

ELF FARM SUPPLIES BIOFILTER TESTING

Prepared for:

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SLR Ref: 610.30446-R01
Version No: -v1.0
September 2021



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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Elf Farm Supplies Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30446-R01-v1.0	6 September 2021	A Naghizadeh	G Starke	G Starke

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1 Introduction

SLR Consulting Australia (SLR) was commissioned by Elf Farm Supplies (EFS) to conduct annual odour emission testing on the Biofilter Control System serving the EFS substrate facility located at 108 Mulgrave Road, Mulgrave NSW.

The purpose of the annual odour emission testing was to measure the odour concentration, odour emission rate and odour removal efficiency of the EFS biofilter and compare these against measurements taken in 2018 (as part of a site wide odour audit completed by SLR) and those adopted by the Odour Impact Assessment prepared by The Odour Unit dated 28 August 2015 (the OIA).

This report outlines the methodology and results of the biofilter odour monitoring.

1.1 Biofilter Testing Methodology

SLR conducted representative Biofilter odour testing in general accordance with:

- Australian Standards and New Zealand Standards (AS/NZS) 4323.3:2001 (R2014) Stationary source emissions – Determination of odour concentration by dynamic olfactometry; and
- AS/NZS 4323.4:2009 Stationary source emissions - Area source sampling - Flux chamber technique.

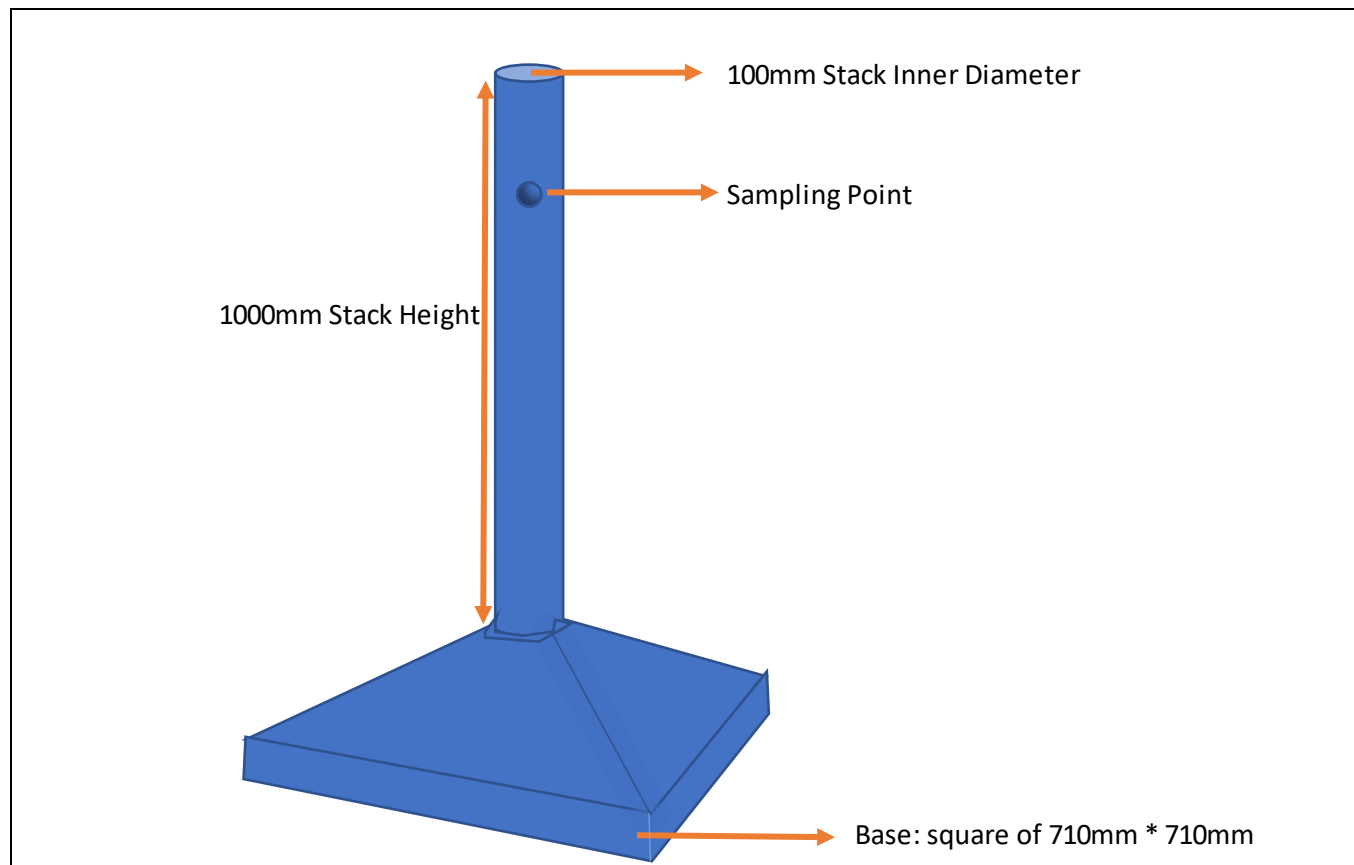
1.1.1 Biofilter Outlet Odour Testing

The AS/NZS 4323.4 Flux chamber technique is typically used for non-aerated surfaces such as landfill sites, ponds etc. An equilibrium hood is placed on the surface and nitrogen supply sweep air is used to stimulate the odorous surface within the equilibrium hood and therefore allowing a sample to be collected. However, a Biofilter system is aerated by a pressurised ventilation system. Therefore, SLR adopted the use of a 'Witches Hat' hood to conduct representative measurements that do not require nitrogen sweep air to collect a representative sample. Refer to **Figure 1** for an illustration of the 'Witches Hat' hoods being used on the EFS Biofilter bed. Refer to **Figure 2** for a schematic of the 'Witches Hat' hood used.

Figure 1 Illustration of Witches Hat Hoods being used on EFS Biofilter Beds



Figure 2 Illustration of Witches Hat Hood Dimensions



In order to ensure consistency with the testing across the whole Biofilter bed and to minimise the variability that is typically associated with biofilters, SLR divided the EFS biofilter system into two (2) beds. SLR has identified these as the Eastern bed and the Western bed. SLR then further divided these two beds into evenly distributed rows (length and width).

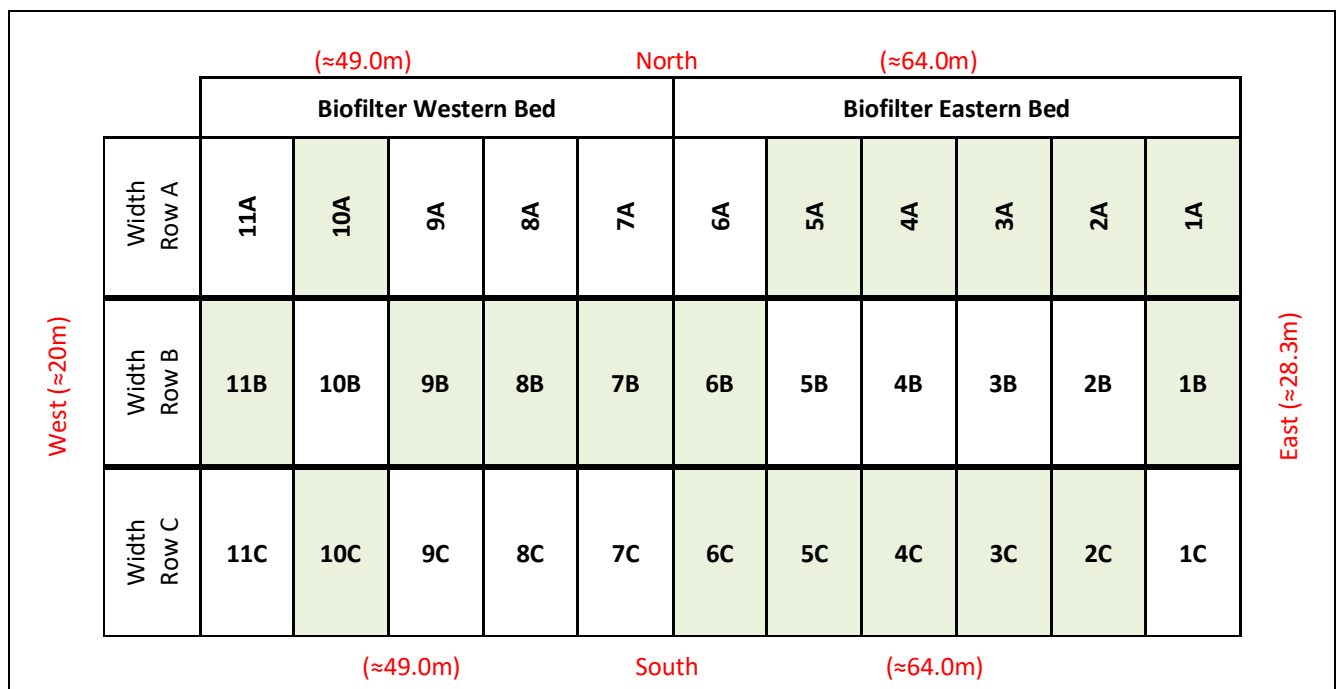
The Eastern bed has a surface area of approximately 1,500 square meters (m²). SLR divided this bed into six (6) equal rows along its length and three (3) equal rows along its width (approximately 10 m by 9 m grids). This resulted in a total of 18 grids evenly distributed across the Eastern biofilter bed.

The Western Bed has a surface area of approximately 1,278 m². SLR divided this bed into five (5) equal rows along its length and three equal rows along its width (approximately 9 m by 9 m grids). This resulted in a total of 15 grids evenly distributed across the Western biofilter bed.

EFS confirmed the total surface area of the Biofilter bed is 2,778 m².

Refer to **Figure 3** for an illustration of the Biofilter beds distributed into their grids.

Figure 3 Illustration of the Biofilter Distributed into 33 Grids



Note: the image above does not represent actual layout.

Note 2: odour samples were collected from cells highlighted green

Each grid was measured, as a minimum, for temperature and surface velocity at approximately the centre of each grid. The data was then assessed to determine if surface velocities measured for each north to south row were consistent or if there was evidence of breakthrough (high velocity) or no flow (low velocity). Should the scenario exist that a north to south row demonstrated inconsistency, SLR collected from that north to south row a single odour sample from the grid with the highest surface velocity measured and a single odour sample from the grid with the lowest surface velocity measured. SLR considered inconsistency to exist when there was a difference of greater than 20% from the average velocity measured. For all north to south rows with consistent surface velocities, SLR collected single samples from the middle grids (Row B).

A total of 18 samples were collected from the biofilter outlet. The locations where samples were collected are indicated in **Figure 3**.

Duplicate or triplicate samples at each nominated grid were deemed not required as each odour sample is based on the same source gas distributed consistently across the biofilter based on the velocities measured. Hence repeatability of the odour samples has already been considered in the 18 samples measured across the biofilter.

The samples were analysed by a NATA accredited odour laboratory, The Odour Unit (TOU) within the specified 30 hours from sample collection. All samples were delivered to TOU as blind samples.

1.1.2 Biofilter Inlet Odour Testing

The 'lung method' was used to collect representative samples from the Biofilter Inlet. SLR collected the gas samples from the Biofilter Inlet in accordance with AS/NZS 4323.3:2001 (R2014) *Stationary source emissions – Determination of odour concentration by dynamic olfactometry*. The samples were analysed by a NATA accredited odour laboratory (TOU) within the 30 hours specification. One (1) sample was collected for the inlet into the Eastern bed and one (1) sample was collected for the inlet into the Western bed.

A sample access point compliant with the requirements of AS/NZS 4323.1:1995 *Stationary source emissions - Method 1: Selection of sampling positions* is available for the western biofilter (see **Figure 4**). However, due to the design of the eastern biofilter, such a access point could not be installed on the inlet to this biofilter and a large number of sample access points would need to be installed along the aluminium ducting to each section of the eastern biofilter bed to obtain total flow to this biofilter. As such, SLR assumed that the total air flow at the Biofilter inlet was equal to the total air flow at the Biofilter outlet. This was verified by comparing SLR measured total air flow from the Biofilter outlet to the EFS online Supervisory Control and Data Acquisition (SCADA) system recordings at each individual post ammonia scrubber location. The odour sample for the eastern biofilter inlet was collected from a sample point installed approximately midway down the biofilter (see **Figure 5**).

Figure 4 Illustration of Western Biofilter Inlet Sample Ports

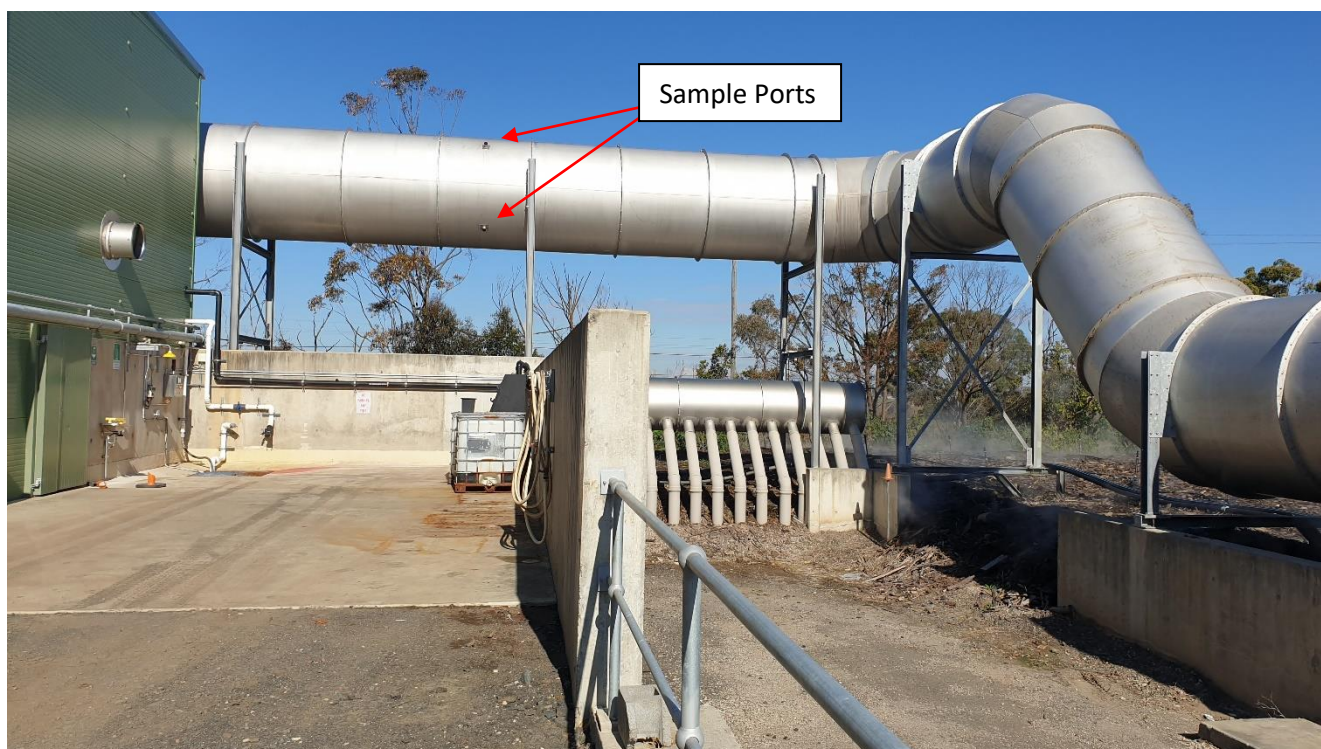
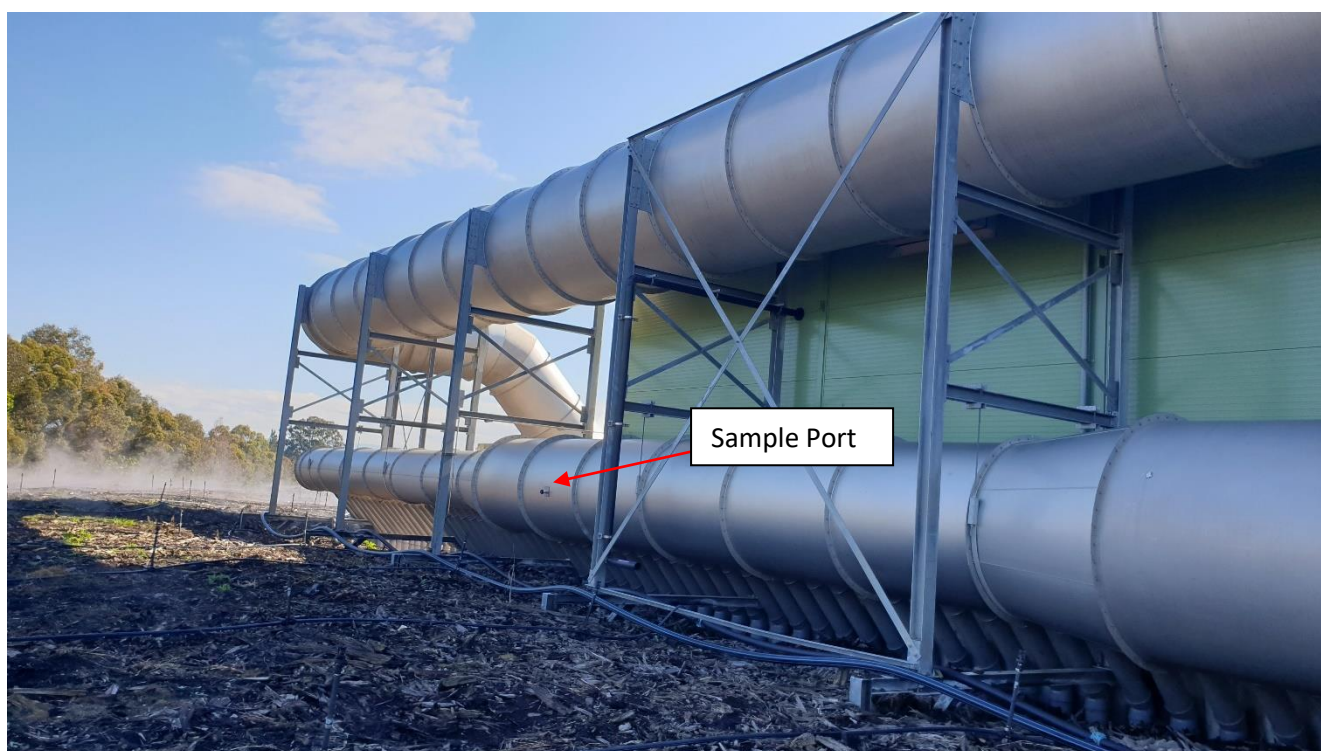


Figure 5 Illustration of Eastern Biofilter Inlet Sample Port



2 Biofilter Results

2.1 Biofilter Outlet Results

The Biofilter Outlet was tested under normal operating conditions on Wednesday 23 June 2021 and Thursday 24 June 2021. These days were nominated for testing as Wednesday and Thursday are considered the worst case scenario in terms of odours being generated from the typical composting activities occurring on site. All samples were collected using the Witches Hat Hood method.

Refer to **Table 1** and **Table 2** for a tabulated summary detailing sampling times, temperature and air velocities measured within the Witches Hat Hoods.

As mentioned in **Section 1.1**, SLR reviewed all air velocities measured across the Biofilter beds to check for consistency along each north to south row (rows 1 to 11) to determine if additional odour samples were required due to variability in the flow through these rows. Flow variations across a row greater than 20% from the average row velocities measured were observed at seven north to south rows. Additional odour samples were collected from these identified rows in line with the methodology outlined in **Section 1.1** to ensure a representative data set is collected.

Refer to **Table 3** to **Table 5** for detailed results of the odour concentrations measured for the Eastern and Western biofilter beds. Refer to **Appendix A** for Certificates of Analysis.

In summary, the maximum odour concentration measured was 235 odour units (ou) and the average odour concentration measured was 82 ou.

Table 6 provides detailed results of the Mass Odour Emission Rates (MOER) per biofilter grid measured. The measured MOER for the entire biofilter is 4,578 ou.m³/s. It is noted that MOERs presented in **Table 6** for each grid point have been calculated based on a 125 m² area for the Eastern biofilter samples and 213 m² for the Western biofilter samples rather than the actual areas to allow for grids not sampled. As such, the sum of all MOERs is representative of the whole biofilter rather than the grids sampled.

Table 1 Summary of Biofilter Measured Results – Temperature and Air Velocities – 23 June 2021

North													
		Biofilter Western Bed					Biofilter Eastern Bed						
Grid Identification	West	Row A	11A	10A	9A	8A	7A	6A	5A	4A	3A	2A	1A
Time of Measurement			10:08	10:03	9:40	9:37	9:22	10:15	10:18	10:20	10:22	10:25	10:28
Air Velocity (m/s)			1.2	0.9	1.2	1.4	1.2	0.9	0.5	0.6	1.0	1.0	0.6
Temp in WHH (°C)			31.7	31.7	32.2	31.1	31.2	28.4	32.9	27.9	26.2	25.6	25.4
Grid Identification		Row B	11B	10B	9B	8B	7B	6B	5B	4B	3B	2B	1B
Time of Measurement			10:10	10:00	9:42	9:35	9:27	10:43	10:40	10:38	10:36	10:34	10:31
Air Velocity (m/s)			1.2	1.1	1.1	1.9	1.1	1.4	1.4	1.0	1.4	1.4	1.5
Temp in WHH (°C)			31.5	32.2	31.7	30.9	31.1	33.1	32.5	24.9	28.7	27.6	27.3
Grid Identification		Row C	11C	10C	9C	8C	7C	6C	5C	4C	3C	2C	1C
Time of Measurement			10:12	9:56	9:45	9:33	9:29	10:45	10:49	10:51	10:53	10:55	10:57
Air Velocity (m/s)			1.1	1.6	1.1	1.6	1.2	0.7	1.4	1.4	1.6	1.4	0.9
Temp in WHH (°C)			31.9	32.6	31	31.7	31.4	26.1	28.4	31.8	26.1	25.7	26.4
South													
Avg. Air Velocity (m/s)			1.17	1.20	1.13	1.63	1.17	0.99	1.11	0.99	1.31	1.29	1.03
Avg. Air Velocity across Biofilter (m/s)			1.18										

East

Table 2 Summary of Biofilter Measured Results – Temperature and Air Velocities – 24 June 2021

North														
			Biofilter Western Bed					Biofilter Eastern Bed						
Grid Identification	West	Row A	11A	10A	9A	8A	7A	6A	5A	4A	3A	2A	1A	
Time of Measurement			13:41	13:39	13:59	14:01	14:03	7:50	8:33	8:37	9:21	9:22	9:43	
Air Velocity (m/s)			1.4	0.8	2.0	0.7	1.0	1.1	0.7	0.8	1.1	1.2	0.8	
Temp in WHH (°C)			32.6	32.1	32.5	31.5	31.3	28.0	32.5	27.8	25.6	25.1	25.4	
Grid Identification		Row B	11B	10B	9B	8B	7B	6B	5B	4B	3B	2B	1B	
Time of Measurement			13:37	13:34	13:31	13:27	13:19	8:13	8:29	8:41	9:11	9:27	9:38	
Air Velocity (m/s)			1.4	0.8	1.8	0.9	1.0	1.6	1.6	1.2	1.6	1.6	1.7	
Temp in WHH (°C)			31.8	32.8	31.9	31.7	31.6	32.2	32.1	24.9	28.6	27.2	26.4	
Grid Identification		Row C	11C	10C	9C	8C	7C	6C	5C	4C	3C	2C	1C	
Time of Measurement			13:45	13:35	13:48	13:51	13:55	8:21	8:26	8:52	9:05	9:30	9:35	
Air Velocity (m/s)			1.3	1.9	1.8	0.8	1.0	0.9	1.6	1.5	1.8	1.8	1.1	
Temp in WHH (°C)			32.3	33.2	31.5	32.7	31.4	26.1	28.3	31.7	25.6	24.8	25.9	
South														
Avg. Air Velocity (m/s)			1.38	1.18	1.86	0.80	1.01	1.18	1.30	1.18	1.53	1.54	1.22	
Avg. Air Velocity across Biofilter (m/s)			1.29											

East

Table 3 Summary of Biofilter Outlet Results – Eastern Bed – 24 June 2021

Parameter	Sample 1A	Sample 1B	Sample 2A	Sample 2C	Sample 3A	Sample 3C
SLR Sample No.	11260	11261	11262	11263	11264	11265
Sample Start Time	24-06-2021 10:37	24-06-2021 10:37	24-06-2021 11:01	24-06-2021 11:01	24-06-2021 11:21	24-06-2021 11:21
Sample Finish Time:	24-06-2021 10:47	24-06-2021 10:47	24-06-2021 11:11	24-06-2021 11:11	24-06-2021 11:31	24-06-2021 11:31
NATA Laboratory I.D No.	SC21467	SC21468	SC21469	SC21470	SC21471	SC21472
Analysis Date & Time Completed	25-06-2021 8:37	25-06-2021 8:59	25-06-2021 9:23	25-06-2021 9:41	25-06-2021 10:06	25-06-2021 10:23
Sample Analysis Period in Compliance (≤30-hrs)	21.8	22.2	22.2	22.5	22.6	22.9
(D _{s WHH}) Sample Point WHH Stack Internal Diameter (mm)	100	100	100	100	100	100
(A _{s WHH}) Sample Plane Cross Sectional Area (m ²)	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079
(T _{s WHH}) Average Stack (Surface) Temperature (°C)	26.0	26.9	24.8	24.2	28.1	31.0
(P _{s WHH}) Average Stack / Surface Pressure (kPa)	101.6	101.6	101.6	101.6	101.6	101.6
(v _{s WHH}) Average Grid Stack Air Velocity (m/s)	0.67	1.53	0.75	1.03	0.33	1.51
(Q _{a WHH}) Actual Grid Flow Rate (m ³ /s)	0.0053	0.0120	0.0059	0.0081	0.0026	0.0119
(D _{B WHH}) WHH Base Internal Diameter (mm)	801	801	801	801	801	801
(A _{B WHH}) WHH Base Cross Sectional Area (m ²)	0.5041	0.5041	0.5041	0.5039	0.5041	0.5041
(Q _{flux}) Actual Grid Surface Flux Velocity (m/s)	0.0104	0.0238	0.0117	0.0160	0.0051	0.0235
Odour Concentration (wet) (ou)	99	83	49	91	41	83
EPL Odour Concentration Limit (ou)	500	500	500	500	500	500
Odour Character	Dirt Soil	Dirt, Soil, sour	Dirt, Soil, sour	Dirt, Soil, sour	Dirt, Soil	Dirt, Soil

Table 4 Summary of Biofilter Outlet Results – Eastern Bed – 24 June 2021- Continued

Parameter	Sample 4A	Sample 4C	Sample 5A	Sample 5C	Sample 6B	Sample 6C
SLR Sample No.	11266	11267	11268	11257	11259	11258
Sample Start Time	24-06-2021 11:53	24-06-2021 11:53	24-06-2021 12:17	24-06-2021 12:17	24-06-2021 12:48	24-06-2021 12:42
Sample Finish Time:	24-06-2021 12:05	24-06-2021 12:05	24-06-2021 12:27	24-06-2021 12:27	24-06-2021 13:00	24-06-2021 12:52
NATA Laboratory I.D No.	SC21473	SC21474	SC21475	SC21476	SC21477	SC21477
Analysis Date & Time Completed	25-06-2021 10:45	25-06-2021 11:05	25-06-2021 11:24	25-06-2021 11:45	25-06-2021 12:42	25-06-2021 12:42
Sample Analysis Period in Compliance (≤30-hrs)	22.7	23.0	22.9	23.3	23.7	23.8
(D _{s WHH}) Sample Point WHH Stack Internal Diameter (mm)	100	100	100	100	100	100
(A _{s WHH}) Sample Plane Cross Sectional Area (m ²)	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079
(T _{s WHH}) Average Stack (Surface) Temperature (°C)	30.7	28.2	28.3	32.5	31.7	26.0
(P _{s WHH}) Average Stack / Surface Pressure (kPa)	101.6	101.6	101.6	101.6	101.6	101.6
(v _{s WHH}) Average Grid Stack Air Velocity (m/s)	0.21	1.21	0.22	1.15	1.48	0.61
(Q _{a WHH}) Actual Grid Flow Rate (m ³ /s)	0.0016	0.0095	0.0017	0.0090	0.0116	0.0048
(D _{B WHH}) WHH Base Internal Diameter (mm)	801	801	801	801	801	801
(A _{B WHH}) WHH Base Cross Sectional Area (m ²)	0.5041	0.5041	0.5041	0.5041	0.5041	0.5041
(Q _{flux}) Actual Grid Surface Flux Velocity (m/s)	0.0033	0.0189	0.0034	0.0179	0.0231	0.0095
Odour Concentration (wet) (ou)	41	76	83	91	91	49
EPL Odour Concentration Limit (ou)	500	500	500	500	500	500
Odour Character	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour

Table 5 Summary of Biofilter Outlet Results – Western Bed – 23 June 2021

Parameter	Sample 11B	Sample 10A	Sample 10C	Sample 9B	Sample 8B	Sample 7B
SLR Sample No.	11251	11250	11252	11253	11254	11255
Sample Start Time	23-06-2021 11:13	23-06-2021 11:44	23-06-2021 11:45	23-06-2021 11:44	23-06-2021 12:28	23-06-2021 12:43
Sample Finish Time:	23-06-2021 11:25	23-06-2021 11:56	23-06-2021 11:55	23-06-2021 11:56	23-06-2021 12:40	23-06-2021 12:55
NATA Laboratory I.D No.	SC21461	SC21460	SC21462	SC21463	SC21465	SC21464
Analysis Date & Time Completed	24-06-2021 10:33	24-06-2021 10:10	24-06-2021 11:02	24-06-2021 11:30	24-06-2021 13:10	24-06-2021 11:57
Sample Analysis Period in Compliance (≤30-hrs)	23.1	22.2	23.1	23.6	24.5	23.0
($D_{s\ WHH}$) Sample Point WHH Stack Internal Diameter (mm)	100	100	100	100	100	100
($A_{s\ WHH}$) Sample Plane Cross Sectional Area (m ²)	0.0079	0.0079	0.0079	0.0079	0.0079	0.0079
($T_{s\ WHH}$) Average Stack (Surface) Temperature (°C)	32.9	26.8	29.4	33.4	34.6	35.1
($P_{s\ WHH}$) Average Stack / Surface Pressure (kPa)	102.8	102.8	102.8	102.8	102.8	102.8
($v_{s\ (WHH)}$) Average Grid Stack Air Velocity (m/s)	1.09	0.76	1.67	1.09	1.81	1.07
($Q_{a\ WHH}$) Actual Grid Flow Rate (m ³ /s)	0.0086	0.0060	0.0131	0.0086	0.0142	0.0084
($D_{B\ WHH}$) WHH Base Internal Diameter (mm)	801	801	801	801	801	801
($A_{B\ WHH}$) WHH Base Cross Sectional Area (m ²)	0.5041	0.5041	0.5041	0.5041	0.5041	0.5041
(Q_{flux}) Actual Grid Surface Flux Velocity (m/s)	0.0170	0.0118	0.0260	0.0170	0.0282	0.0167
Odour Concentration (wet) (ou)	29	27	118	83	235	108
EPL Odour Concentration Limit (ou)	500	500	500	500	500	500
Odour Character	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour	Dirt, Soil, Sour

Table 6 Summary of Biofilter Mass Odour Emission Rates – 23 and 24 June 2021

Location	(Q _{flux}) Actual Grid Surface Flux Velocity (m/s)	Odour Concentration (wet) (ou)	(SOER) Surface Odour Emission Rate (wet) (ou.m/s)	Biofilter Grid Cross Sectional Area (m ²)	Flow through Biofilter during Sampling (m ³ /hr)	(MOER) Mass Odour Emission Rate per Section (wet) (ou.m ³ /s)	OIA MOER Modelled Operations (ou.m ³ /s)
Sample 1A	0.0104	99	1.03	125	4,697	129	NA
Sample 1B	0.0238	83	1.97	125	10,705	247	NA
Sample 2A	0.0117	49	0.57	125	5,258	72	NA
Sample 2C	0.0160	91	1.46	125	7,214	182	NA
Sample 3A	0.0051	41	0.21	125	2,314	26	NA
Sample 3C	0.0235	83	1.95	125	10,587	244	NA
Sample 4A	0.0033	41	0.13	125	1,472	17	NA
Sample 4C	0.0189	76	1.43	125	8,483	179	NA
Sample 5A	0.0034	83	0.28	125	1,542	36	NA
Sample 5C	0.0179	91	1.63	125	8,063	204	NA
Sample 6B	0.0231	91	2.10	125	10,376	262	NA
Sample 6C	0.0095	49	0.47	125	4,277	58	NA
Sample 11B	0.0170	29	0.49	213	13,022	105	NA
Sample 10A	0.0118	27	0.32	213	9,080	68	NA
Sample 10C	0.0260	118	3.07	213	19,951	654	NA
Sample 9B	0.0170	83	1.41	213	13,022	300	NA
Sample 8B	0.0282	235	6.63	213	21,624	1,412	NA
Sample 7B	0.0167	108	1.80	213	12,783	383	NA
Total	--	--	--	2,778	164,470	4,578	54,168

2.2 Biofilter Inlet Results

The biofilter inlets were measured on Wednesday 23 June 2021 and Thursday 24 June 2021 in parallel with the biofilter outlet testing. Refer to **Table 7** for a detailed summary of the biofilter inlet measured results. Refer to **Appendix A** for Certificates of Analysis.

Table 7 Summary of Biofilter Inlet Results – 24 October 2018

Parameter	Inlet -East	Inlet -West
SLR Sample No.	11269	11256
Sample Start Time	24-06-2021 13:12	23-06-2021 13:41
Sample Finish Time:	24-06-2021 13:22	23-06-2021 13:51
NATA Laboratory I.D No.	SC21479	SC21465
Analysis Date & Time Completed	25-06-2021 13:27	24-06-2021 13:36
Sample Analysis Period in Compliance (≤30-hrs)	24.1	23.8
(A _s) Sample Plane Cross Sectional Area (m ²)	--	4.5
(T _s) Average Stack Temperature (°C)	36.3	37.4
(P _s) Average Stack Pressure (kPa)	--	101.6
(Q _a) Actual Flow Rate (m ³ /hr)	--	84,426
Flow through Biofilter Outlet during Sampling (m ³ /hr)	97,031 ¹	89,482
Odour Concentration (wet) (ou)	12,600	23,200
Mass Odour Emission Rate (MOER) (ou.m ³ /s)	262,462	544,081
Odour Character	Dirt, soil, sour, fermented, cabbage	cabbage, sour, fermented, manure

1 denotes that SLR have assumed that Biofilter Inlet total air flow is equal to Biofilter Outlet due to no suitable access points being available to conduct air velocity measurements for the Eastern Biofilter Inlet. **Section 2.3** provides details of total air flow measurements from GTL recordings and Biofilter Outlet recordings to demonstrate the Inlet air flow is equal to the outlet airflow.

2.3 Biofilter Efficiency Results

The efficiency of the Western biofilter (for which a suitable sampling port for the measurement of air velocity is available) were assessed through the comparison of Inlet vs Outlet MOERs as follows:

- {Inlet MOER (544,081 ou.m³/s) – Outlet MOER (2,922 ou.m³/s)} ÷ Inlet MOER (544,081 ou.m³/s)

Result ≥ 95% efficiency.

For the Eastern biofilter, in the absence of a suitable sample point compliant with the requirements of AS 4323.1 for the measurement representative air flow through the inlet duct, efficiency calculations were assessed using the odour concentrations measured and assuming the flows through the biofilter inlet and outlet are similar. A comparison of the measured biofilter outlet flow measurements against recordings made by the Supervisory Control and Data Acquisition (SCADA) system confirms that the inlet and outlet flows are similar (± 10%)(refer **Table 8**).

Table 8 Comparison of Flow Measurements against SCADA Recordings

Date	23-06-2021	24-06-2021
Sampling Point Internal Diameter (mm)	100	100
Sampling Plane Area (m2)	0.0079	0.0079
Biofilter Outlet Average Actual Air Velocity (m/s)	1.18	1.29
Biofilter Outlet Actual Flow Rate (m3/s)	0.0093	0.0101
Base Internal Diameter (mm)	801	801
Biofilter Outlet Actual Surface Flux Velocity (m/s)	0.0185	0.0202
Biofilter Surface Area (m2)	2,778	2,778
Total Measure Biofilter Outlet Flow (m3/hr)	184,582	201,559
EFS SCADA Readings (m3/hr) – Biofilter Inlet	168,864	212,415
Difference Between SCADA and Biofilter Outlet Readings	+9.3%	-5.1%

The efficiency of the Eastern Biofilter has been calculated as follows;

- { Inlet Conc. (12,600 ou) - Maximum Outlet Conc. (99 ou)} ÷ Inlet Conc. (12,600 ou)
Result ≥ 95% efficiency.

Alternatively:

- {Inlet MOER (262,462 ou.m³/s) – Outlet MOER (1,656 ou.m³/s)} ÷ Inlet MOER (262,462 ou.m³/s)
Result ≥ 95% efficiency.

3 Summary and Comparison against OIA and Previous Measurements

Table 9 presents a comparison of odour concentrations and emission rates collected as part of this study and compares these against those assumed by the OIA and collected in 2018 and 2020. In summary:

- The measured biofilter outlet odour emissions are 92% lower than those assumed by the OIA and 48% lower than those measured in October 2018.
- Peak biofilter outlet odour emissions (based on measured concentrations and maximum flow through the biofilter) are estimated to be 82% lower than those assumed by the OIA and 48% lower compared to those measured in July 2020.
- The average biofilter outlet odour concentration measured is 82 ou which is 84% lower than the odour concentration assumed by the OIA.
- The biofilter odour removal efficiency is greater than 95%

Table 9 Summary of Biofilter results and Comparison against OIA and Previous Measurements

Year	Average Flow through Biofilter during Sampling (m ³ /hr)	Average Odour Concentration (wet) (ou)	Total Biofilter MOER (wet) (ou.m ³ /s)	Biofilter Efficiency	Maximum Flow through Biofilter (m ³ /hr)	Maximum Estimated Biofilter MOER (wet) (ou.m ³ /s)	Change Compared to OIA (%)
OIA		500			390,000	54,168	
2018	204,610	165	9,482	> 95%	390,000	18,073	-67%
2020	189,717	150	8,767	> 95%	402,000	18,576	-66%
2021	193,070	82	4,578	> 95%	402,000	9,533	-82%

APPENDIX A

Certificates of Analysis

THE ODOUR UNIT PTY LTD



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Internet: www.odourunit.com.au
ABN: 53 091 163 061



Accreditation Number:
14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	SLR Consulting	Telephone	+61 2 9424 2210
Contact	D. Echeverri	Facsimile	--
Sampling Site	Not disclosed	Email	decheverri@slrconsulting.com
Sampling Method	Not disclosed	Sampling Team	SLR Consulting

Order details:

Order requested by	D. Echeverri	Order accepted by	A. Schulz
Date of order	Refer to correspondence	TOU Project #	N1869R
Order number	Refer to correspondence	Project Manager	A. Schulz
Signed by	D. Echeverri	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: 'Determination of odour concentration by dynamic olfactometry' (AS/NZS4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17} . This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at $22^\circ\text{C} \pm 3^\circ\text{C}$.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-001.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.280$ (October 2019) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.076$ (October 2019) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. 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. Note Disclaimers on last page of this document.

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

Date: Tuesday, 29 June 2021

Panel Roster Number: SYD20210624_065

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20210624_065

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Dilution Equipment ID	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)
11250 - 10A	SC21460	23.06.2021 1125 hrs	24.06.2021 1010 hrs	4	8	--	--	--	27	27
11251 - 11B	SC21461	23.06.2021 1125 hrs	24.06.2021 1033 hrs	4	8	--	--	--	29	29
11252 - 10C	SC21462	23.06.2021 1155 hrs	24.06.2021 1102 hrs	4	8	--	--	--	118	118
11253 - 9B	SC21463	23.06.2021 1156 hrs	24.06.2021 1130 hrs	4	8	--	--	--	83	83
11255 - 7B	SC21464	23.06.2021 1255 hrs	24.06.2021 1157 hrs	4	8	--	--	--	108	108
11254 - 8B	SC21465	23.06.2021 1240 hrs	24.06.2021 1310 hrs	4	8	--	--	--	235	235
11256 - Inlet W	SC21465	23.06.2021 1351 hrs	24.06.2021 1336 hrs	4	8	--	--	--	23,200	23,200

Samples Received in Laboratory – From: SLR Consulting Date: 23.06.2021 Time: 1546 hrs

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

1. The collection of samples by the methods of AS/NZS 4323.4 and the calculation of Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS 4323.3 (Yes / No)
n-butanol	SYD20210624_065	51,000	$20 \leq \chi \leq 80$	1,449	35	Yes

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

SC21460 dirt, soil
 SC21461 dirt, soil, sour
 SC21462 dirt, soil, sour
 SC21463 dirt, soil, sour
 SC21464 dirt, soil
 SC21465 dirt, soil
 SC21466 cabbage, sour, fermented, manure

Disclaimers

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

Report Status

Status	Version	Date	Prepared by	Checked by	Change	Reason
Draft	0.1	29.06.2021	A. Schulz	-	-	-
Final	1.0	29.06.2021	A. Schulz	M. Assal	-	-
Revised	-	-	-	-	-	-

END OF DOCUMENT

THE ODOUR UNIT PTY LTD



THE ODOUR
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Accreditation Number:
14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	SLR Consulting	Telephone	+61 2 9424 2210
Contact	D. Echeverri	Facsimile	--
Sampling Site	Not disclosed	Email	decheverri@slrconsulting.com
Sampling Method	Not disclosed	Sampling Team	SLR Consulting

Order details:

Order requested by	D. Echeverri	Order accepted by	A. Schulz
Date of order	Refer to correspondence	TOU Project #	N1869R
Order number	Refer to correspondence	Project Manager	A. Schulz
Signed by	D. Echeverri	Panel Operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: 'Determination of odour concentration by dynamic olfactometry' (AS/NZS4323.3). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17} . This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at $22^\circ\text{C} \pm 3^\circ\text{C}$.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: TOU-OLF-001.
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS 4323.3. $r = 0.280$ (October 2019) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS 4323.3. $A = 0.076$ (October 2019) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.
Traceability	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. 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. Note Disclaimers on last page of this document.

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This report shall not be reproduced, except in full.

Date: Tuesday, 29 June 2021

Panel Roster Number: SYD20210625_066

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20210625_066

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Dilution Equipment ID	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)
11260 - 1A	SC21467	24.06.2021 1047 hrs	25.06.2021 0837 hrs	4	8	--	--	--	99	99
11261 - 1B	SC21468	24.06.2021 1047 hrs	25.06.2021 0859 hrs	4	8	--	--	--	83	83
11262 - 2A	SC21469	24.06.2021 1111 hrs	25.06.2021 0923 hrs	4	8	--	--	--	49	49
11263 - 2C	SC21470	24.06.2021 1111 hrs	25.06.2021 0941 hrs	4	8	--	--	--	91	91
11264 - 3A (Run 1)	SC21471	24.06.2021 1131 hrs	25.06.2021 1006 hrs	4	8	--	--	--	41	41
11265 - 3C (Run 1)	SC21472	24.06.2021 1131 hrs	25.06.2021 1023 hrs	4	8	--	--	--	83	83

Samples Received in Laboratory – From: SLR Consulting Date: 24.06.2021 Time: 1600 hrs

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

1. The collection of samples by the methods of AS/NZS 4323.4 and the calculation of Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

Odour Sample Measurement Results
Panel Roster Number: SYD20210625_066

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Dilution Equipment ID	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)
11266 - 4A (Run 1)	SC21473	24.06.2021 1203 hrs	25.06.2021 1045 hrs	4	8	--	--	--	41	41
11267 - 4C (Run 1)	SC21474	24.06.2021 1203 hrs	25.06.2021 1105 hrs	4	8	--	--	--	76	76
11268 - 5A (Run 1)	SC21475	24.06.2021 1227 hrs	25.06.2021 1124 hrs	4	8	--	--	--	83	83
11257 - 5C (Run 1)	SC21476	24.06.2021 1227 hrs	25.06.2021 1145 hrs	4	8	--	--	--	91	91
11259 - 6B (Run 1)	SC21477	24.06.2021 1300 hrs	25.06.2021 1242 hrs	4	8	--	--	--	91	91
11258 - 6C (Run 1)	SC21478	24.06.2021 1252 hrs	25.06.2021 1305 hrs	4	8	--	--	--	49	49
11269 - Inlet E	SC21479	24.06.2021 1322 hrs	25.06.2021 1327 hrs	4	8	--	--	--	12,600	12,600

Samples Received in Laboratory – From: SLR Consulting Date: 24.06.2021 Time: 1600 hrs

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

1. The collection of samples by the methods of AS/NZS 4323.4 and the calculation of Specific Odour Emission Rate (**SOER**).
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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/NZS 4323.3 (Yes / No)
n-butanol	SYD20210625_066	51,000	$20 \leq \chi \leq 80$	1,220	42	Yes

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

SC21467	dirt, soil	SC21473	dirt, soil, sour	SC21479	dirt, soil, sour, fermented, cabbage
SC21468	dirt, soil, sour	SC21474	dirt, soil, sour		
SC21469	dirt, soil, sour	SC21475	dirt, soil, sour		
SC21470	dirt, soil, sour	SC21476	dirt, soil, sour		
SC21471	dirt, soil	SC21477	dirt, soil, sour		
SC21472	dirt, soil	SC21478	dirt, soil, sour		

Disclaimers

- Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
- 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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Draft	0.1	29.06.2021	A. Schulz	-	-	-
Final	1.0	29.06.2021	A. Schulz	M. Assal	-	-
Revised	-	-	-	-	-	-

END OF DOCUMENT

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