H1 Assessment to Support a Substantial Variation to Bespoke Installation at Herriard Bio Power Limited

On behalf of: Herriard Bio Power Limited, Bushywarren Lane, Herriard, Basingstoke, RG25 2NS

Prepared by:

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ETL813/2023

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15 December 2023

QUALITY CONTROL

Document Title:	**H1 Assessment to Support a Substantial Variation to Bespoke Installation at Herriard Bio Power Limited**
Revision:	V1.0
Date:	15 December 2023
Document Reference:	ETL813/H1/Final/V1.0/Dec 2023
Prepared For:	Herriard Bio Power Limited
Project Reference:	ETL813/2023
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Quality control sign off

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Abbreviations

AD	Anaerobic Digester
AEL	Associated Emissions Level
APIS	Air Pollution Information System
AQOIA	Air Quality and Odour Impact Assessment
BAT	Best Available Techniques
Defra	Department for the Environment, Food and Rural Affairs
EA	Environment Agency
ELV	Emission Limit Values
ETL	Earthcare Technical Ltd
kWe	kilowatts of electrical power
kWtho	kilowatts of thermal output
MCP	Medium Combustion Plant
PC	Process Contribution
PEC	Predicted Environmental Concentration
PVRV	Pressure and vacuum relief valve
RVEI	Road verges of ecological importance
SINCs	Sites of Importance for Nature Conservation
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TVOC	Total Volatile Organic Compounds

1 Introduction

1.1 Background

This H1 assessment (H1) has been prepared by Earthcare Technical Ltd (ETL) on behalf of Herriard Bio Power Limited, to support an application for a substantial variation to a bespoke waste operation permit for an anaerobic digestion (AD) plant, including the use of resultant biogas, at Herriard Bio Power Limited, Bushywarren Lane, Herriard, Basingstoke, RG25 2NS, herein termed 'the Site'. The plant is operated by Herriard Bio Power Limited, herein termed 'the Operator'.

An H1 risk assessment using the H1 tool, which is a conservative tool, is used to screen out the pollutants from the new emission sources that do not require further assessment. Pollutants that do not screen out would need to be considered in an Air Quality and Odour Impact Assessment (AQOIA) which would use detailed dispersion modelling.

The bespoke waste operation permit for the site was issued by the Environment Agency (EA) on 20 January 2014 (EPR/AB3807KW) under the Environmental Permitting Regulations 2010.[1] It permits no more than 36,500 tonnes a year (TPA) of waste to be accepted at the site, a biological treatment capacity of no more than 100 tonnes per day, and includes as emission points to air:

- 1,200kWe biogas-fuelled combined heat and power plant (CHP) (MWM TCG2020V12)
- biogas-fuelled flare
- pressure and vacuum relief valves (PVRVs) on the crop-fed primary digester and post digester.

The permit now requires updating to reflect the current and proposed infrastructure and to increase the maximum permitted quantity of waste to 40,000 TPA and a biological treatment capacity of over 100 tonnes per day. The current and planned infrastructure that is the subject of the substantial variation is herein termed the 'Proposed AD plant.'

The changes between the permit and this substantial variation with respect of emissions to air are:

- Replacement of UV odour control system in the Waste Reception Building with a woodchip biofilter which will exhaust from the top of the media bed, located outside the building, on the northeast side.
- Addition of a CHP (CHP2), the latest version of the 1,200kWe MWM TCG2020V12. CHP2 will become the 'duty' CHP and the existing CHP, (CHP1), will become the 'standby'. Each CHP will have a thermal input of 2,850kWthi.
- Replacement of the existing flare with a BAT Compliant Uniflare UF10-500-BGF Biogas Controlled Combustion Flare which can burn up to 500m^3/h of biogas and addition of a second flare, a Uniflare UF10-1000-BGF Biogas Controlled Combustion Flare which can burn up to 1,000m^3/h.
- Addition of an 414kWe emergency backup generator (Doosan P158LE). It is unlikely to run for more than 50h/yr, it will only run to provide power in the event of an emergency.

[1] The Environmental Permitting (England and Wales) (Amendment) Regulations 2018, Statutory Instrument 2010 No, 675, 10 March 2010.

- Remodelling of the single uncovered lagoon into two digestate lagoons (each 16,500m^3 capacity) with impermeable, floating covers. Any emissions from the vents on the lagoons will be channelled via pipework through two carbon filters in series before being discharged from a single lagoon vent.
- Installation of a new pasteuriser (180m^3) which will have a PVRV.
- Installation of a Pentair biogas upgrade plant (BUP) for production of biomethane for transport off site via virtual gas pipeline. The BUP is installed but currently vents carbon dioxide (CO_2) to atmosphere; it will be upgraded to include carbon capture and storage of CO_2 prior to dispatch for offsite use.
- Covering of the separator by a tent-like structure above and on three sides. The front will be open to allow access for tractors and trailers.
- PVRVs on:
    - Two new primary digesters (2,440m^3 capacity) treating food waste.
    - A new raw waste buffer tank (RWBT) of 452m^3 capacity with mixing and gas storage.

There are two new process water tanks (100m^3 each) which will hold process water only and do not require a PVRV.

The working face of the clamps, external feed hopper for crop feedstock, separator, leachate tank vent and lagoons vent have been considered as sources of odour.

Figure 1 shows the Site location and Figure 2 shows the emission points.

1.2 Site description

The Site is located to the south of Basingstoke, 3.9km at the nearest point from the M3 motorway which borders Basingstoke to the south; the centre of the Site is at approximate National Grid Reference (NGR) SU 65490 46638, as shown in Appendix A. The surrounding land use is agricultural and horticultural, grassland and woodland: ancient woodland that is partly semi-natural and partly replanted i.e. part deciduous and part coniferous.

The immediate surrounding area is sparsely populated however, Veolia Environmental Services' green waste composting site, Little Bushy Warren Composting Facility lies adjacent to the Site to the northeast. It is an open windrow composting facility accepting up to 100,000 TPA of green waste. It has an office block to the south of the site and employees may work across the site managing the windrows. A solar farm lies to the west of the Site. The nearest residential receptors lie in the village of Herriard, the centre of which lies approximately 1km to the southeast of the Site. The Site does not lie in or near to an Air Quality Management Area (AQMA). The nearest AQMA lies over 18km to the east, it is Waverley AQMA No.1 – Farnham in Waverley Borough Council area.

There are no Sites of Special Scientific Interest (SSSIs) within 2km of the Site; no Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites within 10km of the Site. There are 16 sites of Ancient Woodland (AW) within 2km of the Site including: Great Bushywarren Copse which lies to the south of the Site and partly within the Site boundary; Kingsmore, Allwood & Fryingdown Copses which lie approximately 60m away at the close point; Cowdray's Copse to the north; and Hen Wood to the northeast. There are also four road verges of ecological importance

(RVEI), and seven Sites of Importance for Nature Conservation (SINCs); RVEIs and SINCS are both categories of Local Wildlife Sites (LWSs).

1.3 Scope of report

This report describes: the assessment methodology and source data (section 2); the calculated impact (section 3); and concludes in section 4. Appendix A shows the H1 output tables and graphs.

2 Assessment Methodology

2.1 H1 Emissions to Air Screening Assessment

The H1 screening evaluation has been undertaken following H1 methodology, set out in Environment Agency (EA) guidance[2] and using the EA H1 Assessment Tool v2.78 which was supplied on request. The spreadsheet version of H1, (v8[3]) has not been used as it has been found to have operational issues, such as returning zero values of short-term impacts. As both versions of the tool produce the same results (when operating correctly), v2.78 has been used.

2.2 Assessment Criteria

2.2.1 Air Quality Standards and Critical Levels – Human Health

Table 1 sets out those Air quality strategy (AQS) objectives, Ambient Air Directive (AAD) Limit Values and Environmental Assessment Levels (EALs) for the protection of human health that are relevant to this assessment in determining receptor exposure. In the H1 Assessment Tool these are all referred to as EALs.

There are no EALs for TVOC but there is an EAL for benzene which is one of the volatile organic compounds emitted. TVOC from combustion sources has been modelled as 10% benzene.[4]

Table 1 Air Quality Standards for human health

Substance	Emission period	Limit (average)	Standard	Exceedances[1]
Ammonia	1 hour	2,500µg/m^3	EAL	None
Ammonia	Annual	180µg/m^3	EAL	None
Benzene	24 hour	30µg/m^3	EAL	None
Benzene	Annual	5µg/m^3	AAD Limit Value and AQS Objective	None
Carbon monoxide	8 hour running average across a 24-hour period	10,000µg/m^3	AAD Limit Value	None
Hydrogen sulphide	1 hour	150µg/m^3	EAL	None
Hydrogen sulphide	Annual	140µg/m^3	EAL	None
Nitrogen dioxide	1 hour	200µg/m^3	AAD Limit Value	Up to 18 1-hour periods

[2] Environment Agency and Department for Environment, Food & Rural Affairs, Air emissions risk assessment for your environmental permit, Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed 14 December 2023]

[3] Atmospheric Dispersion Modelling Liaison Committee, H1 Risk Assessment Tool, Available at: https://admlc.com/h1-tool/ [Accessed 14 December 2023]

[4] N R Passant (2002) Speciation of UK emissions of non-methane volatile organic compounds. Reference: AEAT/ENV/R/0545 Issue 1

Substance	Emission period	Limit (average)	Standard	Exceedances[1]
Nitrogen dioxide	Annual	40µg/m^3	AAD Limit Value	None
Sulphur dioxide	15 minutes	266µg/m^3	UK AQS Objective	Up to 35 15-minute periods
Sulphur dioxide	1 hour	350µg/m^3	AAD Limit Value	Up to 24 1-hour periods
Sulphur dioxide	24 hour	125µg/m^3	AAD Limit Value	Up to 3 24-hour periods
Notes: AQS taken from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]number of times a year that you can exceed the limit				

The AQS objectives and AAD Limit Values for the protection of vegetation and ecosystems applicable to this assessment are presented in Table 2.

Table 2 Environmental standards for protected conservation areas

Substance	Target	Emission period
Sulphur dioxide[1]	10µg/m^3 where lichens or bryophytes are present 20µg/m^3 where they are not present	Annual
Nitrogen oxides (expressed as nitrogen dioxide)[2]	30µg/m^3	Annual
Nitrogen oxides (expressed as nitrogen dioxide)	75µg/m^3 200µg/m^3 for detailed assessments where the ozone is below the AOT40[5] critical level and sulphur dioxide is below the lower critical level of 10µg/m^3	Daily
Notes: from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]20µg/m^3 is an AAD Limit Value if you have nature or conservation sites in the area; [2]30µg/m^3 is an AAD Limit Value		

2.3 Environment Agency Risk Assessment Guidance

The current evaluation is based on EA risk assessment guidance[2] to determine the significance of the predicted impact. The guidance provides screening criteria for quantifying the environmental impacts of emissions to air. The criteria include long and short-term Environmental Assessment Levels (EALs).

The guidance considers initial H1 screening and then detailed modelling. At the initial screening stage, **Step 1**, long-term and short-term concentrations due to the sources entered, referred to as the Process Contribution (PC) can be screened out from further assessment if:

[5] The sum of difference between hourly ozone concentration and 40ppb for each hour when the concentration exceeds 40ppb during a relevant growing season (May to July) averaged over five years Available at: AOT40 — European Environment Agency (europa.eu) [Accessed 14 December 2023]

- the short-term PC is less than 10% of the short-term environmental standard, and
- the long-term PC is less than 1% of the long-term environmental standard.

The second stage of screening, **Step 2**, considers the background concentration as well as the PC. The Predicted Environmental Concentration (PEC) is the sum of the PC and background concentration. A further assessment is not needed if:

- for human receptors only, the short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration i.e., less than 20% of the 'Headroom', and
- the long-term PEC is less than 70% of the long-term environmental standards.

In accordance with the guidance, it is not necessary to calculate PEC for short-term targets. For an ecological receptor, if the short-term PC exceeds 10% of the EAL, detailed modelling is required. If the PC cannot be screened out on that basis, the guidance outlines further steps, including detailed modelling, which may lead to a requirement to carry out a cost-benefit analysis.

For odour there is no EAL. Environment Agency H4 Odour Management guidance[6] sets out benchmark odour criteria based on the 98th percentile of hourly mean concentrations of odour modelled over a year at a site boundary, that is the benchmarks are odour concentrations that may be exceeded during 2% of hours. The benchmark of 3.0 ou_E/m^3 for "moderately offensive" odours e.g. intensive livestock rearing, well-aerated green composting, sugar beet processing, has been entered into H1 as a user-defined 'EAL'.

2.4 H1 Inputs – Process Emissions

The following sources have been modelled in H1; the percentage of hours operation is given in brackets:

- CHP1, the duty CHP (100%)
- CHP2, the standby CHP (5% at 80% load)
- Emergency flare 1 (10%)
- Emergency Flare 2 (10%)
- Biofilter exhaust (100%)
- Lagoon vent (100%)
- Leachate tank vent (100%)

Table 6 summarises the sources entered into the H1 assessment tool, their effective height, exit velocity and volume flow rates.

The standby generator would be used as an emergency backup only and as such has not been part of the quantitative screening assessment. Odour emissions from the working face of the clamps and the external feed hopper, and odour and ammonia emissions from the Separator and have not been

[6] Environment Agency (March 2011) Technical Guidance Note H4 - Odour Management. How to comply with your environmental permit

included in H1 as they fugitive-type emissions best represented as volume sources which is not possible in H1. It is anticipated that the outcome of the H1 assessment will be that an AQOIA will be required for the Site and modelling of those sources would be included at that stage.

The effective stack height of each source is 0m as each stack is close to a building taller than the source height: the Waste Reception Building rises to 12.4m at the apex and the digesters and post-digester rise to 13m at the maximum point.

Tables 2.3 to 2.6 shows the source and emissions data entered into H1. While the exact plant has not been finalised at this stage, representative data have been used in this assessment. Manufacturer technical specifications used are given in Appendix D to Appendix H.

Background concentration data has been obtained from Defra background mapped data[7] projected to 2023 for human receptors, and from the APIS website[8] for ecological receptors.

2.2.1 Sources and emissions

Emissions from the CHPs were assumed to meet the Medium Combustion Plant (MCP) Directive emission limit values (ELVs) for NOx and SO_2, and, for the CHP, BAT-AELs[9] for CO and TVOC (Table 3). Source and emission data for the two emergency flares is given in Table 4.

The biofilter exhaust is expected to achieve the Best Available Techniques (BAT) associated emission levels (AELs) for the waste treatment sector, BAT-AEL[9] of 1,000ou_E/m^3 for odour (Table 5). Exhaust concentrations of NH_3 and H_2S are a conservative estimate based on monitored emissions inside the Waste Reception Building before abatement (Appendix B) and biofilter outlet monitoring data from a comparable site processing a similar tonnage of food waste within a similarly sized building[10]: NH_3 <0.5ppm; H_2S <0.2 ppm. The NH_3 concentration of 0.5ppm (0.6mg/m^3) meets the BAT-AEL of 0.3-20mg/m^3 for channelled emissions. Concentrations are low for food waste whether delivered in bulk or packaged, compared to for instance if manure were being stored.

The lagoon vent has been assumed to have a height of 3m, diameter of 0.1m and exit velocity of 0.4m/s; it has been modelled as a point source (Table 5). An odour concentration of 10,000ou_E/m^3 before abatement has been assumed.[11] Emissions of NH_3 before abatement have been calculated using the total nitrogen of the digestate, 5.5kg total N/t (Appendix C, digestate analysis for Herriard AD plant) and an emission rate of 0.0266 kg NH_3/kg N from EMEP/EEA.[12] Emissions will pass through carbon filters between the lagoons and the lagoon vent. The carbon filters, filled with activated carbon/charcoal resin, has been assumed to reduce odour and NH_3 emissions by 95%.

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[7] Defra, Background Maps, Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html [Accessed 20 November 2023]

[8] Air Pollution Information System, Available at www.apis.ac.uk, [Accessed 20 November 2023]

[9] Environment Agency (21 September 2022) Biological waste treatment: appropriate measures for permitted facilities. Available at: https://www.gov.uk/guidance/biological-waste-treatment-appropriate-measures-for-permitted-facilities/1-when-appropriate-measures-apply

[10] Confidential correspondence with ETL.

[11] Smith S. (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire, AS Modelling & Data Ltd, 19 September 2017

[12] EEA/EMEP (2019) Emissions Guidebook, NFR 5.B.2, Biological treatment of waste – anaerobic digestion at biogas facilities

The leachate tank has a maximum cross-sectional area of 76.4m^2 (2.1m x 36.4m) and passively vents at ground level via a grate approximately 0.3m x 0.6m, which has been modelled as an equivalent point source (0.48m diameter) with a low emission velocity (0.1m/s) (Table 5). The odour and NH_3 emission rates have been calculated on the same basis as those from the lagoon, with an 80% reduction has been assumed as the tanks will hold leachate rather than slurry.

Table 3 Point sources: CHP1 at 80% load and CHP2 at full load

Parameter	Units	CHP 1[1] (80%)	CHP 2[2] (100%)
Electrical output	kWe	960	1,200
Thermal input	kWthi	2,330	2,850
Location	NGR (X,Y)	465434, 146688	465444, 146693
Stack height	m	7	7
Internal diameter at stack exit	m	0.35	0.35
Volume flow rate (dry)	Nm^3/s	0.84	1.04
Volume flow rate (wet)	Am^3/s	1.94	2.41
Velocity	m/s	20.1	25.1
Temperature	°C	180	180
Exit concentration SO_2	mg/Nm^3	350 (ELV, 5% O2)	107 (ELV, 5% O2)
Exit concentration TVOC	mg/Nm^3	1,000 (ELV, 5% O2)	1,000 (ELV, 5% O2)
Exit concentration NOx	mg/Nm^3	500 (ELV, 5% O2)	500 (ELV, 5% O2)
Exit concentration CO	mg/Nm^3	1,400 (ELV, 5% O2)	1,400 (ELV, 5% O2)
Emission rate SO_2	g/s	0.293	0.112
Emission rate TVOC	g/s	0.837	1.042
Emission rate NOx	g/s	0.418	0.521
Emission rate CO	g/s	1.172	1.459

Notes:

[1]CHP1, MWM TCG2020V12, 1,200kWe engine (Appendix D) in a dedicated sound proofed container. Emissions will meet the limit set in the current permit of 130mg/Nm^3 of SO_2 (dry gas, 273K, 15% O_2) which is equivalent to 350mg/Nm^3 (dry gas, 273K, 5% O_2).

[2]CHP2, MWM TCG2020V12, 1,200kWe engine (Appendix D) in a dedicated sound proofed container. Emissions will meet the MCPD limit of 40mg/Nm^3 of SO_2 (dry gas, 273K, 15% O_2) which is equivalent to 107mg/Nm^3 (dry gas, 273K, 5% O_2).

Table 4 Emergency flares

Parameter	Units	Emergency Flare 1[1]	Emergency Flare 2[2]
Location	NGR (X,Y)	465437, 1467114	65428, 146709
Stack height	m	7.67	7.67
Internal diameter at stack exit	m	1.183[3]	1.673[3]
Volume flow rate (dry)	Nm^3/s	1.10	2.21
Volume flow rate (wet)	Am^3/s	12.64	25.28
Velocity	m/s	11.5	11.5
Temperature	°C	1,000	1,000
Exit concentration TVOC	mg/Nm^3	10 (3% O_2)	10 (3% O_2)
Exit concentration NOx	mg/Nm^3	100 (3% O_2)	100 (3% O_2)
Exit concentration CO	mg/Nm^3	50 (3% O_2)	50 (3% O_2)
Emission rate TVOC	g/s	0.011	0.022
Emission rate NOx	g/s	0.110	0.221
Emission rate CO	g/s	0.055	0.110

Notes:
[1]Uniflare UF10-500-BGF Biogas Controlled Combustion Flare, Job no. 1836, 29/9/2022 (Appendix E) with maximum biogas flow rate of 500Nm^3/h. Emission rates shown are for continuous operation; for long-term impact it has been assumed the flare will operate for a maximum of 10% of the time.
[2]Uniflare UF10-1000-BGF Biogas Controlled Combustion Flare, Job no. 1837, 29/9/2022 (Appendix F) with maximum biogas flow rate of 1,000Nm^3/h. Emission rates shown are for continuous operation; for long-term impact it has been assumed the flare will operate for a maximum of 10% of the time.
[3]Hot face diameter

Table 5 Biofilter (area), lagoon vent and leachate tank vent

Parameter	Units	Biofilter exhaust[1]	Lagoon vent[3]	Leachate tank vent[4]
Location	NGR (X,Y)	Centred at 465394, 146686	465469, 146539	465452, 146620
Emission height	m	3.6	3	0
Diameter	m	-	0.1	0.48 (equivalent)
Emission area	m^2	56.7 (10.5 x 5.4)	0.0079	0.18
Volume flow rate (wet)	m^3/s	5.647	0.003	0.018
Velocity	m/s	0.1	0.4	0.1
Temperature	°C	15, modelled as 'Ambient'	Ambient	Ambient
Exit concentration H_2S	mg/Nm^3	0.288 (0.2 ppm)	-	-
Exit concentration NH_3	mg/Nm^3	0.36 (0.5 ppm)	987	$1.41x10^{-3}$
Exit concentration Odour	ou_E/Nm^3	1,000[2]	500	2,000
Emission rate H_2S	g/s	0.0016	-	-
Emission rate NH_3	g/s	0.0020	$3.1x10^{-3}$	$2.54x10^{-5}$
Emission rate Odour	ou_E/s	5,647	6.28	36

Notes:
n/a: not applicable
[1]Mike Thompson Ltd, Biofilter Manual – V3 MTP, Job No: RKEBW21-01, Report Issue: December 2021 (Appendix G)
Exit concentrations for NH_3 and H_2S are a conservative estimate based on monitored emissions in the Waste Reception Building (Appendix B) and biofilter outlet data from a comparable site.[10]
[2]BAT AEL for channelled emissions.
[3]Aquaspira Undertank, drawing (Appendix H). A diameter of 0.1m has been assumed and an exhaust velocity of 0.4m/s.
[4]Exit concentrations not given as the emission is assumed to be passive i.e. modelled with zero velocity/volume flow rate.

3 Impact Assessment

Output tables from the H1 Assessment Tool are shown in Appendix A, Tables 6 to 8.

Air Impact Screening, Stage 1

Table 6 shows the long-term and short-term PCs and EALs for each pollutant. In Table 7 the long-term and short-term PCs calculated by the H1 Assessment Tool are compared with the EAL. All pollutant-EAL combinations 'fail' at Stage 1 except the hydrogen sulphide and ammonia EALs for human health which are not considered at Stage 1.

Air Impact Screening, Stage 2

In Table 8 the long-term PECs are compared with the EALs and the short-term PCs are compared with Headroom (EAL minus twice the long-term background concentration). None of the pollutant-EALs assessed at Stage 2 'pass' the screening threshold.

Summary

Those pollutant-EALs which failed at Stage 2 require further assessment and have been assessed using detailed modelling. Those requiring further assessment are:

- Nitrogen Dioxide
- Nitrogen Dioxide (Ecological - Daily Mean)
- Carbon monoxide (8h mean)
- TVOCs (as Benzene)
- Sulphur Dioxide (15 Min Mean)
- Sulphur Dioxide (1 Hour Mean)
- Sulphur Dioxide (24 Hour Mean)
- Sulphur Dioxide (Ecological - Sensitive Lichens)
- Sulphur Dioxide (Other Ecology)
- Ammonia (Ecological - Sensitive Lichens)

Odour was a user-defined pollutant in H1 and an 'EAL' of $3ou_E/m^3$ was specified. Odour was identified as requiring further assessment.

The detailed modelling is reported in the AQOIA[13] prepared to support the application for a substantial variation to a bespoke waste operation permit.

[13] Earthcare Technical Ltd. (2023) Air Quality and Odour Impact Assessment to Support a Substantial Variation to Bespoke Installation at Herriard Bio Power Limited, ETL813/AQOIA/Finalt/V1.0/Dec 2023

4 Conclusion

This H1 Assessment has been completed to assess whether the air quality impact of the proposed AD plant at the Site can be screened out of further assessment as part of an application for a substantial variation to a bespoke waste operation permit for an AD plant, including the use of resultant biogas. The existing permit now requires updating to reflect the current and proposed infrastructure and to increase the maximum permitted quantity of waste to 40,000 TPA and a biological treatment capacity of over 100 tonnes per day.

The H1 Assessment Tool v2.78 was used for quantitative assessment of all point and area sources on the Site; the standby generator would be used as an emergency backup only and as such has not been part of the quantitative screening assessment.

Stage 1 of the assessment compared the long-term and short-term PCs calculated by the H1 Assessment Tool with the relevant EALs; all pollutant-EAL combinations were found to 'fail' Test 1.

Stage 2 compared the long-term PECs are compared with the EALs and the short-term PCs with Headroom (EAL minus twice the long-term background concentration). All of the pollutant-EALs assessed at Stage 2 'fail' the screening threshold.

The pollutant-EALs which require further assessment are:

- Nitrogen Dioxide
- Nitrogen Dioxide (Ecological - Daily Mean)
- Carbon monoxide (8h mean)
- TVOCs (as Benzene)
- Sulphur Dioxide (15 Min Mean)
- Sulphur Dioxide (1 Hour Mean)
- Sulphur Dioxide (24 Hour Mean)
- Sulphur Dioxide (Ecological - Sensitive Lichens)
- Sulphur Dioxide (Other Ecology)
- Ammonia (Ecological - Sensitive Lichens)

Odour was a user-defined pollutant in H1 and an 'EAL' of $3ou_E/m^3$ was specified. Odour was identified as requiring further assessment.

The further assessment using detailed modelling is reported in the AQOIA[13] prepared to support the application for a substantial variation to a bespoke waste operation permit.

Figures

Figure 1 AD Plant permit boundary with CHP and boiler locations

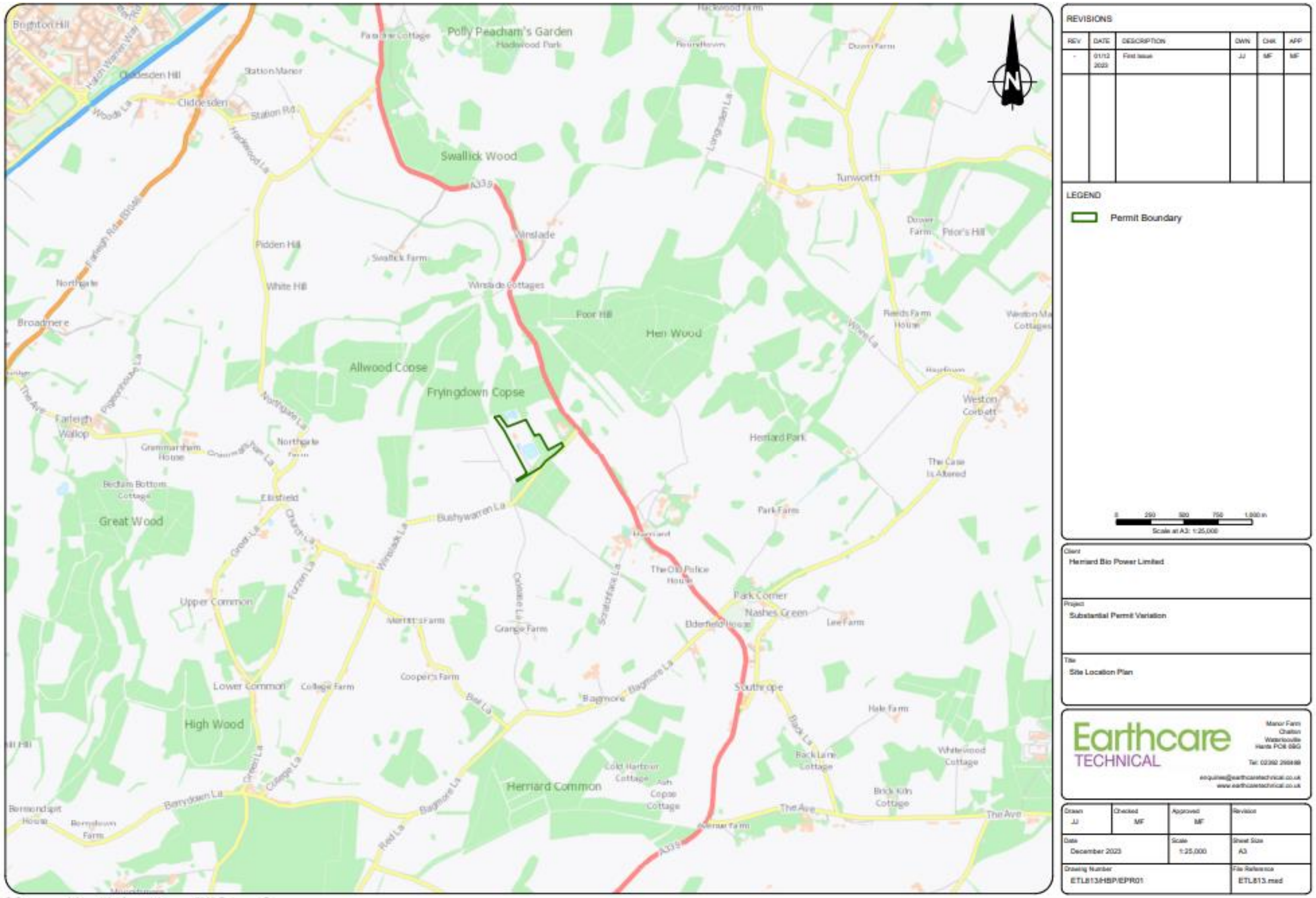
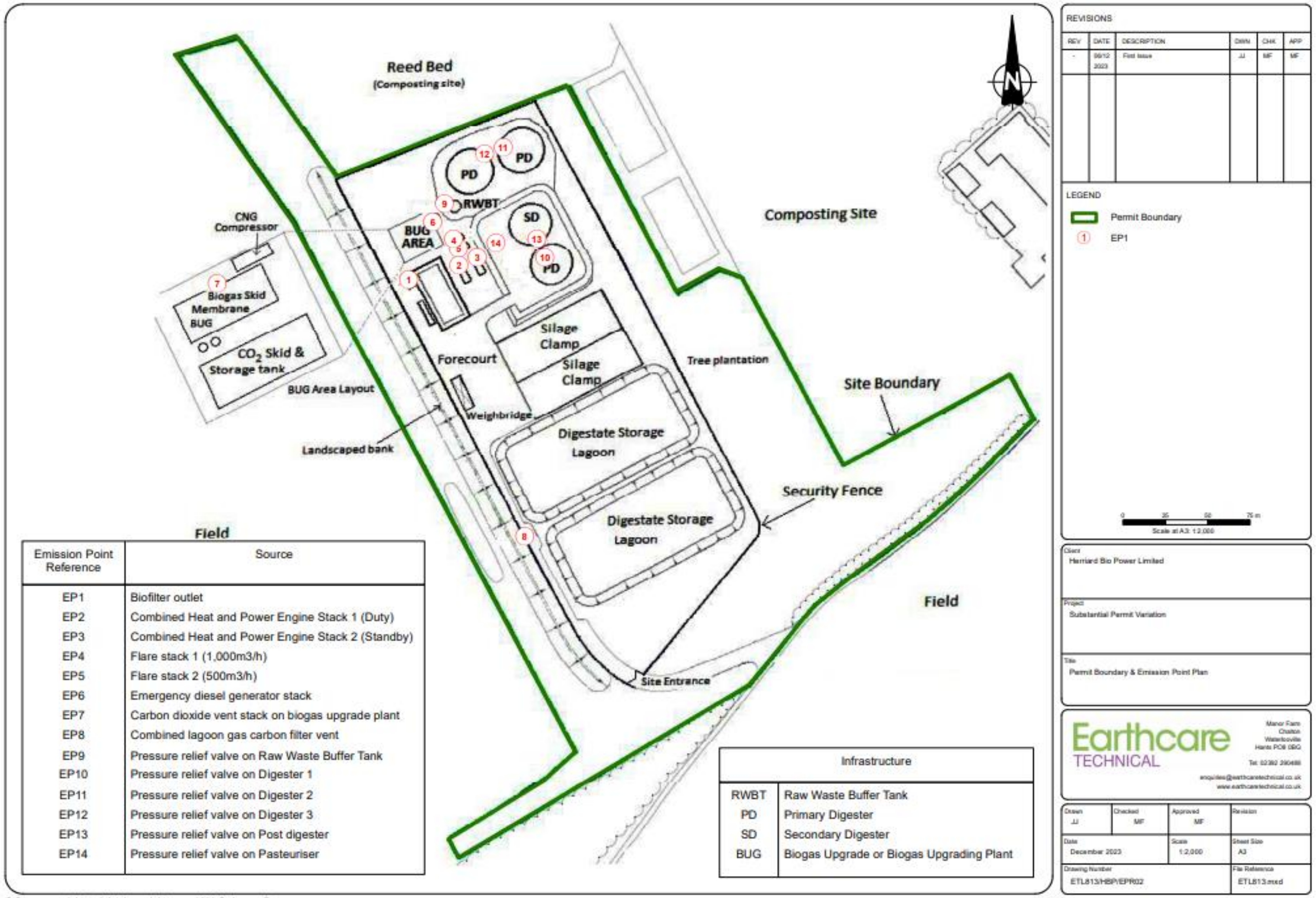


Figure 2 Emission points



Emission Point Reference	Source
EP1	Biofilter outlet
EP2	Combined Heat and Power Engine Stack 1 (Duty)
EP3	Combined Heat and Power Engine Stack 2 (Standby)
EP4	Flare stack 1 (1,000m3/h)
EP5	Flare stack 2 (500m3/h)
EP6	Emergency diesel generator stack
EP7	Carbon dioxide vent stack on biogas upgrade plant
EP8	Combined lagoon gas carbon filter vent
EP9	Pressure relief valve on Raw Waste Buffer Tank
EP10	Pressure relief valve on Digester 1
EP11	Pressure relief valve on Digester 2
EP12	Pressure relief valve on Digester 3
EP13	Pressure relief valve on Post digester
EP14	Pressure relief valve on Pasteuriser

Infrastructure	
RWBT	Raw Waste Buffer Tank
PD	Primary Digester
SD	Secondary Digester
BUG	Biogas Upgrade or Biogas Upgrading Plant

Appendix A H1 Assessment tool input and output

Table 6 Sources entered into the H1 assessment tool

Air Release Points

Please define your Release Points for Releases to Air

Are there any Air emissions? Yes Click the Add button below

Number	Description	Location or Grid Reference	Activity or Activities	Effective Height metres	Efflux Velocity m/s	Total Flow m3/hr
e.g.	A1	North stack		150	25	5,000
1	CHP2	CHP2 duty CHP	heat & power	0	25.1	3752
2	CHP1	CHP1 standby CHP	heat & power	0	20.1	3013
3	Flare1	Emergency flare 1	burn waste gas	0	11.5	3974
4	Flare2	Emergency flare 2	burn waste gas	0	11.5	7949
5	Biofilter	Biofilter exhaust	exhaust after WRB abatement	0	0.1	20331
6	Lagoon vent	Lagoon vent	exhaust after lagoon abatement	0	0.4	11.31
7	Leachate tank vent	Leachate tank vent	vent from leachate tank	0	0.1	64.8

Table 7 Calculated process contributions

Air Impacts

Calculate Process Contributions of Emissions to Air

This table estimates the Process Contribution (PC), calculated as the maximum ground level concentration for each emission listed in the inventory, according to the release point parameters input earlier. If you have more accurate data obtained through dispersion modelling, this may be entered as indicated and will be used instead of the estimated PC.

		Long Term			Short Term		
Number	Substance	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3	EAL µg/m3	PC µg/m3	* Modelled PC µg/m3
1	Sulphur Dioxide (15 Min Mean)		18.7		266	1,577	
1	Odour	3000000	841,390		3000000	22,171,776	
2	Sulphur Dioxide (1 Hour Mean)		18.7		350	1,577	
2	Hydrogen sulphide	140	0.241		150	6.35	
3	Sulphur Dioxide (24 Hour Mean)		18.7		125	1,577	
3	Ammonia (ecological receptor - Sensitive Lichens)	1	0.760			20.0	
4	Sulphur Dioxide (Ecological - Sensitive Lichens)	10	18.7			1,577	
4	Ammonia (human health receptor)	180	0.760		2500	20.0	
5	Sulphur Dioxide (Other Ecology)	20	18.7			1,577	
6	Benzene	5	161		195	7,458	
7	Nitrogen Dioxide	40	85.2		200	4,956	
8	Nitrogen Dioxide (Ecological - Daily Mean)	30	85.2		75	4,956	
9	Carbon monoxide		227		10000	10,906	

Table 8 Results of Stage 1

Air Impact Screening Stage One

Screen out Insignificant Emissions to Air

This page displays the Process Contribution as a proportion of the EAL or EQS. Emissions with PCs that are less than the criteria indicated may be screened from further assessment as they are likely to have an insignificant impact.

Number	Substance	Long Term EAL	Short Term EAL	Long Term PC	Long Term % PC of EAL	Long Term > 1% of EAL?	Short Term PC	Short Term % PC of EAL	Short Term > 10% of EAL?
		µg/m3	µg/m3	µg/m3	%		µg/m3	%	
1	Sulphur Dioxide (15	-	266	18.7	-		1,577	593	**Yes**
1	Odour	3,000,000	3,000,000	841,390	28.0	**Yes**	22,171,776	739	**Yes**
2	Sulphur Dioxide (1 H	-	350	18.7	-		1,577	451	**Yes**
2	Hydrogen sulphide	140	150	0.241	0.172	**No**	6.35	4.23	**No**
3	Sulphur Dioxide (24 I	-	125	18.7	-		1,577	1,262	**Yes**
3	Ammonia (ecological	1.000	-	0.760	76.0	**Yes**	20.0	-	
4	Sulphur Dioxide (Ecc	10.00	-	18.7	187	**Yes**	1,577	-	
4	Ammonia (human he	180	2,500	0.760	0.423	**No**	20.0	0.801	**No**
5	Sulphur Dioxide (Oth	20.0	-	18.7	93.4	**Yes**	1,577	-	
6	Benzene	5.00	195	161	3,219	**Yes**	7,458	3,825	**Yes**
7	Nitrogen Dioxide	40.0	200	85.2	213	**Yes**	4,956	2,478	**Yes**
8	Nitrogen Dioxide (Ec	30.0	75.0	85.2	284	**Yes**	4,956	6,608	**Yes**
9	Carbon monoxide	-	10,000	227	-		10,906	109	**Yes**

Table 9 Results of Stage 2

Air Impact Modelling Stage Two Screening

Identify need for Detailed Modelling of Emissions to Air

This page displays the Process Contributions in relation to the backgound pollutant levels and the EAL or EQS. You should use this information to decide whether to conduct detailed modelling. Note that releases that are insignificant are not shown as they are screened from further assessment.
Also complete this page if you have already done detailed modelling.

			Long Term					Short Term		
Number	Substance	Air Bkgrnd Conc. µg/m3	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	PEC mg/m3	% PEC of EAL %	% PEC of EAL >=70?	PC µg/m3	% PC of headroom (EAL - Bkgrnd)	% PC of headroom >=20?
	e.g.	12								
1	Sulphur Dioxide (15 Min Mean)	2.38	18.7	-	0	-		1,577	604	Yes
1	Odour	0	841,390	28.0	841,390	28.0	No	22,171,776	739	Yes
2	Sulphur Dioxide (1 Hour Mean)	2.38	18.7	-	0	-		1,577	457	Yes
3	Sulphur Dioxide (24 Hour Mean)	2.38	18.7	-	0	-		1,577	1,312	Yes
3	Ammonia (ecological receptor - Sensitive Lichen:	1.4	0.760	-190	2.16	216	Yes	20.0	-	
4	Sulphur Dioxide (Ecological - Sensitive Lichens)	0.8	18.7	203	19.5	195	Yes	1,577	-	
5	Sulphur Dioxide (Other Ecology)	0.8	18.7	97.3	19.5	97.4	Yes	1,577	-	
6	Benzene	0.18	161	3,339	161	3,222	Yes	7,458	3,832	Yes
7	Nitrogen Dioxide	7.4	85.2	261	92.6	231	Yes	4,956	2,676	Yes
8	Nitrogen Dioxide (Ecological - Daily Mean)	9.5	85.2	415	94.7	315	Yes	4,956	8,850	Yes
9	Carbon monoxide	111	227	-	0	-		10,906	112	Yes

Appendix B Waste Reception Building concentration monitoring

From Odour Data to Odour Knowledge

Ammonia (NH_3) report - results of NH_3 concentration analysis

This report summarises the results of the NH_3 concentration analysis performed at Olfasense's odour laboratory, performed by Olfasense staff.

The following table presents the results of NH_3 concentration analysis.

Table 1: NH_3 concentration results

Analyser used :	Gastec GM36 3L	Project Code:	REDM21C
Client Reference	OSUK Analysis File	NH_3 concentration (ppm)	Date of measurement
1	210803AGP	<0.5	04/08/21
2	210803BGP	<0.5	04/08/21
3	210803CGP	<0.5	04/08/21

From Odour Data to Odour Knowledge

Hydrogen Sulphide (H_2S) report - results of H_2S analysis

This report summarises the results of the H_2S concentration analysis performed at Olfasense's odour laboratory, performed by Olfasense staff.

The following table presents the results of H_2S analysis.

Table 1: Hydrogen sulphide concentration results

Analyser used :	Jerome GM01	Project Code:	REDM21C
Client Reference	OSUK Analysis File	H_2S concentration (ppm)	Date of measurement
1	210803AGP	0.069	04/08/21
2	210803BGP	0.074	04/08/21
3	210803CGP	0.047	04/08/21

Appendix C Digestate analysis

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: HERRIARD BIOPOWER
SEPARATED LIQUOR

Lab ID: 72388 - 137656
Sample ID: HBSL160523
Sample Type: Separated Liquor

Certification Code: HER-HER-SL
BCS Number: BCS1214C59
Plant / Site Name: Herriard

Date Received: 17/05/2023
Date Reported: 19/06/2023
Date Sampled: 16/05/2023

Potentially Toxic Elements in WD / SL / SF, on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Cadmium (Cd)	mg/kg	0.02	0.72 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Chromium (Cr)	mg/kg	0.32	48 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Copper (Cu)	mg/kg	1.66	96 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Lead (Pb)	mg/kg	<0.5	96 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Mercury (Hg)	mg/kg	<0.05	0.48 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Nickel (Ni)	mg/kg	0.49	24 mg / kg	Y	BS EN 15587 (soluble in aqua regia)
Zinc	mg/kg	8.36	192 mg / kg	Y	BS EN 15587 (soluble in aqua regia)

Stability of WD / SL / SF on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Volatile Fatty Acids	g COD / g VS	0.10	0.774 g VS	Y	Chromatography
Residual Biogas Potential	l / g VS	0.21	0.45 l / g VS	Y	OFW004-005 (WRAP)

Parameter	Units	Digestate Result *	QC Result **	Inoculum Result ***
RBP 1st Replicate	l / g VS	0.22	0.62	0.06
RBP 2nd Replicate	l / g VS	0.21	0.65	0.06
RBP 3rd Replicate	l / g VS	0.20	0.66	0.06

28 day plot of biogas results for sample, inoculum and QC can be emailed as a PDF file on request.
VFAs expressed as COD equivalent. Used as a pre-screening method: high VFA concentration indicates high potential biodegradability.
Samples with VFA concentrations above 0.774 g COD / g VS are expected to fail on RBP.
Test is valid as no spikes or inconsistencies were observed, the plots were smooth for all replicates.
All quality control criteria have been met.

* The digestate RBP is allowed to be negative only during the first 5 days of the test.
** The reference material RBP is allowed to be negative only during the first 5 days of the test. The 28-day RBP of the reference material should exceed 0.5 l/g VS
*** The inoculum control should produce a measurable volume of biogas over the 28 day period.

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis (Continued)

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: HERRIARD BIOPOWER SEPARATED LIQUOR

Lab ID: 72388 - 137656
Sample ID: HBSL160523
Sample Type: Separated Liquor

Certification Code: HER-HER-SL
BCS Number: BCS1214C59
Plant / Site Name: Herriard

Date Received: 17/05/2023
Date Reported: 19/06/2023
Date Sampled: 16/05/2023

Physical contaminants in WD / SL / SF on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Plastics > 2mm	kg / t	0.062			NRM-SOP-JAS-497
Glass > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Metals > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Other > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Total > 2mm	kg / t	0.062	0.22 kg / t	Y*	NRM-SOP-JAS-497
of which Sharps:	kg / t	Zero	Zero in sample tested	Y	NRM-SOP-JAS-497
Stones > 5mm	kg / t	Zero	19.2 kg / t		NRM-SOP-JAS-497

Zero - No visible contaminants were found in the sample as submitted

The sample was dispatched within one day of sampling
The sample was received within 24 hours of dispatch (48 for extreme geographical locations)
The sample was received within 72 hours of dispatch.
The sample was received in a cool box with ice packs

Released by: *Daniel Petty* **Date: 19/06/2023**

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis (Continued)

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: HERRIARD BIOPOWER
SEPARATED LIQUOR

Lab ID: 72388 - 137656
Sample ID: HBSL160523
Sample Type: Separated Liquor

Certification Code: HER-HER-SL
BCS Number: BCS1214C59
Plant / Site Name: Herriard

Date Received: 17/05/2023
Date Reported: 19/06/2023
Date Sampled: 16/05/2023

Characteristics of WD / SL / SF for declaration, without limit values, that influence application rates
(Results on an 'as received' basis)

Parameter	Units	Result	M *	Amount per fresh tonne or m^3	Amount applied at an equivalent total Nitrogen application of 250 kg N/ha	Units
pH		8.8	1			
Oven Dry Matter	% m/m	4.34	2	43.40	2127	Kg DM
Loss On Ignition	% m/m	3.04	3	30.40	1490	Kg OM
Total Kjeldahl Nitrogen (N)	% m/m	0.51	4	5.10	250	Kg N
Ammoniacal Nitrogen (NH4-N)	mg/kg	3341	5	3.34	163.78	Kg NH4-N
Total Phosphorus (P)	mg/kg	710	6	1.63	79.70	Kg P2O5
Total Potassium (K)	mg/kg	2512	6	3.01	147.77	Kg K2O
Total Magnesium (Mg)	mg/kg	162	6	0.27	13.18	Kg MgO
Total Sulphur (S)	mg/kg	365	6	0.91	44.73	Kg SO3
Equivalent field application rate		——		1.00	49.02	tonnes or m^3 / ha

*** Method of Test**

1 BS EN 13037
2 BS EN 14346
3 BS EN 15169
4 BS EN 13654-1 (Kjeldahl)
5 Sciantec SOP S1162 (Kjeldahl)
6 BS EN 15587 (soluble in aqua regia)

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis (Continued)

Client:	MICHAL ANTOS	**Originator:**	HERRIARD BIOPOWER
(P427)	HERRIARD BIOPOWER LTD		SEPARATED LIQUOR
	BUSHYWARREN LANE		
	HERRIARD		
	BASINGSTOKE		
	RG25 2NS		

Lab ID:	72388 - 137656	**Certification Code:**	HER-HER-SL	**Date Received:**	17/05/2023
Sample ID:	HBSL160523	**BCS Number:**	BCS1214C59	**Date Reported:**	19/06/2023
Sample Type:	Separated Liquor	**Plant / Site Name:**	Herriard	**Date Sampled:**	16/05/2023

Pathogens (human and animal indicator species) **in WD / SL / SF**

Parameter	Units	Result Rep 1	Result Rep 2	Result Rep 3	Result Rep 4	Result Rep 5	Pass	Method of Test
Salmonella		Absent	Absent	Absent	Absent	Absent	Y	Part II schedule of ABP regulations 2005
E. coli	CFU/g	<10	<10	<10	<10	<10	Y	Part III schedule of ABP regulations 2005

For Salmonella spp 5 out of 5 sub-sample results must be ABSENT in the quantity tested.

For Escherichia coli 4 out of 5 sub-sample results must be less than or equal to 1000 CFU/g but none may be greater than 5000 CFU/g.

How does your sample analysis compare with the 'standard' figures for organic manures?

Farmyard Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Cattle FYM	25	6.0	3.2	9.4	2.4	1.8
Pig FYM	25	7.0	6.0	8.0	3.4	1.8
Sheep FYM	25	7.0	3.2	8.0	4.0	2.8
Duck FYM	25	6.5	5.5	7.5	2.6	2.4
Horse FYM	25	5.0	5.0	6.0	1.6	1.5
Goat FYM	40	9.5	4.5	12.0	2.8	1.8

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Poultry Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
	20	9.4	8.0	8.5	3.0	2.7
	40	19.0	12.0	15.0	5.6	4.3
	60	28.0	17.0	21.0	8.2	5.9
	80	37.0	21.0	27.0	11.0	7.5

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Cattle & Pig Slurries	Dry Matter (% DM)	Total Nitrogen (Kg N/m3)	Total Phosphate (Kg P2O5/m3)	Total Potash (Kg K2O/m3)	Total Sulphur (Kg SO3/m3)	Total Magnesium (Kg MgO/m3)
Cattle slurry	6.0	2.6	1.2	2.5	0.7	0.6
Dirty water (from cattle)	0.5	0.5	0.1	1.0	0.1	0.1
Separated cattle slurries						
- strainer box liquid	1.5	1.5	0.3	1.5	ND	ND
- weeping wall liquid	3.0	2.0	0.5	2.3	ND	ND
- mechanically separated liquid	4.0	3.0	1.2	2.8	ND	ND
- solid portion after separation	20.0	4.0	2.0	3.3	ND	ND
Pig slurry	4.0	3.6	1.5	2.2	0.7	0.7
Separated pig slurry - liquid	3.0	3.6	1.1	2.0	ND	ND
Separated pig slurry - solid	20.0	5.0	3.7	2.0	ND	ND

Notes: ND = no data.
The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively (50% & 100% for dirty water).

Biosolids	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Digested cake	25	11.0	11.0	0.6	8.2	1.6
Thermally dried	95	40.0	55.0	2.0	23.0	6.0
Lime stablised	25	8.5	7.0	0.8	7.4	2.4
Composted	40	11.0	10.0	3.0	6.1	2.0

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively.

Other Organic Manures	Dry Matter	Total Nitrogen	Total Phosphate	Total Potash	Total Sulphur	Total Magnesium
Composts	(% DM)	(Kg N/t)	(Kg P2O5/t)	(Kg K2O/t)	(Kg SO3/t)	(Kg MgO/t)
Green compost	60	7.5	3.0	6.8	3.4	3.4
Green/food compost	60	11.0	4.9	8.0	5.1	3.4
Mushroom compost	35	6.0	5.0	9.0	ND	ND
Digestates						
Food-based whole	4.1	4.8	1.1	2.4	0.7	0.2
Food-based separated liquor	3.8	4.5	1.0	2.8	1.0	0.2
Food-based separated fibre	27.0	8.9	10.2	3.0	4.0	2.2
Farm-sourced whole	5.5	3.6	1.7	4.0	0.8	0.6
Farm-sourced separated liquor	3.0	1.9	0.6	2.5	<0.1	0.4
Farm-sourced separated fibre	24.0	5.6	4.7	6.0	1.2	1.8
Paper Crumble						
Chemically / physically treated	40	2.0	0.4	0.2	0.6	1.4
Biologically treated	30	7.5	3.8	0.4	2.4	1.0
Water Treatment Cake						
Water treatment cake	25	2.4	3.4	0.4	5.5	0.8
Food industry 'wastes'	(% DM)	(Kg N/m3)	(Kg P2O5/m3)	(Kg K2O/m3)	(Kg SO3/m3)	(Kg MgO/m3)
Dairy waste	4	1.0	0.8	0.2	ND	ND
Soft drinks waste	4	0.3	0.2	Trace	ND	ND
Brewing waste	7	2.0	0.8	0.2	ND	ND
General food waste	5	1.6	0.7	0.2	ND	ND

Notes: ND = no data.

The 'standard' figures for the above organic manures have been taken from Defra's Fertiliser Manual 2017 (RB209) 9th edition and the corresponding PLANET version 3 software. Further information on fertiliser recommendations for organic manures can be obtained from the Fertiliser Manual or from a FACTS qualified adviser.

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: BUSHYWARREN LANE
SEPARATED FIBRE

Lab ID:	94959 - 152281	**Certification Code:**	BCS-OUTPUT-0008	**Date Received:**	12/10/2023
Sample ID:	HBSF111023	**BCS Number:**		**Date Reported:**	15/11/2023
Sample Type:	Separated Fibre	**Plant / Site Name:**	Bushywarren Lane	**Date Sampled:**	11-10-2023

Potentially Toxic Elements in WD / SL / SF, on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Cadmium (Cd)	mg/kg	<0.1	0.72 mg / kg	Y	BS EN 13650 (soluble in aqua regia)
Chromium (Cr)	mg/kg	<2	48 mg / kg	Y	BS EN 13650 (soluble in aqua regia)
Copper (Cu)	mg/kg	4.06	96 mg / kg	Y	BS EN 13650 (soluble in aqua regia)
Lead (Pb)	mg/kg	<1	96 mg / kg	Y	BS EN 13650 (soluble in aqua regia)
Mercury (Hg)	mg/kg	<0.1	0.48 mg / kg	Y	BS ISO 16772
Nickel (Ni)	mg/kg	1.20	24 mg / kg	Y	BS EN 13650 (soluble in aqua regia)
Zinc	mg/kg	19.2	192 mg / kg	Y	BS EN 13650 (soluble in aqua regia)

Stability of WD / SL / SF on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Volatile Fatty Acids	g COD / g VS	N/A	0.774 g VS		Chromatography
Residual Biogas Potential	l / g VS	0.13	0.45 l / g VS	Y	OFW004-005 (WRAP)

Parameter	Units	Digestate Result *	QC Result **	Inoculum Result ***
RBP 1st Replicate	l / g VS	0.12	0.55	0.03
RBP 2nd Replicate	l / g VS	0.13	NR (2)	0.03
RBP 3rd Replicate	l / g VS	0.14	0.52	0.03

28 day plot of biogas results for sample, inoculum and QC can be emailed as a PDF file on request.
NR (2) = No result due to equipment failure
VFAs expressed as COD equivalent. Used as a pre-screening method: high VFA concentration indicates high potential biodegradability.
Samples with VFA concentrations above 0.774 g COD / g VS are expected to fail on RBP.
Test is valid as no spikes or inconsistencies were observed, the plots were smooth for all replicates.
All quality control criteria have been met.
* The digestate RBP is allowed to be negative only during the first 5 days of the test.
** The reference material RBP is allowed to be negative only during the first 5 days of the test. The 28-day RBP of the reference material should exceed 0.5 l/g VS
*** The inoculum control should produce a measurable volume of biogas over the 28 day period.

nrm part of Cawood

Biofertiliser certification scheme
REA RENEWABLE ENERGY ASSOCIATION

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PAS110 2014 Certificate of Analysis (Continued)

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: BUSHYWARREN LANE
SEPARATED FIBRE

Lab ID:	94959 - 152281	**Certification Code:**	BCS-OUTPUT-0008	**Date Received:**	12/10/2023
Sample ID:	HBSF111023	**BCS Number:**		**Date Reported:**	15/11/2023
Sample Type:	Separated Fibre	**Plant / Site Name:**	Bushywarren Lane	**Date Sampled:**	11-10-2023

Physical contaminants in WD / SL / SF on a fresh weight basis

Parameter	Units	Result	Upper Limit	Pass	Method of Test
Plastics > 2mm	kg / t	0.040			NRM-SOP-JAS-497
Glass > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Metals > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Other > 2mm	kg / t	Zero			NRM-SOP-JAS-497
Total > 2mm	kg / t	0.040	0.22 kg / t	Y*	NRM-SOP-JAS-497
of which Sharps:	kg / t	Zero	Zero in sample tested	Y	NRM-SOP-JAS-497
Stones > 5mm	kg / t	Zero	19.2 kg / t		NRM-SOP-JAS-497

Zero - No visible contaminants were found in the sample as submitted

The sample was dispatched within one day of sampling
The sample was received within 24 hours of dispatch (48 for extreme geographical locations)
The sample was received within 72 hours of dispatch.
The sample was received in a cool box with ice packs

Released by: *Myles Nicholson* **Date: 15/11/2023**

REAL BCS Approved Testing Laboratory

PAS110 2014 Certificate of Analysis (Continued)

Client: MICHAL ANTOS
(P427) HERRIARD BIOPOWER LTD
BUSHYWARREN LANE
HERRIARD
BASINGSTOKE
RG25 2NS

Originator: BUSHYWARREN LANE
SEPARATED FIBRE

Lab ID: 94959 - 152281
Sample ID: HBSF111023
Sample Type: Separated Fibre

Certification Code: BCS-OUTPUT-0008
BCS Number:
Plant / Site Name: Bushywarren Lane

Date Received: 12/10/2023
Date Reported: 15/11/2023
Date Sampled: 11-10-2023

Characteristics of WD / SL / SF for declaration, without limit values, that influence application rates
(Results on a dry matter basis)

Parameter	Units	Result	M *	Amount per fresh tonne or m³	Amount applied at an equivalent total Nitrogen application of 250 kg N/ha	Units
pH		9.1	1			
Oven Dry Matter	% m/m	28.5	2	285.00	13022	Kg DM
Loss On Ignition	% m/m	89.1	3	253.93	11602	Kg OM
Total Nitrogen (N)	% m/m	1.92	4	5.47	250	Kg N
Ammoniacal Nitrogen (NH4-N)	mg/kg	1109	5	0.32	14.44	Kg NH4-N
Total Phosphorus (P)	% m/m	0.659	6	4.30	196.51	Kg P2O5
Total Potassium (K)	% m/m	1.39	6	4.75	217.20	Kg K2O
Total Magnesium (Mg)	% m/m	0.268	6	1.27	57.93	Kg MgO
Total Sulphur (S)	% m/m	0.345	6	2.46	112.31	Kg SO3
Equivalent field application rate		——		1.00	45.69	tonnes or m³ / ha

*** Method of Test**

1 BS EN 13037
2 BS EN 14346
3 BS EN 15169
4 BS EN 13654-2 (Dumas)
5 NRM-SOP-JAS-083 (soluble in potassium chloride)
6 BS EN 13650 (soluble in aqua regia)

REAL BCS Approved
Testing Laboratory

PAS110 2014 Certificate of Analysis (Continued)

Client: MICHAL ANTOS
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BUSHYWARREN LANE
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Date Reported: 15/11/2023
Date Sampled: 11-10-2023

Pathogens (human and animal indicator species) **in WD / SL / SF**

Parameter	Units	Result Rep 1	Result Rep 2	Result Rep 3	Result Rep 4	Result Rep 5	Pass	Method of Test
Salmonella		Absent	Absent	Absent	Absent	Absent	Y	Part II schedule of ABP regulations 2005
E. coli	CFU/g	<100	<100	<100	<100	<100	Y	Part III schedule of ABP regulations 2005

For Salmonella spp 5 out of 5 sub-sample results must be ABSENT in the quantity tested.
For Escherichia coli 4 out of 5 sub-sample results must be less than or equal to 1000 CFU/g but none may be greater than 5000 CFU/g.
Salmonella & E Coli testing is sub-contracted to a UKAS accredited testing laboratory which also meets the requirements for DEFRA ABPR testing.

How does your sample analysis compare with the 'standard' figures for organic manures?

Farmyard Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Cattle FYM	25	6.0	3.2	9.4	2.4	1.8
Pig FYM	25	7.0	6.0	8.0	3.4	1.8
Sheep FYM	25	7.0	3.2	8.0	4.0	2.8
Duck FYM	25	6.5	5.5	7.5	2.6	2.4
Horse FYM	25	5.0	5.0	6.0	1.6	1.5
Goat FYM	40	9.5	4.5	12.0	2.8	1.8

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Poultry Manure	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
	20	9.4	8.0	8.5	3.0	2.7
	40	19.0	12.0	15.0	5.6	4.3
	60	28.0	17.0	21.0	8.2	5.9
	80	37.0	21.0	27.0	11.0	7.5

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 60% & 90% respectively.

Cattle & Pig Slurries	Dry Matter (% DM)	Total Nitrogen (Kg N/m3)	Total Phosphate (Kg P2O5/m3)	Total Potash (Kg K2O/m3)	Total Sulphur (Kg SO3/m3)	Total Magnesium (Kg MgO/m3)
Cattle slurry	6.0	2.6	1.2	2.5	0.7	0.6
Dirty water (from cattle)	0.5	0.5	0.1	1.0	0.1	0.1
Separated cattle slurries						
- strainer box liquid	1.5	1.5	0.3	1.5	ND	ND
- weeping wall liquid	3.0	2.0	0.5	2.3	ND	ND
- mechanically separated liquid	4.0	3.0	1.2	2.8	ND	ND
- solid portion after separation	20.0	4.0	2.0	3.3	ND	ND
Pig slurry	4.0	3.6	1.5	2.2	0.7	0.7
Separated pig slurry - liquid	3.0	3.6	1.1	2.0	ND	ND
Separated pig slurry - solid	20.0	5.0	3.7	2.0	ND	ND

Notes: ND = no data.
The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively (50% & 100% for dirty water).

Biosolids	Dry Matter (% DM)	Total Nitrogen (Kg N/t)	Total Phosphate (Kg P2O5/t)	Total Potash (Kg K2O/t)	Total Sulphur (Kg SO3/t)	Total Magnesium (Kg MgO/t)
Digested cake	25	11.0	11.0	0.6	8.2	1.6
Thermally dried	95	40.0	55.0	2.0	23.0	6.0
Lime stablised	25	8.5	7.0	0.8	7.4	2.4
Composted	40	11.0	10.0	3.0	6.1	2.0

Notes: The 'standard' phosphate & potash availability figures to the next crop grown from Defra's Fertiliser Manual are 50% & 90% respectively.

Other Organic Manures	Dry Matter	Total Nitrogen	Total Phosphate	Total Potash	Total Sulphur	Total Magnesium
Composts	(% DM)	(Kg N/t)	(Kg P2O5/t)	(Kg K2O/t)	(Kg SO3/t)	(Kg MgO/t)
Green compost	60	7.5	3.0	6.8	3.4	3.4
Green/food compost	60	11.0	4.9	8.0	5.1	3.4
Mushroom compost	35	6.0	5.0	9.0	ND	ND
Digestates						
Food-based whole	4.1	4.8	1.1	2.4	0.7	0.2
Food-based separated liquor	3.8	4.5	1.0	2.8	1.0	0.2
Food-based separated fibre	27.0	8.9	10.2	3.0	4.0	2.2
Farm-sourced whole	5.5	3.6	1.7	4.0	0.8	0.6
Farm-sourced separated liquor	3.0	1.9	0.6	2.5	<0.1	0.4
Farm-sourced separated fibre	24.0	5.6	4.7	6.0	1.2	1.8
Paper Crumble						
Chemically / physically treated	40	2.0	0.4	0.2	0.6	1.4
Biologically treated	30	7.5	3.8	0.4	2.4	1.0
Water Treatment Cake						
Water treatment cake	25	2.4	3.4	0.4	5.5	0.8
Food industry 'wastes'	(% DM)	(Kg N/m3)	(Kg P2O5/m3)	(Kg K2O/m3)	(Kg SO3/m3)	(Kg MgO/m3)
Dairy waste	4	1.0	0.8	0.2	ND	ND
Soft drinks waste	4	0.3	0.2	Trace	ND	ND
Brewing waste	7	2.0	0.8	0.2	ND	ND
General food waste	5	1.6	0.7	0.2	ND	ND

Notes: ND = no data.

The 'standard' figures for the above organic manures have been taken from Defra's Fertiliser Manual 2017 (RB209) 9th edition and the corresponding PLANET version 3 software. Further information on fertiliser recommendations for organic manures can be obtained from the Fertiliser Manual or from a FACTS qualified adviser.

Appendix D CHP1 and CHP2 technical specification

Design conditions

Comb. air temperature / rel. Humidity:	[°C / %]	25 / 60
Altitude:	[m]	100
Exhaust temp. after heat exchanger:	[°C]	180
NO_x Emission (tolerance - 8%):	[mg/m³n]	500

Genset:

Engine:	**TCG2020V12.**	
Speed:	[1/min]	1500
Configuration / number of cylinders:	[-]	V / 12
Bore / Stroke / Displacement:	[mm / mm / dm³]	170 / 195 / 53
Compression ratio:	[-]	13,5
Mean piston speed:	[m/s]	9,8
Mean lube oil consumption at full load:	[g/kWh]	0,2
Engine-management-system:	[-]	TEM EVO
Generator:	**Marelli MJB 450 LB4**	
Voltage / voltage range / frequency:	[V / % / Hz]	400 / ±5 / 50
Speed:	[1/min]	1500

Fuel gas data:

MWM Methane number:	[-]	134
Lower calorific value:	[kWh/m³]	6,48
Gas density:	[kg/m³n]	1,16
Standard gas:	Sewage gas	
Analysis: CO_2	[Vol%]	35
N_2	[Vol%]	0
O_2	[Vol%]	0
H_2	[Vol%]	0
CO	[Vol%]	0
CH_4	[Vol%]	65
C_2H_6	[Vol%]	0
C_3H_8	[Vol%]	0
C_4H_{10}	[Vol%]	0
C_xH_y	[Vol%]	0
H_2S	[Vol%]	0

Energy balance

Load:	[%]	100	75	50
Electrical power COP acc. ISO 8528-1:	[kW]	**1200**	**900**	**600**
Generator efficiency with cos Phi = 1 / ind	[%]	97,4	97,3	96,8
Engine power acc. ISO 3046-1:	[kW]	1232	925	620
Engine jacket water heat:	[kW ±8%]	626	466	333
Intercooler LT heat:	[kW ±8%]	93	68	43
Lube oil heat:	[kW ±8%]			
Exhaust heat with temp. after heat exchanger:	[kW ±8%]	564	462	346
Exhaust temperature:	[°C]	459	482	506
Exhaust mass flow, wet:	[kg/h]	6526	4920	3396
Combustion mass air flow - ISO 3046/1:	[kg/h]	6017	4530	3122
Radiation heat engine / generator:	[kW ±8%]	41 / 32	39 / 25	38 / 20
Fuel consumption:	[kW +5%]	2852	2184	1534
electrical /mechanical / thermal efficiency:	[%]	42,1 / 43,2 / 41,7	41,2 / 42,4 / 42,5	39,1 / 40,4 / 44,2
Total efficiency:	[%]	83,8	83,7	83,3

System parameters 1)

Ventilation air flow (comb. air incl.) with ΔT = 15 K	[kg/h]	30100
Combustion air temperature minimum / design:	[°C]	20 / 25
Exhaust back pressure from / to:	[mbar]	30 / 50
Maximum pressure loss in front of air cleaner:	[mbar]	5
Zero-pressure gas control unit selectable from / to: 2)	[mbar]	20 / 300
Pre-pressure gas control unit selectable from / to: 2)	[bar]	0,5 / 10
Starter battery 24V, capacity required:	[Ah]	430
Starter motor:	[kWel. / VDC]	15 / 24
Lube oil content engine / base frame:	[dm³]	205 / -
Dry weight engine / genset:	[kg]	5080 / 10600

Cooling system

Glycol content engine jacket water / intercooler:	[% Vol.]	35 / 35
Water volume engine jacket / intercooler:	[dm³]	111 / 20
KVS / Cv value engine jacket water / intercooler:	[m³/h]	42 / 30
Jacket water coolant temperature in / out:	[°C]	80 / 93
Intercooler coolant temperature in / out:	[°C]	50 / 53
Engine jacket water flow rate from / to:	[m³/h]	36 / 56
Water flow rate engine jacket water / intercooler:	[m³/h]	44 / 35
Water pressure loss engine jacket water / intercooler:	[bar]	1,1 / 1,4

1) See also MWM "Layout of power plants": 2) See also Techn. Circular 0199-99-3017

Engine noise level	Octave band centre frequency 63	125	250	500	1000	2000	4000	8000	Sum level (distance 1 meter)
Exhaust noise [dB(lin)]	116	123	122	119	111	110	108	107	**120 dB(A)** (±2,5 dB(A))
Air-borne noise [dB(lin)]	92	104	104	100	99	96	99	99	**106 dB(A)** (±1,0 dB(A))

Appendix E Uniflare UF10-500 technical specification

Uniflare Group

Unit 19

Runway Farm Technical Park

KENILWORTH CV8 1NQ

Tel +44 1676 529118

Fax +44 1676 529119

enquiries@uniflare.co.uk

UF10-500-BGF BIOGAS CONTROLLED COMBUSTION FLARE

BASINGSTOKE

HERRIAD BIOPOWER

Job No 1836

Document Control Sheet

O&M Manual Reference number	1836 UF10-500-BGF/OM/01	
	Number	**Date**
Version	01	29/09/2022
	Initials	**Date**
Manual prepared by	GW	29/09/2022
Checked by		
Approved by		

Description

High Temperature Flarestack (FL-1)

Stack Calculation

Calculation of retention time
Calculation of composition of combustion products to BS 5854
Per one volume of fuel @ 15 deg C and 1013 mbar

Constituent	Percentage in fuel	Relative density	Relative density fuel to air
Methane CH_4	65%	0.554	0.3601
Carbon Dioxide CO_2	35%	1.5198	0.53193
	100%	OK	0.89203
Stoichiometric air per unit volume of methane is 9.55			
Biogas flow rate		500 m^3/hour	325 m^3/hr CH_4
Min air required		3103.75 m^3/hour	
Excess air		200%	
Specific volume of air		0.819 m^3/kg	
Mass flow rate of air		11369 kg/hr	
Mass flowrate of biogas		545 kg/hr	
Total mass flow rate		11914 kg/hr	
Fuel gases above their dew point have a specific volume similar to air at the relevant temperature			
Volume of 1kg of flue gases @ 1000 deg C		4 m^3/kg	
Therefore volume flow rate		45498 m^3/hr	
		13 m^3/sec	
Hot face diameter		1.183 m	
Area		1.10 m^2	
Velocity		11.5 m/sec	
Height above flame		5.5 m	
Retention time		0.48 sec	
Retention time at sample port 1		0.39 sec	Port 1m down from top
Heat release turn down ratio		5:1	
Combustion heat release at full load		3.24 MW	
Minimum heat release		0.65 MW	
EA Guidance on Landfill Gas Flaring 4.8.7 Page 24			

Structure

The flarestack is a 500 m^3/ hour controlled combustion ground flare with cyclonic action burners. At full load, with a gas quality of 65% CH_4 and a combustion temperature of 1,000°C the retention time is greater than 0.3 seconds

Machine type	UF10-500 Biogas booster and controlled combustion ground flare.
Use environment	Landfill site in open air with restricted access and supervised by trained personnel.
Maximum design emissions Normalised at 0°C, 101.3 kPa and 3% O_2:	Carbon monoxide (CO) 50 mg Nm^{-3} Oxides of nitrogen (NO_x) 100 mg Nm^{-3} Total volatile organic carbon as carbon 10 mg Nm^{-3} Non-methane volatile organic carbon 5 mg Nm^{-3}
Operation	Unattended
Media	Biogas containing Methane 30% to 65%v/v Hydrogen sulphide 0 to 1 000 ppm
Design Flow assuming 1.292 kg m^{-3} density landfill gas	500 m3h-1 @ 0mbarg + 105 mbarg pressure lift
Turn down	5:1
Combustion temperature	1 000°C
Combustion minimum retention time	0.3 seconds
Biogas Inlet Flange (BS EN 1092-2: 1997) DN100 PN16	
Control system UNIFLARE standard complete with sun & weather protection roof connecting to site control	

Appendix F Uniflare UF10-1000 technical specification

Uniflare Group

Unit 19

Runway Farm Technical Park

KENILWORTH CV8 1NQ

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UF10-1000-BGF BIOGAS CONTROLLED COMBUSTION FLARE

BASINGSTOKE

HERRIAD BIOPOWER

Job No 1837

Document Control Sheet

O&M Manual Reference number	1836 UF10-500-BGF/OM/01	
	Number	**Date**
Version	01	29/09/2022
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Description

High Temperature Flarestack (FL-1)

Stack Calculation

Calculation of retention time
Calculation of composition of combustion products to BS 5854
Per one volume of fuel @ 15 deg C and 1013 mbar

Constituent	Percentage in fuel	Relative density	Relative density fuel to air
Methane CH_4	65%	0.554	0.3601
Carbon Dioxide CO_2	35%	1.5198	0.53193
	100%	OK	0.89203
Stoichiometric air per unit volume of methane is 9.55			
Biogas flow rate		1000 m^3/hour	650 m^3/hr CH_4
Min air required		6207.5 m^3/hour	
Excess air		200%	
Specific volume of air		0.819 m^3/kg	
Mass flow rate of air		22738 kg/hr	
Mass flowrate of biogas		1089 kg/hr	
Total mass flow rate		23827 kg/hr	
Fuel gases above their dew point have a specific volume similar to air at the relevant temperature			
Volume of 1kg of flue gases @ 1000 deg C		4 m^3/kg	
Therefore volume flow rate		90996 m^3/hr	
		25 m^3/sec	
Hot face diameter		1.673 m	
Area		2.20 m^2	
Velocity		11.5 m/sec	
Height above flame		5.5 m	
Retention time		0.48 sec	
Retention time at sample port 1		0.39 sec	Port 1m down from top
Heat release turn down ratio		5:1	
Combustion heat release at full load		6.48 MW	
Minimum heat release		1.30 MW	
EA Guidance on Landfill Gas Flaring 4.8.7 Page 24			

Structure

The flarestack is a 1000 m^3/ hour controlled combustion ground flare with cyclonic action burners. At full load, with a gas quality of 65% CH_4 and a combustion temperature of 1,000°C the retention time is greater than 0.3 seconds

Machine type	UF10-1000 Biogas booster and controlled combustion ground flare.
Use environment	Landfill site in open air with restricted access and supervised by trained personnel.
Maximum design emissions Normalised at 0°C, 101.3 kPa and 3% O_2:	Carbon monoxide (CO) 50 mg Nm^{-3} Oxides of nitrogen (NO_x) 100 mg Nm^{-3} Total volatile organic carbon as carbon 10 mg Nm^{-3} Non-methane volatile organic carbon 5 mg Nm^{-3}
Operation	Unattended
Media	Biogas containing Methane 30% to 65%v/v Hydrogen sulphide 0 to 1 000 ppm
Design Flow assuming 1.292 kg m^{-3} density landfill gas	1000 m3h-1 @ 0mbarg + 105 mbarg pressure lift
Turn down	5:1
Combustion temperature	1 000°C
Combustion minimum retention time	0.3 seconds
Biogas Inlet Flange (BS EN 1092-2: 1997) DN150 PN16	
<u>Control system</u> UNIFLARE standard complete with sun & weather protection roof connecting to site control	

Appendix G Biofilter manual and details (extract)

Biofilter System Details,
Construction & Operation Manual

Herriard Bio Power Site
Bushywarren Lane
Herriard
Basingstoke
Hampshire
RG25 2NS

Prepared for

RKE Bio-group,

**Office Suite,
Wealden House,
First Floor,
Lewes Rd,
East Grinstead.
RH19 3TB**

V.3 – December 2021

Mike Thompson Partnership Ltd E:mike.thompson@mikethompsonpartnership.co.uk

Contents

Mike Thompson Partnership Ltd E:mike.thompson@mikethompsonpartnership.co.uk

Preface

This report has been prepared by Mike Thompson Associates Ltd (MTP), and associated consultants as necessary, with all reasonable care, skill & diligence.

Information reported herein is based on the interpretation of data collected from various sources which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the client named in the report header and only for the project also detailed in the header. No warranties are expressed or should be inferred by any third parties. This report should not be relied upon by other parties without written consent from MTP.

MTP disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the works.

Evaluations and conclusions detailed herein do not preclude the presence of other issues on site, which could not be reasonably have been revealed by this report or the assessment detailed herein.

Civils works shown within this report are to be taken as a guide only and may be amended as required by site contractors in the light of experience or site conditions.

Where proprietary, branded equipment, media or items are detailed as preferred components in this project documentation, these are referred to and recommended as they are produced to a consistently high, documented specification and performance value and are able to deliver that performance as required for this project.

Alternative equipment, media or items may be used for the sake of expediency or cost, but these must be of demonstrably equivalent specification & performance to the proprietary items. If this is not so, then the overall efficiency and efficacy of the biofilter and odour control system cannot be guaranteed.

The same caveat must be recognised for equipment designed and manufactured specifically for this project, such as ductwork, venting or fan systems. Where such has been undertaken by experienced suppliers or design engineers, the supplied equipment would be specified and documented to be capable of meeting the performance requirements of the project. Where alternatives have been sourced for the sake of expediency or cost, these must be supported by competent design & performance specifications & guarantees. If this is not so, then the overall efficiency and efficacy of the biofilter and odour control system cannot be guaranteed.

1.0 Biofilter Design Rationale

The following requirements must be achieved to meet BAT for the biofilter installation.

This section details how these requirements are met.

1.1. Effective System and Biofilter Design Requirements

- Minimum 3 air changes per hour for the building
- Minimisation of dead spaces
- Air & odour flows from low odour to high odour to biofilter
- High odour areas should be away from access, etc
- Residence time should be between 30 & 60 seconds
- Provisions must be made to add water and remove bed drainage
- Media depth of >1m and <2m
- Dust and aerosols absent from airflow
- Air flow distribution via plenum before passing to media
- Humidity of inlet air

1.2. Media Selection Requirements

- Demonstrate adequate residence times
- Sufficient sorption capacity for contaminants and microbiobial attachment
- Living space and reserve nutrients for micro-organisms
- Media water/moisture content – 50 to 80% by weight
- Structural support to maintain internal structure
- Media temperature – near ambient – 15- 35 or 40^{o}C
- Media pH – 7 to 8.5
- Biologically active, but reasonably stable
- Organic matter content >60%
- Porous and friable with 75 to 90% void volume
- Resistant to waterlogging and compaction
- Relatively low fines content to reduce gas head loss
- Relatively free of residual odour

1.3. Minimum 3 air changes per hour for the building

1.1.1. The system will give the buildings 3 air changes per hour.

1.1.2. The system is equipped with a single large fan, rated at c.20,000m^3 per hour maximum. This gives the required airflow.

1.1.3. The number of air changes may be reduced by slowing down the fan.
This may be appropriate for periods when waste processing is not taking place to reduce the power requirements of the system.

1.2. Minimisation of dead spaces

1.2.1. The main flow of air into the buildings will be through doorways or one-way inlet louvres placed as required.
Venting for the tanks will be through sleeved top vents, exhausting to the ducting system.

1.2.2. Exhausts from the buildings will be through one-way louvres into fan ducts located as shown.

1.2.3. The louvres are set to only allow air to flow through the building in one direction towards the biofilter. Their spacing is such to promote air flow through the building.

1.2.4. Odour pooling and air flow eddies may be an issue. This can be caused by dead spots in the building, flow obstruction from installed plant or air currents from the cooling fans on processing equipment.

1.2.5. Additional small one-way wall louvres (c.450mmx450mm) may be added to the buildings, should this be necessary. If used, these will act as additional inlets to disrupt any pooling within the building close to the gable ends.

1.2.6. As well as or as instead of these additional vents, small air moving fans may be used to amend the internal air currents and so promote a more effective cross flow through the building.

1.3. Air & odour flows from low odour to high odour to biofilter

1.3.1. The main flow of air through the building will be from low odour areas to high odour (processing & storage) to biofilter

1.3.2. The incoming waste storage and blending areas are located directly below the exhaust louvre to the biofilter. Odour generated here is drawn straight into the biofilter.

1.4. High odour areas should be away from access, etc

1.4.1. The internal layout of the Reception Barn means that most of the waste reception and storage will be away from the main vehicle and access doors.

1.4.2. To reduce open time, the vehicle door will use fast close mechanisms.

1.4.3. The air flow control louvres ensure that, should the wind direction be against a vehicle door when it opens, any increase in air pressure within the building assists the airflow through the biofilter as opposed to working against it.

1.5. Residence time should be between 30 & 60 seconds

1.5.1. Residence time for biofilters is measured as Empty Bed Residence Time (EBRT).

1.5.2. BAT requires that a biofilter have a minimum EBRT of between 30 & 60 seconds, the longer EBRT being required for more odorous exhausts.

1.5.3. This system gives an average EBRT of c.30seconds.
This will be sufficient on this site. The Reception Barn is not large enough to allow excessive storage of incoming waste and the whole storage area will be cleared to the floor every week, so ensuring waste within the Reception barn is relatively fresh.

1.6. Provisions must be made to add water and remove bed drainage

1.6.1. The floor of the biofilter chamber (under the plenum) is furnished with its own sealed drainage system.

1.6.2. The biofilter will also be fitted with an irrigation system to wet the media surface should this prove necessary.

1.6.3. As the air exiting the buildings will be of high humidity, irrigation will only be required through the summer months when called for by regular inspections.

1.7. **Media depth of >1m or <2m**

1.7.1. The media in the biofilter will be c.3.0m deep, above a c.400mm deep (air void) plenum.

1.7.2. This is deeper than the maximum 2m set down in BAT.

1.7.3. Woodchip media will support a 3.0m deep media bed. The deeper bed depth assists air flow and distribution.

1.7.4. This deeper bed depth also reduces the chance of tracking or bypassing within the media. Some tracking or differential flow may occur but the deeper media depth means the airflow has more time within the media, even if such instances take place.

1.8. Dust and aerosols absent from airflow

1.8.1. Dust and aerosols will not be present in the exhaust from the buildings due to the nature of the material being processed within the shed.

1.9. Air flow distribution via plenum before passing to media

1.9.1. The plenum below the media will be formed using the proprietary HAHN Biofilter Flooring System. This has a large, unobstructed void space and is resistant to damp and chemical attack.

1.9.2. The plenum will be c.400mm deep (air void), so allowing the exhaust air to dissipate evenly across the whole base of the biofilter, presenting an even flow and pressure to the base of the media.

1.9.3. All louvres are protected by grids to prevent the ingress of foreign matter that will either impede the louvre or plenum air flow.

1.10. Humidity of inlet air

1.10.1. The exhaust air going to the biofilter is relatively humid, coming from directly above the waste storage bays.

1.10.2. Should the humidity drop, the biofilter can be watered if required.

1.10.3. Wood chip media is very resistant to drying, especially as the inlet air will be at ambient temperature and relatively moist.
However, should media drying become an issue, it is possible and practical to place an atomiser into the exhaust air stream within the top of the stack if needed. These can be timer controlled to give the cover required.

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2.0 Biofilter Construction Notes

To be read in conjunction with the attached figures.
Both notes and figures are to be taken as a guide for the system construction. Amendments may be made due to site conditions or engineering requirements.
Should amendments be made, the system should be re-assessed to ensure it still meets the BAT requirements.

2.1. Order of Construction

2.1.1. An order for the civils works for the biofilter is suggested below.
This is a guide and not an exhaustive list.

2.1.2. The construction contractor is to provide RAMS and work safe procedures of work to cover the civils works required for the biofilter works.

2.1.3. The area should be checked for services as per normal site practise.
The chamber adjacent to the road kerb will have to be moved into the road to allow room for the biofilter.
The lightning rod at the corner of the Reception Barn will need to be moved.
The following assumes all services are clear of the construction area or have been relocated, as required.

2.1.4. Set the end column for the panel wall

2.1.5. Excavate and pour the foundations for the panel wall.
The top of this foundation should be at the same level as the concrete pad for the old odour control unit.
This foundation should be designed by the contractor to ensure it is suitable for the site conditions.
Starter bars should be included at each end of the foundation to tie in the foundations for the lego block walls.

2.1.6. Place the base 3 panels.
Sikaflex (or similar) should be used to seal between the panels.

2.1.7. Pour a minimum 150mm deep concrete infill behind the panels, between the Reception Barn columns, to form an air seal to the base of the panels.
The top level of this pour should be higher than the floor of the Reception Barn to stop liquid creeping out from under the Reception Barn wall over time.

2.1.8. Place the rest of the concrete panels to form the back wall of the biofilter.
Again, Sikaflex (or similar) should be used to seal between the panels.

2.1.9. Place the drainage run for the biofilter, alongside the existing concrete pad.
The risers should be taken to c.200mm above the level of the existing concrete pad.

2.1.10. Pour the foundation for the lego block walls, to the same level as the concrete pad for the old odour control unit.
Place a hardcore base within the foundation ring, outside the existing concrete pad.

2.1.11. Place the lower 2 lifts of the lego block walls.
A large bead of Sikaflex should be placed along the block between the lugs and up the sides to give a seal. The inside of the block joints should be caulked with Sikaflex as well.

2.1.12. Pour the inner floor of the biofilter, to a level c.100mm above the level of the existing concrete pad and over the top of the pad, within the placed walls.

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If required, expansion joints may be placed against the walls and across the floor but these must be sealed when the floor has cured.
This single pour floor will provide a good air seal to the base of the walls.
The floor should be laid flat, with no fall.
A tamped surface will suffice.

2.1.13. Once the floor has set, cut the drainage risers off level with the top of the new floor.
Do not place any grates over the top of the pipes.

2.1.14. Place the Hahn air floor units, starting at the corner with the new column. Follow the Hahn instructions for laying the floor.
The Hahn floor panels can be cut to fit as required as the air floor reaches the opposite walls.
Final cuts should retain the bracer ribs under the panels so the legs can be placed.
There will be a small gap around the floor once the panels have been set. This can be closed by laying a geotextile mesh when placing the biofilter media or by cable tying a suitable pipe along the edges of the panels in the gap (as shown in the drawings).

2.1.15. Lie one of the stack braces on the surface of the floor panels and mark the centre of the ring on the floor.

2.1.16. The stack should stand 2.4m away from the concrete panel wall.
Place the base plate on the floor, locating it with the marks drawn.
Mark the inner and outer limits of the base plate.
Lift the base plate and put a bead of Tiger Seal (www.eurocarparts.com) along the ribs of the floor panels. This will bond the base plate to the panels.
Put the base plate on the panels in the location marked & over the Tiger Seal, press down & leave overnight for the Tiger Seal to cure.
Once the Tiger Seal has cured, cut out the panels to the pattern shown in Figure 4. Do not cut any of the strengthening ribs under the panels.
Once the cut outs are done, drill 8 bolt holes in the base plate and down through the air floor panels. Make sure these are outside the footprint of the stack.
Put 8 M10 stainless steel bolts down through the base plate and floor panel and bolt the base plate to the air floor below. Big washers will be needed on each end of the bolt.

2.1.17. Stand the stack on the base plate.
Place the 2 bracers between the stack and the panel wall, rawl bolting the bracers to the wall, making sure the stack is in the correct position.
Tighten the ring around the stack.
A thick rubber strip can be used between the stack and bracer ring if required but is not necessary.
Once the bracers are in place, 8 150mm stainless steel angle brackets should be placed around the base of the stack. These should be drilled & coach bolted (M10 stainless steel coach bolts) to both the stack and base plate.
After placing the brackets, a 50mm fillet of Sikaflex should be placed around the base of the stack, sealing it to the base plate.

2.1.18. Once the Hahn Air Floor and stack are in place, position the rest of the lego block walls.

2.1.19. Ensure the gap around the edge of the air floor is closed (see Section 2.1.14) and place the biofilter media.
If a telehandler is to be used, take care not to bounce air floor panels out while filling the biofilter.
Close to the stack, media should be placed by hand. Do not drop media close to the stack with a telehandler as it will knock the stack out of true.
The biofilter should be filled to the top of the walls, domed up along the centre line of the biofilter by c.200mm.

2.1.20. Once the media is in place, fit the hand rails around the side of the biofilter walls.

2.1.21. Drill & fit the monitoring point so it lies beneath the air floor, so allowing access to the plenum. This is shown in Figure 4.

2.1.22. The air ducting and fan can then be fitted by the ventilation contractor.

2.2. Biofilter Wall Concrete Panel & Block Walls

2.2.1. Walls to be formed of precast concrete panels, as used within the Reception Barn structure.

2.2.2. Wall panels to be 150mm thick and 1200mm wide. Biofilter requires 6 panels:
6 No. panels c.5705mm long
3 No panels c.2525mm long

2.2.3. Panels to be sealed (using Sikaflex or similar) top, base and sides to prevent air and moisture leakage.

2.2.4. Concrete panel retainer tags to be welded to column if possible and weld painted with galvanising paint.

2.2.5. Panels to be bolted to the lego block walls using galvanised angle brackets, rawl bolted to both panel and block.

2.2.6. Concrete panels to either be sealed to floor or cast into floor to ensure air and condensate tightness.

2.2.7. All joints to be sealed with Sikaflex between walling units and internally caulked with Sikaflex as well.

2.3. Biofilter Wall Steel Support Column

2.3.1. The single support column is a suitable Universal Column. Column is to be galvanised and is to be fixed to all 3 wall panels.

2.3.2. The column shown in the Figures has the same dimensions as the Reception Barn columns, as this was done to ease drawing the Figures. A different sized column may be used if the civil engineer feels it suitable.

2.3.3. Column and foundation to be as per local civil contractor design.

2.4. Personnel Access to Biofilter Surface

2.4.1. Access is required for regular biofilter inspections.

2.4.2. Handrails to be placed around the edge of the biofilter (Interclamp or similar system).

2.4.3. Access to top of the biofilter to be by suitable permanent access ladder up the southern wall of the biofilter.

2.5. Biofilter Plenum

2.5.1. The plenum across the base of the biofilter will be built using HAHN biofilter air floor sections. These provide a good method of providing a stable base for the biofilter and facilitating even air dispersal across the base of the biofilter media.

2.5.2. The plenum system requires a minimum load bearing capacity of 3tonnes per sq.m. to allow for machine cleaning.

2.5.3. The supplier details for this air floor are attached in Appendix 3.

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2.6. Biofilter Drainage

2.6.1. The drainage system comprises a single 160mm ID drain pipes, laid alongside the existing concrete pad, with 3 drain points along the approximate centre line of the biofilter.

2.6.2. No gulleys, gratings or U bends are to be used under the media bed. Unblocking these would require emptying the biofilter.

2.6.3. Installation & fall as per standard sewage pipe.

2.6.4. The drainage line is to be provided with a cleaning/rodding access at the southern end of the biofilter, as shown in Figure 1.

2.6.5. The pipe discharges into a small, sealed chamber. Discharge from this chamber is via a small pump, discharging via a standard 15mm water pipe.
The electricity supply for this pump is to be taken from the enclosure for the inverter.

2.6.6. The pump and rodding chamber has screw-down, sealing lids to prevent surface water ingress, odour egress or air bypass from biofilter.

2.6.7. The pump chamber cis a standard small, preformed sewage or effluent pumping chamber of c.1.0cu.m.

2.7. Biofilter Stack

2.7.1. The biofilter stack is to be formed using a single 3m length of Polypipe 1200mm internal diameter twinwall culvert duct.
This is strong enough to carry the weight of the fan and ducting above and the lateral load from the placed media.

2.7.2. The stack is to be braced back to the concrete panel walls using galvanised bracers, as shown in Figure 5.

2.7.3. The stack is to have a 30mm thick HDPE base plate, cut as an annular ring, 1550mm in external diameter and 1100mm internal diameter.

2.7.4. Base plate may be sourced from Beckox (Poole) – 01202 736725

2.8. **Biofilter Monitoring Point**

2.8.1. The biofilter monitoring point is to be constructed & installed as detailed within Figure 4.

2.8.2. The monitoring point is to be placed c.300mm up from the base of the biofilter floor, to allow access to the biofilter plenum.

2.9. Biofilter Ducting

2.9.1. The inlet ducting for the biofilter is constructed to the drawings and details as attached in Appendix 5.

2.9.2. All delivery ducting, upstream of the fan will be standard pressed steel galvanised ventilation ducting to facilitate easy replacement, maintenance and sourcing of the system.

2.9.3. All items in the air ducting and fan system are standard units to ease supply and maintenance.

2.10. Building Outlet Vents

2.10.1. The air leaves the Reception Barn through a louvre protected by a grill to stop rubbish being drawn into the duct and damaging the fan.

2.10.2. The louvre will also help cut down noise caused by air entering the duct and from the fan itself.

2.10.3. Within the duct is a non-return baffle. This is to stop any exhaust returning back up the duct should a fan fail and the wind be from the west to north east quadrant, causing a vacuum by the open vehicle door.

2.10.4. The outlet vent is located above and behind the waste storage area to ensure that the most concentrated odours are dealt with right at source.

2.11. Fan & The Controls

2.11.1. The fan utilises a single, large fan. This has a duty of c.20,000m^3 per hour, sufficient to deliver 3 air changes, as required by BAT.

2.11.2. The fan is controlled by an inverter, so allowing the speed to be varied as required.

2.11.3. The details for the fan & inverter are attached in Appendix 5.

2.12. Biofilter Media

2.12.1. Melcourt Biofil Coarse to be used for the biofilter. The specification is attached as Appendix 2.
If a different media is to be used, material with similar specifications should be installed.

2.12.2. For instructions on how to place & replace media, see Appendix 2 and Section 4.4 of this manual.

2.12.3. Upon placement, media is to be back raked as it is placed to stop compaction.

2.13. Irrigation System

2.13.1. The biofilter requires an irrigation system to be installed to wet the surface of the filter, should it be required.

2.13.2. All the system needs to comprise is a pair of small horticultural irrigators, supplied by temporary water hoses that can be removed in winter to prevent frost damage.

2.13.3. The system should be provided with a timer control system to prevent people turning the system on and then forgetting to turn it off again.

2.13.4. Different atmospheric conditions will require different watering rates and regimes. These will be determined by the site operatives through observation of the biofilter media condition.

2.14. Misting System

2.14.1. A water atomiser can be mounted within the delivery ducting, immediately above the stack and downstream of the fan.

2.14.2. Mounting in this location will ensure that the mist gets to the media, as required, without causing damage to the fans.

2.14.3. The stack, plenum and contact surfaces from this point onwards will be proof against contact with the moisture-laden air.

2.14.4. This can be used to add moisture to the air feed into the biofilter media if required.

2.14.5. This system also should be fitted with a timer control system to prevent it being inadvertently left on.

2.14.6. This system should be used sparingly, for short periods with long rests in between. Excessive use will cause the lower section of the biofilter media to rot, settle, generate fines and block. This will seriously impede airflow, harm the efficiency of the filter and necessitate changing the media a lot more often.

2.15. Air Control Within Reception Barn

2.15.1. To reduce uncontrolled airflow, the Reception Barn should be sealed as far as is practical.

2.15.2. The main doors should be fast action units to reduce open time and chance of uncontrolled exhaust.

2.15.3. Personnel access doors should be fitted with auto-closure mechanism.

2.15.4. Eaves and changes in cladding should be sealed to be draught proof as well as vermin proof.

2.15.5. Once the buildings and biofilter are operational, with waste being processed and plant in place, then the internal air flow will be assessed to ensure no eddies or pooling occurs.

2.15.6. This assessment will allow the placement of small air movers on processing plant and/or small extra inlet vents in the walls of the buildings, if required.

2.15.7. The intention is that these extra measures stop any eddies or pools being generated within the building and so causing localised build-up of odour.

2.15.8. These measures are to be assessed and reviewed regularly to ensure no changes of process or layout within the building cause potential issues.

3. Media Selection Rationale

3.1. Woodchip media selection & specification

3.1.1. The media selected for this system is woodchip, specifically Melcourt Biofil Coarse. This media is produced to a specification, which is included in Appendix 2.

3.1.2. Should a different supplier for the woodchip media be appointed, the material supplied must conform to the specification in Appendix 2.

3.2. Demonstrate adequate residence times

3.2.1. The system has an EBRT of c.30 seconds.

3.2.2. With the specified wood chip media and the reduced odour loading of the exhaust air, this EBRT will be more than sufficient for this installation.

3.3. Sufficient sorption capacity for contaminants and microbiobial attachment

3.3.1. By its nature physical nature, woodchip has excellent sorption capacity and microbiobial attachment characteristics.

3.4. Living space and reserve nutrients for micro-organisms

3.4.1. Woodchip media has excellent living space for bacteria, due to the inherent rough surface and pores available within the media.

3.4.2. The media also provides an intrinsic source of nutrient for the bacterial colony through its organic nature and also as it slowly degrades.

3.5. Media water/moisture content – 50 to 80% by weight

3.5.1. The moisture content of woodchip is around 50% when unseasoned wood chip is used.

3.5.2. Seasoned woodchip has a lower water content but the water is at the surface of the woodchip, so bacteria can utilise the moisture whilst living on a stable core of material.

3.6. Structural support to maintain internal structure

3.6.1. Woodchip is light and its particle shape means that the media will lock, so preventing compaction and maintaining void space.

3.6.2. Woodchip is also strong enough to self-support at depth, maintaining the void space required for the successful operation of the biofilter.

3.7. Media temperature – near ambient – 15- 35 or 40ºC

3.7.1. Properly maintained and monitored woodchip media does not self-heat or readily compost, so the temperature of the media remains at ambient levels.

3.8. Media pH – 7 to 8.5

3.8.1. Woodchip media has a relatively neutral pH, as required.

3.9. Biologically active, but reasonably stable

3.9.1. The media is biologically active due to its nature and maintained colony.

3.9.2. It is also reasonably stable due to the colony existing on the surface of the particle, rather than through its core.

3.9.3. The mass and nature of the media also imparts physical and environmental stability to the biological colony.

3.10. Organic matter content >60%

3.10.1. Woodchip biomedia is of over 90% organic matter content, higher if virgin material is used.

3.11. Porous and friable with 75 to 90% void volume

3.11.1. Woodchip biofilter media is both porous and friable by nature.

3.11.2. The media also has a very high void volume as required by BAT and successfully demonstrated by the use of the material as biofilter media through the UK.

3.12. Resistant to waterlogging and compaction

3.12.1. Woodchip media does not self-pack or compact under its own weight as some other media is liable to do.

3.12.2. As the material is relatively light, and has a rough surface, it can self-support its own void space as it locks together.

3.12.3. Should the humidity drop, the biofilter can be watered if required.

3.12.4. Due to its high void space, the material will also self-drain relatively easily.

3.13. Relatively low fines content to reduce gas head loss

3.13.1. The media will be screened prior to use, so removing fines from the biofilter.

3.13.2. The lower 1m will be of courser grade to further assist with air dispersal through the media and reducing blocking or tracking.

3.13.3. Woodchip biofilter media is also relatively slow in generating fines from its own degradation with time.

3.14. Relatively free of residual odour

3.14.1. Woodchip media has no residual odour.

3.14.2. Should any residual process odour occur, the natural resins in the media will assist in countering any residuals.

4.0 Biofilter Operation Manual

4.1 Normal Operation

4.1.1 The biofilter system is to be run continuously, unless down for short periods for scheduled maintenance or breakdown.

4.1.2 During the site's operating and waste reception hours, the biofilter system is to be operated with the fan at the capacity required to give the air flows as detailed within the Biofilter Calculations (Appendix 3).

4.1.3 When the site is not receiving or processing waste, the fan capacity may be decreased to 60% of daytime running.
This is because less odour will be generated when the site is dormant.

4.1.4 The Reception Barn must be operated with doors closed to maintain the efficiency of the system.

4.1.5 Inspection and maintenance procedures and remedial actions as detailed below must be undertaken and recorded within the Site Diary.

4.1.6 The biofilter system is simple and robust. As long as it has been built in accordance with the construction notes, the periodic checks are carried out and the system is properly maintained, it will give reliable service.

4.2 Inspection and Maintenance Procedures

4.2.1. Daily &/or Weekly Inspection Regime

4.2.1.1. Fan
Are it operating? If it isn't – why not?
The fan should be completely free from vibration and metallic noise.
If there is noise or vibration, find out why & rectify.
The fan should have no visible damage to the casing or motor

4.2.1.2. Biofilter Ducting
The ducting should have no damage, leaks or blockages.
Any such should be recorded and rectified.
Any misting system installed below (downstream) of the fan should be checked for operation.

4.2.1.3. Biofilter Media
The media should be free from matting, surface holes, dust or weeds.
It should have no visible venting (holes) or tracking (wet or dry patches or noticeable draughts at surface).
It should not be visibly too wet (saturated) or dry to the touch. The woodchip should be damp at surface but not soaked.
Whilst over wetting at surface due to precipitation may appear to be a problem, this will rarely descend more than 300mm into the media and so will not be a major issue.
Should the media be too dry (dry to touch) at around 300mm deep, then the biofilter should be irrigated as necessary to maintain the efficiency of the bacterial colony.
The media should be temperature checked once per week, at 2 differing locations and at depth of between 300 – 1000mm.
This check may be undertaken using a hand held infrared temperature sensor, pointed at the base of a hole recently excavated within the media.
The media temperature should be close to ambient. Some rise or fall is allowable in summer and winter.
Should the media show a temperature of >50°C, then a further 3 temperature checks must take place at 1000mm depth to ascertain the extent of any heating.

Should this be discovered, refer to Section 5 below.
Any holes excavated for temperature checks should be refilled when the checks are completed.
The excavated material should also be inspected for excessive degradation, composting or mould growth.
The media irrigation system should be checked for operation and leaks and any issues noted and rectified.
Any such action should be recorded.

4.2.1.4. Biofilter Drainage System
The drainage system should show no evidence of leaking or blockages.
Any such should be recorded and rectified.

4.2.1.5. Biofilter Structure
The structure of the biofilter should be checked for damage from impact or degradation.
There should be no visible air bleed from the plenum out through joints in the wall structure.
Any such should be recorded and rectified.

4.2.1.6. Reception Barn Odour Control
Inspect all grids, one-way louvres, fans and air movers (if fitted).
If they are blocked, damaged or not working properly, they should be rectified and the action recorded.

4.2.2. Monthly Inspection Regime
As per the daily and Weekly Inspection Regime, the following should be undertaken with fan at reduced duty to reduce the air pressure in the plenum.

4.2.2.1. Fan
Check inverter operation if fitted.

4.2.2.2. Biofilter Ducting
Where accessible, open ducting inspection hatches and inspect duct interiors.

4.2.2.3. Biofilter Media
Dig four 600mm deep check pits in the biofilter media to check for sub-surface blocking, soaking, drying or excessive fines.

4.2.2.4. Biofilter Drainage System
Open the drainage system pumping chamber cover to check for airflow into the chamber (so proving the filter discharge clear), condition of the chamber and the pump.

4.2.2.5. Biofilter Structure
As per the daily and weekly checks.
Any issues should be rectified.

4.2.2.6. Reception Barn Odour Control
As per the daily and weekly checks.
Pooling, eddies and odour hot-spots within the building also need to be checked for.
With all systems in operation, an operator (or external consultant) must walk round the inside of the Reception Barn with a calibrated gas monitoring set.
The operator (or consultant) will check for any noticeable odour hot-spots whilst the monitoring set will detect raised levels of gas present.
Should this occur (and dependant on the location or operation), extra small air movers (or vents if close to the building wall) may be required to break up the pool.
Any issues should be rectified.

4.2.2.7. Reception Barn Structure

The structure of the Reception Barn should be visibly checked for damage or openings due to age, weather damage, etc.
Vehicle and personnel doors should be checked for closing and sealing efficiency.
All airflow into the Reception Barn should be controlled to assist the deodorising system as much as possible.
Any issues should be rectified.

4.2.3. Annual Inspection Regime (or as required by Permit) As per Monthly Inspection Regime as well as:

4.2.3.1. Reception Barn Structure
The overall seal of the Reception Barn and the effectiveness of the air flow system should be checked on an annual basis.

This may be done in 1 of 3 ways:

1. Method 1
   Seal all louvres, openings and doors.
   Turn off the biofilter fan & block the extraction duct.
   Pressurise the Reception Barn using a big impeller fan mounted in one of the vehicle doors and check the air pressure increase between the interior and exterior of the building.
   Should no pressure difference occur then the fabric of the building must be investigated and rectified, and the test repeated to prove air tightness.
   This must be undertaken by an external consultant, who will bring a trailer-mounted impeller fan to site.
   This test renders the odour management system redundant for the period of the test, when the Reception Barn is actively pressurised.
   As the test actively pressurises the Reception Barn with no odour control, the floor should be cleared prior to the test and no processing can take place during, to minimise odour generation during the test.
   Once the test has been completed, remove all the test equipment, unseal the louvres, doors & openings, turn the biofilter fan back on and recommence waste processing.

2. Method 2
   Seal all louvres, openings and doors.
   Turn off the biofilter fan & block the extraction duct.
   Exhaust the shed using a big extractor fan mounted in one of the vehicle doors and check the air pressure decrease between the interior and exterior of the building.
   Should no pressure difference occur then the fabric of the building must be investigated and rectified, and the test repeated to prove air tightness.
   This must be undertaken by an external consultant, who will bring a trailer-mounted extraction fan to site.
   This test renders the odour management system redundant for the period of the test, when the Reception Barn has a partial (mild) vacuum inside.
   As the test requires the biofilter be stopped, the floor should be cleared prior to the test and no processing can take place during, to minimise odour generation during the test.
   Once the test has been completed, remove all the test equipment, unseal the louvres, doors & openings, turn the biofilter fan back on and recommence waste processing.

3. Method 3
   Do not undertake this test in the rain or any smoke markers will not be visible.
   Turn off the waste processing plant.
   Turn off the biofilter fan.
   Close the Reception Barn doors but do not seal any louvres.
   Turn off the fire alarm and gas detection system, if possible. If this is not possible, inform the fire alarm monitoring company prior to the test taking place.
   Discharge 8 large proprietary smoke markers (Enola Gay or similar make) within the barn, sufficient to give a good, distributed smoke cloud within the building.

The markers should be placed regularly across the building floor and a bright colour (blue, purple or red) should be chosen.
Externally monitor the outside of the building to check for leaks from the building fabric. Occasional whisps are acceptable. Heavy clouds leaving the building aren't.
If heavy leaks are seen, photograph the location, repair the building & repeat the test once the repairs have been completed.
Assuming the building shows no heavy leakage, when the smoke inside the building is well distributed, turn on the biofilter.
The airflow through the biofilter is enough to cause mild negative pressure within the building, so any airflow will be into the building.
Walk round the outside of the building with a camera. No smoke traces, will be visible outside the building.
Photographs of the outside of the building should be taken during the test to prove the building fabric and mark any areas for repair.
Once the fan system has cleared the smoke, turn the fire alarm system back on and recommence waste processing operations.

All 3 test methods are satisfactory but method 3 allows the odour control system to remain active during testing, is less disruptive to operations and can be carried out without the use of external consultants or specialist equipment. It is also much more of a real-world test that attempting to pressurise or exhaust the Reception Barn.

The tests must be recorded and any findings or rectification works noted within the site maintenance diary.

4.2.3.2. Biofilter Efficiency
The inflow and exhaust to & from the biofilter can be sampled to check on the efficiency of the system if this is required as part of the site Permit.
It has to be undertaken by an external consultant and requires air samples to be taken immediately before and after the filter.
This testing gives a measure of objective analysis of the biofilter's performance but should not be required if the filter is monitored and maintained properly.
The pressure in the plenum can be tested by a consultant using the installed monitoring point.

4.3. Critical limits and actions in the event of non-compliance

4.3.1. The system is very simple and robust. The odour loading on the biofilter will be relatively low.

4.3.2. Highly proscriptive, technical critical limits are not required for this system, apart from monitoring the media temperature, moisture content and surface condition, the monitoring required will be kept simple to assist the site to carry out its own checks as required.

4.3.3. Any intervention required for the biofilter should be kept as simple & low impact as possible to maintain the bacteriological colony within the media at good population levels.
Heavy handed or excessive media changes or the thoughtless use of heavy machinery on the filter media pack will harm the performance of the filter to a great extent.

4.3.4. The best, most effective and simplest check on the performance of the biofilter is for a site operative to walk the whole of the surface of the filter as the first duty on shift, checking the condition of the surface of the filter media and whether any odour is apparent within the exhaust from the filter.
Walking the filter surface as first duty will ensure the operative's nose is "fresh" and so give the best check.
Traces or patches of odour above the filter will denote possible tracking within the filter, whilst a general scent across the whole surface will denote media that is too dry or is beginning to compost too much to be effective and requires changing (see Section 5).

4.3.5. Media temperature should be monitored as set down in the maintenance checks above.

Temperatures within the media should be noted against their rough locations within the media bed.
These temperatures should be referenced to ensure the temperature within the media is not moving too far away from ambient.
A temperature increase well above ambient will denote the media is beginning to compost.
A temperature drop will denote the media has become anaerobic due to blocking through excess fines or dust and is biologically dead.
Both the above changes will necessitate a change and blending of the filter media.
With woodchip (especially seasoned woodchip) it would be expected to have the change some of the media, blending the remainder, approximately once every 5 years, depending on loading, media, maintenance and weather conditions.

4.3.6. Media moisture content should be assessed by visual inspection at surface and at c.600mm depth.
Unless during a period of heavy rain, the surface tends to be the driest part of a biofilter media pack, but still should be checked as a guide to conditions below.
At around 600mm depth, the conditions have become more uniform and will be indicative of the depth of the biofilter below.
The media should be excavated and a sample taken at depth. Only a handful of pieces are required.
These pieces should be squeezed to check what moisture is present on the particle's surface.
They should feel wet to the touch but not spongy or saturated.
The pieces of woodchip should not be rotten or soft.
Some discolouration is to be expected (woodchip media rapidly goes black in operation).
Most of the moisture content within woodchip biofilter media will be at the chip's surface, especially when the media is comprised of seasoned woodchip.
If the chips are broken up and drier material lies at their centre, this is not an issue.
However, if the media sample is surface dry to the touch, the irrigation and/or misting system should be used for a set period each day and the condition monitored.
If the material is too wet, then any irrigation or misting system should be turned off.
The biofilter watering system should be checked for leaks.
The drainage system should also be inspected to ensure there are no blockages.
If the media is saturated within the middle of a very wet winter, then the pack will dry after the winter as the weather improves. Its efficiency will not be seriously impacted during the period of bad weather.
However, if the media is saturated during the drier months, this means that the lower levels of the media are choked and the airflow is not easily passing through the media, so stopping moisture evaporating from the surface of the media. Should this occur, then the media will need to be partially changed and blended, as set out on Section 5.

4.3.7. The surface condition of the media should be monitored whenever the biofilter is walked over.
Choking, tracking or weed growth can be easily detected during a walk over.
Surface matting and weeds should be removed and the local area forked over to reduce any sub-surface choking.
When the inspection pits are dug, matting should be checked for just below the surface. If this is present, then forking over the surface of the biofilter to break this up is all that is needed.
Deeper matting, heavy composting or severe degradation of the media will require a partial change and refreshing of the pack. Please see Section 5 for this.

4.4 Media Renewal

4.4.1. Wood Chip Media Source

4.4.1.1. The recommended wood chip media will be Melcourt Biofil Coarse. This material is known and is produced to a good specification.

4.4.1.2. If a different media is used, it must be to the same specification.

4.4.2. Wood Chip Media Changing Frequency

4.4.2.1. The media should only be changed when necessary. It is vital that the bacterial colony within the filter media be maintained in as good a condition as possible to maintain the biofilter's performance.

4.4.2.2. The media should only be changed when it is choked to the point that air flow is not possible and odour is apparent above the filter, as are signs of tracking and venting from the media. This will occur if the media begins to choke with fines, so blocking the void space.
This occurs as the media starts to self-compost, so softening and losing structural integrity to the point that the settlement so caused obstructs air flow through the media.

4.4.2.3. If the media becomes saturated and anaerobic, it will also settle and choke and so will need changing if this happens.

4.4.2.4. As long as the media is maintained in a good condition and the airflow is maintained, so slowing degradation, the media should require a partial change at around c.5 years after commissioning and a full change c.7 years after commissioning.

4.4.2.5. This prediction depends on the media internal environment, weather conditions, odour loading, airflow characteristics and biofilter maintenance.

4.4.3. Wood Chip Media Changing Method

4.4.3.1. Media can be changed using a small (c.1tonne) low ground pressure 360º excavator, lifted onto the top of the biofilter. This can be used to remove the media from within the filter bed in a controlled manner.

4.4.3.2. Media should be moved from around the filter stack only by hand. No excavator should work close to the stack in case of damage to the duct or fan system.

4.4.3.3. Care should also be taken when working close to the biofilter walls to prevent impact damage to the seals between the blocks and panels.

4.4.3.4. The excavator should always work on top of a bed of at least 1.5m of media to prevent damage to the plenum from track and excessive compaction and matting of the media.

4.4.3.5. Any compaction will only affect the top 300-500mm of media and then only mildly. The excavator should work backwards, raking and breaking up any compaction as it goes.

4.4.3.6. When removing media, it should be cleared down to 300mm above the plenum to prevent damage, with the excavator working from a suitable pad of old media. The fresh replacement media can then be added to this remainder and be blended with it to build up the media.

4.4.3.7. Apart from when first loading the biofilter, any replacement biofilter media is to be blended 10:1 with media removed from the biofilter to provide a bacterial seeding for the new filter. The blending can be undertaken using machine bucket before loading into the biofilter. Loading and blending can be undertaken using a telehandler, feeding to the excavator within the biofilter.

4.4.4. Wood Chip Media Disposal

4.4.4.1. As long as the media is from a virgin wood source and has not been allowed to become anaerobic and odorous, it may be used as a mulch with no detrimental effects to the environmental, flora or fauna.
Some residual odour may be apparent on placement but, as long as the mulch is not over-used, this will quickly pass.
The end-of-life media will perform well as a mulch, be it originally seasoned or unseasoned wood.

4.4.4.2. If any residual odour remains from the biofilter duty, the media may be composted for a few weeks prior to use as a mulch.

4.4.4.3. To promote successful composting, it should be treated as any other green waste – blended, turned and monitored – to ensure a quality product.

Mike Thompson Partnership Ltd E:mike.thompson@mikethompsonpartnership.co.uk

Figures

Figures for Biofilter Design with 'Lego' Block Walls

Appendix 1 - Biofilter Design Calculations

Reception Building Dimensions and Volumes	**L m**	**W m**	**H m**	**Volume m^3**
Main Building Envelope	39.4	17.2	10.0	6776.8
Total Building Volume				6776.8
Effective Air Volume for Biofilter Calculations	**6776.8**	**cubic metres**		
Air Flow Requirements				
Effective Air Volume of Building	6776.8	cubic metres		
Air changes per hour req'd	3	changes/hr		
Air Flow Through Biofilter Per Hour	**20330.4**	**cubic metres/hr**		
Biofilter Residence Time Requirement (EBRT)				
Minimum Empty Bed Residence time (EBRT)	30	Seconds		
Biofilter Bed Volume Requirement to gain EBRT				
Hourly Air Flow Volume	20330.4	cubic metres/hr		
Air Flow Volume per second	5.6	cubic metres/sec		
Required Biofilter Volume	**169.4**	**cubic metres**		
Internal Biofilter Dimensions				
Biofilter Length	10.5	metres		
Biofilter Width	5.4	metres		
Biofilter Height (Bed only)	3.0	metres		
Biofilter Volume	**170.1**	**metres**		
Overall biofilter internal height (inc. 0.5m plenum)	3.6	metres		

Appendix 2 - Melcourt Biofil Media Course Specification

Attached as Melcourt-Biofil-Coarse-Technical-Information-Sheet.pdf

Appendix 3 – Hahn Air Floor Details

Attached as HAHN UK TS Biofilter Raised Flooring System.pdf

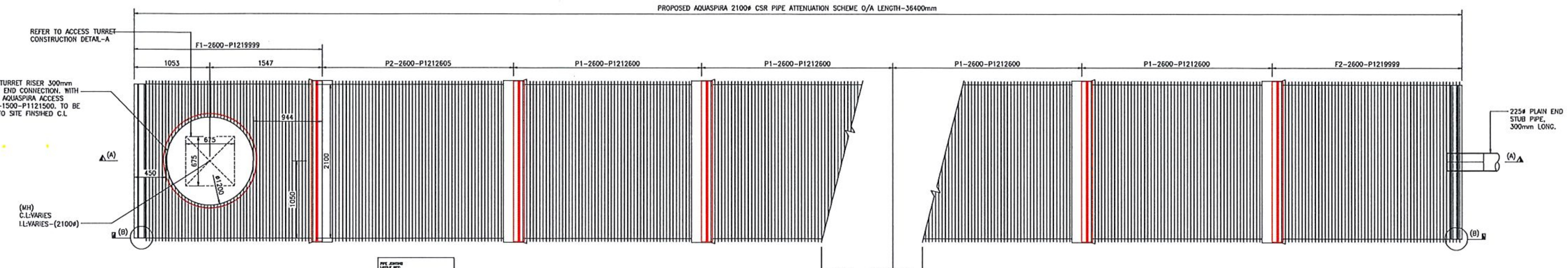
Appendix 4 – Ducting and Fan Manual, Details and Drawings

Details supplied by KVS Ltd

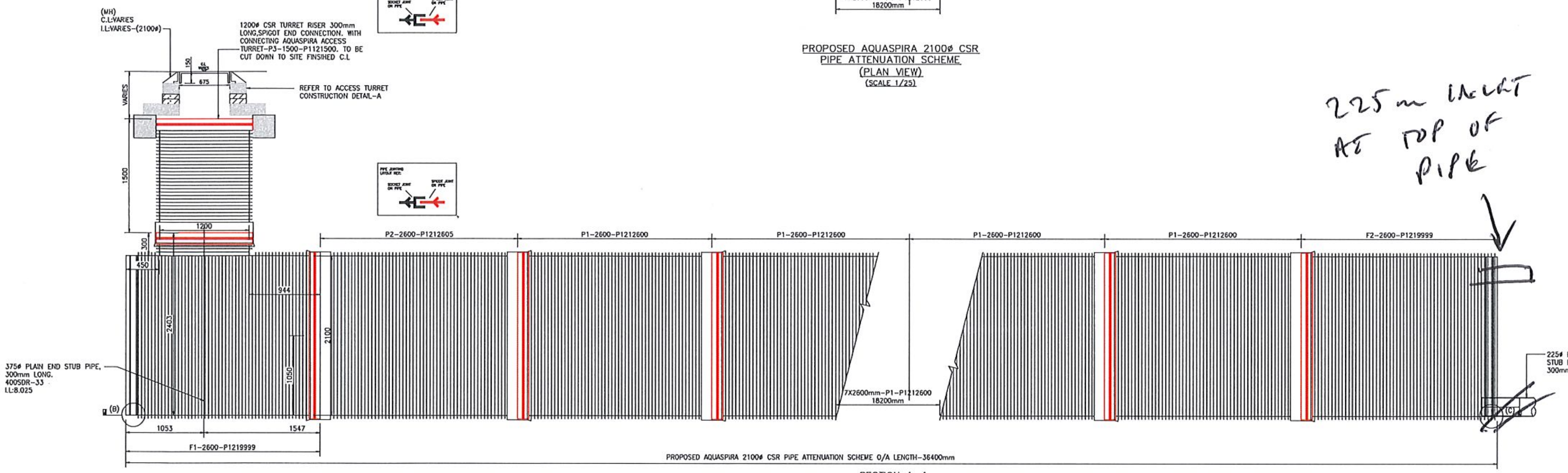
Appendix H Leachate tank drawing, Aquaspira Undertank

DO NOT SCALE

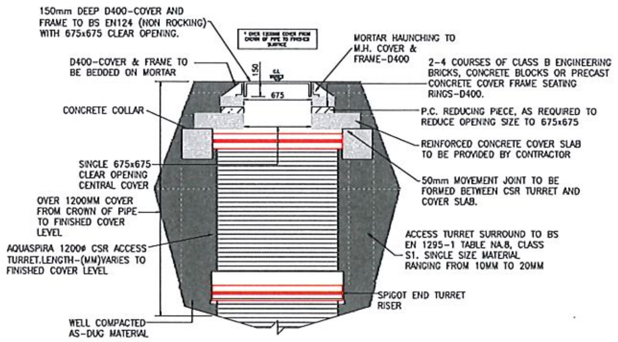
REV	DESCRIPTION	DATE	BY



PROPOSED AQUASPIRA 2100ø CSR PIPE ATTENUATION SCHEME (PLAN VIEW) (SCALE 1/25)



SECTION A-A (SCALE 1/25)



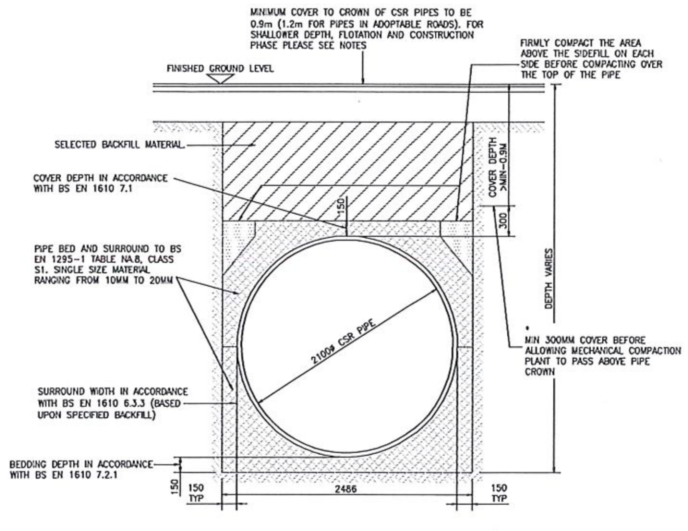
ACCESS TURRET CONSTRUCTION DETAILS 1200ø-(A) (SCALE 1/25)

225 mm INLET AT TOP OF PIPE

APPROVED SUBJECT TO RELOCATION OF INLET PIPE.

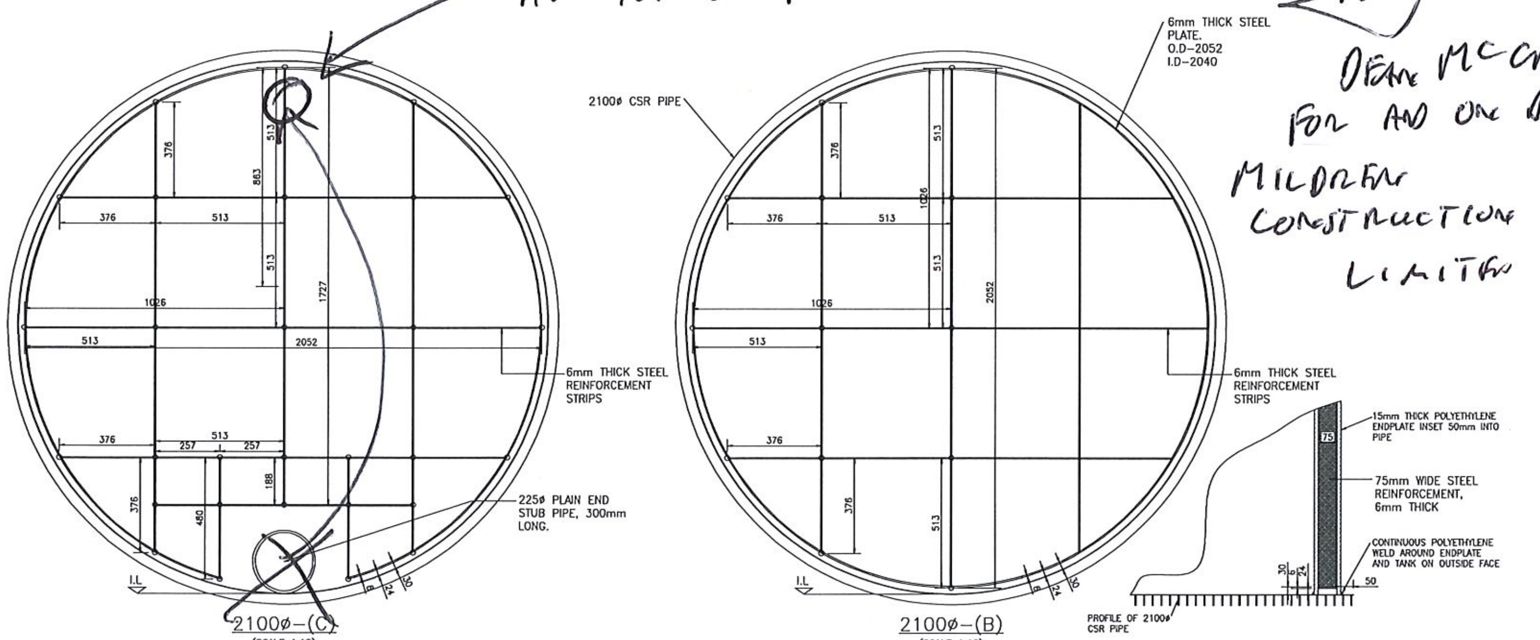
25/3/22

DEAN McCARTHY FOR AND ON BEHALF OF MILDREN CONSTRUCTION LIMITED



SECTION BED AND SURROUND DETAILS FOR HARD LANDSCAPED/TRAFFICKED AREAS (SCALE 1/25)

BACKFILL TO BE IN ACCORDANCE WITH 'SPECIFICATION FOR HIGHWAY WORKS' VOLUME 1, TABLE 6/2



2100ø ENDPLATE WELDING DETAIL-(1) (SCALE 1:10)

CUTTING/PARTS LIST							
PART REF.	PRODUCT CODE	PIPE SIZE	PIPE LENGTH	END 1 FINISH	END 2 FINISH	DESCRIPTION	QUANTITY
P1	P1212600	2100ø CSR	2.6m	PUSH FIT SPIGOT	PUSH FIT SOCKET	STANDARD AQUASPIRA CSR PIPE-SOCKET/SPIGOT	11
P2	P1212605	2100ø CSR	2.6m	PUSH FIT SOCKET	PUSH FIT SOCKET	STANDARD AQUASPIRA CSR PIPE-SOCKET/SOCKET	1
P3	P1121500	1200ø CSR	1.5m	PUSH FIT SPIGOT	PUSH FIT SOCKET	STANDARD AQUASPIRA CSR PIPE-SPIGOT/SOCKET-ACCESS TURRET	1
F1	P1219999	2100ø CSR	2600mm	PUSH FIT SPIGOT	CSR ACCESS PIPE	CSR ACCESS END PIPE-2100ø + 1X1200ø TURRET RISER + ENDPLATE	1
F2	P1219999	2100ø CSR	2600mm	PUSH FIT SPIGOT	ENDPLATE	2100ø CSR PIPE + END PLATE	1

NOTE:

1. FOR DETAILS OF TRADITIONAL MANHOLE CONSTRUCTION REFER TO SEWERS FOR ADOPTION 7TH EDITION.
2. ALL DIMENSIONS ARE NOMINAL AND IN MILLIMETERS
3. PLEASE REFER TO AQUASPIRA PIPE INSTALLATION GUIDE FOR DETAILED INFORMATION ON PIPE INSTALLATION
4. ALL STAINLESS STEEL SPECIFIED TO BE GRADE 304,4mm THICK.
5. ALL PIPE SPECIFIED TO BE AQUASPIRA CSR PIPE

PIPE BEDDING NOTES:

1. ALL DIMENSIONS ARE NOMINAL AND IN MILLIMETERS
2. PROCESSED GRANULAR MATERIALS TO INCLUDE AGGREGATES TO BS 882, AIR-COOLED BLAST FURNACE SLAG TO BS 1047 AND LIGHTWEIGHT AGGREGATES TO BS 3797.
3. ALL TEMPORARY ENABLING WORKS ARE BY OTHERS
4. PROJECT ENGINEERS TO CONFIRM THE BACKFILL DETAILS ARE APPROPRIATE FOR THE SITE GROUND CONDITIONS AND LOADING CRITERIA.
5. SINGLE SIZE BACKFILL TO BE IN ACCORDANCE WITH 'SPECIFICATION FOR HIGHWAYS WORKS' VOLUME 1, TABLE 6/2.
6. IF RECLAIMED AND SITE WON MATERIAL TO BE USED AS BACKFILL DCC MATERIALS LABORATORY TO BE CONSULTED IN THE SELECTION, AND APPROVAL OF THE MATERIAL PRIOR TO USE BELOW HIGHWAY
7. WHERE MINIMUM COVER DEPTHS SHOWN CANNOT BE ACHIEVED, A REINFORCED CONCRETE PROTECTION SLAB IS REQUIRED. FOR DETAILS PLEASE SEE 'Your Questions Answered' IN THE TECHNICAL SECTION OF OUR WEBSITE-www.aquaspira.com

FLOTATION

PIPES ABOVE 1500ø MAY REQUIRE MORE THAN 900mm COVER. PLEASE REFER TO THE HYDRAULIC PAGE IN THE 'TECHNICAL' SECTION OF OUR WEBSITE-www.aquaspira.com

APPROVAL ISSUE

NOTES:

THIS DRAWING HAS BEEN PRODUCED FOR THE PURPOSE OF OFFERING DESIGN AND LAYOUT INFORMATION TO ASSIST THE PROJECT ENGINEER WHEN ASSESSING THE SUITABILITY OF AQUASPIRA PRODUCTS. THE INFORMATION CONTAINED IN THIS DRAWING IS APPROPRIATE TO AQUASPIRA PRODUCTS ONLY, AND ALL REFERENCES TO ASSOCIATED CONSTRUCTION DETAILS ARE OFFERED AS TYPICAL DETAILS AND DO NOT TAKE ACCOUNT OF PROJECT CONDITIONS. THE PROJECT ENGINEER/S MUST SATISFY THEMSELVES THAT THE INFORMATION PROVIDED IN THIS DRAWING IS SATISFACTORY.

Client
MILDREN CONSTRUCTION Ltd
HERRIARD BOIMASS PLANT, BUSHY WARREN LANE, BASINGSTOKE

Drawing Title.
PROPOSED AQUASPIRA 2100ø CSR PIPE ATTENUATION SCHEME & CONSTRUCTION DETAILS

AquaSpira

Date	Scale	Drawn	Checked
22.03.22	AS SHOWN	JH	CG

Drawing No 22.80610-D1 | -