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Report:	**Bioaerosol Monitoring**
Client:	Yorkshire Water Services Ltd
Date of Site Work:	7th September 2022
Prepared for:	Mr Tom Broderick Sandall STW North End of Clay Lane Sandall Doncaster
Prepared by:	Abigail Pickard
Reviewed by:	Ian Evans B.Sc. (Hons), CertOH, LFOH
Issued by:	
Issue date:	21/10/2022
Report Ref:	**113845 V1**

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Executive Summary

Tom Broderick of Yorkshire Water Services Ltd requested that Element Materials Technology Environmental UK Limited undertake monitoring of bioaerosols at its Sandall site. Monitoring was undertaken in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'.

Site work was undertaken by Abigail Pickard on 7th September 2022.

The purpose of the bioaerosol monitoring exercise was to establish the concentration of bioaerosols being dispersed from the site to the nearest sensitive receptor.

Monitoring Findings:

Sampling Location	Analyte	Guidance Limit (CFU/m^3)	Median Concentration of Parallel Samples (CFU/m^3)
Upwind	Total bacteria	1000	125
	Aspergillus fumigatus	500	<125
Downwind	Total bacteria	1000	<125
	Aspergillus fumigatus	500	<125
Downwind Left Hand Fan	Total bacteria	1000	<125
	Aspergillus fumigatus	500	<125
Downwind Right Hand Fan	Total bacteria	1000	<125
	Aspergillus fumigatus	500	<125
Sampling Point 1	Total bacteria	1000	<125
	Aspergillus fumigatus	500	<125
Sampling Point 2	Total bacteria	1000	125
	Aspergillus fumigatus	500	250
Sampling Point 3	Total bacteria	1000	<125
	Aspergillus fumigatus	500	250
Sampling Point 4	Total bacteria	1000	<125
	Aspergillus fumigatus	500	250

< Less than CFU/m^3 Colony Forming Units Per Cubic Metre

Below Limit **Exceeds Limit**

1. Introduction

Element Materials Technology Environmental UK Ltd was commissioned by Yorkshire Water Services Ltd to carry out a bioaerosol monitoring exercise at the Waste Water Treatment Works at their site in Sandall.

The purpose of the bioaerosol monitoring exercise was to establish the concentration of bioaerosols being dispersed from the site to the nearest sensitive receptor, as part of a permit application.

Monitoring was undertaken in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. This report details the survey methodology and results on the monitoring of all locations.

Site work was undertaken by Abigail Pickard of Element Materials Technology Environmental UK Ltd on 7th September 2022.

2. Measurement Methodology

Measurements were carried out in accordance with parameters specified in Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. Of the methods suggested in the protocol, the filter method was utilised in this project.

On site calibration checks were performed on the pumps used and were found to be within the permitted tolerance of the standard.

For all measurements the sample head was located 1.5 metres above ground level. The upwind sample was taken further away from the centre of operations than recommended in the guidance. This was to ensure the sample was outside the operational area and represented a true upwind value.

Triplicate samples were carried out at each selected sampling location. Once completed, filters were transferred in a refrigerated container to the laboratory within 24 hours.

The IOM heads containing a polycarbonate filter were used to determine the bioaerosol exposure under the test conditions. Upon arrival at the laboratory the bioaerosols impacted on each filter were recovered in 2 ml maximum recovery diluent. The target micro-organisms were cultured using appropriate dilutions on the following media.

Half-strength nutrient agar (1/2NA) plates were used for total mesophilic bacteria. Malt extract agar (MEA) plates were used for *Aspergillus fumigatus*.

Samples were incubated for up to seven days at 37°C (total mesophilic bacteria), and for two days at 45°C (*Aspergillus fumigatus*).

The laboratory retained information regarding each sample. Dates and times of preparation, incubation times, batch numbers, personnel responsible, storage medium and incubator temperature were all recorded.

3. Site Information

Yorkshire Water Services Ltd operates a Waste Water Treatment Works at their site in Sandall, Yorkshire. The site currently is not required to undertake ambient air monitoring but has done so to support a permit application.

The site is not currently permitted, with an application being submitted in the near future. As such the limits used are the standard limits used by the Environment Agency (EA).

Parameter	Threshold limit (CFU/m^3)
Total bacteria (TB)	1000
Aspergillus fumigatus (AF)	500

Table 1. Environmental Parameters - Bioaerosol monitoring							Job Number 113845
Site:		Sandall, Yorkshire		Site Operator			Yorkshire Water Services Ltd
Date:		07/09/22		Commissioning Laboratory			EMT Environmental
				Types of materials processed on site			Waste Water
Location	**Bearing of samplers from boundary of operational area (degrees °)**	**Mean direction the wind blows to during the sampling period (degrees °)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)**	**Mean wind speed (mph)**	**Arithmetic mean of air temperature °C**	**Arithmetic mean of relative humidity (%)**	**Prevailing weather conditions including cloud cover**
Upwind	180	10	170	11	22	80	Cloudy. 5/8
Downwind	0	10	10	11	22	80	Cloudy. 5/8
Downwind Left Hand Fan	330	10	320	11	22	80	Cloudy. 5/8
Downwind Right Hand Fan	30	10	20	11	22	80	Cloudy. 5/8

4. Measurement Results

The results for measurements undertaken at all locations are shown within a number of standardised tables on the following pages:

Table 2. Upwind: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Upwind	UW1	100	180	13:31 – 14:31	60	TB	<125	TB: 125	-
	UW2	100	180			TB	125		
	UW3	100	180			TB	125		
Upwind	UW1	100	180	13:31 – 14:31	60	AF	<125	AF: <125	-
	UW2	100	180			AF	<125		
	UW3	100	180			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 3. Downwind: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Downwind	DW1	130	0	13:50 – 14:50	60	TB	250	TB: <125	-
	DW2	130	0			TB	<125		
	DW3	130	0			TB	<125		
Downwind	DW1	130	0	13:50 – 14:50	60	AF	<125	AF: <125	-
	DW2	130	0			AF	<125		
	DW3	130	0			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 4. Downwind Left Hand Fan: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Downwind Left Hand Fan	LHS1	75	30	14:00 – 15:00	60	TB	<125	TB: <125	-
	LHS2	75	30			TB	<125		
	LHS3	75	30			TB	<125		
Downwind Left Hand Fan	LHS1	75	30	14:00 – 15:00	60	AF	<125	AF: <125	-
	LHS2	75	30			AF	<125		
	LHS3	75	30			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit | **Exceeds permit limit**

Table 5. Downwind Right Hand Fan: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Downwind Right Hand Fan	RHS1	90	110	13:46 – 14:46	60	TB	<125	TB: <125	-
	RHS2	90	110			TB	<125		
	RHS3	90	110			TB	<125		
Downwind Right Hand Fan	RHS1	90	110	13:46 – 14:46	60	AF	<125	AF: <125	-
	RHS2	90	110			AF	<125		
	RHS3	90	110			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 6. Sample Point 1: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Sample Point 1	S1A	110	200	12-27 – 13:27	60	TB	<125	TB: <125	-
	S1B	110	200			TB	125		
	S1C	110	200			TB	<125		
Sample Point 1	S1A	110	200	12:27 – 13:27	60	AF	<125	AF: <125	-
	S1B	110	200			AF	<125		
	S1C	110	200			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 7. Sampling Point 2: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Sample Point 2	S2A	110	300	12:34 – 13:34	60	TB	125	TB: 125	-
	S2B	110	300			TB	125		
	S2C	110	300			TB	<125		
Sample Point 2	S2A	110	300	12:34 – 13:34	60	AF	375	AF: 250	-
	S2B	110	300			AF	125		
	S2C	110	300			AF	250		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 8. Sample Point 3: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Sample Point 3	S3A	100	70	12:43 – 13:43	60	TB	250	TB: <125	-
	S3B	100	70			TB	<125		
	S3C	100	70			TB	<125		
Sample Point 3	S3A	100	70	12:43 – 13:43	60	AF	250	AF: 250	-
	S3B	100	70			AF	375		
	S3C	100	70			AF	<125		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit	**Exceeds permit limit**

Table 9. Sample Point 4: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 113845	
Site:			Sandall, Yorkshire		Site Operator:			Yorkshire Water Services Ltd	
Date:			07/09/22		Commissioning Laboratory:			EMT Environmental	
Activities affecting Bioaerosol Conc^{n}			None		Types of materials processed on site:			Waste Water	
Location	**Sample REF**	**Distance from centre of operational area (m)**	**Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees ^{o})**	**Sampling Times**	**Sampling duration (mins)**	**Microbial Type**	**Calculated concentration of airborne microorganisms (CFU/m^3)***	**Median of parallel samples (CFU/m^3)**	**Comments**
Sample Point 4	S4A	75	110	12:51 – 13:51	60	TB	<125	TB: <125	-
	S4B	75	110			TB	125		
	S4C	75	110			TB	<125		
Sample Point 4	S4A	75	110	12:51 – 13:51	60	AF	<125	AF: 250	-
	S4B	75	110			AF	625		
	S4C	75	110			AF	250		

* Site permit limits: Total Bacteria (TB) = 1000 **CFU/m^3** *Aspergillus fumigatus* (AF) = 500 **CFU/m^3**

Below permit limit **Exceeds permit limit**

Table 6. Controls and Filter Counts - Bioaerosol monitoring				Job Number: 113845
Site: Sandall, Yorkshire	Date: 07/09/22	Site Operator : Yorkshire Water Services Ltd	Commissioning Laboratory : EMT Environmental	
		Types of materials processed on site : Waste Water		

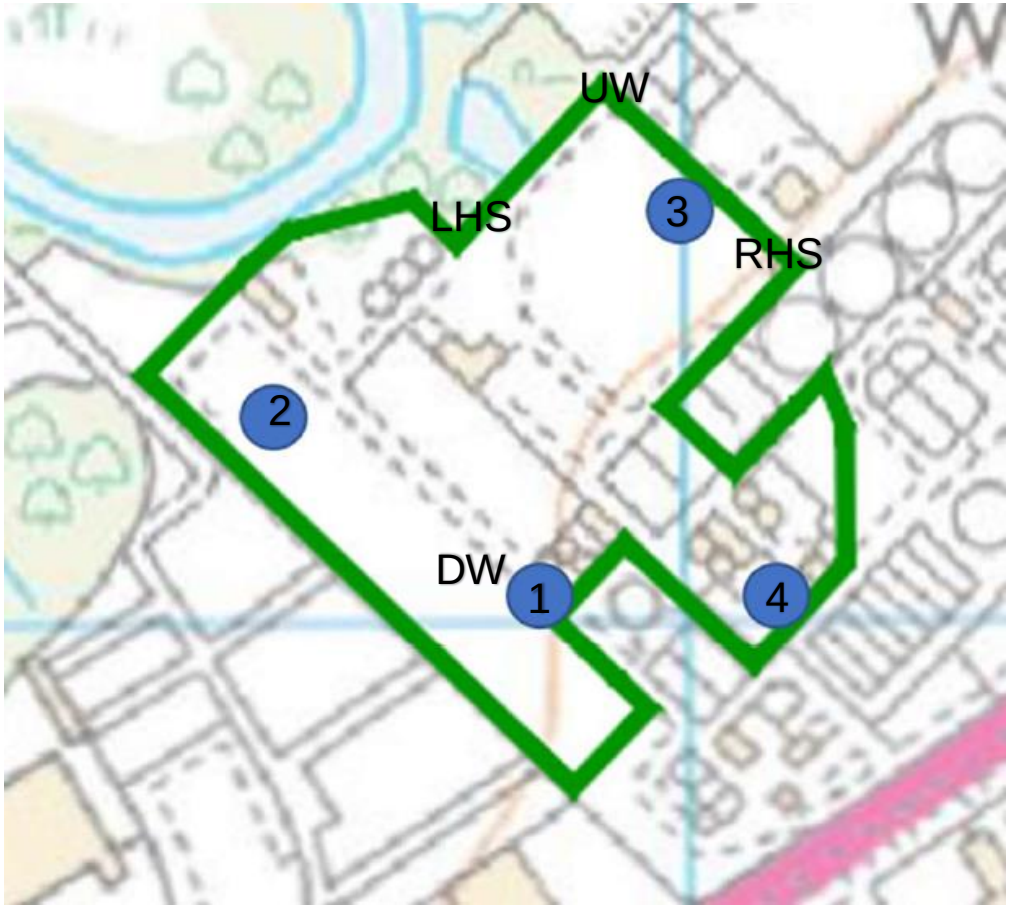
Location	Sample Ref Number	Microbial Type	Average Count of microorganisms (CFU/filter)	Comments
Upwind	UW1	TB	0	None received
		AF	0	
Upwind	UW2	TB	2	None received
		AF	0	
Upwind	UW3	TB	0	None received
		AF	0	
Downwind	DW1	TB	2	None received
		AF	0	
Downwind	DW2	TB	1	None received
		AF	0	
Downwind	DW3	TB	0	None received
		AF	0	
Downwind Left Hand Fan	LHS1	TB	0	None received
		AF	0	
Downwind Left Hand Fan	LHS2	TB	0	None received
		AF	0	
Downwind Left Hand Fan	LHS3	TB	0	None received
		AF	0	
Downwind Right Hand Fan	RHS1	TB	0	None received
		AF	0	
Downwind Right Hand Fan	RHS2	TB	0	None received
		AF	0	
Downwind Right Hand Fan	RHS3	TB	0	None received
		AF	0	

5. Plan

A standard map is shown on the next page. The operational boundary of the site is shown in red and the sample points are shown and labelled.

Bioaerosol Monitoring – Estimated Concentrations of Airborne Micro Organisms		Job Number 113845	
Site	Sandall, Yorkshire	Site Operator	Yorkshire Water Services Ltd
Date	07/09/22	Commissioning Laboratory	EMT Environmental
Types of materials processed on site	Municipal solid waste		

Site boundary marked on in Green.



6. Discussion

Samples for this monitoring were collected using the filter option of the guidance document M9.

It is important to continue to monitor the site. It would be particularly useful to monitor on a day when the prevailing wind is in a different direction.

Whilst it is possible to replicate the sampling points, many other variables will have changed such as temperature, wind speed and wind direction. As such this monitoring is only a snapshot of the situation on site, not a complete picture. The sampling should be carried out at least quarterly to build up an idea of the characteristics of the site.

There were no nearby activities observed which could adversely impact the upwind results.

All results for total bacteria and *Aspergillus fumigatus* (AF) were below the limits.

It should be noted that the fixed points were undertaken in addition to the required sampling locations at the request of Yorkshire Water.

7. Conclusions

Element Materials Technology Environmental UK Limited was commissioned by Yorkshire Water Services Ltd to carry out a bioaerosol monitoring exercise at the Waste Water Treatment Works at their site in Sandall, Yorkshire.

Measurements were carried out in accordance with parameters specified in Technical Guidance Note M9 'Environmental monitoring of bioaerosols at regulated facilities'. Of the methods suggested in the protocol, the filter method was utilised in this project.

All results for total bacteria and *Aspergillus fumigatus* (AF) were below the limits.

The site would be due to be re-assessed in December 2022 assuming the standard frequency requested by the Environment Agency.

Appendix 1. Analysis Certificates

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Abi Pickard
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Our Ref: ELE/22/16

Date: 28th September 2022

BIOAEROSOL EXPOSURE REPORT

Log No. 3162
Sample date. 7th September 2022
Engineer: Abigail Pickard
Job no.: 113845

Twenty-six IOM bioaerosol exposure heads were received on 9th September 2022.
Occupational exposure events were monitored:

Sample no.	Sample ID	Date	Volume (litres)
Bio1	S1A	07/09/2022	120
Bio2	S1B	07/09/2022	120
Bio3	S1C	07/09/2022	120
Bio4	S2A	07/09/2022	120
Bio5	S2B	07/09/2022	120
Bio6	S2C	07/09/2022	120
Bio7	S3A	07/09/2022	120
Bio8	S3B	07/09/2022	120
Bio9	S3C	07/09/2022	120
Bio10	S4A	07/09/2022	120
Bio11	S4B	07/09/2022	120
Bio12	S4C	07/09/2022	120
Bio13	UW 01	07/09/2022	120
Bio14	UW 02	07/09/2022	120
Bio15	UW 03	07/09/2022	120
Bio16	DW 01	07/09/2022	120
Bio17	DW 02	07/09/2022	120
Bio18	DW 03	07/09/2022	120
Bio19	DW LHS 01	07/09/2022	120
Bio20	DW LHS 02	07/09/2022	120
Bio21	DW LHS 03	07/09/2022	120
Bio22	DW RHS 01	07/09/2022	120

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Bio23	DW RHS 02	07/09/2022	120
Bio24	DW RHS 03	07/09/2022	120
Bio25	Blank 01	07/09/2022	120
Bio26	Blank 02	07/09/2022	120

The IOM heads containing a polycarbonate filter were used to determine the bioaerosol exposure under the test conditions. Upon arrival at the laboratory the bioaerosols impacted on each filter were recovered in 3 ml maximum recovery diluent. The target micro-organisms were cultured using appropriate dilutions on the following media.

Nutrient agar (NA) agar plates were used for total bacteria.
Malt extract agar (MEA) agar plates were used for *Aspergillus fumigatus*.

The samples were incubated for 2 days at 37C (total bacteria) and for 2 days at 44C (*Aspergillus fumigatus*).

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Results:

Date 5th September 2022
Comments: All polycarbonate filters and filter heads were in good condition.

Table 1. Microbiological Culture Plate Data:

Sample no.	Sample ID	Volume (litres)	Total Bacteria (cfu per plate)	Total *Aspergillus fumigatus* (cfu per plate)
Bio1	S1A	120	0, 0	0, 0
Bio2	S1B	120	1, 0	0, 0
Bio3	S1C	120	0, 0	0, 0
Bio4	S2A	120	1, 0	2, 1
Bio5	S2B	120	1, 0	1, 0
Bio6	S2C	120	0, 0	1, 1
Bio7	S3A	120	2, 0	2, 0
Bio8	S3B	120	0, 0	2, 1
Bio9	S3C	120	0, 0	0, 0
Bio10	S4A	120	0, 0	0, 0
Bio11	S4B	120	1, 0	4, 1
Bio12	S4C	120	0, 0	1, 1
Bio13	UW 01	120	0, 0	0, 0
Bio14	UW 02	120	1, 0	0, 0
Bio15	UW 03	120	0, 0	0, 0
Bio16	DW 01	120	2, 0	0, 0
Bio17	DW 02	120	0, 0	0, 0
Bio18	DW 03	120	0, 0	0, 0
Bio19	DW LHS 01	120	0, 0	0, 0
Bio20	DW LHS 02	120	0, 0	0, 0
Bio21	DW LHS 03	120	0, 0	0, 0
Bio22	DW RHS 01	120	0, 0	0, 0
Bio23	DW RHS 02	120	0, 0	0, 0
Bio24	DW RHS 03	120	0, 0	0, 0
Bio25	Blank 01	n/a	0, 0	0, 0
Bio26	Blank 02	n/a	0, 0	0, 0

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Table 2. Microbiological Results:

Sample no.	Sample ID	Volume (litres)	Total Bacteria (cfu per m^3)	Total *Aspergillus fumigatus* (cfu per m^3)
Bio1	S1A	120	<125	<125
Bio2	S1B	120	125	<125
Bio3	S1C	120	<125	<125
Bio4	S2A	120	125	375
Bio5	S2B	120	125	125
Bio6	S2C	120	<125	250
Bio7	S3A	120	250	250
Bio8	S3B	120	<125	375
Bio9	S3C	120	<125	<125
Bio10	S4A	120	<125	<125
Bio11	S4B	120	125	625
Bio12	S4C	120	<125	250
Bio13	UW 01	120	<125	<125
Bio14	UW 02	120	125	<125
Bio15	UW 03	120	125	<125
Bio16	DW 01	120	250	<125
Bio17	DW 02	120	<125	<125
Bio18	DW 03	120	<125	<125
Bio19	DW LHS 01	120	<125	<125
Bio20	DW LHS 02	120	<125	<125
Bio21	DW LHS 03	120	<125	<125
Bio22	DW RHS 01	120	<125	<125
Bio23	DW RHS 02	120	<125	<125
Bio24	DW RHS 03	120	<125	<125
Bio25	Blank 01	n/a	<15 per membrane	<15 per membrane
Bio26	Blank 02	n/a	<15 per membrane	<15 per membrane

Exposure results are expressed as total micro-organisms per cubic metre collected during the exposure time.

BIODET

28th September 2022