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Taylor Preston Limited

2018 Biofilter and Odour Extraction System Assessment

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Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to undertake an inspection and assessment of the odour extraction system and biofilter at the Taylor Preston Ngauranga site, in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

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1. Introduction

Taylor Preston Limited (Taylor Preston) is a privately owned slaughter, processing, and meat export company located at Kiwi Point, Ngaraunga Gorge. The facility utilises an odour extraction system that terminates in a bark/compost mix bed biofilter to treat ventilation air, specifically malodorous compounds from the various plant operations.

Taylor Preston is required under its resource consent to commission an annual assessment of the biofilter and odour extraction system performance. A copy or the consent (Consent ID 160137 [33809]) is attached as Appendix A of this report. Conditions 17 and 18 of the consent are relevant to this assessment, and state:

> *"17. The consent holder shall undertake a comprehensive assessment of the quality of the biofilter media on an annual basis (or more frequently if appropriate), based on the measurements required in condition 16 of this consent. The assessment shall be undertaken by an appropriately qualified and experienced person, and shall involve an evaluation of the media size distribution and composition, the total air flow from the PSES[1] and the temperature and humidity of the inlet duct.*
>
> *The results of this assessment, including a summary of the findings, details of any action(s) to be taken to improve the efficiency of the biofilter, and a timetable for those actions to be undertaken; must be submitted to the Manager, Environmental Regulation, Wellington Regional Council* ***by 31 March annually*** *and may be incorporated into the report prepared under condition 18.*
>
> *18. The consent holder shall, on an annual basis, measure and record the vacuum (pressure) at all enclosed equipment items that are extracted by the PSES.*
>
> *a) Pressure shall be measured in the head space of the equipment items that are targeted by the PSES. The measurements shall be undertaken by an appropriately qualified and experienced person following industry best practice for measurements of this type. The person and the measurement method shall be to the satisfaction of the Manager, Environmental Regulation, Wellington Regional Council.*
>
> *b) The consent holder shall prepare a report on the findings and critically analyse the results (including a comparison with historical data) and if required, make recommendations as to the adequacy of the extraction rates, whether pressures are sufficiently negative and whether additional sealing/enclosing of any rendering plant process area is needed to ensure adequate extraction. This report must be submitted to GWRC* ***by 31 March annually*** *and may be incorporated into the report prepared under condition 17."*

Taylor Preston commissioned Jacobs to undertake the assessment in accordance with its resource consent. Jacobs personnel visited the site on 8 February 2018 to assess the condition of the odour extraction system and collected pressure data at various PSES locations. The condition of the biofilter media was also assessed. This report sets out a general description of the biofilter and extraction system, the sampling methodology used, sampling results and analysis, and recommendations to maintain the biofilter and the extraction system performance.

[1] Point Source Extraction System

2. Odour Extraction Assessment

2.1 Odour Extraction System Description

The odour extraction system includes multiple hoods and ducts fabricated with primarily stainless steel. The biofilter fan creates a vacuum on the entire odour extraction system, drawing air from the rendering facilities, white fats duct, belt press enclosure, sludge bins and screws, rotary screen area, Dissolved Air Flotation (DAF) tanks and sump. A secondary fan is used to provide additional extraction capacity for the rendering plant. The collected air is passed through a humidification chamber immediately before it enters a bark/compost bed biofilter. All extraction points from the odour extraction system, excluding the press cake hoppers and screws, are fitted with dampers to control flow rates. The dampers allow some control over the extraction rates at various points of the odour extraction system. Conditions 6 through 8 of the current consent relate to the general operation of the biofilter:

> *"6. The inlet temperature of the foul air at the final air duct immediately ahead of the biofilter shall not exceed 40C and shall be 35C or lower for at least 95% of the time.*
>
> *7. The loading of the biofilter as measured in the final air duct inlet shall not exceed a maximum limit of 37* $m^3{}_{air}/hr/m^3{}_{media}$.
>
> *8. The biofilter shall be maintained in efficient working order to the satisfaction of the Manager, Environmental Regulation, and Wellington Regional Council."*

In compliance with condition 7, assuming the media bed dimensions of 36m long, 11m wide (as built), and 1.7m deep (as measured), the maximum flow rate of air through the biofilter would be approximately 25,000 m^3/hr.

2.2 Odour Extraction System Assessment Methodology

2.2.1 Process Containment Tuning

The flow rate into the biofilter was initially measured to ensure that the flow into the biofilter meets conditions 6 and 7 of the current consent, which requires a flow rate through the biofilter not to exceed 25,000 m^3/hr.

An S-type pitot, a digital monometer and a digital thermometer were used to determine the temperature and pressure drop along the duct according to USEPA Method 2 for Determination of Stack Gas Velocity and Volumetric Flow Rate[2]. Initial flow rates to the biofilter were around 23,800 m^3/hr.

Preliminary pressure measurements showed that the White Fats duct was under slight positive pressure. The damper to this duct was opened slightly to increase extraction and provide negative pressure to the duct. This had minimal effect on extraction rates through the rest of the odour extraction system.

2.2.2 Damper Setting and Fan Speed

There are six dampers in the odour extraction system which are secured in place using lock nuts. The settings for each damper are provided in Table 1.

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[2] http://www.epa.gov/ttnemc01/promgate/m-02.pdf

Table 1 Damper Locations and Settings

Damper Location	Setting (degrees from horizontal)
Rendering Inlet	180 (fully open)
Belt Press Inlet	75 (1/4 open)
White Fats	75(1/4 open)
Rotary Screen Inlet	75 (1/4 open)
DAF 1 Inlet	15 (1/8 open)
DAF 2 Inlet	15 (1/8 open)

The dampers were adjusted to enable maximum extraction capacity to the rendering plant, while still maintaining negative pressure at the other PSES locations.

2.2.3 Assessment of Point Source Extraction System Locations

The pressures at the PSES points within the odour extraction system were measured as required by Taylor Preston's discharge consent. Appendix B sets out the PSES sample locations as described in Condition 3 of the current discharge consent.

2.3 Results of Odour Extraction System Assessment

2.3.1 Odour Extraction System Integrity

With the exception of the pre-cooker and the drainer conveyor, all PSES extraction points were either completely sealed or were under negative pressure. The pre-cooker is fitted with hatches along its length, which are sealed with rubber gaskets. The gaskets keep discharges of steam and other gases from the pre-cooker to a minimum, however some intermittent discharges of steam were observed.

Pressure measurements in the drainer conveyor indicated ambient pressure. However, the absence of gas and steam discharging from the conveyor indicate that there are no significant discharges from the conveyor, and that sufficient extraction is being achieved to prevent discharges into building air.

The valve controlling the extraction from the load-out point for the sludge hopper was stuck in the closed position at the time of the audit, and so measurement of pressure was not possible at this point. The sludge hopper can only be an odour source when the sludge is being loaded into trucks for disposal, which occurs once per day at night. Taylor Preston should ensure that the valve is opened during the load-out period to minimise discharges of fugitive odour.

There was a moderate odour within the rendering building itself, but this was largely contained to within the building, indicating adequate containment and extraction of odour from the process. Mild odours of stock yard and rendering were observed in the general vicinity of the rendering plant and biofilter, which would be expected to decrease to minor levels beyond the plant boundary under normal operating and meteorological conditions.

2.4 Conclusion and Recommendations

Overall the odour extraction system at Taylor Preston appears to be functioning as designed and in good repair. Negative pressure was measured at the majority of PSES extraction points. Where measurement was not possible, visible assessments indicated that these processes were fully enclosed with no air discharges to outside of the process containers.

Pressure measurement was not possible at many of the PSES extraction points within the rendering building, as these processes were enclosed and without any openings for inserting the measurement probe. These processes were assessed visually and were found to be enclosed and not emitting odour. Pressure gauges could be inserted near the extraction ports to enable readings to be taken at any time, although we note that this may compromise the integrity of the odour extraction system by introducing additional points for odour to be discharged from the process (e.g. if the measurement points cannot be adequately sealed).

Mild odours of rendering, meal and stockyards were detected within the site boundary, although there was no significant odour detected fom the biofilter itself or outside the rendering plant. The new enclosure around the belt press on the second floor of the rendering plant which was installed in late 2017 has also allowed for more efficient extraction of odour from the rendering building, thereby reducing fugitive emissions of odour.

3. Biofilter Assessment

The assessment of the odour extraction and treatment system at TPL included an assessment of the biofilter media and the general performance of the biofilter, which is required annually for compliance with Taylor Preston's resource consent for discharges to air WGN160137[33809].

The following sections of this report set out a general description of the biofilter, the sampling methodology used, sampling results and analysis of the media samples, and recommendations to maintain the biofilter's performance.

3.1 Biofilter Description

The biofilter fan creates a vacuum on the entire odour extraction system. Air is drawn from the rendering facilities, white fats duct, belt press enclosure, sludge bins and screws, rotary screen area, and DAF tanks and wastewater sump. The collected air is passed through the humidification chamber before it enters a bark/compost biofilter.

The biofilter has a design air inlet flow rate of 20,000 -25,000m^3/hr. The biofilter bed itself is 36 m long, 10 m wide and 2 m deep, with approximately 1.75 m of active media. The bed is equipped with a sprinkler system that is used during periods of dry weather. A humidification chamber supplies moisture to the waste air stream at the inlet to ensure the ventilation air entering the base of the biofilter is sufficiently moist (exceeding around 95% humidity) to prevent the base media from drying out.

Moist ventilation air enters the biofilter bed through a 0.76 meter ID duct at ground level, which continues 36 m to the end of the biofilter bed were it is capped. Lateral ducts (0.1 meter ID) branch out from the main duct starting 0.4 m into the bed and continuing every 0.8 m through the length of the bed. The lateral ducts extend across the width of the bed and are capped at their termination on each side of the bed. The lateral ducts are perforated along their length to disperse the extracted air throughout the bed. The biofilter bed is designed to provide a ratio of 37 m^3 of extracted air per m^3 of media per hour.

The humidification unit is depicted in Photograph 1 and Figure 1 below. The biofilter is depicted in Photograph 2 and Figure 2.

Photograph 1 Humidification Chamber

Photograph 2 Biofilter Surface as at 8th February 2018

Figure 1 Humidification Chamber Drawings

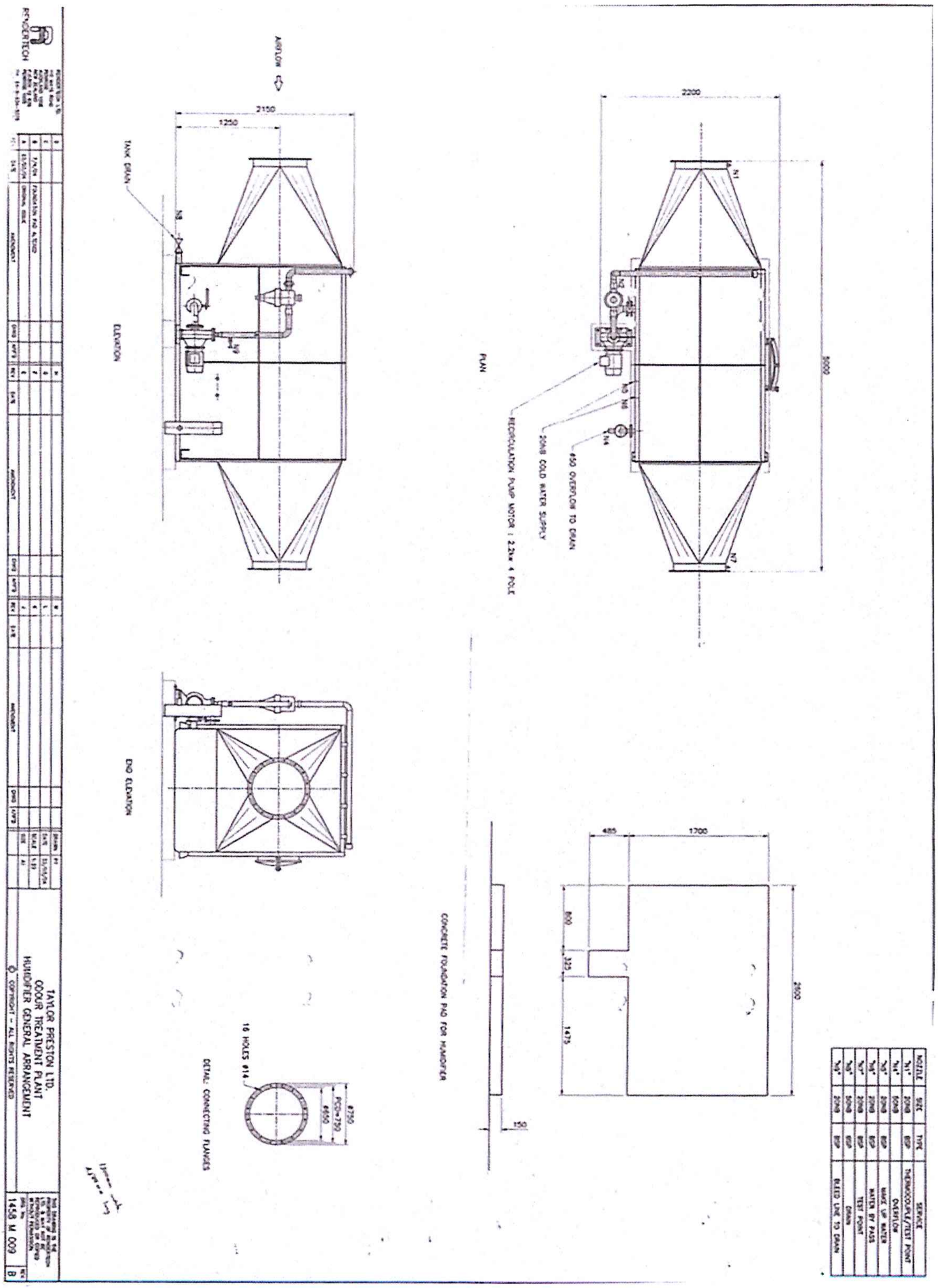
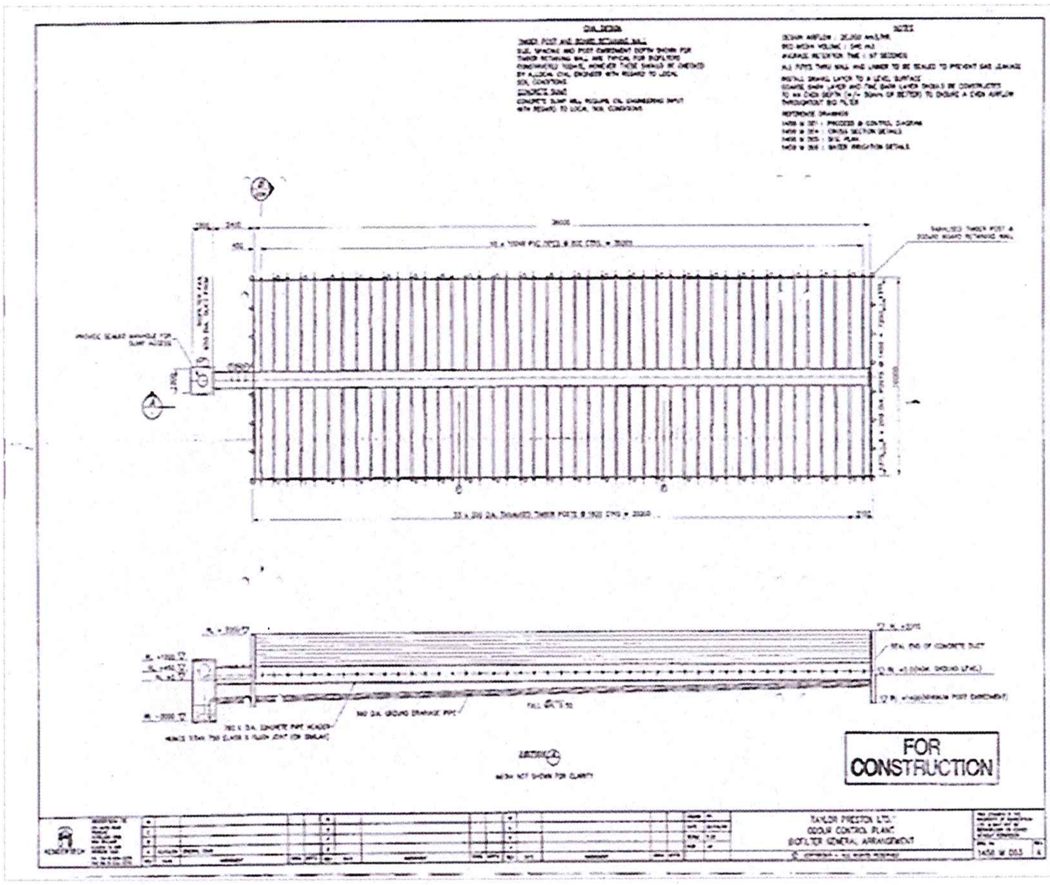


Figure 2 Biofilter Technical Drawing



3.2 Modifications to the Biofilter since Previous Assessment

There have been no significant changes to the biofilter since Jacobs' 2017 assessment[3]. In compliance with the operations and maintenance plan, additions of lime were made to the biofilter on an approximately 3-monthly schedule to neutralise excessive acidity as determined from regular measurement of media pH.

The following biofilter operating parameters are required to be met under the TPL Resource Consent Conditions and have been implemented over the past year by TPL:

1) Inlet gas temperature to the biofilter shall generally not exceed 35°C;
2) Continuous measurement and display of differential pressure and temperature in the final duct prior to the biofilter. Temperature readings shall be recorded at least once per shift;
3) Moisture content shall be measured in the upper 2/3 layer of the biofilter every month;
4) pH shall be measured and recorded every two months; and
5) General visual assessment shall be carried out every two months, to include: weed growth, compaction, short circuiting.

[3] Jacobs NZ Ltd, *Taylor Preston Ltd 2017 Biofilter and Odour Extraction System Assessment*, 2017.

3.3 Biofilter Assessment Methodology

3.3.1 Sampling

A total of six test holes (test pits) were excavated by spade in the compost/bark media at selected locations across the biofilter. Each pit was excavated to a depth of 1000 mm below the surface of the bed. The media in each pit was visually assessed for moisture and compactness. Samples were collected from each location at 500 mm and 1000 mm below the bed surface. A plan showing the approximate locations of the sampling pits is presented as Appendix C.

Single samples were taken at each depth and the collected media were placed in sealable plastic bags. A total of twelve media samples were collected. Six randomly selected samples were selected to determine media size, moisture content, pH and biological activity. The collected samples (six) were held in a chillybin maintained at approximately 4°C before being couriered within 24 hours to Eurofins Environmental Laboratory Service (ELS). ELS extracted sub-samples from each of the six samples for the analysis discussed below.

3.3.2 Bio-filter media moisture

Moisture content assessment was carried out according to APHA 21st Edition Method 2540 B, AOAC 18th Edition 950.46 B(a) and LAS official test 3.1.3.

3.3.3 Media acidity (pH)

The pH of the sub samples was assessed using a Soil Suspension/pH Meter via ANZECC GUI 624.131.37 method.

3.3.4 Media micro-organism content

Total micro-organism viable counts (Aerobic Plate Count) was carried out using FDA-BAM 8th ed 1995, Ch. 3.

3.3.5 Media Size

The media size was assessed using ELS's manual in house sieving method by dry weight.

3.4 Results of Biofilter Assessment

3.4.1 Surface Observations

Air flow was also observed from the biofilter bed surface, and no significant rendering odour was detected from the biofilter surface. The flow into the biofilter was measured at 23,800 m^3/hr and the gas temperature was measured at 31°C. The bed of the biofilter was without weeds and appeared to provide even airflow across the surface.

3.4.2 Sampling Conditions

Biofilter sampling was conducted on 8th February between 10:00 and 11:00. The ambient temperature was approximately 20° C, the atmospheric pressure was 1023 mbar, and the skies were mostly sunny. The previous four days had been without rain.

3.4.3 Media Conditions

The media in all test holes displayed homogenous moisture, size, composition and density characteristics throughout the entire depth. The media removed for the test holes was laid outside the holes and photographed to document the condition of the media. The material appeared damp to the touch and the mixture of bark and compost was homogenous throughout. When squeezed in the hand the media readily crumbled after pressure was released. The media within all test holes had an earthy (aerobic) smell and did not clump when compressed in the hand. Visually, media particle size generally ranged from around 5 mm to relatively fine and did not contain excessive amounts of fine material.

Recorded observations of the biofilter media are provided in Table 2.

Table 2 Media Observation - Taylor Preston Biofilter 8 February 2018

Hole Location	Depth (mm)	Moisture Level (observational)[1]	Media Odour Level	Other Information
Surface	-	N/A	N/A	Loose and not compacted
1	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable
2	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable
3	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable
4	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable
5	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable
6	400	Damp	Earthy odour	Not compacted; friable
	800	Damp	Earthy odour	Not compacted; friable

[1]Dry refers to no apparent moisture, slightly damp refers to slight apparent moisture, damp refers to when the media is squeezed it leaves the hand moist but not wet (this is the recommended level of moisture), and wet refers to the media when squeezed leaves the hand wet.

3.4.4 Media Moisture Analysis

Table 3 provides analysis results of moisture content of the media samples. A copy of the laboratory report is provided as Appendix D.

Table 3 Media Moisture

ELS Lab Number	Sample Description	Moisture Content (%) Oven Dry Basis
18/6752-01	Hole 1 800mm	69
18/6752-02	Hole 2 400mm	70
18/6752-03	Hole 3 400mm	69
18/6752-04	Hole 4 800mm	71
18/6752-05	Hole 5 800mm	72
18/6752-06	Hole 6 400mm	70

The media moisture content analysis confirms the visual observations made during the site visit with all samples at the optimum moisture content. Moisture content was also shown to be consistent throughout the length and depth of the biofilter in terms of the samples collected. Moisture content is comparable to that observed in the 2017 assessment, and is within the recommended range[4] (40-80% oven dry basis) throughout the bed.

3.4.5 Media pH analysis

Table 4 present the results from laboratory testing of media pH from each of the six test holes. Higher acidity (lower pH) in biofilters may depress the microbiological activity and hence directly affects odour removal efficiency.

Table 4 Media Moisture

ELS Lab Number	Sample Description	pH
18/6752-01	Hole 1 800mm	4.5
18/6752-02	Hole 2 400mm	5.7
18/6752-03	Hole 3 400mm	5.5
18/6752-04	Hole 4 800mm	4.2
18/6752-05	Hole 5 800mm	4.8
18/6752-06	Hole 6 400mm	5.5

The media was found to be of acidic pH throughout. The recommended range of pH for microbiological activity for biofilters is between 6.5 and 8 pH units[5]. The pH was found to be within a similar range to what was measured in the 2017 assessment (4.2 – 5.7 pH units).

3.4.6 Media micro-organism content

Table 5 presents the results from laboratory testing of media micro-organism content from each of the six test holes.

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[4] Devinny et al. (1999)

[5] "Datta, I. and D. G. Allen, (2005) "Biofilter Technology", in Biotechnology for Odor and Air Pollution Control", Z. Shareefden and A. Singh (Ed), Springer-Verlag, 125-145

Table 5 Microbiological Activity of Media Samples

ELS Lab Number	Sample Description	Colony Forming Units (CFUs)
18/6752-01	Hole 1 800mm	77,000
18/6752-02	Hole 2 400mm	96,000
18/6752-03	Hole 3 400mm	85,000
18/6752-04	Hole 4 800mm	47,000
18/6752-05	Hole 5 800mm	58,000
18/6752-06	Hole 6 400mm	76,000

The biological activity in the biofilter media ranged from 47,000 to 96,000 colony forming units (cfu) per gram, with the samples being below the minimum recommended level of 100,000 cfu/g. The bacterial counts were on average below those measured in the 2017 assessment which were 49,000 to 12,000,000 cfu/g.

The level of biological activity observed is an indication that the biofilter media is providing an environment suitable for the growth and retention of microorganisms, although at a reduced level from previous years. We recommend that if the microbial activity continues to decline then additional measures to encourage microbial growth be taken, including increased addition of lime to raise the pH, and addition of NPK fertiliser to provide nutrients for microbial growth.

3.4.7 Size Analysis

Sieve analysis was undertaken to determine the various size fractions for the biofilter media. The results of this analysis are reported in Table 6. The samples of biofilter media indicated that size and composition were generally homogenous throughout the biofilter. The majority of media sampled (76% averaged over all six samples) lay within the 2 to 10mm size sieve range, with about 5.1% of the media being greater than 10mm and 19% being less than 2mm.

Table 6 Media Size Analysis Results

ELS Lab Number	Sample Description	Retained on Sieve (sieve size - % retained)
18/6752-01	Hole 1 800mm	19mm – <0.1 10mm – 38.7 8mm – 1.8 6mm – 15.5 4mm – 9.4 2mm – 14.7 0.5mm – 17.0 Base – 5.1
18/6752-02	Hole 2 400mm	19mm – 16.6 10mm – 36.3 8mm – 0.4 6mm – 13.3 4mm – 5.6 2mm – 11.7 0.5mm – 12.1 Base – 2.9
18/6752-03	Hole 3 400mm	19mm – 4.1 10mm – 43.6 8mm – 2.7 6mm – 17.9 4mm – 7.0 2mm – 9.6 0.5mm – 12.0 Base – 4.1
18/6752-04	Hole 4 800mm	19mm – 5.8 10mm – 19.6 8mm – 1.8 6mm – 26.8 4mm – 11.3 2mm – 18.2 0.5mm – 15.4 Base – 2.4
18/6752-05	Hole 5 800mm	19mm – 0.7 10mm – 26.8 8mm – 0.4 6mm – 22.3 4mm – 8.5 2mm – 16.9 0.5mm – 20.6 Base – 4.8

ELS Lab Number	Sample Description	Retained on Sieve (sieve size - % retained)
18/6752-06	Hole 6 400mm	19mm – 3.7 10mm – 39.5 8mm – 0.3 6mm – 15.0 4mm – 9.5 2mm – 12.9 0.5mm – 17.1 Base – 3.2

3.5 Conclusion and Recommendations

3.5.1 Conclusion

The biofilter was assessed as being in good working order overall, and is adequately treating odours from the rendering plant and other PSES locations.

The biofilter media was found to be acidic, although this is consistent with previous years' measurements and does not appear to be adversely affecting the odour treatment capacity of the biofilter. Microbial counts were lower than in previous years, and should be observed during future assessments to determine whether mitigation measures need to be implemented to encourage microbial growth.

Only minor odours were detected either from the biofilter or outside the rendering plant. The biofilter continues to be fit for the purpose of removing odour from the odour extraction gas stream, and is in good working order.

3.5.2 Recommendations

We recommend that the media be treated by addition of hydrated lime at an increased rate to raise pH. The lime should be mixed into the upper layer of media and watered down to allow penetration to the lower layers. Multiple applications of lime may be needed in order to adequately raise the pH to the recommended range, which should be confirmed by regular pH measurements.

The following measures already being implemented should continue to ensure the media's moisture and biological activity is maintained across the entire biofilter:

1) The relative humidity of the air following the humidification unit should be above 95%.
2) The level of watering of the media needs to be maintained in dry periods. The current programme for monitoring of media moisture content should be retained.
3) The surface of the bed should remain free from vegetation to ensure the media remains porous.
4) Regular monitoring and management of pH.
5) Addition of NPK or similar fertiliser should microbial counts continue to fall.