, %	-6	

Gas Analyser Results	Average			Minimum			Maximum		
Sampling time	1304-1405			1304-1405			1304-1405		
	Concentration	Corrected to 7% O2	Mass Rate	Concentration	Corrected to 7% O2	Mass Rate	Concentration	Corrected to 7% O2	Mass Rate
	mg/m³	mg/m³	g/min	mg/m³	mg/m³	g/min	mg/m³	mg/m³	g/min
Combustion Gases									
Nitrogen oxides (as NO_2)	340	360	33	310	330	31	360	390	36
Carbon monoxide	670		67	640		64	700		70
	Concentration %			Concentration %			Concentration %		
Carbon dioxide	11.6			11.4			11.7		
Oxygen	8			7.9			8.4		

Date	1-08-2017	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R004721	**Stack ID**	EPA Point 8 - (Engine 1 Exhaust Stack)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		

Hydrogen Sulfide	Results
Sampling time	1220-1410
	Concentration mg/m³ / Mass Rate g/min
Hydrogen sulfide	0.0074 / 0.00073

Isokinetic Results	Results	
Sampling time	1227-1331	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	110	11
Sulfur trioxide and/or Sulfuric acid (as SO3)	4.3	0.42
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	108	
Velocity difference, %	-6	

Total VOCs (as n-Propane)	Results	
Sampling time	1300-1430	
	Concentration mg/m³	Mass Rate g/min
Total *	1.4	0.14

* Total excluding methane

VOC's C_1-C_4	Results		
Sampling time	1400-1405		
	Concentration mg/m³	Concentration %	Mass Rate g/min
Methane	1100	0.16	110
Ethane	<1		<0.1
Ethylene	<1		<0.1
Acetylene	<1		<0.1
Propane	<2		<0.2
Propylene	<2		<0.2
Cyclopropane	<2		<0.2
Isobutane	<3		<0.3
n-Butane	<3		<0.3
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	1300-1430	
	Concentration mg/m³	Mass Rate g/min
Detection limit[(1)]	<0.2	<0.02
Benzene	0.29	0.028
Toluene	0.6	0.059
Acetone	1.2	0.12

(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, Trichloroethene, 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 1) Stack	21	0.14	99.3

4.2 EPA Point 5 – LFG Supply

Date	1-08-2017	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R004721	**Stack ID**	EPA Point 5 - (LFG Supply)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		

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	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1400 & 1518	
Temperature, °C	3	
Temperature, K	276	
Velocity at sampling plane, m/s	5.5	
Volumetric flow rate, discharge, m³/s	0.59	
Volumetric flow rate, discharge, m³/hour	2100	
Volumetric flow rate (wet STP), m³/s	0.7	
Volumetric flow rate (wet STP), m³/hour	2500	
Volumetric flow rate (dry STP), m³/s	0.7	
Volumetric flow rate (dry STP), m³/hour	2500	
Mass flow rate (wet basis), kg/hour	3200	
Velocity difference, %	2	

Gas Analyser Results	Average	Minimum	Maximum
Sampling time	1412-1514	1412-1514	1412-1514
	Concentration	Concentration	Concentration
	%	%	%
Carbon dioxide	36.5	36.2	36.7
Oxygen	3.6	3.6	3.7

Siloxanes	Results	
Sampling time	1355-1359	
	Concentration	Mass Rate
	mg/m³	g/min
hexamethyl cyclotrisiloxane	0.011	0.00046
octamethyl cyclotetrasiloxane	0.12	0.0051
decamethyl cyclopentasiloxane	0.022	0.00091
dodecamethyl cyclohexasiloxane	0.002	0.000084
tetradecamethyl cycloheptasiloxane	<0.002	<0.0001
hexadecamethyl cyclooctasiloxane	<0.003	<0.0001

Date	1-08-2017	**Client**	Veolia Environmental Services (Australia) Pty Ltd
Report	R004721	**Stack ID**	EPA Point 5 - (LFG Supply)
Licence No.	11436	**Location**	Tarago
Ektimo Staff	Ryan Collins, Scott Woods	**State**	NSW
Process Conditions	Engine load: 1065Kw		

Total VOCs (as n-Propane)	Sampling time	Results 1403-1503	
		Concentration mg/m³	Mass Rate g/min
Total*		500	21

* Total excluding methane

VOC's C_1-C_4	Sampling time	Results 1350-1355		
		Concentration mg/m³	Concentration %	Mass Rate g/min
Methane		330000	46	14000
Ethane		<1		<0.06
Ethylene		<1		<0.05
Acetylene		<1		<0.05
Propane		<2		<0.08
Propylene		<2		<0.08
Cyclopropane		<2		<0.08
Isobutane		<3		<0.1
n-Butane		<3		<0.1
Propadiene		<2		<0.08
1-Butene		<3		<0.1
Propyne		<2		<0.08
trans-2-Butene		<3		<0.1
1,3-Butadiene		<2		<0.1
cis-2-Butene		<3		<0.1

VOC (speciated)	Sampling time	Results 1403-1503	
		Concentration mg/m³	Mass Rate g/min
Detection limit[(1)]		<0.3	<0.01
cis-1,2-Dichloroethene		4.1	0.17
1,2-Dichloroethane		1.6	0.069
Butanol		78	3.3
Toluene		98	4.1
Tetrachloroethene		4.4	0.18
Ethylbenzene		43	1.8
m + p-Xylene		84	3.6
Styrene		3.7	0.16
o-Xylene		31	1.3
Isopropylbenzene		3	0.13
Propylbenzene		5.1	0.22
1,3,5-trimethylbenzene		8.1	0.34
1,2,4-trimethylbenzene		22	0.91
1,2,3-trimethylbenzene		4.3	0.18
Methyl ethyl ketone		91	3.8
Ethyl acetate		82	3.4
Cyclohexane		9.7	0.41
2-Methylhexane		80	3.4
2,3-Dimethylpentane		2.9	0.12
Heptane		18	0.77
Propyl acetate		35	1.5
Methylcyclohexane		18	0.77
MIBK		5.9	0.25
2-Hexanone		1.2	0.049
Octane		16	0.68
Butyl acetate		23	0.95
alpha-Pinene		80	3.4
beta-Pinene		43	1.8
Decane		28	1.2
3-Carene		5.1	0.22
D-Limonene		240	10
Undecane		13	0.54
Dodecane		2.8	0.12

(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, Trichloroethene, 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

5 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See record for 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	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Moisture content	NSW TM-22	NSW TM-22	19%	✓	✓
Temperature	NSW TM-2	NA	2%	✓	NA
Flow rate	NSW TM-2	NA	8%	✓	NA
Velocity	NSW TM-2	NA	7%	✓	NA
Sulfuric acid mist (including sulfur trioxide)	NSW TM-3	Ektimo (EML Air) 235	16%	✓	✓[1]
Nitrogen oxides (NO_x)	NSW TM-11	NSW TM-11	12%	✓	✓
Carbon monoxide	NSW TM-32	NSW TM-32	12%	✓	✓
Carbon dioxide	NSW TM-24	NSW TM-24	13%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Sulfur dioxide	NSW TM-4	USEPA 6C	12%	✓	✓[2]
C1-C4 hydrocarbons	Ektimo (ETC) 200	Ektimo (EML Air) 340	19%	✓	✓[3]
Hydrogen sulfide	NSW TM-5	NSW TM-5	19%	✓	✓[4]
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo (EML Air) 344	19%	✓	✓[5]
Siloxanes	NA	SGS inhouse	not specified	×	×[6]

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

1. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 10 August 2017 in report number R004721_SOx.
2. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 10 August 2017 in report number R004721_SOx.
3. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 18 August 2017 in report number R004721_C1-C4
4. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 4 August 2017 in report number R004721-H2S
5. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 22 August 2017 in report number R004721-VOC.
6. Analysis performed by SGS, NATA accreditation number 14429. Results were reported to Ektimo on 30 August 2017 in report number ENV26765

7 QUALITY ASSURANCE/ QUALITY CONTROL INFORMATION

Ektimo (EML) and Ektimo (ETC) are 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 (EML) and Ektimo (ETC) are accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025. – General Requirements for the Competence of Testing and Calibration Laboratories. ISO/IEC 17025 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 Compliance Manager.

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 world –wide.

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:

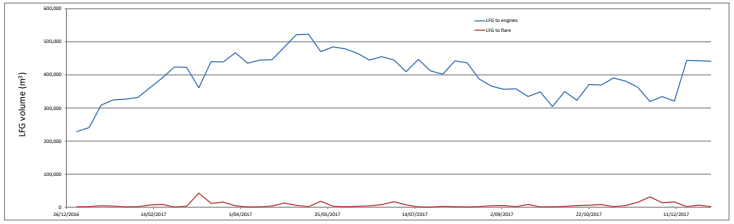
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Disturbance	A flow obstruction or instability in the direction of the flow which may impede 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.
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.
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
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).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
BSP	British standard pipe
NT	Not tested or results not required
NA	Not applicable
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.
D	Duct diameter or equivalent duct diameter for rectangular ducts
<	Less than
>	Greater than
≥	Greater than or equal to
~	Approximately
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
DWER	Department of Water and Environmental Regulation
DECC	Department of Environment & Climate Change (NSW)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
NATA	National Association of Testing Authorities
RATA	Relative Accuracy Test Audit
AS	Australian Standard
USEPA	United States Environmental Protection Agency
Vic EPA	Victorian Environment Protection Authority
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
CARB	Californian Air Resources Board
TM	Test Method
OM	Other approved method
CTM	Conditional test method
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
NIOSH	National Institute of Occupational Safety and Health
XRD	X-ray Diffractometry

LANDFILL GAS PRODUCTION DATA:

1 JANUARY 2017 – 31 DECEMBER 2017

Veolia Woodlawn - Landfill gas production data

	Week No	Week 01	Week 02	Week 03	Week 04	Week 05	Week 06	Week 07	Week 08	Week 09	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48	Week 49	Week 50	Week 51	Week 52	Week 53
	Week Ending	1/01/2017	8/01/2017	15/01/2017	22/01/2017	29/01/2017	5/02/2017	12/02/2017	19/02/2017	26/02/2017	5/03/2017	12/03/2017	19/03/2017	26/03/2017	2/04/2017	9/04/2017	16/04/2017	23/04/2017	30/04/2017	7/05/2017	14/05/2017	21/05/2017	28/05/2017	4/06/2017	11/06/2017	18/06/2017	25/06/2017	2/07/2017	9/07/2017	16/07/2017	23/07/2017	30/07/2017	6/08/2017	13/08/2017	20/08/2017	27/08/2017	3/09/2017	10/09/2017	17/09/2017	24/09/2017	1/10/2017	8/10/2017	15/10/2017	22/10/2017	29/10/2017	5/11/2017	12/11/2017	19/11/2017	26/11/2017	3/12/2017	10/12/2017	17/12/2017	24/12/2017	31/12/2017
RAS																																																						
Gas to Generators	m^3	238,600	240,680	309,016	324,464	326,832	331,992	361,552	390,824	474,016	422,840	361,312	440,048	439,168	467,184	435,288	444,864	445,808	483,560	521,664	522,896	470,680	484,696	478,912	465,416	444,936	455,192	445,040	409,704	446,760	412,112	402,232	442,292	436,568	387,536	360,056	356,632	358,040	334,720	348,464	304,368	349,776	323,168	371,040	369,504	390,792	381,280	362,384	319,608	334,464	320,792	443,840	442,936	441,248
Gas to Flare 1	m^3	110	1,396	2,926	238	538	381	1,783	2,214	436	404	14,617	1,445	3,160	2,918	552	1,094	3,579	1,544	917	1,478	4,815	1,912	1,264	1,118	377	5,757	1,604	814	800	50	2,717	1,404	647	956	4,446	3,191	1,645	5,467	887	406	1,138	378	2,038	997	818	782	1,396	6,300	2,124	1,746	1,078	1,570	1,570
Gas to Flare 2	m^3	834	540	1,640	2,958	525	1,108	5,067	6,348	69	2,497	28,161	10,310	12,214	1,230	0	0	0	11,093	4,745	49	13,325	1,039	53	1,327	3,714	2,066	15,121	6,414	0	0	0	0	0	835	5	1,952	1	2,931	186	674	1,021	4,427	3,931	7,199	513	4,216	13,664	25,051	11,525	14,259	691	2,712	92
Total flare	m^3	944	1,936	4,566	3,196	1,063	1,489	6,850	8,562	505	2,901	42,778	11,755	15,374	4,148	552	1,094	3,579	12,637	5,662	1,527	18,140	2,951	1,317	2,425	4,091	7,823	16,725	7,228	800	50	2,717	1,404	647	1,791	4,451	5,143	1,646	8,398	1,073	1,080	2,159	4,805	5,969	8,396	1,771	4,998	15,060	31,351	13,649	16,005	1,769	6,282	1,662
		229,544	242,616	313,582	327,650	327,895	333,481	368,402	399,386	424,521	425,741	404,090	451,803	454,542	471,332	435,840	445,958	449,387	496,197	527,326	524,423	488,820	487,647	480,229	468,041	449,027	463,015	461,765	416,932	447,560	412,162	404,949	443,696	437,215	389,327	370,507	361,775	359,686	343,118	349,537	305,448	351,935	327,973	377,009	377,700	392,163	386,278	377,444	350,959	348,113	336,797	445,609	449,218	442,910



APPENDIX D:

LIQUID ODOUR MEASUREMENT METHODOLOGY

Methodology

The Liquid Odour Method (hereafter referred to as **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 AS/NZS 4323.3:2001; 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 AS/NZS 4323.3:2001.

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-3

Parameter	Value	Unit
Volume of liquid from ED3N-4	0.413	mL
Volume of dry N_2	25	L
Measured odour concentration	166^	ou
Calculated liquid odour concentration	= (166 x 25/1000)/0.413 = 10.0	ou.m^3/mL

^ TOU Sample Number SC18096 – see **Table 6.3** 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-3 (SC18096) which returned a measured odour concentration of 10.0 ou.m^3/mL (see **Table D2**) with an evaporation rate of 0.194 L/s (based on on-site evaporation data collected by Veolia between May 2007 and June 2012):

Odour concentration = 10.0 ou.m^3/mL

Ambient pond evaporation rate = 0.194 L/sec

Odour emission rate = 10.0 ou.m^3/mL x 194 mL/sec
= 1,940 ou.m^3/sec (see **Table 6.3** in Main Report)