ELF FARM SUPPLIES

Annual Biofilter Testing

Prepared for:

Elf Farm Supplies Pty Ltd
PO Box 615
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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.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30900-R01-v1.0	10 August 2022	A Naghizadeh	G Starke	A Naghizadeh

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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.

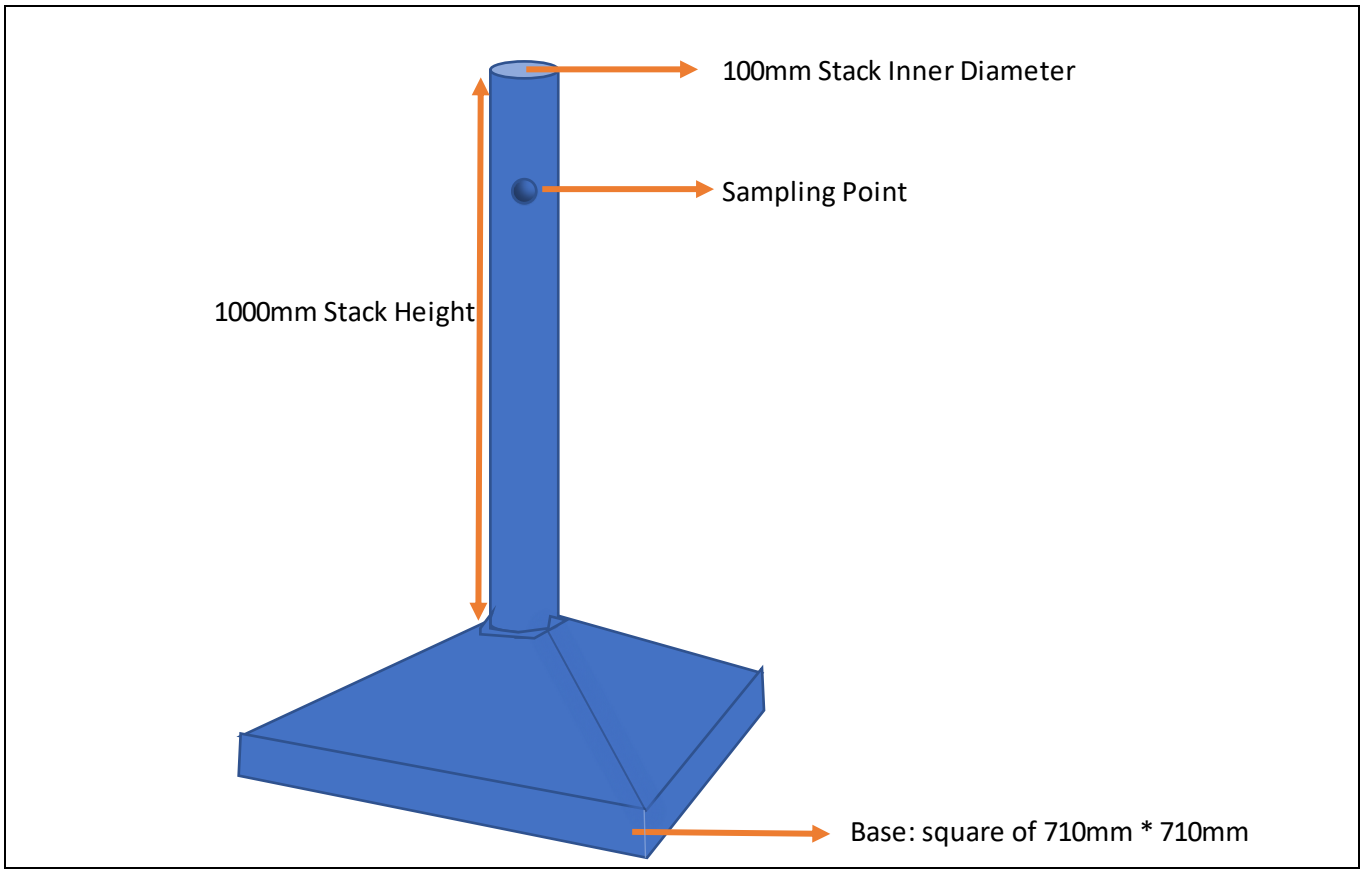
1.1.1 Biofilter Outlet Odour Testing

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 (WHH) 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

Witches Hat Hoods on Eastern Bed	Witches Hat Hoods on Western Bed
	

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 (m^2). 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 grid cells). This resulted in a total of 18 sample points evenly distributed across the Eastern biofilter bed.

The Western Bed has a surface area of approximately 1,278 m^2. SLR divided this bed into five (5) equal rows along its length and three equal rows along its width (approximate 9 m by 9 m grid cells). This resulted in a total of 15 sample points evenly distributed across the Western biofilter bed.

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

It is noted that at the time of the sampling, part of the eastern and western beds were inactive as the bedding material was being replaced. The active area of the beds was measured as follows:

- Eastern bed: approximately 22 m by 43 m
- Western bed: approximately 20 m by 43 m

The number of sample points for each bed was kept consistent with sampling conducted as part of a site wide odour audit completed by SLR in 2018. The smaller active surface area resulted in a tighter grid (approximately 7 m by 7 for the Eastern bed and 8 m by 8 for the Western bed).

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

Figure 3 Illustration of the Biofilter Distributed into 33 Grids

(≈43m) North (≈43m)

	Biofilter Western Bed					Biofilter Eastern Bed					
West (≈20m) / Width Row A	11A	10A	9A	8A	7A	6A	5A	4A	3A	2A	1A
Width Row B	11B	10B	9B	8B	7B	6B	5B	4B	3B	2B	1B
Width Row C / East (≈22m)	11C	10C	9C	8C	7C	6C	5C	4C	3C	2C	1C

(≈43m) South (≈43m)

Note: the image above does not represent actual layout.

Note 2: odour samples were collected from cells highlighted green

Each grid cell was measured, as a minimum, for temperature and surface velocity at approximately the centre of each grid cell. 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 blockage (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 15 samples were collected from the biofilter outlet. The locations where samples were collected are indicated in **Figure 3**. It is noted that flows from the Eastern bed, which contained fresh media, were overall much more consistent than flows from the Western bed which has not yet had its media replaced. SLR understands that replacement of the Western bed media is scheduled to be completed by prior to the next round of annual testing.

Duplicate or triplicate samples, to quantify odour emission variability, at each nominated grid point 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 15 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 bed, such an 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 bed to obtain total flow. 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 29 June 2022 and Thursday 30 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 four 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 431 odour units (ou) and the average odour concentration measured was 183 ou.

Table 6 provides detailed results of the Mass Odour Emission Rates (MOER) per biofilter grid cell measured. The measured MOER for the entire biofilter is 11,752 ou.m^3/s. It is noted that MOERs presented in **Table 6** for each grid point have been calculated based on a 158 m^2 area for the Eastern bed samples and 96 m^2 for the Western bed 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 grid cells sampled.

Table 1 Summary of Biofilter Measured Results – Temperature and Air Velocities – 29 June 2022

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			12:27	12:25	12:16	12:14	12:04	9:19	9:06	9:01	8:50	8:48	8:32
Air Velocity (m/s)			2.3	3.0	1.9	2.3	2.4	2.5	2.3	2.3	2.1	1.8	2.0
Temp in WHH (°C, dry)			34.1	35.2	34.5	35.3	35.1	26.2	24.8	23.7	21.3	21.0	20.7
Grid Identification		Row B	**11B**	**10B**	**9B**	**8B**	**7B**	**6B**	**5B**	**4B**	**3B**	**2B**	**1B**
Time of Measurement			12:30	12:23	12:17	12:12	12:06	9:16	9:09	8:58	8:52	8:46	8:36
Air Velocity (m/s)			2.5	1.4	2.3	2.5	1.9	2.3	2.4	2.4	2.2	2.0	1.9
Temp in WHH (°C, dry)			33.7	31.4	34.6	34.9	35.2	26.8	26.2	25.1	21.4	20.8	20.6
Grid Identification		Row C	**11C**	**10C**	**9C**	**8C**	**7C**	**6C**	**5C**	**4C**	**3C**	**2C**	**1C**
Time of Measurement			12:32	12:21	12:19	12:10	12:08	9:14	9:12	8:56	8:54	8:44	8:42
Air Velocity (m/s)			3.6	2.9	2.3	3.3	3.1	2.1	2.3	2.5	2.1	1.9	2.1
Temp in WHH (°C, dry)			34.6	34.5	33.4	36.7	37.2	27.1	26.3	24.7	21.6	20.9	20.8

East

South

Avg. Air Velocity (m/s)	**2.8**	**2.4**	**2.2**	**2.7**	**2.5**	**2.3**	**2.3**	**2.4**	**2.2**	**1.9**	**2.0**
Avg. Air Velocity across Biofilter (m/s)	**2.3**										

Table 2 Summary of Biofilter Measured Results – Temperature and Air Velocities – 30 June 2022

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			10:43	10:05	9:45	9:10	8:15	11:59	11:46	11:41	11:30	11:28	11:12
Air Velocity (m/s)			2.0	2.7	3.5	2.1	2.1	2.5	2.3	2.2	2.1	1.8	1.9
Temp in WHH (°C, dry)			34.9	32.1	32.5	34.0	31.3	26.2	24.8	23.7	21.3	21.0	20.7
Grid Identification		Row B	**11B**	**10B**	**9B**	**8B**	**7B**	**6B**	**5B**	**4B**	**3B**	**2B**	**1B**
Time of Measurement			11:07	10:00	9:40	9:30	8:20	11:56	11:49	11:38	11:32	11:26	11:16
Air Velocity (m/s)			2.3	1.3	2.8	1.5	1.2	2.2	2.3	2.4	2.2	1.9	1.9
Temp in WHH (°C, dry)			31.8	35.1	35.7	31.7	35.2	26.8	26.2	25.1	21.4	20.8	20.6
Grid Identification		Row C	**11C**	**10C**	**9C**	**8C**	**7C**	**6C**	**5C**	**4C**	**3C**	**2C**	**1C**
Time of Measurement			10:50	9:55	9:50	9:20	8:30	11:54	11:52	11:36	11:34	11:24	11:22
Air Velocity (m/s)			3.3	3.0	3.0	3.0	2.3	2.1	2.3	2.5	2.1	1.9	2.0
Temp in WHH (°C, dry)			36.4	33.2	36.0	36.0	34.5	27.1	26.3	24.7	21.6	20.9	20.8

East

South

Avg. Air Velocity (m/s)	**2.6**	**2.3**	**3.1**	**2.2**	**1.9**	**2.3**	**2.3**	**2.4**	**2.1**	**1.9**	**2.0**
Avg. Air Velocity across Biofilter (m/s)	**2.3**										

Table 3 Summary of Biofilter Outlet Results – Eastern Bed – 29 June 2022

Parameter	Sample 1B	Sample 2B	Sample 3B	Sample 4B	Sample 5B	Sample 6B
SLR Sample No.	12326	12325	12324	12323	12322	12321
Sample Start Time	29-06-2022 10:59	29-06-2022 10:44	29-06-2022 10:30	29-06-2022 10:15	29-06-2022 9:58	29-06-2022 9:46
Sample Finish Time:	29-06-2022 11:09	29-06-2022 10:58	29-06-2022 10:40	29-06-2022 10:27	29-06-2022 10:08	29-06-2022 10:58
NATA Laboratory I.D No.	SC22374	SC22373	SC22372	SC22371	SC22370	SC22369
Analysis Date & Time Completed	30-06-2022 13:45	30-06-2022 13:18	30-06-2022 12:05	30-06-2022 11:22	30-06-2022 10:49	30-06-2022 10:15
Sample Analysis Period in Compliance (≤30-hrs)	26.6	26.3	25.4	24.9	24.7	23.3
($D_{s\ WHH}$) 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 (^oC)	26.7	27.0	25.9	32.1	28.8	30.1
($Ps_{\ WHH}$) Average Stack / Surface Pressure (kPa)	102.7	102.7	102.7	102.7	102.8	102.8
($v_{s\ (WHH)}$) Average Grid Stack Air Velocity (m/s)	2.08	1.85	1.77	2.11	2.26	2.15
($Q_{a\ WHH}$) Actual Grid Flow Rate (m^3/s)	0.0163	0.0145	0.0139	0.0166	0.0177	0.0169
($D_{B\ WHH}$) WHH Base Internal Diameter (mm)	801	801	801	801	801	801
($A_{B\ WHH}$) WHH Base Cross Sectional Area (m^2)	0.504	0.504	0.504	0.504	0.504	0.504
(Q_{flux}) Actual Grid Surface Flux Velocity (m/s)	0.032	0.029	0.028	0.033	0.035	0.034
Odour Concentration (wet) (ou)	**99**	**91**	**118**	**235**	**181**	**64**
EPL Odour Concentration Limit (ou)	500	500	500	500	500	500
Odour Character	Dirt, Soil	Dirt, Soil	Dirt, Soil, cabbage	Dirt, Soil	Dirt, Soil, cabbage	Dirt, Soil

Table 4 Summary of Biofilter Outlet Results – Western Bed – 30 June 2022

Parameter	Sample 7B	Sample 7C	Sample 8A	Sample 8C	Sample 9B
SLR Sample No.	12328	12329	12330	12331	12332
Sample Start Time	30-06-2022 8:33	30-06-2022 8:38	30-06-2022 9:06	30-06-2022 9:15	30-06-2022 9:34
Sample Finish Time:	30-06-2022 8:45	30-06-2022 8:48	30-06-2022 9:18	30-06-2022 9:25	30-06-2022 9:46
NATA Laboratory I.D No.	SC22376	SC22377	SC22378	SC22379	SC22380
Analysis Date & Time Completed	01-07-2022 10:01	01-07-2022 10:33	01-07-2022 11:05	01-07-2022 11:35	01-07-2022 12:02
Sample Analysis Period in Compliance (≤30-hrs)	25.3	25.7	25.8	26.2	26.3
($D_{s\ WHH}$) Sample Point WHH Stack Internal Diameter (mm)	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
($T_{s\ WHH}$) Average Stack (Surface) Temperature (^oC)	35.2	34.5	34.0	36.0	35.7
($Ps_{\ WHH}$) Average Stack / Surface Pressure (kPa)	102.5	102.5	102.5	102.5	102.5
($v_{s\ (WHH)}$) Average Grid Stack Air Velocity (m/s)	1.65	2.15	1.82	4.45	2.54
($Q_{a\ WHH}$) Actual Grid Flow Rate (m^3/s)	0.0130	0.0169	0.0143	0.0350	0.0199
($D_{B\ WHH}$) WHH Base Internal Diameter (mm)	801	801	801	801	801
($A_{B\ WHH}$) WHH Base Cross Sectional Area (m^2)	0.504	0.504	0.504	0.504	0.504
(Q_{flux}) Actual Grid Surface Flux Velocity (m/s)	0.026	0.034	0.028	0.069	0.040
Odour Concentration (wet) (ou)	**235**	**256**	**215**	**256**	**332**
EPL Odour Concentration Limit (ou)	500	500	500	500	500
Odour Character	Dirt, Soil	Dirt, Soil	Dirt, Soil	Dirt, Soil, Cabbage	Dirt, Soil

Table 5 Summary of Biofilter Outlet Results – Western Bed – 30 June 2022- Continued

Parameter	Sample 10A	Sample 10B	Sample 11A	Sample 11C
SLR Sample No.	12333	12334	12335	12336
Sample Start Time	30-06-2022 10:10	30-06-2022 10:14	30-06-2022 10:39	30-06-2022 10:45
Sample Finish Time:	30-06-2022 10:20	30-06-2022 10:26	30-06-2022 10:49	30-06-2022 10:57
NATA Laboratory I.D No.	SC22381	SC22382	SC22383	SC22384
Analysis Date & Time Completed	01-07-2022 13:12	01-07-2022 13:55	01-07-2022 14:28	01-07-2022 15:06
Sample Analysis Period in Compliance (≤30-hrs)	26.9	27.5	27.7	28.1
($D_{s\ WHH}$) Sample Point WHH Stack Internal Diameter (mm)	100	100	100	100
($A_{s\ WHH}$) Sample Plane Cross Sectional Area (m^2)	0.0079	0.0079	0.0079	0.0079
($T_{s\ WHH}$) Average Stack (Surface) Temperature (^oC)	36.0	35.1	34.9	36.4
($Ps_{\ WHH}$) Average Stack / Surface Pressure (kPa)	102.5	102.4	102.4	102.4
($v_{s\ (WHH)}$) Average Grid Stack Air Velocity (m/s)	2.57	1.62	2.15	3.23
($Q_{a\ WHH}$) Actual Grid Flow Rate (m^3/s)	0.0202	0.0127	0.0169	0.0254
($D_{B\ WHH}$) WHH Base Internal Diameter (mm)	801	801	801	801
($A_{B\ WHH}$) WHH Base Cross Sectional Area (m^2)	0.504	0.504	0.504	0.504
(Q_{flux}) Actual Grid Surface Flux Velocity (m/s)	0.040	0.025	0.034	0.050
Odour Concentration (wet) (ou)	**59**	**54**	**118**	**431**
EPL Odour Concentration Limit (ou)	500	500	500	500
Odour Character	Dirt, Soil	Dirt, Soil	Dirt, Soil	Dirt, Soil, Cabbage

Table 6 Summary of Biofilter Mass Odour Emission Rates – 29 and 30 June 2022

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[1] MOER Modelled Operations (ou.m^3/s)
Sample 1B	0.032	99	3.2	158	18,479	508	NA
Sample 2B	0.029	91	2.6	158	16,435	415	NA
Sample 3B	0.028	118	3.3	158	15,725	515	NA
Sample 4B	0.033	235	7.7	158	18,745	1,224	NA
Sample 5B	0.035	181	6.4	158	20,078	1,009	NA
Sample 6B	0.034	64	2.1	158	19,101	340	NA
Sample 7B	0.026	235	6.0	96	8,847	577	NA
Sample 7C	0.034	256	8.6	96	11,527	820	NA
Sample 8A	0.028	215	6.1	96	9,758	583	NA
Sample 8C	0.069	256	17.8	96	23,859	1,697	NA
Sample 9B	0.040	332	13.1	96	13,618	1,256	NA
Sample 10A	0.040	59	2.4	96	13,779	226	NA
Sample 10B	0.025	54	1.4	96	8,686	130	NA
Sample 11A	0.034	118	4.0	96	11,527	378	NA
Sample 11C	0.050	431	21.7	96	17,318	2,073	NA
Total	--	--	--	**1,810**	**227,483**	**11,752**	**54,168**

[1] Odour Impact Assessment prepared by The Odour Unit dated 28 August 2015

2.2 Biofilter Inlet Results

The biofilter inlets were measured on Wednesday 29 June 2022 and Thursday 30 June 2022 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 – 29 and 30 June 2022

Parameter	Inlet -East	Inlet -West
SLR Sample No.	12327	12337
Sample Start Time	29-06-2022 11:25	30-06-2022 12:28
Sample Finish Time:	29-06-2022 11:35	30-06-2022 12:38
NATA Laboratory I.D No.	SC22375	SC22385
Analysis Date & Time Completed	30-06-2022 14:19	01-07-2022 15:38
Sample Analysis Period in Compliance (≤30-hrs)	26.7	27.0
(A_s) Sample Plane Cross Sectional Area (m^2)	--	4.5
(T_s) Average Stack Temperature (^oC)	33.8	36.2
(Ps) Average Stack Pressure (kPa)	--	103.3
(Q_a) Actual Flow Rate (m^3/hr)	--	92,360
Flow through Biofilter Outlet during Sampling (m^3/hr)	108,563[1]	118,920
Odour Concentration (wet) (ou)	**2,050**	**27,600**
Mass Odour Emission Rate (MOER) (ou.m^3/s)	**61,820**	**708,096**
Odour Character	Fish, oily	Grease, Ammonia, fermented

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 SCADA recordings and Biofilter Outlet recordings to demonstrate the Inlet air flow is similar to the outlet airflow. Difference between the presented Biofilter Outlet and Inlet flows above (~20%) is likely a result of the samples being collected at different times and variability in fan speeds.

2.3 Biofilter Efficiency Results

The efficiency of the Western biofilter bed (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 (708,096 ou.m^3/s) – Outlet MOER (7,740 ou.m^3/s)} ÷ Inlet MOER (708,096 ou.m^3/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 (± 20%)(refer **Table 8**).

Table 8 Comparison of Flow Measurements against SCADA Recordings

Date	29-06-2022	30-06-2022
Sampling Point Internal Diameter (mm)	100	100
Sampling Plane Area (m^2)	0.0079	0.0079
Biofilter Outlet Average Actual Air Velocity (m/s)	2.3	2.3
Biofilter Outlet Actual Flow Rate (m^3/s)	0.018	0.018
Base Internal Diameter (mm)	801	801
Biofilter Outlet Actual Surface Flux Velocity (m/s)	0.036	0.035
Biofilter Surface Area (m^2)	1,810	1,810
Total Measure Biofilter Outlet Flow (m^3/hr)	236,449	230,563
EFS SCADA Readings (m^3/hr) – Biofilter Inlet	281,609	279,196
Difference Between SCADA and Biofilter Outlet Readings	**-16.0%**	**-17.4%**

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

- { Inlet Conc. (2,050 ou) - Average Outlet Conc. (131 ou)} ÷ Inlet Conc. (2,050 ou)

  Result ≥ 90% efficiency.

Alternatively:

- {Inlet MOER (61,820 $ou.m^3/s$) – Outlet MOER (4,012 $ou.m^3/s$)} ÷ Inlet MOER (61,820 $ou.m^3/s$)

  Result ≥ 90% 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, 2020 and 2021. In summary:

- The measured biofilter outlet odour emissions are 78% lower than those assumed by the OIA.
- Peak biofilter outlet odour emissions (based on measured concentrations and maximum flow through the biofilter) are estimated to be 63% lower than those assumed by the OIA.
- The average biofilter outlet odour concentration measured is 183 ou which is 63% lower than the odour concentration assumed by the OIA.
- The average 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) ($ou.m^3/s$)	Average Biofilter Efficiency	Maximum Flow through Biofilter (m3/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%
2022	**233,506**	**183**	**11,752**	**> 95%**	**402,000**	**20,231**	**-63%**

Appendix A:

Certificates of Analysis

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

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MASCOT NSW 2020

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

NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	SLR Consulting	Telephone	+61 437 774 243
Contact	D. Echeverri	Facsimile	--
Sampling Site	Not Disclosed	Email	decheverri@slrconsulting.com
Sampling Method	Not Disclosed	Sampling Team	SLR

Order details:

Order requested by	D. Echeverri	Order accepted by	A. Schulz
Date of order	15 June 2022	TOU Project #	N1869R
Order number	31583	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 °C ±3 °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-004.
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. $r = 0.280$ 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. $A = 0.076$ 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: Monday, 18 July 2022

Panel Roster Number: SYD20220630_048

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20220630_048

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (ou)
#1 6B – 12321	SC22369	29.06.2022 0953 hrs	30.06.2022 1015 hrs	4	8	64
#2 5B – 12322	SC22370	29.06.2022 1008 hrs	30.06.2022 1049 hrs	4	8	181
#3 4B – 12323	SC22371	29.06.2022 1027 hrs	30.06.2022 1122 hrs	4	8	235
#4 3B – 12324	SC22372	29.06.2022 1040 hrs	30.06.2022 1205 hrs	4	8	118
#5 2B – 12325	SC22373	29.06.2022 1058 hrs	30.06.2022 1318 hrs	4	8	91
#6 1B – 12326	SC22374	29.06.2022 1109 hrs	30.06.2022 1345 hrs	4	8	99
#7 Inlet East – 12327	SC22375	29.06.2022 1135 hrs	30.06.2022 1419 hrs	4	8	2,050

Samples Received in Laboratory – From: SLR Date: 29.06.2022 Time: 1630 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.

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/NZS 4323.3 (Yes / No)
n-butanol	SYD20220630_048	51,000	$20 \leq \chi \leq 80$	1,024	50	Yes

Comments

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

SC22369	dirt, soil	SC22373	dirt, soil
SC22370	dirt, soil, cabbage	SC22374	dirt, soil
SC22371	dirt, soil	SC22375	fish, oily
SC22372	dirt, soil, cabbage		

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	18.07.2022	A. Schulz	M. Assal	-	-
Final	1.0	18.07.2022	A. Schulz	M. Assal	-	-
Revised	-	-	-	-	-	-

END OF DOCUMENT

THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

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

NATA
Accreditation Number: 14974

Odour Concentration Measurement Report

The measurement was commissioned by:

Organisation	SLR Consulting	Telephone	+61 437 774 243
Contact	D. Echeverri	Facsimile	--
Sampling Site	Not Disclosed	Email	decheverri@slrconsulting.com
Sampling Method	Not Disclosed	Sampling Team	SLR

Order details:

Order requested by	D. Echeverri	Order accepted by	A. Schulz
Date of order	15 June 2022	TOU Project #	N1869R
Order number	31583	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 °C ±3 °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-004.

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.
$r = 0.280$ 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.
$A = 0.076$ 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.

Date: Monday, 18 July 2022

Panel Roster Number: SYD20220701_049

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20220701_049

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (ou)
#1 7B – 12328	SC22376	30.06.2022 0845 hrs	01.07.2022 1001 hrs	4	8	235
#2 7C – 12329	SC22377	30.06.2022 0848 hrs	01.07.2022 1033 hrs	4	8	256
#3 8A – 12330	SC22378	30.06.2022 0918 hrs	01.07.2022 1105 hrs	4	8	215
#4 8C – 12331	SC22379	30.06.2022 0925 hrs	01.07.2022 1135 hrs	4	8	256
#5 9B – 12332	SC22380	30.06.2022 0946 hrs	01.07.2022 1202 hrs	4	8	332

Samples Received in Laboratory – From: SLR Date: 30.06.2022 Time: 1540 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.

THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20220701_049

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (ou)
#6 10A – 12333	SC22381	30.06.2022 1020 hrs	01.07.2022 1312 hrs	4	8	59
#7 10B – 12334	SC22382	30.06.2022 1026 hrs	01.07.2022 1355 hrs	4	8	54
#8 11A – 12335	SC22383	30.06.2022 1049 hrs	01.07.2022 1428 hrs	4	8	118
#9 11C – 12336	SC22384	30.06.2022 1057 hrs	01.07.2022 1506 hrs	4	8	431
#10 Inlet West - 12337	SC22385	30.06.2022 1230 hrs	01.07.2022 1538 hrs	4	8	27,600

Samples Received in Laboratory – From: SLR Date: 30.06.2022 Time: 1540 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).

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/NZS 4323.3 (Yes / No)
n-butanol	SYD20220701_049	51,000	$20 \leq \chi \leq 80$	724	70	Yes

Comments

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

SC22376	dirt, soil	SC22381	dirt, soil
SC22377	dirt, soil	SC22382	dirt, soil
SC22378	dirt, soil	SC22383	dirt, soil
SC22379	dirt, soil, cabbage	SC22384	dirt, soil, cabbage
SC22380	dirt, soil	SC22385	grease, ammonia, fermented

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.
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Draft	0.1	18.07.2022	A. Schulz	M. Assal	-	-
Final	1.0	18.07.2022	A. Schulz	M. Assal	-	-
Revised	-	-	-	-	-	-

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