Blackburn WwTW Sludge Treatment Facility

Application Support Document

March 2024

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1. Introduction

The purpose of this Application Support Document (ASD) is to provide supplementary information to support an environmental permit (EP) variation application for EP XP3638LJ to include the thickening of indigenous and imported wastewater (sewage) sludge and anaerobic digestion of the thickened sludge at Blackburn Wastewater Treatment Works (WwTW). This application is being made under the Environmental Permitting (England and Wales) Regulations 2016 (the EPR 2016). This will include an extension to the existing permit boundary.

The address of the installation is:
Blackburn WwTW Sludge Treatment Facility
Cuerdale Lane
Samlesbury
Lancashire
PR5 0UY

NGR: SD 60385 29537

United Utilities Water Limited (UUW) operates a non-hazardous wastewater treatment facility at the Blackburn WwTW. The treatment process consists of screening imported sludge and thickening via gravity belt thickeners (GBT), thickening of surplus activated sludge (SAS) from the Nereda wastewater treatment process by rotating drum thickeners, enhanced enzymic hydrolysis (EEH) of thickened sludge, followed by anaerobic digestion (AD) and centrifugation of digested sludge.

Combustion of biogas produced at the facility is already permitted as a waste operation (EPR/XP3638LJ) and no changes are proposed to this operation.

The maximum design capacity of the facility is limited by the feed rate to both the gravity belt thickeners (876,000 wet tonnes per year) and to the rotating drum thickeners (1,752,000 wet tonnes per year), providing a total maximum treatment capacity of 2,628,000 wet tonnes per year.

The sludge treatment activity has not previously required an environmental permit as the digested sewage sludge from the site is normally sent for recovery to land. However, this application has been submitted based on the Environment Agency's recent conclusion that sewage sludge is a waste and therefore the treatment of sewage sludge by anaerobic digestion for recovery is a permittable activity under Schedule 1 of the EPR 2016, specifically Chapter 5, Section 5.4, Part A 1(b)(i).

Due to the non-flammable nature of wastes handled at the installation, the site falls outside the requirement to prepare and operate a fire prevention plan (FPP).

2. Non-Technical Summary

This application is for varying the current Environmental Permit to add thickening, enzymic hydrolysis and anaerobic digestion (AD) of mixed (indigenous and imported) sewage sludges, followed by dewatering, cake storage and liming at the Blackburn Wastewater Treatment Works (WwTW), operated by United Utilities Water Limited (UUW).

The Blackburn WwTW permit EPR/XP3638LJ currently permits the operation of the Combined Heat and Power (CHP) plant as a waste activity, along with directly associated activities as per Table S1.1 of the permit.

This variation is for re-designation of the facility to an installation undertaking treatment of sewage sludge for recovery, including anaerobic digestion of sewage sludge for recovery under Section 5.4 A(1)(b)(i). The waste treated consists of sludges imported from other WwTWs and indigenous sludges produced from Blackburn WwTW (on-site) from the urban wastewater flow.

Additional associated activities include:

- Unthickened sludge storage;
- Enhanced enzymic hydrolysis (EEH);
- Sludge dewatering by gravity belt thickeners (2), drum thickeners (3) and centrifuges (2);
- Addition of polyelectrolyte;
- Settlement of solids from dewatering liquors using a Lamella tank;
- Storage and combustion of biogas in CHP and dual fuel boilers;
- Flaring of excess gas;
- Siloxane removal from the biogas;
- Disposal of process liquors;
- Raw material handling and storage;
- Odour abatement;
- Sludge cake storage;
- Sludge cake re-liquification; and
- Sludge cake liming.

The changes to the site layout require a change to the current permit boundary and a new layout and emissions point plan for the site. The activities already authorised under the permit remain operational.

There are no direct emissions to land or water. Point source emissions to air are from the installation's three odour control units (from the unthickened sludge tank, EEH feed tank and centrate buffer tank), the CHP engines and dual fuel boilers, the flare, AD tanks' pressure release valves (PVRVs), enzymic hydrolysis plant PVRV and the gas bag PVRV. Process wastewaters are discharged back into the WwTW to receive full biological treatment. Process wastewaters comprise filtrate from sludge thickening, centrate from sludge dewatering, blowdown from the steam boilers, condensate from the biogas and run off from sludge cake storage areas.

3. Application Form C2 Supporting Information

3.1. Question 2b and Table 1: Changes to Existing Activities

The current permit (XP3638LJ) is a waste facility permit (R1) for the operation of the site's CHP units and dual fuel boilers.

The changes to the existing activity are to include the following additional activities (with an associated extension to the permit boundary):

- Addition of listed activity Section 5.4 A(1)(b)(i) for AD for recovery;
- R3: Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes);
- Reception and storage of wastes pending recovery (R13: Storage of wastes pending the R3 activity);
- Thickening and digestion of the wastes (R3);
- Receipt and storage of raw materials;
- Centrifugation of digested sludge to form a dewatered cake;
- Treatment of digestate cake by the addition of lime;
- Storage of waste sludge cake prior to removal off-site;
- Discharge of centrate and filtrate to the on-site but off installation WwTW;
- Discharge of surface water, biogas condensate and boiler blowdown water from the installation to the on-site but off installation WwTW via the private drainage system; and
- Associated odour abatement for the installation.

As there are no changes to the current permitted CHP process there is no need for any partial surrender of any activities.

Table 3.1.1a below summarises the currently permitted activities and the proposed change to those activities.

Table 3.1.1a: Currently Permitted Activities

Activity Reference and Description	**Proposed Change to Activity**
Combustion of Biogas (R1: Use principally as a fuel or other means to generate energy)	Vary existing permit (EPR/XP3638LJ) to include anaerobic digestion as the primary activity (installation permit) along with associated DAA's.
Directly Associated Activities (DAAs)	
Flaring of excess biogas	No change
Surface water, condensate and blowdown drainage	No change
Raw materials storage, standby fuel oil storage, and waste lubricant oil storage	No change
Siloxane removal plant	No change

Table 3.1.1b below introduces the new activity to be added to the permit.

Table 3.1.1b: New Activities to be Added

Activity listed in Schedule 1 of the EP Regulations	Description of specified activity and WFD Annex I and II operations	Limits of specified activity and waste types
S5.4 A(1)(b)(i) Recovery or a mix of recovery and disposal of non-hazardous waste with a capacity exceeding 75 tonnes per day (or 100 tonnes per day if the only waste treatment activity is anaerobic digestion) involving biological treatment.	R3: Recycling/reclamation of organic substances which are not used as solvents.	From receipt of thickened sewage sludge from the EEH buffer tank and subsequent enzymic hydrolysis, through to digestion and recovery of by-products (digestate). Enzymic hydrolysis of waste in six reactor vessels. Anaerobic digestion of waste in 4 primary digestion tanks followed by burning of biogas produced from the process.
Directly associated activities		
Receipt and storage of sludges pending recovery via the S5.4 A(1)(b)(i) activity.	R13: Storage of waste pending the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced).	Storage of non-hazardous sewage sludge prior to anaerobic digestion. Blending and mixing of imported UUW sewage sludge with indigenous site-produced sewage sludge from within the works.
Sludge screening and thickening/ dewatering associated with the S5.4 A(1)(b)(i) activity.	R13: Storage of waste pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced) R3: Recycling/reclamation of organic substances which are not used as solvents	Screening and thickening of non-hazardous sewage sludge (including polyelectrolyte dosing) within the following plant: 2 x sludge screens 2 x centrifuges 2 x gravity belt thickeners 3 x drum thickeners 1 x lamella clarification tank
Pre-treatment of sewage sludge prior to anaerobic digestion for recovery by means of treatment in an enhanced enzymic hydrolysis plant.	R3: Recycling/reclamation of organic substances which are not used as solvents	From receipt of non-hazardous sewage sludge into the enhanced enzymic hydrolysis plant to discharge of treated sludges into the anaerobic digestion S5.4 A(1)(b)(i) activity for recovery.
Raw material handling and storage.	Raw material handling and storage.	From delivery and acceptance of raw materials to storage awaiting use on site.
Odour abatement	Odour control units.	From receipt of odours from unthickened sludge tank, EEH feed tank and centrate buffer tank to emission to air (3 No. odour control units).

Activity listed in Schedule 1 of the EP Regulations	Description of specified activity and WFD Annex I and II operations	Limits of specified activity and waste types
Cake (digestate) storage	R13: Storage of waste pending the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced).	From the receipt of processed digestate produced from the on-site anaerobic digestion process to despatch off-site for recovery to land. Storage of digestate produced at the on-site anaerobic digestion process in 3 post digestion storage tanks prior to thickening. Storage of thickened digestate cake on an impermeable surface with sealed drainage system.
Treatment of dewatered digestate to produce an enhanced cake for despatch off-site for recovery to land.	R3: Recycling/reclamation of organic substances which are not used as solvents	Treatment of digestate cake by the addition of lime within the following plant: 1 x lime storage silo 1 x lime hopper 1 x mixing drum 1 x conveyor
Disposal of process liquors to the UWWT flow to full treatment	D13	From generation of process liquors to discharge into the inlet flows of the WwTW.

3.2. Question 3a to 3d: Technical Competence and Management Systems

Technically competent management is provided by UUW's Environmental Regulatory Advisers (ERAs). A copy of the relevant COTC certificate and the continuing competency certificate for the site's ERA are provided at Appendix A.

United Utilities environmental management system (EMS) is certified to ISO14001, which covers the management system of UUW Limited for all activities involved in the provision of utility services, including the proposed permitted waste activities. A copy of the ISO14001 certificate is provided at Appendix B - the certification covers all activities and locations therefore specific sites are not listed.

A management systems summary is provided at Appendix B. A Residue Management Plan is provided with this application (see Attachment 1).

3.3. Question 5a: Site Plans

The new activity requires an extension to the current permit boundary. A revised permit boundary plan for the sludge treatment installation is provided at Appendix C. A site layout plan is provided at Appendix D. An emissions plan is provided at Appendix D. A process flow diagram is provided at Appendix E. A site drainage plan is provided at Appendix G.

3.4. Question 5b: Site Condition Report

This variation includes an extension to the existing installation boundary, as shown on the site boundary plan at Appendix C. A Site Condition Report (SCR) is included in Section 10.

The change to the permit boundary does not include a reduction to the boundary at any point; therefore, a partial surrender application is not required.

3.5. Question 5b: Non-Technical Summary of Your Application

Please see Section 2 of this report.

3.6. Question 5f: Adding an Installation

Anaerobic digestion activities shall be added as installation activities.

3.7. Question 6: Environmental Risk Assessment

Please see Section 9 of this report for a risk assessment and management plan.

4. Application Form C3 Supporting Information

4.1. Table 1a: What Activities Are You Applying to Vary?

For changes to activities, please see Tables 3.1.1a and 3.1.1b in Section 3.

The application is to vary the existing permit to include the existing anaerobic digestion process and its directly associated activities for recovery. The currently permitted activities (R1 as detailed in table S1.1 to the permit) will now be directly associated activities to the anaerobic digestion activity. See "Form C2 2b Changes or additions to existing activities" above for full details of the listed activity and its directly associated activities.

Maximum Throughput

As set out in Table 4.1.1 below, the maximum design capacity of the facility is limited by the feed rate to both the gravity belt thickeners (876,000 wet tonnes per year) and to the rotating drum thickeners (1,752,000 wet tonnes per year) which act as 'pinch points' in the process. The GBTs and drum thickeners provide a total maximum treatment capacity of 2,628,000 wet tonnes per year (assuming they all operate continuously throughout the year).

At any one time on the installation, the maximum volume of sludge present is 22,411m^3 (total storage capacity).

Table 4.1.1: Blackburn Sludge Treatment Capacity Calculation

	GBTs	Drum Thickeners	Units
Number	2	3	
Operation	D/ D	D/ A/ S	Duty / Assist / Stand By
Design throughput per machine	60	100	m^3/hr
Maximum no. of machines in use	2	2	
Maximum combined throughput	100	200	m^3/hr
Maximum daily throughput	2,400	4,800	m^3/day
Maximum annual throughput	**876,000**	**1,752,000**	**m^3/year**

The current operational treatment capacity per year is 372,300m^3 based on the feed into the digesters. We run a regional system and therefore the actual annual throughput at a site will vary depending on operational needs.

The assets utilised for the AD and DAAs (excluding the biogas management assets) are:

- Imported sludge reception chamber;
- Sludge screens;
- Unthickened sludge tank;

- Sludge mixing and balancing tanks x 4;
- Gravity belt thickeners x 2;
- Drum thickeners x 3;
- Drum thickeners emergency storage tank x 1;
- Enzymic hydrolysis (EEH) feed tank;
- EEH reactor vessels x 6;
- Digesters x 4;
- Post-digestion tanks x 3;
- Centrate buffer tank;
- Lamella liquor clarification tank;
- Liquor return pump well;
- Cake reliquification hopper;
- Lime storage silo x 1;
- Lime hopper x 1;
- Mixing drum;
- Conveyor;
- Mobile generator x 1; and
- Odour control units x 3.

Total Waste Storage Capacity

Table 4.1.2 below provides a description of the waste storage vessels associated with the sludge treatment activities.

Table 4.1.2: Waste Storage Vessels

Storage Container	Total Volume
Unthickened sludge reception tank	10m^3
Unthickened sludge holding tank	1,800m^3
Sludge mixing and balancing tanks (x4)	2,000m^3
Drum thickeners emergency storage tank (x1)	700m^3
EEH feed tank	1,400m^3
EEH vessels (x6)	1,680m^3
Digesters (x4)	10,000m^3
Post digestion tank 1 & 2	1,800m^3
Post digestion tank 3	1,200m^3
Centrifuge sludge feed tank	600m^3
Centrate break tank	Approximately 2m^3
Centrate/ filtrate tank	1,200m^3
Lamella tank	19m^3
Total storage capacity	**22,411m^3**

Table 4.1.3 below details the waste the installation accepts.

Table 4.1.3: Types of Waste Accepted

19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**	
19 02	**Physico/chemical treatments of waste**	**Restrictions**
19 02 06	Sludges from physico/chemical treatment other than those mentioned in 19 02 05	Sewage sludge only
Comprising: • Thickened imported sludge: sewage sludge arising from other WwTW (comprising of thickened sludge arising from sewage settlement and/or surplus activated sludge/humus sludge from biological stages).		
19 08	**Wastes from waste water treatment plants not otherwise specified**	**Restrictions**
19 08 05	Sludges from treatment of urban waste water	Sewage sludge only
Comprising: • Imported sludge: sewage sludge arising from other WwTW (comprising of raw sludge from sewage settlement and/or surplus activated sludge/humus sludge from biological stages). • Indigenous sludge: sewage sludge arising from Blackburn WwTW. * Note: the EWC does not apply for the classification of indigenous sludges and SAS unless these streams are considered for removal off-site.		

Point Source Emissions to Air

There are several point source emissions to air. The location of these discharge points is shown on the emission points plan at Appendix D.

There are eight point source emissions to air associated with the existing permit (A1 to A8), namely:

- A1 - Dual fuel boiler No.1;
- A2 - Dual fuel boiler No.2;
- A3 - Dual fuel boiler No.3;
- A4 - CHP engine No.1;
- A5 - CHP engine No.2;
- A6 – Flare;
- A7 - Pressure vacuum relief valve (PVRV) on gas bag; and
- A8 - Breather vent on oil storage tank

There will be eight additional point-source emissions to air associated with the sludge treatment process from the following locations:

- A9 - EEH pressure vacuum release valve (PVRV);
- A10 - Odour control unit for the unthickened sludge tank;

- A11 - Odour control unit for the EEH feed tank;
- A12 - Odour control unit for the centrate buffer tank;
- A13 - Digester No. 1 tank PVRV;
- A14 - Digester No. 2 tank PVRV;
- A15 - Digester No. 3 tank PVRV; and
- A16 - Digester No. 4 tank PVRV

It should be noted that the odour control units A10-A12 are not currently operational. As the OCUs are not operating and actively drawing air through the units, emissions are currently being released fugitively from the tanks and duct work.

The location of these emission points is shown on the air emission points plan at Appendix D.

Please refer to Section 5 for details of gas emission controls from the AD facility.

Please refer to Section 6 for details of odour assessment and control.

Please refer to the Blackburn BAT Improvement Programme submitted with this application for details on reinstatement of the odour control units.

Point Source Emissions to Sewers, Effluent Treatment Plant or Other Transfers Off-site

Emissions to sewer are all routed into the wastewater treatment works' flow to full treatment. These emissions are limited to the following:

- W1 – Liquor return pump well (combined centrate, filtrate and drum thickening liquor);
- W2 - Site drainage;
- W3 - Digestion plant condensate pots;
- W4 - EEH Plant condensate pot;
- W5 - Gas bag condensate pots;
- W6 - Gas line to CHP condensate pot;
- W7 - Siloxane removal plant condensate pots;
- W8 - Steam boilers blowdown;
- W9 - Thickening and dewatering GBT filtrate;
- W10 - Drum thickeners filtrate;
- W11 - Centrifuge centrate;
- W12 - Run-off from digested sludge open cake bay;
- W13 - Run-off from raw sludge cake open cake bay;
- W14 – Run-off from digested sludge liming cake bay.

The location of these emission discharge points is shown on the wastewater emissions point plan at Appendix D2.

The proposed locations to provide representative samples for these emissions are:

- W1 – Liquor return pump well (combined centrate, filtrate and drum thickening liquor); and
- W2 - Site drainage pump well (all installation drainage and discharges into it).

These sample points are considered to be adequate for monitoring the wastewater discharges returned to the wastewater treatment works as W1 picks up the process liquors (W9 - thickening and dewatering GBT filtrate, W10 - drum thickeners filtrate, and W11 - centrifuge centrate) and W2 picks up all discharges to the drainage system (W3 - digestion plant condensate pots, W4 - EEH Plant condensate pot, W5 - gas bag condensate pots, W6 - gas line to CHP condensate pot, W7 - siloxane removal plant condensate pots, W8 - steam boilers blowdown, W12 - run-off from digested sludge open cake bay, W13 - run-off from raw sludge cake open cake bay, and W14 – run-off from digested sludge liming cake bay).

Representative sampling points are shown in Appendix D.

There are no point source emissions to sewer or other transfers.

Point Source Emissions to Water and Land

There are no point source emissions to water or land from this installation.

Surface water from the sealed drainage system will be routed into the WwTW's flow to full treatment downstream of the storm overflow.

Fugitive Emissions

The Environmental Risk Assessment and Management Plan provided in Section 9 assesses potential fugitive emissions from the installation.

An Environmental Quantitative Risk Assessment (EQRA) Report[1] has previously been provided to the Environment Agency. This risk assessment considered the risks to groundwater and surface water receptors from fugitive emissions, in line with CIRIA C552 guidance, which we consider is an appropriate reference because it 'defines the qualitative assessment of consequences/likelihood' in relation to potential contamination.

Further assessment of the potential environmental risks associated with a loss of containment from process tanks at the site has been undertaken and is provided in Attachment 8[2]. This assessment was undertaken using the Anaerobic Digestion & Bioresources Association (ADBA) Risk Assessment Tool, which is based on CIRIA 736: Containment systems for the prevention of pollution. The ADBA risk assessment was used to inform hydraulic spill modelling undertaken for the site.

[1] Environmental Quantitative Risk Assessment for Blackburn Wastewater Treatment Works, Stantec UK Ltd., Report Ref. 331001867R4 dated February 2022
[2] Blackburn Sludge Treatment Centre (STC) Secondary Containment Modelling Assessment Stantec UK Ltd., dated 31 October 2022

Please refer to the Blackburn BAT Improvement Programme document submitted with this application for details on proposed containment mitigation measures to be installed and timescales for installation. Work is ongoing to provide the Environment Agency with a written secondary containment improvement plan containing the finalised designs and specifications and an implementation schedule for the proposed secondary containment systems. This will be submitted at a date to be agreed with the Environment Agency.

Fugitive emissions of biogas may arise from open tanks and the activation of PVRVs on gassing tanks or leaks in gas pipework e.g. around flanges.

Please refer to Section 5.14 and 5.16 for details of gas emission controls from the AD facility and to Section 5.21 for details of fugitive emissions from open tanks.

4.2. Question 3a: Technical Standards

A block diagram of the process is provided at Appendix E. Please refer to Section 5 for a description of the operating techniques for the installation.

Please refer to Section 8 of this report for the BAT assessment.

4.3. Question 3b: General Requirements

Please refer to Section 9 for the Environmental Risk Assessment and Management Plan. The assessment shows that the:

- Risk of emissions of substances not controlled by emission limits is low; and
- Risk of noise and vibration resulting from the changes is very low.

Please refer to Section 6 for details of odour assessment and control.

4.4. Question 3c: Types and Amounts of Raw Materials

There will be no change to the raw materials associated with the CHP and waste activities currently permitted. Additional raw materials associated with AD and DAAs are:

- Polyelectrolyte;
- Antifoaming agents;
- Anti-corrosive agents;
- Lime;
- Odour control media;
- Final effluent for washdown waters; and
- Potable water

Table 4.4.1 provides details of the raw materials used by the installation. Copies of the Material Safety Data Sheets (MSDS) for the polyelectrolyte and antifoam are provided in Appendix H.

Table 4.4.1: Raw Materials Use

Schedule 1 Activity	Raw material	Maximum amount stored	Annual throughput (tonnes / year)	Description of the use of the raw material including any main hazards (include safety data sheets)
Anaerobic digestion	Polyelectrolyte	Approx. 1,200kg	115 (6-8 bags (800kg) for centrifuge per month and 4 bags per month for GBT)	This is used to aid the thickening process for flocculation
Anaerobic digestion	Antifoaming agents	Approx. 3,000 litres	39,000 litres (1,000 litres per 4 months for centrifuge and 2,000-3,000 litres per month for digesters)	Used to prevent / reduce foaming
Anaerobic digestion	Lime (calcium hydroxide)	$36m^3$	1,260 tonnes	Used to treat digested dewatered sludge to produce an enhanced cake
Anaerobic digestion	Odour control media	None currently	Not known – OCUs not currently operational	To prevent / reduce odours
Anaerobic digestion	Anti-corrosive water treatment products in the boilers/ heat exchangers	Approx. 500 litres	Not known	To prevent corrosion and enhance the use of the equipment
Anaerobic digestion	Final effluent for wash down waters	N/A	No meter for final effluent	Used to wash down the GBT, centrifuge and digesters
Anaerobic digestion	Potable water	N/A	No meter for potable water	Used for mixing with the polyelectrolyte for the thickening process
Anaerobic digestion	Refrigerant	None - brought in as required	As required	Used for gas chillers

Potable water is used only to make up polyelectrolyte, a compound used to enhance the sludge thickening process. The quantity of polyelectrolyte used and the concentration of the polyelectrolyte/water mix will be monitored and recorded; these records will be used to calculate annual potable water consumption. Information regarding the storage of raw hazardous substances is discussed in Section 5.18 of this document.

4.5. Question 4a: Measures you use for Monitoring Emissions

There are a number of emission points from the sludge treatment process. The location of all the emission points is shown in Appendix D. Please refer to Section 5.22 of this document for details of the process emissions and associated monitoring.

Table 4.5.1 below summarises the measures used for monitoring emissions at the installation.

Table 4.5.1: Emissions Monitoring

Location or description	Grid Reference	Parameter	Monitoring Frequency	Monitoring standard or method	Other specifications/ Information
Gaseous Emissions					
CHP engine	A4 & A5 (SD 60441 29633)	Oxides of nitrogen Carbon monoxide Volatile organic compounds (VOCs) Non-methane volatile organic compounds Oxygen Sulphur dioxide	Annually	BS EN 14792 BS EN 15058/ ISO 12039 BS EN12619: 1999 BS EN14791 or CEN TS 17021	Sampling undertaken by a third party specialist
Dual fuel boilers	A1, A2 & A3 (SD 60448 29600)	Oxides of nitrogen Sulphur dioxide	Annually	BS EN 14792 BS EN14791 or CEN TS 17021	Sampling undertaken by a third party specialist
Flare	A6 (SD 60459 29527)	Oxides of nitrogen Carbon monoxide Total VOCs	Running time monitored; emissions only tested in the event that running time exceeds more than 10% of operational hours.	BS EN 14792 BS EN 15058 BS EN 12619 and/or BS EN 13526	Inspected annually, including mechanical and safety systems.
OCUs (x3)	A10 (E 360343 N 429488), A11 (E 360375 N 429624) &	Ammonia Hydrogen Sulphide	6 monthly	EN SIO 21877	No EN standard available for either ammonia

Location or description	Grid Reference	Parameter	Monitoring Frequency	Monitoring standard or method	Other specifications/ Information
	A12 (E 360290 N 429529)			CEN TA 13649 for sampling and NIOSH 6013 for analysis	or hydrogen sulphide Sampling undertaken by a third party specialist - Taking 3 samples on the inlet and outlet of each OCU for each parameter over the course of 1 day
		Odour concentration	2 rounds of monitoring	EN 13725	
		Total volatile organic compounds (TVOC) Hydrogen chloride	1 round of monitoring	EN 12619 EN 1911	
Liquid Emissions					
Wastewater Monitoring (combined returns to WwTW)	W1 – Liquor return pump well (SD 60320 29598)	156 hazardous and priority substances as per separate list*	Monthly for 12 months	MCERTS or UKAS where possible*	*Please refer to Section 5.22 for further information
Wastewater Monitoring	W2 - Site drainage pump well (all installation drainage and discharges into it) (SD 60395 29481)	pH Total nitrogen COD Total phosphorous Suspended solids Ammoniacal nitrogen Oil and grease	Monthly for 12 months	MCERTS MCERTS MCERTS MCERTS MCERTS Accredited by flexible scope to MCERTS Visual assessment only	
Wastewater Monitoring	W1 – Liquor return pump well (SD 60320 29598)	pH Total nitrogen COD Total phosphorous Suspended solids Ammoniacal nitrogen Hydrocarbon oil index;	Minimum - monthly for 12 months	MCERTS MCERTS MCERTS MCERTS MCERTS Accredited by flexible scope to MCERTS EN ISO 9377-2	

Location or description	Grid Reference	Parameter	Monitoring Frequency	Monitoring standard or method	Other specifications/ Information
		BTEX; Free cyanide; Halogens (AOX); Metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Mn); Mercury Hexavalent chromium (VI)) PFOS and PFOA		EN ISO 15680 EN ISO 14403-1 or EN ISO 14403-2 EN ISO 9562 EN ISO 11885, EN ISO 17294-2 or EN ISO 15586 EN ISO 17852 or EN ISO 12846 EN ISO 10304-3 or EN ISO 23913 -	

Point Source Emissions to Air

The current permit was issued in December 2006 and requires that CHP engine and boiler emissions are monitored annually, although the boiler emissions do not have any emission limits. The results of the monitoring are reviewed by the site's ERA and any other relevant staff to check that they are compliant with the relevant emissions limit value. The CHP stack has an M1 compliant sample location.

The Odour Control Unit (OCU) stacks have been included as point source emissions as all point source emissions are required to be identified within a permit application. The OCU stacks are not currently operational. Once reinstated, suitable measurement ports will be provided to allow access and monitoring of the OCU stacks. We understand there is no requirement for an M1 compliant sample location. To meet BAT 8 requirements, monitoring of the OCUs for hydrogen sulphide and ammonia[3], once every six months, will be introduced. Total volatile organic compounds (TVOC) and hydrogen chloride (HCl) will be monitored on one occasion to check for their presence in the emissions from each stack and the results provided to the EA. The sampling will be undertaken three times over the course of one day. Dependent upon the results, TVOCs and/or HCl may be added to the bi-annual monitoring schedule. In addition, each stack will be sampled for odour concentration on two occasions during the first year of monitoring to validate that the design odour concentration is being achieved. A copy of the site's OMP is supplied with this permit application. (See Attachment 3).

The existing air emission points retain their current monitoring requirements.

There is no proposal to monitor the PVRV's as these only emit emissions to air in an emergency or when equipment is being serviced/repaired.

[3] No EN standard is available for either ammonia or hydrogen sulphide monitoring.

There is no proposal to routinely monitor the flare, however its running time will be recorded and in the event of the flare operating for more than 10 per cent of a year, emissions monitoring will be undertaken in accordance with permit requirements.

Point Source Emissions to Sewers, Effluent Treatment Plants or Other Transfers Off Site

There are fourteen wastewater emissions from the installation. Monitoring is proposed at points W1 and W2 over a 12 month period to characterise the wastewater streams in accordance with BAT 3, BAT 6 and BAT 7. Please refer to Section 5.22 for further information on monitoring of wastewater streams.

Where monitoring is proposed, a minimum of 12 samples will be taken in accordance with the minimum sampling requirement for screening in the EAs 'surface water pollution risk assessment' guidance.

Monitoring for hazardous and priority substances will be undertaken at sampling point W1 (the point at which the combined centrate, filtrate and drum thickening liquor streams leave the installation (Grid reference SD 60320 29598) on 12 occasions and the results will be screened against relevant environmental quality standards detailed in the EA guidance.

Procedures for Data Review/Evaluation

A draft Standard Operating Procedure (SOP) detailing the operating requirements, practices and support processes required to undertake emission monitoring as per the environmental permit requirements and to assess the results is contained in Appendix I. This will be finalised on issue of the permit and incorporated into the company's management systems documentation as a controlled document.

4.6. Question 6a-b: Energy Efficiency

The thickening processes themselves are not energy intensive, so there is limited opportunity for improving energy efficiency. When selecting new and/or replacement pumps and motors, energy efficiency is one of the factors considered.

All of the electricity produced by the CHP facility is used by the installation and the WwTW. The following measures are used to improve energy efficiency:

- All relevant buildings/vessels are appropriately insulated.
- Use of biogas in the CHP engines and/or boilers, with the heat generated recycled to sludge treatment.

The digesters are all suitably insulated. The CHP engines are suitably sized to maximise energy utilisation for the parasitic load, while minimising the use of the flare.

Low energy lighting is installed across the plant.

Current energy reporting requirements under the existing permit are for the following parameters:

- Heat generated – kWth;

- Power generated – kWe;
- Engine efficiency - kWth input / kWth (equivalent) output; and
- Boiler efficiency - kWth input / kWth (equivalent) output.

Energy consumption for the WwTW as a whole is monitored and tracked via the site environmental dashboard. The dashboard can provide reports on energy generation and consumption, including CHP performance and anaerobic digestion performance (e.g. information such as digester feed and biogas yield).

The energy demand for key plant and equipment is listed in Table 4.6.1.

Table 4.6.1: Energy Demand

Asset	Total kW rating
Sludge Dewatering Centrate Pump No.1	5
Sludge Dewatering Centrate Pump No.2	15
Centrifuge Feed Pump No1 Press House	22
Centrifuge Feed Pump No 2	22
Centrifuge Feed Pump No 3	22
No 1 Polyelectrolyte Transfer Pump (Small)	4
No 2 Polyelectrolyte Transfer Pump (Small)	4
Pasteurisation Stage Sludge Recirc Pump	30
Pasteurisation Stage Sludge Recirc Pump	30
Pasteurisation Stage Hot Water Circ Pump	18.5
Pasteurisation Stage Hot Water Circ Pump	18.5
Boiler Circulation Pump No1	11
Boiler Circulation Pump No2	11
Prim Dig: Hot Water Circ. Pump No1	7.5
Prim Dig: Hot Water Circ. Pump No2	7.5
Sludge Cooling water Circ Pump No1	15
Sludge Cooling water Circ Pump No2	15
Back Well Filtrate Return Pump No1	7.5
Back Well Filtrate Return Pump No2	7.5
Unthickened Sludge Pump 1	9
Unthickened Sludge Pump 2	9
Unthickened Sludge Transfer Pump No2	9
Unthickened Sludge Transfer Pump No1	9
No 1 (Small) Thick Polyelectrolyte Dose Pump (S-H)	1.25
No 2 (Small) Thick Polyelectrolyte Dose Pump (S-H)	1.25
No.2 GBT Feed Pump	11
No.1 GBT Feed Pump	7.5
Thickened Sludge Screen Feed Pump No1	5.5

Asset	Total kW rating
Thickened Sludge Screen Feed Pump No2	5.5
Reliquified Sludge Tank Transfer Pump	13.5
No 1 belt washer pump	12.615
No 2 belt washer pump	12.615
No 2 Filtrate Return Pump	11
No 1 Filtrate Return Pump	30
Digester Feed Pump No2	22
Digester Feed Pump No1	22
No 1 post digestion tank feed pump	16
No 2 post digestion tank feed pump	16
Post Digestion Transfer Pump No1	3
Post Digestion Transfer Pump No2	3
No 1 Fast Fill Pump	20
No 2 Fast Fill Pump	20
No 1 Centrate Dosing Pump Jail	4
No 2 Centrate Dosing Pump Jail	4
No 1 Effluent Discharge Pump (P12)	9
No 2 Effluent Discharge Pump (P13)	9
Standby Centrate Pump Tank No 2	5.5
Centrate Holding Tank Pump	5
Detention Tank Fluidic Mixer	5
Polyelectrolyte Mixer Module Mixer	1.1
Sludge Tank No1 Mixer	5.5
Sludge Tank No2 Mixer	6.08
Sludge Tank No3 Mixer	6.08
Sludge Tank No4 Mixer	5.5
GBT Thickened Tank Air Mix System	10
No 2 Sludge Mixer Tank 2	6.08
Post Digestion Chopper Mixer Pump 1	5
Pd Tank No.1 3-Nozzle Pipe Mixing System	18
Pd Tank No.2 3-Nozzle Pipe Mixing System	18
Post Digestion Chopper Mixer Pump 2	5
Centrifuge Feed Buffer Tank Mixer	5

Periodic targets for energy improvements will be identified as part of the annual energy review, which identifies opportunities for improvement and sets out the site's energy management strategies and energy balance record. This review is set out in the Energy Review FY21, which has been provided with this document (see Attachment 7).

4.7. Question 6d-e: Raw Materials and Waste

Please refer to Table 4.4.1 above for raw material usage. Raw materials to be used in the process include electrolyte and potable water that are used in the sludge thickening/de-watering process, only necessary quantities are used to achieve the required thickening parameters. The quantity of polyelectrolyte used and the concentration of the polyelectrolyte/water mix will be monitored and recorded; these records will be used to calculate annual potable water consumption. Powdered lime (calcium hydroxide) is mixed with digested sludge cake to produce an enhanced product for agricultural land spreading.

All raw and other materials used are essential for the efficient and successful operation of the digestion activity and wider on-site off-installation wastewater treatment works. Only the quantities required are used and UUW regularly reviews the types and quantities of materials used.

Activated carbon is utilised in the three OCUs.

The digestion activity is a waste recovery activity and is undertaken in order to recover energy and organic materials that may otherwise be disposed of. UUW regard the sludge cake and biogas produced as useful resources that are subject to full recovery. They replace fossil fuels and raw materials that would otherwise be required.

The main solid waste produced from the treatment process is sludge screenings. It is essential that these coarse solids are removed from the sludge in order to attain the required sludge quality. Screenings are currently sent to landfill as there are currently no viable recycling or recovery routes available.

Limited amounts of servicing and maintenance waste are produced and these are managed in accordance with the waste hierarchy.

4.8. Form C6

Responses to Form C6 are contained in the document ‘Blackburn Form C6 – Additional Responses’.

5. Variation Technical Description and Operations

5.1. Pre-acceptance, Acceptance and Storage of Waste

The wastewater sludge to be received for treatment consists of sewage sludges imported from other WwTWs and indigenous sludges produced from Blackburn WwTW. The imported sludge arrives at the site via tanker and is pumped into a reception chamber through a screening unit.

The process has been designed to treat sewage sludges generated within the UUW network in compliance with the Biosolids Assurance Scheme (BAS). A BAS risk assessment is carried out for each source of sewage sludge. A copy of Blackburn's Site Specific Instruction (SSI) Waste Characterisation and Acceptance Procedure for imported sludge is provided with this application (see Attachment 2), which includes information regarding staff responsibilities; waste types accepted; waste characterisation; waste acceptance, waste non-conformance and rejection; and waste audit and reassessment. The following sludge acceptance/recording procedures are used at Blackburn:

- United Utilities Bioresources is responsible for the movement of all UUW sludges produced. The "PODFather" system is used to plan and manage the movement of UUW tankers transporting UUW sludges between wastewater treatment works. POD stands for "Proof of Delivery".
- Waste characterisation and pre-acceptance is provided for each sewage sludge import. This is provided through completion of the "WwTW Sludge Waste Declaration Form". The WwTW Sludge Waste Declaration Form is completed by a representative of the WwTW production site or production area with knowledge and authority to provide this information (e.g. Process Controller, Technical Officer, Production Manager, or Area Production Manager).
- The characterisation provided on the WwTW Sludge Waste Declaration Form is required in order for a technical assessment of the waste to be completed by the Blackburn site. The Technical Assessment will confirm if the proposed import stream is suitable for processing. The Blackburn Production Manager is responsible for the approval of incoming waste.
- Following approval, the PODFather system provides a link each week to Process Controllers (PC) at export sites, the PC then provides information relating to sludge levels on site and what volume they need exporting the following week.
- Import sites provide information on what volume they are able to accept and ensure that volumes received are within Permit and licence conditions.
- Sludge loggers linked to the PODFather system are present at all import sites; they automatically monitor the quantity and the dry solids of the sludge imports as they are discharged from the tanker.
- The PODFather system records all sludge movements, detailing the site it has come from, the volume, the quality (dry solids content) and date and time delivered. These records are all kept electronically and used in the quarterly submissions to the EA as well as the annual reporting to OFWAT.
- Sampling of imports on arrival is not required as the material consists of sewage sludge which will have undergone pre-acceptance characterisation and technical evaluation. Where there are operational or technical reasons to carry out sampling these will be done as detailed in the waste acceptance procedure.

- The tanker discharge point has a WaSP system that doesn't allow discharge unless the tanker driver has the correct access fob. As well as allowing the discharge to take place, the driver has to enter details such as name, registration number and sludge source, these records are kept as part of the duty of care compliance.

5.2. Waste Treatment and Processing

A block process diagram for the sludge treatment process is included at Appendix E.

As can be seen from the process diagram, Blackburn WwTW accepts three types of sludge:

- Indigenous sludges arising at Blackburn WwTW;
- Imported raw sewage sludge (unthickened and thickened); and
- Imported raw sewage sludge cake.

The processes for treating the different imports of waste are interlinked, as detailed in the following sections.

Organic matter is digested, resulting in the production of biogas and treated sludge cake. The biogas has a high calorific value and is burned in a CHP plant to produce heat and electricity as a by-product. Biogas can also be used as a fuel in dual fuel boilers. The sludge cake produced is recycled to land.

5.3. Blackburn WwTW Sludge

Indigenous sludge from the Nereda wastewater treatment system is drawn off into two sludge reception tanks (these tanks do not form part of the installation). From here it is fed via an underground pipe to three drum thickeners. A flow meter is in place on pipework upstream of each drum thickener (one flow meter per thickener).

Photo 1 – Drum thickeners (x3)

Thickened sludge is pumped into the EEH feed tank. Liquor from the drum thickeners is discharged into the Liquor Return Pump Well for return to the Nereda inlet channel.

In the event that the drum thickeners are struggling to achieve the optimum percentage dry solids concentration (5-6%) or there is capacity in EEH plant, a contingency tank is available for use (Tank No.5)

for the emergency storage of thickened sludge. Sludge is stored for short periods of time, typically 2-3 days.

5.4. Tanker Imported Sludge

There is one operational tanker import point, see Photo 2. This raw sludge comes from other WwTWs and may be thickened or unthickened.

Photo 2 – Tanker import point

Following off-loading, the sludge discharges through a screen into a below ground chamber (No.43). From the chamber sludge is pumped into an above ground storage tank (unthickened sludge tank No.24). The unthickened sludge is passed through a second screen into four mixing and balancing tanks. Sludge screenings are collected in open skips.

Photo 3 – Screening unit and screenings skip

Photo 4 – Unthickened sludge storage tank

The unthickened sludge tank is connected to an odour control unit, see Photo 5, which takes odorous air from the top of the tank via a pipe protruding from the fixed roof and chemically scrubs the extracted air before release to atmosphere.

Photo 5 – OCU connected to the unthickened sludge tank

5.5. Gravity Belt Thickeners (GBT)

From the mixing and balancing tanks the blended sludge is pumped into two GBTs for thickening, which are located within a building, see Photo 6. Polyelectrolyte is added (see 5.16). Final effluent is used to wash out the GBTs. Filtrate is discharged into an external storage tank where it is combined with the centrifuge centrate.

Photo 6 – GBTs within the building

5.6. Thickened sludge storage tank

The thickened sludge drops into a thickened sludge storage tank below the GBTs (within the building) and is pumped to the EEH feed tank.

5.7. EEH Feed Tank

The EEH feed tank receives thickened indigenous sludge (from the drum thickeners), thickened imported sludge (from the GBTs) and reliquefied sludge (from the reliquification unit). The EEH feed tank is connected to an odour control unit, seen in Photo 7 to the left of the green EEH feed tank. More information about the odour control system can be found within Section 6 of this document.

Photo 7 - EEH feed tank and OCU

5.8. Enhanced Enzymic Hydrolysis (EEH)

Within the EEH feed tank, air is pumped in from an air compressor to aid the mixing process. From the EEH buffer tank, the thickened sludge is pumped to the EEH plant, see Photo 8. The boiler building beside the EEH process houses 3 boilers that are authorised under the current permit.

Photo 8 – EEH Plant

The EEH plant is a pre-digestion sludge treatment plant capable of working in either mesophilic (enhanced hydrolysis [EH]) or thermophilic/pasteurisation range (EEH). Currently the plant is operating as EH (see below) but can be reconfigured to operate as EEH. It comprises the following equipment:

- Six reactor vessels with level monitors (sludge reception reactor vessels 1 and 2 are also fitted with temperature transmitters);
- Hydrolyser stage heat exchange;
- Pasteurisation stage heat exchanger;
- Gas lifting and gas mixing system;
- Duty/standby digester feed pumps;
- Cooling heat exchanger and two air blast coolers; and
- Enzymic hydrolyser MCC.

The process operates in series always in reactor 1-3 (with No.1 able to be taken out of service to reduce retention times in low throughputs). There are then two ways to operate the process – either in series (conventional mesophilic EH) or in enhanced mode (pasteurisation EEH). In conventional mode (as it is currently operating), the reactors pass on sludge in series from 1-6 (with currently only 1-5 in use). Vessel 5 feeds the digester, then sludge transfers from 4-5, 3-4, 2-3 and then 1-2 when the temperature is acceptable. Then the plant can feed and the whole process repeats.

When in enhanced mode, the process is a batch process in vessels 4, 5 and 6. The process is the same up to R3 (at normal mesophilic temps or just higher to start hydrolysis). This transfers in the same way up to V4, which is directly connected to the secondary heat exchanger and lifts the temp to 55 degrees. From V4, V5 and V6 hold in batches, with one holding as the other empties and fills for a pre-set time. The time and temperature are the key enhanced process parameters.

The flow route of the sludge through the plant is controlled by actuated control valves. The hot sludge being pumped to the digesters passes through a cooling heat exchanger (if required) where the temperature of the sludge is reduced to the required digester temperature.

Whilst the system is operating, the gas mixing compressor provides gas mixing in the operational reactor vessels, each reactor vessel being mixed at least once in each process cycle.

Biogas produced in the EEH is stored in the installation's gas bag. EEH produced gases are used by the EEH Plant for gas mixing of the reactor vessels and transfer of sludge between the reactor vessels.

The EEH feed tank and the hydrolyser sludge feed pumps are installed at a higher level than the enzymic hydrolyser plant. To prevent gravitation sludge flow from the holding tank to the EEH plant, the sludge feed is controlled by an actuated valve. The valve opens when requesting a sludge feed and closes on completion of the sludge feed.

If required, to keep the temperature in the mesophilic range, the sludge is passed from the EEH plant through the blast cooler which has two water coolers. This cools the sludge rapidly before it is sent to the digesters. The rapid cooling of the sludge enables the sludge to be more easily broken down. Should the EEH plant require shut down for maintenance or other reasons, the EEH plant can be bypassed and sludges sent directly to the digesters. This may involve the use of the EEH auxiliary pumping equipment and control systems and will also require temporary pumps and pipework. In such a case, the sludge cake quality will be reduced and may need to be improved by other temporary processes, such as extended storage to allow further maturation to take place.

5.9. Digesters and Centrifuges

From the EEH vessels the sludge is batch fed into four primary digesters, see Photo 9. The hydrolysed sludge enters the digesters where the AD process takes place. Biogas from the digesters is discharged under very low pressure to the gas bag.

Digestion generally takes place at a temperature range of 38 – 27 ºC, although the range can be greater, with a minimum retention time of 10 days. Under normal operating conditions there are four digesters working continuously and simultaneously.

Photo 9 – Primary digesters

The digested sludge within the digesters is passed to the post-digestion tanks via positive displacement by incoming hydrolysed sludge from the EEH plant. From the post digestion tanks, the digested sludge is pumped by two sludge buffer transfer pumps to a centrifuge sludge buffer tank, through the three centrifuge feed pumps and two dewatering centrifuges. The two centrifuges and polyelectrolyte dosing plant are housed in the "press" house; these are used for final dewatering of the treated sludge.

The centrate from the centrifuge passes through a small break tank (connected to an odour control unit) before being pumped to an external concrete tank where it is combined with the GBT filtrate. The combined liquors are discharged into the Liquor Return Pump Well for return to the Nereda inlet channel.

Should the centrifuges be unavailable for a period such that all three post digestion tanks may reach capacity, a temporary centrifuge will be installed at the site, in a suitable location on the cake pad.

5.10. Digested Cake Storage

Digested dewatered sludge cake falls onto a conveyor and is deposited onto an adjacent cake bay area, see Photo 10, where it is temporarily stored prior to treatment by the addition of lime (see Section 5.11). The bay is constructed from concrete and is laid to a fall to be captured by the site drainage system, from where all drainage is returned to the WwTW flow to full treatment.

Photo 10 – Press House cake bay

A second larger cake bay is situated to the north of the Press House. This area is used for the cake liming process and for the storage of lime treated (enhanced) and untreated (conventional) digested cake in segregated bays. The bays are constructed from concrete and drained to the site drainage system which returns to the WwTW flow to full treatment.

Photo 11 – Liming cake pad

5.11. Liming Process

Under normal operations, all the digested dewatered cake receives further treatment by mixing with lime to produce an enhanced product for agricultural land spreading. Digested cake is loaded into a mixing drum using a telehandler in a dedicated bucket. Powdered lime is introduced into the mixing drum from an enclosed storage silo with a discharge auger and air fluidisation system. The mixing plant can process 20 tonnes of cake per hour. Up to 40,000 tonnes of cake can be processed per year.

Mixing the cake with lime raises the pH to 12 which virtually eliminates any remaining pathogens which may be present in the sludge when held for a period of two hours. The process is controlled by a dedicated HACCP with critical control points of two hours retention time and 4% weight of sludge vs % lime. Further information is provided in Section 5.17 Process Controls.

Processed cake is transferred to a stockpile on the cake pad via a conveyor. As the volume increases treated material is moved away from the conveyor drop zone and into storage with the telehandler using a clean bucket.

Concrete A frame panels separate lime treated (enhanced) cake from untreated (conventional) digested cake. The fall on the pad is away from the treated cake, minimising the risk of run-off from the untreated storage area causing contamination.

If there are constraints within the landbank due to weather or outages on the liming plant, conventional cake (without the addition of lime), may be exported from the discharge bay by the Press House.

A 40 KvA diesel generator is used to provide power to the lime mixing plant. The generator and all of the equipment associated with the lime treatment process is owned (or rented) by a third-party operator (4R Group Ltd).

5.12. Lamella Tank

Centrate and filtrate are pumped from the storage tank to a Lamella tank for solids removal (see Photo 12). Settled solids are returned to the GBTs for processing. The liquor is discharged into a Liquor Return Pump Well where the installation ends.

From the Liquor Return Pump Well the liquor is pumped to a second pump station where it is mixed with wastewater from the tertiary backwash filter before being pumped to the Nereda inlet channel for biological treatment.

Photo 12 – Lamella plant

5.13. Imported Raw Cake Reliquification

Raw sewage sludge cake is imported to site from other UWWT sites and is reliquefied. The sludge cake is brought onto site and stored in a dedicated cake bay in accordance with the relevant work instruction. If necessary, raw cake can also be stored in a segregated area of the large cake pad. From the cake bay (or cake pad), the cake is loaded into the re-liquification sludge unit (Photo 13), where the cake is loaded into a hopper. Liquid sludge from the mixing and balancing tanks is pumped into the hopper, where it reliquefies the raw cake via mixing within an inclined conveyor. The reliquefied sludge discharges into a pump station and is then pumped into the EEH feed tank. If necessary, final effluent can be used for the reliquification process.

Photo 13 – Cake and re-liquifying equipment

5.14. Biogas

The biogas process is as per the existing permit.

Gas production rates are measured via gas flowmeters; and organic loading is assessed based on the composition of raw digested sludge which is monitored via instrumentation and affirmed by regular lab analysis. The calculated digester feed rate is built into the Hazard and Critical Control Point (HACCP) Plan and Biosolids Assurance Scheme (BAS) plans and feed rates are not exceeded to ensure organic loading is controlled.

Fugitive emissions of biogas may arise from the activation of PVRVs on gassing tanks (see Section 6.10) or leaks in gas pipework e.g. around flanges. Leak detection for biogas is not currently undertaken unless a fault is suspected. However, a Leak Detection and Repair (LDAR) Site Specific Instruction (SSI) has been developed for the site which is included with this application (see Attachment 7). Assets (such as the digesters, gas bag, PVRV's, CHP engines, boilers and flare stack) are scheduled for routine proactive inspection by thermal imaging camera on an annual basis.

5.15. Polyelectrolyte dosing System

The polyelectrolyte, which is in either in powder or liquid form, is kept within the GBT building. The undiluted raw material is diluted with potable water to create the correct consistency, within the polyelectrolyte dilution line. The polyelectrolyte dosing then pumps into the sludge feed line and into the centrifuge.

Photo 14 – Polyelectrolyte preparation area

5.16. Pressure Vacuum Relief Valves (PVRVs)

PVRV's are installed on the primary digesters, gas bag and EEH plant. PVRVs are calibrated, serviced and installed by a trusted competent/specialist contractor (Qualtech). The PVRVs only operate when the pressures within the system occasionally exceed a set value and this value is set at a level whereby the PVRVs will be able to reduce the excess pressure prior to any critical pressure point being exceeded. The size and number of PVRVs for each vessel is based upon design criteria, taking into account system

pressure and biogas volumes. PVRVs at Blackburn WwTW are set to operate on the digester at 22.5 mb and on the EEH plant at 28.5 mb, as per the design criteria.

All PVRV's are installed in accordance with the current Asset Standards which consider current industry best practice. We note that BS EN ISO 28300-2008 is relevant to usage in the petrochemical industry and we consider the current standards, including compliance with IGEM[4] standards, are appropriate for the operating conditions.

PVRVs are installed with wildlife cages to prevent nesting birds; and frost protection measures are not considered necessary due to the normal operating temperature of the biogas, i.e. 30 – 38.75°C. The condition and performance of the PVRVs will be monitored via a 2-yearly service and calibration programme carried out by a specialist contractor in accordance with design specifications and regular site tours by operational staff which include inspection of the PVRVs.

The operation of PVRVs is minimised by monitoring pressures within the digesters and gas bag and controlling digester feed accordingly. Different types of pressure sensors are installed to allow monitoring and control through the process. These comprise: E&H transducers to provide digital readouts; analogues gauges for visual checks; and Krom Schoeder pressure switches to control safety interlocks. Regular site tours undertaken by operational staff include inspection of the PVRVs.

In the event of an overtopping or foaming event, the digester(s) will be dosed with antifoam to inhibit foam generation. Once foam levels subside, the PVRVs will be cleaned down and inspected for debris blocking the sealing plate or protective cage: and checked to ensure the PVRV seal is operating correctly. If there is any suspicion that the integrity of the PVRV has been affected, then service and calibration by the specialist contractor will be arranged.

Any releases from PVRVs (or foaming events) observed will be recorded in the site diary, along with any escalations or remedial actions taken.

There is no requirement to monitor emissions from the PVRVs as they are a safety critical system that do not operate routinely and, when they do operate, are only open for a very limited period of time (however the volume of gas released can be estimated based on measured gas generation rates at the time of PVRV operation).

The PVRVs will be checked for fugitive biogas leaks on a six-monthly basis with an optical gas imaging camera as part of the site LDAR Plan. A copy of the LDAR Plan is provided with this application (see Attachment 5).

5.17. Process Controls

Maintaining the sludge treatment process within the defined operating conditions for the plant is important in maintaining the health of the digesters, the quality of the sludge cake and minimising the potential for odour emissions. Process monitoring controls are set out in the Wastewater Services

[4] Institution of Gas Engineers and Managers

Mesophilic Digestion SOP (WwP/S/001/02), Blackburn Primary Digestion SOP (WwP/I/3006/18/04) and the site HACCP (WwP/I/3006/18/39). Target operating parameters for the anaerobic digestion process include:

- pH – 5 to 8;
- temperature 35 +/- 3ºC;
- VFA in digested sludge - <200mg/l;
- VFA/alkalinity ratio <0.2;
- Alkalinity in digested sludge - 3,000 - 5,000mg/l; and
- Biogas quality - 60-70% CH_4

The AD and EEH systems are controlled by SCADA system and local HMI controls, which allows plant operations personnel to monitor, control and record the status and performance of key equipment in the various plant areas. The system also provides alarms in the event of an equipment failure.

The monitoring of digester key process parameters and biogas key process parameters is summarised in Table 5.17.1 below.

Table 5.17.1: Summary of Process Monitoring

Parameter	Frequency of measurement	Point of measurement	System of measurement
pH (sludge)	Weekly	Sample taken (digester feed)	Lab analysis
Alkalinity (sludge)	Weekly	Sample taken (digester feed)	Lab analysis
Temperature	Continuous	Temperature probe within digesters and EEH vessels	SCADA
Volatile fatty acids concentration (sludge)	Weekly	Sample taken (digesters)	Lab analysis
Ammonia (sludge)	Weekly	Sample taken (digesters)	Lab analysis
Sludge flow	Continuous	Flow meter	SCADA
Biogas Flow	Continuous	Flow meter	SCADA
Methane (biogas)	Continuous	Gas meter	SCADA
CO_2 (biogas)	Fortnightly	Gas meter	SCADA
O_2 (biogas)	Fortnightly	Gas meter	Engine HMI
Hydrogen Sulphide (biogas)	Continuous	H_2S analyser	PLC/ HMI boiler plant room
Pressure	Continuous	Pressure Transducer	SCADA

The sludge digestion process is operated under a HACCP Plan which sets out operating conditions, critical control points within the process and sampling requirements. Digester feed rates are defined in the HACCP Plan and will be maintained unless process control monitoring identifies any problems indicative of a

reduction in active volume. If monitoring indicates operational parameters (i.e. digested sludge composition and digester temperatures) are close to compliance limits (as per the HACCP Plan) then digester feeds will be reduced accordingly and appropriate maintenance actions will be taken.

The HACCP for anaerobic digestion sets out the process to be taken in the event of a breach of a critical control point (CCP). Examples of site specific corrective actions are provided in Table 5.17.2.

Several Site Specific Instructions (SSI) (such as the Digestion and Biogas Emergency Plan and the Process Loss Contingency Plan) are also contained within the overall environmental management system for the site. If normal operating parameters are not met, then suitable actions are undertaken in accordance with the relevant SOPs.

Table 5.17.2: Corrective Actions in the event of a Critical Control Point Breach – Digestion Process

CCP	Name	Critical Limit (CL)	Corrective Actions Approaching CL	Corrective Actions when CL breached
3 - 6	Primary Digester Minimum Temperature	28 degrees Celsius	Cease feeding digester to prevent any non-compliant sludge being produced. Advise HACCP failure contacts of potential for breach. Investigate cause & take corrective action. Once up to temperature, resume digester feeding the following day.	Cease feeding digester to prevent any further non-compliant sludge being produced. Advise HACCP failure contacts. Investigate cause & take corrective action. Once up to temperature, resume digester feeding the following day.
8	Primary Digester Maximum Feed	260 m^3/day	Not possible if using digester feed plc in auto mode. Any excess daily feed rates derived from site readings are likely due to differences in the times reading the totalisers. When at peak feed rates; ensure readings are taken at a similar time each day.	Cease feeding digester to prevent any further non-compliant sludge being produced. Advise HACCP failure contacts. Investigate cause & take corrective action. Resume digester feeding the following next day.
1	EEH Plant Reactor No.1 Temperature	30 degrees Celsius	Cease feeding EEH plant to prevent any non-compliant sludge being produced. Advise HACCP Failure contacts of potential for breach. Investigate cause & take corrective action. Once up to temperature, resume EEH feeding the following day.	Cease feeding EEH plant to prevent any further non-compliant sludge being produced. Advise HACCP failure contacts. Investigate cause & take corrective action. Once up to temperature, resume EEH feeding the following day.

CCP	Name	Critical Limit (CL)	Corrective Actions Approaching CL	Corrective Actions when CL breached
7	EEH Maximum Daily Feed	835 m^3	Highly unlikely if PLC in auto mode, reduce feed rates to prevent any non-compliant sludge being produced. Any excess daily feed rates derived from site readings are likely due to differences in the times reading the totalisers. When at peak feed rates; ensure readings are taken at a similar time each day.	Cease feeding EEH to prevent any further non-compliant sludge being produced. Advise HACCP failure contacts. Investigate cause & take corrective action. Resume EEH feeding the following next day.

The digested cake liming process, as described in Section 5.11, is controlled by a dedicated HACCP. Mixing the cake with lime raises the pH to 12 which virtually eliminates any remaining pathogens which may be present in the sludge when held for a period of two hours. The HACCP sets out critical control points (CCPs) and the process to be taken in the event of a breach of a CCP. Examples of site specific corrective actions are provided in Table 5.17.3.

Table 5.17.3: Corrective Actions in the event of a Critical Control Point Breach – Liming Process

CCP	Name	Critical Limit (CL)	Corrective Actions Approaching CL	Corrective Actions when CL breached
L1	Retention time	2 hours	Increase monitoring process and if possible reduce sludge being limed.	Stop the process, quarantine the cake and take samples to be sent to the labs for testing.
L2	Weight of sludge vs % lime	4 %	Increase monitoring process and if possible reduce sludge being limed.	Stop the process, quarantine the cake and take samples to be sent to the labs for testing.

5.18. Containment and Drainage

All above ground and below ground tanks and pipework related to the sludge treatment process are constructed of suitable materials, in accordance with UUW asset standards, to ensure longevity and minimise the risks of failure/leaks.

The sludge storage/treatment tanks, their construction details and capacity are summarised in are summarised in Table 5.18.1. The layout of operational tanks at the site is shown in Appendix D. Open topped tanks are discussed in Section 5.21.

***Table 5.18.1*: Tank construction and capacity**

Tank Name	Construction Material	Above/ Below Ground	Enclosed/ Open	Tank Capacity (per vessel)
Unthickened sludge chamber (No.43)	Concrete	Below ground	Open	10m^3
Unthickened sludge tank (No.24)	Glass fused to steel	Above ground	Enclosed	1,800m^3
Sludge mixing and balancing tanks (x 4, No. 18 – 21)	Reinforced concrete	Below ground	Open	500m^3
Drum thickeners emergency storage tank for thickened sludge (No.5)	Reinforced concrete	Below ground	Open	700m^3
EEH feed tank (No.6)	Glass fused to steel	Above ground	Enclosed	1,400m^3
EEH vessels (x 6 No. 9-14)	Glass fused to steel	Above ground	Enclosed	280m^3
Post Digestion tanks 1 & 2 (No.37 & 38)	Reinforced concrete	Partly below ground	Enclosed	900m^3
Post digestion tank 3 (No.36)	Glass fused to steel	Above ground	Enclosed	1,200m^3
Centrifuge sludge feed buffer tank	Reinforced concrete	Partly below ground	Enclosed - in building	600m^3
Centrate buffer tank	GRP	Above ground	Enclosed	Approx. 2m^3
Centrate/ filtrate storage tank (No.17)	Concrete	Partly below ground	Open	1,200m^3
Digesters x 4 (No.26-29)	Reinforced concrete	Above ground	Enclosed	2,500m^3
Lamella tank (No.40)	Steel	Above ground	Enclosed	19m^3

Sludge storage and treatment areas are situated on a mixture of impermeable hard surfacing and gravel aprons with drains to the sealed site drainage system. There are areas of the site that are not impermeably surfaced, particularly around the mixing and balancing tank, the digesters and post digestions tanks. A site surfacing plan is provided at Appendix F.

Sludge storage tanks do not currently have secondary containment and rely on tertiary containment provided by the site drainage system. The surface water drains provide a 'self-contained' sealed system, i.e. all drains on site are connected to private drainage leading to the WwTW treatment process.

UUW commissioned Stantec Limited to undertake an assessment of the potential environmental risks associated with a loss of containment from process tanks at the site. The assessment was undertaken using the Anaerobic Digestion & Bioresources Association (ADBA) Risk Assessment Tool, which is based on CIRIA 736: Containment systems for the prevention of pollution. The ADBA risk assessment was used to inform hydraulic spill modelling undertaken for the site. A 2D model of the Blackburn site was constructed in InfoWorks ICM to assess the impact of failure or loss of containment on site. Use of the 2D hydraulic model allows the failure of a containment vessel to be represented, including the subsequent overland flow and ponding of released flow. A copy of the Stantec Secondary Containment Modelling Assessment Report is provided with this application.

Results from the simulations indicate that the spilled flows from these tanks could reach receptors, as detailed in the Stantec report. High-level containment solutions for each critical asset have therefore been developed to meet the requirements set out in CIRIA c736. The proposed mitigation measures to be installed and timescales for installation are detailed in the Blackburn BAT Improvement Programme document submitted with this application (see Attachment 9). Solution modelling has been completed on all tanks to show the simulated flood extents and the depths of the settled sludge with the proposed mitigation measures in place. The proposed containment solution is based on 110% containment volume of the largest tank at the Blackburn Sludge Treatment Facility. CIRIA 736 states that sites should use 25% of the total inventory or 110% of the largest tank sludge volume within the contained area, whichever is larger. However, CIRIA 736 also outlines that sites can undertake a quantitative assessment of the credible failure scenarios to propose a secondary containment capacity that deviates from that outlined in Section 4.2.1 of the CIRIA guidance. In some cases, a 25% containment volume can result in overengineered solutions.

UUW are undertaking further risk assessment to demonstrate that a single catastrophic tank failure would not be of any detriment to the adjacent assets and that there are no credible scenarios for simultaneous initiation of multiple tank and pipework failures, providing suitable evidence to the EA that 110% containment volume of the largest tank is appropriate. Following discussion with the EA Permitting Officer, UUW understand that this risk assessment can be provided under a permit Improvement Condition. The permit Improvement Condition will require UUW to submit finalised designs, specifications and an implementation schedule to the EA for their consideration and approval. UUW are committed to meeting BAT, or justified BAT equivalent, for the final containment solution at the Blackburn Sludge Treatment Facility.

The conceptual design existing site drainage and any new connections associated with the sacrificial areas within the permit boundary will include locations for isolation (or multiple points of isolation) of the system in the event of a catastrophic failure. The location and full solution will be determined during detailed design and will follow the principles identified in Section 11.2.1 and Figure 11.1 of CIRIA 736 guidance.

In the interim period, site inspection tours of the impermeable surface, storage tanks and drainage system will be carried out on a daily basis by site-based staff and monthly by the site's ERA. These tours will include visual inspection of the site drains to ensure they are working as expected. Once the proposed

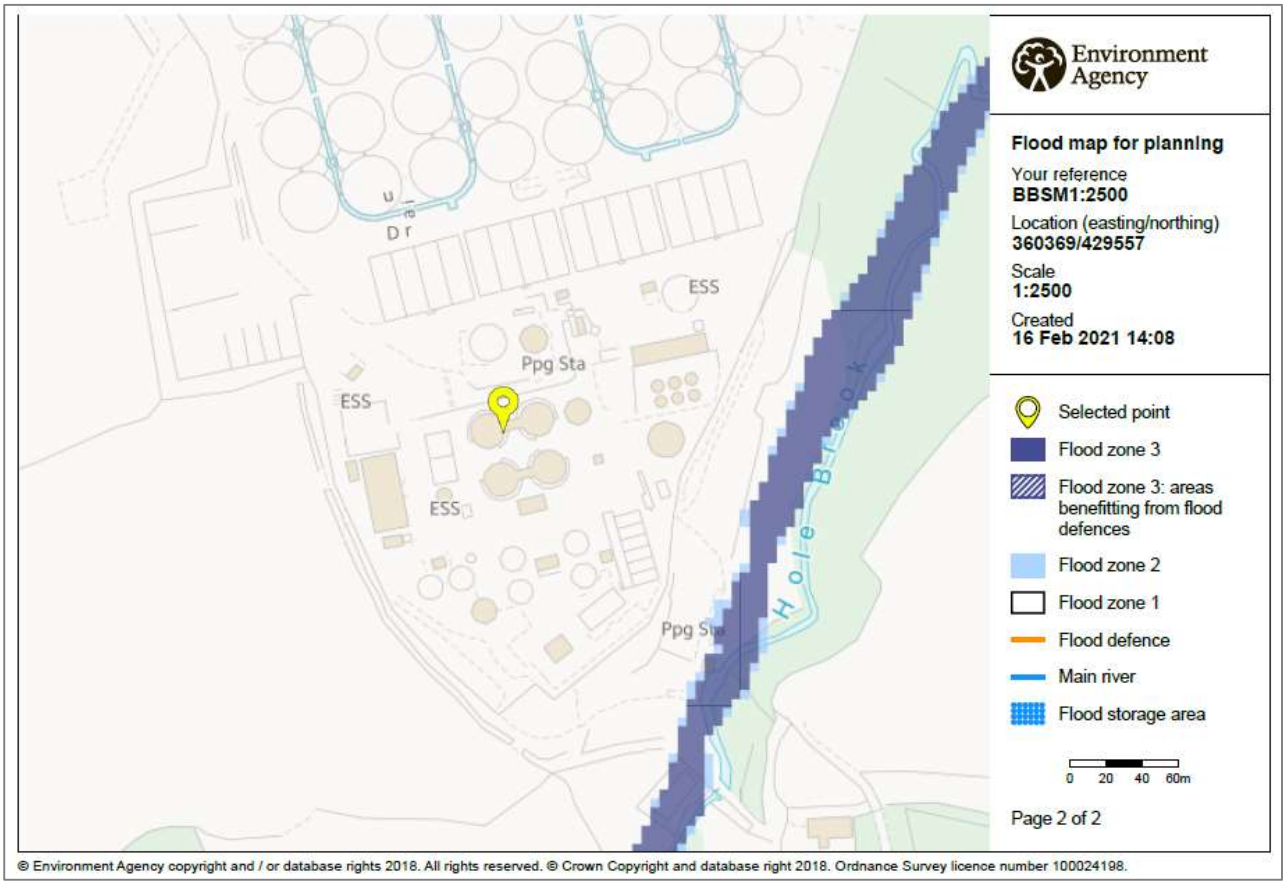
secondary containment measures are in place, the site inspection tours will be extended to include a visual check of these also.

Regular CCTV inspections are to be carried out (every 5 years) on the drainage systems. If any issues or concerns are identified, they will be logged on the corporate action tracker for prompt remediation. A site drainage plan is provided at Appendix G.

Process control monitoring is also used to assess tank and sludge pipework integrity e.g. comparison of flow meters (where present) throughout the system to identify any losses. Flow readings are displayed and monitored continuously via the site SCADA system.

The risk of any environmental impacts from damaged/leaking drains is considered to be very low. Clayey glacial till is present at thicknesses exceeding 22.5m beneath the site and the risk to groundwater from a leaking sludge asset at Blackburn is considered to be insignificant.

Interrogation of the Environment Agency's online Flood Map shows that the site is within Flood Zone 1 which has a low probability of flooding. No part of the site is within either a Flood Zone 2 or Flood Zone 3.



5.19. Storage of Hazardous Substances

Raw hazardous substances are used and stored at the site. Table 5.19.1 sets out the risk assessment of hazardous substances for Blackburn WwTW.

Table 5.19.1: Hazardous Substances Risk Assessment

Hazardous Substance	Capable of Causing Pollution?	Maximum volume stored	Pollution Prevention Measures Assessment	Risk of Soil & Groundwater Contamination
Gas oil – serving the steam boilers	Yes	25,000 litres	Stored in a steel tank within a bund that is fully compliant with The Control of Pollution (Oil Storage) (England) Regulations 2001. The bunded area is within a concrete apron that is drained to the WwTW flow to full treatment via the site's sealed drainage system.	Low
Lubricating oil – clean oil for CHP engine maintenance.	Yes	5,000 litres	Stored externally in a double skinned steel tank that is fully compliant with The Control of Pollution (Oil Storage) (England) Regulations 2001.	Low
Waste lubricating oil – arising from CHP engine maintenance.	Yes	5,000 litres	Stored externally in a double skinned steel tank that is fully compliant with The Control of Pollution (Oil Storage) (England) Regulations 2001.	Low
Fuel oil – serving mobile generator for the liming process.	Yes	1,000 litres	Stored externally in a bunded fuel cell (cube) with isolation valves fitted.	Low
Note: Both polyelectrolyte and anti-foam were assessed and determined to be non-hazardous substances. Refrigerant is used for gas chillers and anti-corrosives are used in the boilers/heat exchangers, but none is stored on site; this is brought to site by contractors as needed.				

5.20. Monitoring and Maintenance

The site operates under an EMS manual detailing the Standard Operating Procedures (SOP's) and Site-Specific Instructions (SSI's) applicable to each process. These instructions have been designed to ensure safe and effective operation and to minimise known hazards from the installation and include procedures for maintenance, training and accident response.

The Production Manager will review the EMS for the installation and arrange the necessary updates to include the operations, inspection and maintenance of the plant. The Production Manager will also arrange staffing resources and training for operation, monitoring and maintenance of the plant.

All scheduled maintenance will be set up on the Mobile Asset Resource Scheduling (MARS) and all proactive and reactive maintenance undertaken will be recorded on MARS against the requirements of the plan.

Equipment and pipework at site are installed in accordance with UUW asset standards to ensure reliability. The UUW standards are based on industry best practice and are regularly reviewed by technical specialists within the business. Assets are also subject to regular inspections and defect management via UUW's statutory maintenance team, which includes checking for corrosion and the general condition of pipework and equipment. In addition, site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). These tours include tank level monitoring, visual inspection of asset integrity, where possible, and general ground conditions. If any evidence of leaks or ground contamination is seen further investigations or remedial actions will be instigated immediately.

Critical parts and chemicals are available in the event of equipment failure. Stocks are counted biannually on site, and on a cycle counting basis at the central stores. The central stores is the default storage location for all spares and is a third party warehouse. All counts are held in SAP, a resource planning software system used across UUW activities. This same SAP system links stock movements to work instructions for the site and reorders via the Purchasing team. Chemicals stocks are managed through procurement framework agreements with suppliers and a quantity is stored on site which may be used in an emergency.

5.21. Open Topped Tanks

There are a number of open topped tanks at the site, namely:

- 4 x mixing and balancing tanks – below ground reinforced concrete tanks, each 500m^3 capacity. The tanks hold screened, unthickened, undigested imported sludge;
- 1 x centrate/ filtrate tank – a partially below ground concrete tank with a capacity of 1,200m^3. The tank holds filtrate from the GBTs and centrate from the centrifuges;
- 1 x sludge chamber – a below ground concrete chamber with a capacity of approximately 10m^3. The chamber holds screened, unthickened, undigested imported sludge; and
- 1 x emergency storage tank for thickened sludge – a below ground concrete tank with a capacity of 700m^3 for contingency storage only.

UUW recognise that these open tanks represent a potential source of fugitive emissions of volatile organic compounds, hydrogen sulphide and ammonia to the atmosphere. A programme of monitoring is proposed to characterise and, as far as possible, quantify the diffuse emissions from these tanks. We propose to carry out a programme of monitoring for ammonia, hydrogen sulphide, methane and volatile organic compounds (VOCs). Currently we have assumed that this monitoring will be undertaken using hand held instruments in line with the MCERTS Performance Standard for Handheld Emission Monitoring Systems (Version 4, September 2018) combined with the use of a sampling hood to determine process specific, unit area emission rates. If this approach is not considered acceptable by the Environment Agency the methodology would be modified based on taking discrete samples subject to off-site analysis.

The monitoring data collected will be used to confirm the level of emissions and to determine the need to provide mitigation, i.e. if BAT 14 should or should not apply. The base design solution highlighted by the EA is that tanks should be enclosed and directed to an appropriate abatement system. Our approach will be to confirm the need and then, if required, develop an appropriate solution to prevent or, where that is not practicable, to reduce emissions. The design solution will need to satisfy all relevant legislative and UUW safety criteria.

5.22. Process Emissions and Monitoring

There are a number of emission points from the sludge treatment process. The location of all the emission points are shown in Appendix D.

Table 5.22.1 sets out the inventory of wastewater and waste gas stream emissions from the sludge treatment process, in line with BAT 3 requirements. Wastewater streams at the site consist of:

- Gas condensate (from the CHP engine, EEH Plant, boiler plant and biogas lines) - condensate pots are strategically placed in the biogas pipework systems to collect water that condenses from the biogas. The condensate comprises water with trace components of acid gases. Condensate is automatically discharged from the collection pots to the site's surface water drainage system for return to the WwTW inlet for treatment.
- Filtrate (from the gravity belt thickeners) - filtrate is an organic nutrient-rich watery effluent. The filtrate contains elevated levels of ammonia, nitrogen and phosphorus, and is typically characterised by a BOD of approximately 1,720mg/l. The filtrate is piped to a holding tank (where it is mixed with the centrate) and then pumped to the Nereda inlet channel (via a Lamella unit) for biological treatment.
- Centrate (from the centrifuges) - centrate is an organic nutrient-rich watery effluent. The centrate contains elevated levels of ammonia, typically around 900mg/l. The centrate is piped to a holding tank (where it is mixed with the filtrate) and then pumped to the Liquor Return Pump Well (via a Lamella unit) for return to the Nereda inlet channel for biological treatment.
- Drum thickening liquor is an organic nutrient-rich effluent arising from the Nereda indigenous sludge. This is discharged directly into the Liquor Return Pumping Station. From here it is piped to another pumping station where it is mixed with Tertiary Backwash Filter effluent from the WwTW. The combined effluent is then pumped to the Nereda inlet channel for biological treatment.
- Lamella tank liquor - centrate and filtrate pass through a lamella clarifier tank to reduce the solids content. Settled solids are returned through the GBTs and the liquid is pumped to the Nereda inlet channel via the liquor return pumping station.
- Surface water drainage - all surface water drains within the permit boundary discharge into a pumping chamber which is returned to the head of the WwTW as part of the site's containment strategy.

Waste gas streams at the site consist of:

- Biogas combustion exhaust (from the CHP engine stack and flare).
- Combustion exhaust from the boilers – the boilers run on biogas when available, but gas oil is the primary fuel and as such the emissions will principally comprise carbon dioxide, carbon monoxide, volatile organic compounds and oxides of nitrogen.
- Combustion emissions from a small (40 KvA) mobile generator – the generator serves the digested cake/ lime mixing equipment. The generator runs off diesel and as such the emissions will principally comprise carbon dioxide, carbon monoxide, volatile organic compounds and oxides of nitrogen. Given that the generator is mobile it has not been included as a fixed point source emission.

- Biogas releases from PVRVs (digesters, EEH plant and gas bag) – the PVRVs are safety devices and as such only operate when the pressure set points are triggered, as described in Section 5.16.
- Treated foul air (from the OCU's) from the unthickened sludge tank, EEH feed tank and centrate buffer tank.

Table 5.22.1: Inventory of Waste Gas and Wastewater Streams

Nature	Source	Typical Composition	Variability	Control Measures
Gaseous Streams				
Gas oil combustion	Steam boiler stacks (A1, A2 & A3)	Combustion products: NO_2, CO, Total VOCs, Non-methane VOCs *NO_2 <190 mg/m^3 **CO <150 mg/m^3 * MCPD limit for NOx ** ELV from Process Guidance Note 1/3, 'Statutory Guidance for Boilers and Furnaces 20-50MW thermal input'	NO_2 – 68.1 – 68.6mg/m^3 CO – 8.7 – 17.3mg/m^3 Total VOCs – 1.9 - 2.9mg/m^3 SO_2 – 46.5 - 60.4mg/m^3 Results from 2020 monitoring	Boiler maintenance in accordance with engine manufacturers recommended frequency.
Biogas combustion	CHP engine stacks (A4 & A5)	Combustion products: NO_2 <500mg/m^3 CO <1,400 mg/m^3 Total VOCs <1,000mg/m^3 Non-Methane VOCs <75mg/m^3	NO_2 – 419 – 594*mg/m^3 CO – 776 - 1159 mg/m^3 Total VOCs – 634 – 1,545*mg/m^3 SO_2 – 2.9 - 4.3mg/m^3 Non-Methane VOCs Results from 2020 monitoring *assessed against uncertainty limit set within LFTGN08 v2 2010	Annual emissions monitoring. CHP maintenance in accordance with engine manufacturers recommended frequency. Biogas is passed through carbon filter/scrubber unit to remove siloxanes and other VOCs prior to flow to the CHP engine.

Nature	Source	Typical Composition	Variability	Control Measures
Biogas combustion	Flare (A6)	Combustion products: NO_x, CO, SO_2, VOCs NOx <150 mg/m^3 *CO <50 mg/m^3 *Total VOCs <10 mg/m^3 * ELVs from 'Guidance for monitoring enclosed landfill gas flares' LFTGN05 v2 2010	Emissions not tested	Running time monitored and does not exceed more than 10% of operational hours. Inspected annually, including mechanical and safety systems.
Biogas	Gas Bag PVRV (A7)	CH_4, CO_2, H_2S	Estimated: CH_4 - 60–70% CO_2 – 30-40%	Inspected and calibrated on a periodic basis to ensure they are operating at the correct set points.
Volatile hydrocarbon compounds	Oil storage tank breather vent (A8)	VOCs	Not known	Compliance with Oil Storage Regulations
Biogas	EEH PVRV (A9)	CH_4, CO_2, H_2S	Estimated: CH_4 - 50–60% CO_2 – 40-50%	Inspected and calibrated on a periodic basis to ensure they are operating at the correct set points.
Foul air	Unthickened sludge tank OCU (A10)	H_2S, NH_4, VOCs No testing available	Not known	The OCU is not currently operational. Daily odour tours are conducted by site staff.
Foul air	EEH feed tank OCU (A11)	H_2S, NH_4, VOCs No testing available	Not known	The OCU is not currently operational. Daily odour tours are conducted by site staff.
Foul air	Centrate buffer tank OCU (A12)	No testing available	Not known	The OCU is not currently operational. Daily odour tours are conducted by site staff.
Biogas	Digester PVRVs (A13 – A16)	CH_4 - 60–70% CO_2 – 30-40% H_2S < 1,500ppm	CH_4 - 60–70% CO_2 – 30-40% H_2S < 1,500ppm	Inspected and calibrated on a periodic basis to ensure they are operating at the correct set points. Gas quality (CH_4, CO_2, O_2 and H_2S), pressure and flow rate are continuously monitored

Nature	Source	Typical Composition	Variability	Control Measures
				and displayed on the SCADA system. DSEAR zoning.
Liquid Streams				
Gas condensate	Condensate pots and drain valves on the biogas lines (W1 – W5)	Mildly acidic, organic content No testing available	Not known	None required – process controls in place for biogas quality
Boiler blowdown	Steam boilers (W6)	Mildly alkaline COD, dissolved solids	Not known	None
Filtrate	Thickening gravity belt thickeners (W7)	Ammonia as N – 128mg/l COD – 3,864mg/l BOD – 1,716mg/l Suspended Solids – 1,747mg/l Total Nitrogen – 243mg/l Total Phosphorous – 49mg/l Average monitoring results between Nov 2020 to Nov 2021 (40 to 142 data sets)	Ammonia as N – 3-851mg/l COD – 918 – 7,660mg/l BOD – 396 – 4,440mg/l Suspended Solids – 545 – 5,370mg/l Total Nitrogen – 95 - 445mg/l Total Phosphorous – 21 - 112mg/l Monitoring results from Nov 2020 to Nov 2021 (40 to 142 data sets)	Filtrate is returned to the WwTW at a controlled rate of approximately 1,140m^3 per day (over a 16 hour working day). The filtrate is sampled and tested five times in a fortnight to ensure that the flow rate is appropriate and adjusted if required. The main parameter that requires control is the loading of ammonia to the works.
Drum thickeners	Drum thickeners - commenced use in 2021 (W8)	Ammonia as N, COD, BOD, Suspended Solids, Total Nitrogen, Total Phosphorous	Not known	None
Centrate	Centrifuge (W9)	Ammonia as N – 900mg/l COD – 1,344mg/l Suspended Solids – 540mg/l Total Nitrogen – 1,125mg/l Total Phosphorous – 32mg/l	Ammonia as N – 6 - 2,430mg/l COD – 584 – 4,110mg/l Suspended Solids – 244 – 1,030mg/l Total Nitrogen – 624 – 1,420mg/l Total Phosphorous - 4 – 107mg/l	Centrate is returned to the WwTW at a controlled rate of approximately 75m^3 per day (over a 16 hour working day). The centrate is sampled five times in a fortnight to ensure that the flow rate is appropriate and

Nature	Source	Typical Composition	Variability	Control Measures
		Iron – 12,282 micrograms/l Average monitoring results between Dec 2020 to Oct 2021 (13 to 45 data sets)	Iron – 4,580 – 29,500 micrograms/l Monitoring results from Dec 2020 to Oct 2021 (13 to 45 data sets)	adjusted if required. The main parameter that requires control is the loading of ammonia to the works.
Leachate and surface water	Run-off from digested sludge open cake bays (W10 & W13)	COD, BOD, NH_3, SS No testing available	Not known	Maximum storage retention time is 5 days.
Leachate and surface water	Run-off from raw sludge cake open cake bay (W11)	COD, BOD, NH_3, SS No testing available	Not known	Cake is treated within 24 to 48 hours of delivery.
Surface water	Site drainage (W12)	COD, BOD, NH_3, SS No testing available	Not known	Emergency and Spill Response Procedures to control any unplanned discharges to the drainage system.
Combined liquors	Combined centrate, filtrate and drum thickening liquor (W14)	COD – 3,864mg/l BOD – 1,716mg/l Suspended Solids – 1,747mg/l Total Phosphorous – 49mg/l Ammonia as N – 900mg/l Total Nitrogen – 1,125mg/l Iron – 12,282 micrograms/l Estimated – based on highest typical composition for individual waste streams	Ammonia as N – 3 - 2,430mg/l COD – 584 – 7,660mg/l Suspended Solids – 244 – 5,370mg/l Total Nitrogen – 95 – 1,420mg/l Total Phosphorous - 4 – 112mg/l Iron – 4,580 – 29,500 micrograms/l Estimated – based on typical composition for individual waste streams	As previous

Table 5.22.2 summarises the emission points sources to air and water, associated monitoring points and the proposed monitoring schedule.

Monitoring for emissions to air has been assessed in relation to the BAT 8 requirements for biological waste treatment processes and BAT 10 for odour emissions. Combustion emission monitoring requirements are detailed in the current permit.

The proposed monitoring for wastewater returns to the WwTW inlet has been reviewed against BAT 6 and BAT 7 requirements. On direction from the EA, monitoring requirements have also been assessed with reference to EA Guidance on discharges to surface waters 'Surface water pollution risk assessment for your environmental permit'; Surface water pollution risk assessment for your environmental permit - GOV.UK (www.gov.uk). This guidance requires operators to evaluate and assess any hazardous chemicals and elements to be released into surface water. No monitoring has been undertaken to date to investigate the presence of hazardous substances in the wastewater returns.

As the final effluent from Blackburn WwTW discharges into the River Darwen via Hole Brook, testing will be undertaken for the hazardous and priority substances listed within the guidance for fresh waters. There are 60 priority hazardous pollutants and 96 specific pollutants listed in the tables contained in the EA Guidance on 'Surface water pollution risk assessment for your environmental permit'. The total number of parameters is 156.

UUW is committed to undertaking full characterisation of the wastewater streams to meet BAT 3, however we will assess whether it is possible to screen out any of these parameters based on the character of the wastewater coming into the works and, if so, provide a justification to the EA during the permit determination period for any reduction in the list of parameters to be analysed.

Monitoring for hazardous and priority substances will be undertaken at the Liquor Return Pumping Station (location W1), the point at which the combined liquor effluent stream leaves the installation (centrate, filtrate and drum thickening liquor). Twelve samples will be taken, in accordance with the minimum sampling requirement for screening in the EAs 'surface water pollution risk assessment' guidance, and the results screened against relevant environmental quality standards detailed in the EA guidance. Laboratory analysis will be undertaken to MCERTS or UKAS ISO17025 standards for determinands where available. However, it should be noted that only around 10% of the 156 hazardous and priority substances can be analysed in-house at UUWs laboratories and initial contact with commercial laboratories has indicated that for some parameters they would not be able to achieve the EQS levels as a limit of detection on a centrate/ filtrate matrix and potentially may not be able to analyse at all.

Monitoring for wastewater returns to the WwTW inlet has also been reviewed against BAT 6 and BAT 7 requirements.

BAT 6 specifies that 'for relevant emissions to water, as identified by the inventory of wastewater streams (see BAT 3), BAT is to monitor key process parameters (e.g. waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g. at the inlet and/or outlet of the pre-treatment, at the inlet to the final treatment, at the point where the emission leaves the installation)'.

BAT 7 states: BAT is to monitor emissions to water with at least the defined frequency, and in accordance with EN standards. The proposed BAT monitoring requirements have been compared with those for

biological treatment of waste. The EA has directed that 'treatment of water-based liquid waste' BAT AELs are also appropriate.

Based on the BAT requirements, monitoring for the following parameters is proposed at W1 to characterise the centrate and filtrate wastewater streams at the frequency set out in Table 5.22.2:

- pH;
- Total nitrogen;
- Chemical oxygen demand (COD);
- Ammonia;
- Total phosphorous;
- Suspended solids;
- Hydrocarbon oil index;
- Benzene, toluene, ethylbenzene, xylene (BTEX);
- Free cyanide;
- Halogens (AOX);
- Metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg, Mn, Cr(VI));
- PFOS; and
- PFOA.

All discharges to the surface water drainage system will be captured by sampling at the site drainage pump well (W2). Monitoring for a more limited suite of parameters is proposed to characterise the biogas condensate and site drainage/cake bay run-off at emission points W2, as these are smaller volume wastewater streams and/or have less potential for contaminants such as metals to be present. Monitoring for the following parameters is proposed at the frequency set out in Table 5.22.2:

- pH;
- Total nitrogen;
- COD;
- Total phosphorous;
- Suspended solids;
- Ammonia; and
- Oil and grease (visual assessment only)

Where monitoring is proposed, a minimum of 12 samples will be taken in accordance with the minimum sampling requirement for screening in the EAs 'surface water pollution risk assessment' guidance.

Flow meters are installed to record the flow of centrate and filtrate returns to the Nereda system. An MCERTS flow meter is installed at the final effluent outlet from the wider WwTW works.

Monitoring of the wastewater returns to the head of the works and gaseous emission streams is summarised in Table 5.22.2.

Table 5.22.2: Emission Point Sources & Monitoring

Source	Emission Point	Current Monitoring	Proposed Monitoring	Frequency
Gaseous Streams				
Gas oil combustion	Steam boiler stacks (A1, A2 & A3)	Annually for NO_2, CO, VOCs and non-methane VOCs.	Oxides of nitrogen	Annual
Biogas combustion	CHP engine stacks (A4 & A5)	Annually for NO_2, CO, VOCs and non-methane VOCs.	Oxides of nitrogen Carbon monoxide Total VOCs Sulphur dioxide	Annual
Biogas combustion	Flare stack (A6)	None	Oxides of nitrogen Carbon monoxide Total VOCs	Running time monitored and does not exceed more than 10% of operational hours.
Biogas	Gas Bag PVRV (A7)	None – not required under permit	None	Daily inspection
Volatile hydrocarbon compounds	Oil storage tank breather vent (A8)	None – not required under permit	None	-
Biogas	EEH PVRV (A9)	None – not required under permit	None	Daily inspection
Foul air	Unthickened sludge tank OCU (A10)	None	H_2S and ammonia in line with BAT Odour concentration Total volatile organic compounds (TVOC) and HCL Odour tours by site staff	Six monthly 2 rounds 1 round Daily
Foul air	EEH feed tank OCU (A11)	None	H_2S and ammonia in line with BAT Odour concentration Total volatile organic compounds (TVOC) and HCL Odour tours by site staff	Six monthly 2 rounds 1 round Daily
Foul air	Centrate buffer tank OCU (A12)	None	H_2S and ammonia in line with BAT Odour concentration	Six monthly 2 rounds 1 round

Source	Emission Point	Current Monitoring	Proposed Monitoring	Frequency
			Total volatile organic compounds (TVOC) and HCL Odour tours by site staff	Daily
Biogas	Digester PVRVs (A13 – A16)	None	None	N/A
Liquid Streams				
Filtrate and centrate	Combined liquor returns pump well (W1)	Five times testing in a fortnight for: COD, BOD, Ammonia as N, Total Nitrogen, Phosphorous, Suspended Solids	To further characterise the filtrate/centrate, monthly testing over a 12 month period for: pH; Total nitrogen; COD; Total phosphorous; Suspended solids; Ammonia; Hydrocarbon oil index; BTEX; Free cyanide; Halogens; Metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg, Mn, Cr(VI)); PFOS and PFOA.	Monthly – 12 samples
Liquors into UWWT flow	Liquor returns pump well (W1)	None	156 hazardous and priority substances as per separate list	Monthly – 12 samples
Biogas condensate, boiler blow down, run off from cake bays	Site drainage pump well (W2)	None	pH; Total nitrogen; COD; Total phosphorous; Suspended solids; Ammonia; Hydrocarbon oil index.	Monthly – 12 samples

Monitoring will be carried out in accordance with established process monitoring procedures using appropriate equipment, which will be calibrated to manufacturer's instructions where required. All samples will be collected and stored in an appropriate manner by suitably qualified personnel. All liquid stream analysis is undertaken at UU Scientific Services Lingley Mere Laboratory, which is a United Kingdom Accreditation Services (UKAS) laboratory accredited to ISO/IEC 17025:2017. Wherever possible sampling

and analysis is accredited to MCERTS by UKAS (confirmed by the laboratory for Suspended Solids, COD, Total nitrogen and Total phosphorous, with Ammonia as N accredited by flexible scope to MCERTS). However, it should be noted that only around 10% of the 156 hazardous and priority substances (to be analysed at monitoring location W29) can be analysed in-house at UUWs laboratories (please refer to Appendix J for a copy of UU's UKAS Accreditation Certificate) and initial contact with commercial laboratories has indicated that for some parameters they would not be able to achieve the EQS levels as a limit of detection on a centrate/ filtrate matrix and potentially may not be able to analyse at all.

Where monitoring and/or sampling is undertaken by third party (e.g. gas emissions monitoring from the gas engines) this would be undertaken to similar standards. Emissions monitoring will be carried out by an MCERTS accredited third party laboratory. Suitable measurement ports will be provided to allow access and monitoring of the OCU stacks.

6. Odour Control System

6.1. Odour Monitoring and Management

An Odour Management Plan (OMP) is established for Blackburn WwTW and subject to regular review. The objective of the OMP is to provide guidance to all Operations and Maintenance staff regarding practices that will minimise the risk of odour emissions being discharged from the Blackburn site. A copy of the OMP is included with this application.

The WwTW is situated in an agricultural area. There are a number of isolated farms and residential properties, a brewery, a restaurant and a hotel within 1km of the installation boundary.

The facility has three odour control units, each with its own emission stack, as detailed below. These odour control units have fallen into disrepair and are not currently operational.

1. Unthickened Sludge Tank OCU - Emission Point A10 (E 360343 N 429488)

   The unthickened sludge tank is connected to an OCU, which is designed to continuously remove odours from the air expelled from the tank. The OCU has two stages of treatment, comprising catalytic iron filtration (CIF) and an activated carbon unit (dry media adsorption process). The CIF comprises rusting iron Pall rings for bulk hydrogen sulphide removal. The first adsorption stage uses a proprietary media for hydrogen sulphide and mercaptans removal, followed by a second stage which contains dry media selected to remove other odorous wastewater compounds, including VOCs, that maybe present. The odour control extraction fans are used to extract air out of the odour control unit and push it up the stack (emission point A10). In the event that the CIF stage is out of service, the second stage is designed to treat the ‘full’ design load into the plant.

2. EEH Feed Tank (thickened sludge) - Emission Point A11 (E 360375 N 429624)

   The OCU serving the EEH buffer tank comprises catalytic iron filtration (CIF) and an activated carbon adsorption odour control unit, which is designed to continuously remove odours from the air expelled from the tank. The CIF stage operates as two separate columns operating on a duty/standby basis, followed by two carbon vessels operating in parallel. The adsorption stage uses an alkali impregnated carbon media for enhanced hydrogen sulphide and mercaptans removal. The odour control extraction fans are used to extract air out of the odour control unit and push it up the stack (emission point A11). In the event that the CIF stage is out of service, the second stage is designed to treat the ‘full’ design load into the plant.

3. Centrate Buffer Tank OCU - Emission Point A12 (E 360290 N 429529)

   The centrate break tank is connected to an OCU. The OCU has one stage of treatment (adsorption), comprising an activated carbon unit (alkali impregnated carbon media) for enhanced hydrogen sulphide and mercaptans removal.

The stacks from these OCUs are identified as point source emissions on the emissions points plan in Appendix D.

The odour control technologies were designed in accordance with UUW's Asset Standard for Odour Control and Removal[5].

The design operating parameters and odour removal efficiencies for the OCUs at Blackburn are detailed in the OMP. The design operating parameters for air flow rate and odour emission concentration were used to conduct odour dispersion modelling using ADMS 5.2.4 software to quantify the odour impacts at relevant sensitive receptor locations, surrounding the site (included with this application). The dispersion model included the site layout buildings and infrastructure (as appropriate).

For the modelling exercise, emissions of odour from the on-site OCUs were assessed against an odour benchmark level of 1.5 ouE/m^3 at nearby sensitive receptors, which is the H4 odour benchmark for the most offensive odours and the UU Odour Control and Removal Asset Standard (for high sensitivity receptors).

The results indicate that the maximum predicted 1-hour mean (98th percentile) odour concentration at the assessed sensitive receptors is less than 0.1 ouE/m^3, which is significantly below the 1.5 ouE/m^3 benchmark.

Table 6.1.1: OCU operating parameters and emission rates

Emission point	Source	Stack height (m)	Effective stack diameter (m)[1]	Efflux velocity (m/s)	Design air flow rate (m^3/s)	Odour conc (ou_E/m^3)	Odour release rate (ou_E/s)
A10	Unthickened Sludge Tank OCU	3.50	0.21	15.0	0.528	1,000	527.78
A11	EEH Feed Tank OCU	6.00	0.23	15.0	0.611	1,000	611.11
A12	Centrate Buffer Tank OCU	14.40	0.06	15.0	0.037	1,000	36.94

The odour dispersion modelling demonstrates that the design operation of the OCUs at the site is compliant with H4 standards and with the UUW Odour Control and Removal Asset Standard.

The design of the odour control technologies is considered to comply with BAT for the treatment process.

Engineering studies are being undertaken to allow a programme of refurbishment of the existing OCUs to be costed and funding secured for implementation of the works. The proposed timescale for reinstatement of the OCUs is detailed in the Blackburn BAT Improvement Programme document and is to be agreed with

[5] Odour Control and Removal Asset Standard, Document Reference 33412

the Environment Agency. It should be noted that despite the OCUs not currently being operational, the site is not receiving odour complaints and there are no on-going odour issues.

Until such time that the OCUs are operating, olfactory monitoring ('sniff' testing) will be undertaken on a weekly basis at the boundary of the sludge treatment facility. Sniff testing will be undertaken in accordance with the guidance contained in H4. In addition, a Jerome hydrogen sulphide monitor will be utilised as hydrogen sulphide is typically the dominant compound of interest. This is detailed in the OMP.

Following recommissioning, odour monitoring will be undertaken from all OCU stacks for the following:

- Hydrogen sulphide once every six months; and
- Ammonia once every six months

Total volatile organic compounds (TVOC) and HCl will be monitored on one occasion to check for their presence in the emissions from each stack and the results provided to the EA. The sampling will be undertaken three times over the course of one day. Dependent upon the results, TVOCs and/or HCl may be added to the bi-annual monitoring schedule. In addition, each stack will be sampled for odour concentration on two occasions during the first year of monitoring to validate that the design odour concentration is being achieved.

Following recommissioning, odour monitoring will be undertaken from all OCU stacks, as detailed in Table 5.22.2. Suitable measurement ports will be provided to allow access and monitoring of the OCU stacks. Emissions monitoring will be carried out by an MCERTS accredited third party laboratory.

7. Application Form F1 Charges

The application charges consist of:

- Application to add a listed activity - Charge A 1.16.2.1 Non-hazardous waste installation - biological treatment for recovery;
- Liquor treatment plant – Charge A 1.16.2.1 Non-hazardous waste installation – biological treatment for recovery (new repeat, hence 90% fee reduction);
- Habitats assessment - Charge B 1.19.2; and
- Odour management plan - Charge B 1.19.6.

The total application fee is therefore £17,407.40.

8. BAT Assessment

8.1. Assessment Against BAT

As this is a waste treatment operation, an assessment of best available techniques (BAT) has been made for the installation against the BAT Conclusions for Waste Treatment, provided within Commission Implementing Decision 2018/1147, published on 17 August 2018. The assessment against BAT is presented in Table 8.1.1 below.

An Environmental Risk Assessment for the installation is contained in Section 9 of this document.

Table 8.1.1: Assessment against BAT Conclusions for Waste Treatment

BAT conclusions for waste treatment reference:		**Treatment of Best Available Technique (BAT)**
BAT 1.	Overall environmental performance	*In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS).* UUW operates the site under a fully certified ISO14001 management system. A copy of the ISO14001 certificate and a management systems summary is provided in Appendix B. A residue management plan is included with this application (see Attachment 1).
BAT 2.	Waste acceptance techniques	BAT is to use all of the techniques given below. • *Set up and implement waste characterisation and pre-acceptance procedures* - the waste received is produced and treated by the same operator (UUW) (it is either indigenous sludges produced by Blackburn WwTW or sludges from other UUW WwTW works) and thus the waste type is well known and controlled. The applicability of pre-acceptance and acceptance procedures are considered to be very low risk in terms of process safety, occupational safety and environmental impacts. Blackburn's Waste Characterisation and Acceptance Procedure SSI details that each incoming waste stream will be subject to pre-acceptance checks and records will be retained in electronic format for a minimum of 3 years. Only waste codes EWC 19 08 05 (urban wastewater sludges) and 19 02 06 (sludge from physico/chemical treatment, sewage sludge only) are accepted at the facility. • *Set up and implement waste acceptance procedures* – as above; indigenous sludge is delivered to the installation from the Nereda system via two holding tanks upstream of the drum thickeners. Imported sludge from other WwTW sites arrives at the site via road tanker and is pumped from the tanker off-loading point into the unthickened sludge tank. • *Set up and implement a waste tracking system and inventory* - refer to BAT 5 for imported sludge. United Utilities Bioresources monitors and tracks all movements of UUW sludges between wastewater treatment works. Movement of sewage sludge is planned and managed via PODFather.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		• *Set up and implement an output quality management system* - treated sludge in the form of digestate cake is recovered to land for agricultural benefit in accordance with The Sludge (Use in Agriculture) Regulations 1988. • *Ensure waste segregation* – not applicable for incoming waste, only sewage sludge is treated at the installation. Digestate cake (output) found to be non-compliant with the required standards (The Sludge (Use in Agriculture) Regulations 1988) will be quarantined within an isolated area of the cake storage bay. All material accumulated within the same stockpile will be deemed as 'non-conforming'. Following confirmation of non-conforming biosolids, an appropriate route will be determined by the specialist agricultural services team depending upon the nature of the failure and considering the waste hierarchy. In this situation, waste imports would be suspended until digestate cake production is back in compliance. • *Ensure waste compatibility prior to mixing or blending of waste* - not applicable, only sewage sludge is treated at the installation. • *Sort incoming solid waste* – not applicable.
BAT 3.	Inventory of waste water and waste gas streams	*In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of wastewater and waste gas streams, as part of the EMS.* Please see Section 5.22 for an inventory of wastewater and waste gas streams for the installation. The location of all the emission points is shown on the plans included in Appendix D. Routine operation checks and maintenance are undertaken on all relevant assets. The sites discharge consent limits are being met. Sampling and analysis will be carried out in line with BAT 3, as appropriate. Sampling and analysis will be undertaken to MCERTs or evidence of equivalent standards.
BAT 4.	Storage of waste	*In order to reduce the environmental risk associated with the storage of waste, BAT is to use techniques to optimise storage locations, provide adequate storage capacity and safely store wastes.* The maximum storage capacity of the tanks is adequate for the process flow and the quantity of waste in the tanks is monitored by level probes connected to PLCs and displayed on the SCADA. Most treatment tanks and pipework are enclosed, however there are a number of open process tanks, namely the centrate/ filtrate tank, unthickened sludge pump chamber and the mixing and balancing tanks. Other open storage of waste consists of the screening solids (stored in a skip) and digestate cake. The sludge screens or strainpresses skip is housed in an enclosure, to reduce the risk of pests (birds and rats) and is regularly emptied. A Pest Control contractor provides pest control services for the site.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
BAT 5.	Handling and transfer of waste	*In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.* Indigenous sludge is delivered to the installation via a pipe from the Nereda treatment tank into two holding tanks which feed three drum thickeners. After thickening it is pumped to the EEH feed tank. Imported sludge from other WwTW treatment sites arrives at the site via tanker. United Utilities Bioresources is responsible for the movement of all UUW sludges produced. The "PODFather" system is used to plan and manage the movement of UU tankers transporting UUW sludges between wastewater treatment works. POD stands for "Proof of Delivery". The system records all sludge movements, detailing the site it has come from, the volume, the quality (dry solids content) and date and time delivered. These records are all kept electronically and used in the quarterly submissions to the EA as well as the annual reporting to OFWAT. Digestate cake is removed off site for agricultural land spreading. The movement of digestate cake is coordinated regionally. A list of potential outlets is maintained and includes suitably regulated storage, enhanced treatment (e.g. lime treatment to increase the scope of onward recovery options); recovery (deposit) and, as a contingency only, disposal facilities (e.g. permitted landfill restoration sites). The availability of potential outlets is constantly reviewed in line with legislative developments and local market changes (e.g. closure of an outlet site).
BAT 6.	Emissions to water	There are no direct emissions to water from the sludge treatment activities. The wastewater streams are returned to the WwTW for full treatment, before being discharged (indirectly) via the WwTW final effluent into the River Darwen via Hole Brook following biological treatment. There is currently limited monitoring of these returned wastewater streams for key process parameters, but it should be noted that the WwTW site undertakes regular routine monitoring of final effluent quality and is meeting the discharge consent limits to Hole Brook. Additional monitoring of wastewater streams is proposed as detailed in Table 4.6.1 (Emissions Monitoring), Table 5.22.2 (Emission Point Sources) and Section 5.22 of this document.
BAT 7.	Emissions to water	Additional monitoring is proposed to meet BAT 7 in order to characterise the wastewater streams from the sludge treatment process returned to the wastewater treatment plant. Please refer to Table 4.6.1 (Emissions Monitoring), Table 5.22.2 (Emission Point Sources) and Section 5.22 of this document.
BAT 8.	Emissions to air	*BAT is to monitor channelled emissions to air with at least the frequency given below, and in accordance with EN standards:* • *H_2S – once every six months* • *NH_3 - once every six months* • *Odour concentration – once every six months*

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		The channelled emissions to air i.e. point source emissions are shown in Appendix D. The only channelled emissions to air from the treatment process, relevant to this BAT requirement, are from the odour control unit (OCU) stacks and the PVRVs on the primary digesters, gas bag and EEH Plant. The PVRVs operate on a Duty/Stand-by configuration to protect against over/under pressurisation of the vessels. The PVRVs are maintained, monitored, inspected and calibrated on a periodic basis to reduce emissions (see Section 5.16 for further information). There is no requirement to monitor emissions from the PVRVs as they are a safety critical system that do not operate routinely and, when they do operate, are only open for a very limited period of time. The OCUs serving the sludge storage tanks are not currently operational, but an improvement programme to reinstate these has been identified and is detailed in Blackburn BAT Improvement Programme document. When the OCUs are operational they treat the air by adsorption using a combination of catalytic iron filtration and carbon filter media. There is currently no monitoring data for the emissions from the OCUs. To meet this BAT requirement, monitoring of the OCUs for hydrogen sulphide and ammonia, once every six months, will be introduced. Total volatile organic compounds (TVOC) and HCL will monitored on one occasion to check for their presence in the emissions from each stack and the results provided to the EA. The sampling will be undertaken three times over the course of one day. Dependent upon the results, TVOCs and/or HCL may be added to the bi-annual monitoring schedule. In addition, each stack will be sampled for odour concentration on two occasions during the first year of monitoring to validate that the design odour concentration is being achieved. Suitable measurement ports will be provided to allow access and monitoring of the OCU stacks. Emissions monitoring will be carried out by an MCERTS accredited third party laboratory. The potential for dust emissions is very low as it is a wet treatment process.
BAT 9.	Emissions to air	Not applicable – there are no treatment processes involving solvents
BAT 10.	Odour emissions	*BAT is to periodically monitor odour emissions. However, applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.* Odour emissions will be monitored in accordance with BAT 8 and the updated OMP, a copy of which is attached to this application.
BAT 11.	Monitor consumption of water, energy and raw materials	*BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of residues and wastewater, with a frequency of at least once per year.* Current energy reporting requirements under the permit are for the following parameters:

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		• heat generated - kWth • power generated - kWe • engine efficiency - KWth input / kWth (equivalent) output • boiler efficiency - KWth input / kWth (equivalent) output Energy consumption for the WwTW as a whole is monitored and tracked via the site environmental dashboard. Currently consumption for the sludge treatment process cannot be differentiated from the water treatment process. Potable water consumption for the sludge treatment process is not recorded separately but is only used for polyelectrolyte make up. The volume of water consumed will recorded based on the use of polyelectrolyte. Final effluent is used for cleaning the GBTs. Raw material use is measured in accordance with Table 4.5.1 to this document and is recorded annually. As part of the permit requirements, UUW will report annual energy consumption and raw material usage to the EA and will conduct periodic reviews to consider where future energy and raw material savings can be delivered. The tonnage of waste screenings is recorded on a monthly basis.
BAT 12.	Odour Management Plan	*In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the EMS. The applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.* The site operates an Odour Management Plan, a copy of which is provided in support of this application. See also Section 6 and 9.1.
BAT 13.	Odour Management	*In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of these techniques:* • *Minimising residence times of (potentially) odorous waste in storage or in open handling systems* – the majority of the process tanks at the facility are covered and equipment such as centrifuges are enclosed. However, there are a number of open tanks within the sludge treatment installation. UUW recognise that these open tanks represent a potential source of fugitive emissions of volatile organic compounds, hydrogen sulphide and ammonia to the atmosphere which could give rise to odours. A programme of monitoring is proposed to characterise and quantify emissions from the tanks. Please refer to BAT 14 below. • *Using chemicals to destroy or to reduce the formation of odorous compounds* – this has not been necessary. • *Optimising aerobic treatment* – no aerobic treatment.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
BAT 14.	Diffuse air emissions	*In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the following techniques:* • *minimising the number of potential diffuse emission sources* • *selection and use of high-integrity equipment* • *corrosion prevention* • *containment, collection and treatment of diffuse emissions* • *dampening in dusty areas* • *maintenance* • *cleaning of waste treatment and storage areas* • *leak detection and repair (LDAR) programme* The potential for dust emissions is very low as it is a wet treatment process. Fugitive emissions of biogas may arise from the activation of PVRV's or leaks in gas pipework e.g. around flanges. The PVRV's operate on a Duty/Stand-by configuration to protect against over/under pressurisation of the vessel. The PRV's are maintained, monitored, inspected and calibrated on a periodic basis to reduce fugitive emissions. Leak detection for biogas is not currently undertaken unless a fault is suspected. However, an LDAR Site Specific Instruction (SSI) has been developed for the site and is included with this application. Assets (such as the digesters, gas bag, PVRV's, CHP engine and flare stack) are scheduled for routine proactive inspection by thermal imaging camera on an annual basis. Fugitive odour emissions may arise during normal operations, principally from the unthickened sludge buffer tank, the EEH feed buffer tank and / or the centrate pumping station. This is mitigated by directing the air flow through one of three odour control units, which will be reinstated (refer to the site BAT Improvement Programme provided with this application). There are a number of open topped tanks at the site, namely: four mixing and balancing tanks and a sludge chamber holding undigested imported sludge and a centrate/ filtrate holding tank. UUW recognise that these open tanks represent a potential source of fugitive emissions of volatile organic compounds, hydrogen sulphide and ammonia to the atmosphere. A programme of monitoring is proposed to characterise and quantify emissions from the tanks. The monitoring data collected will be used to confirm the level of emissions and to determine the need to provide mitigation, i.e. if BAT 14 should or should not apply. The base design solution highlighted by the EA is that tanks should be enclosed and directed to an appropriate abatement system. Our approach will be to confirm the need and then, if required, develop an appropriate solution to prevent or, where that is not practicable, to reduce emissions. The design solution will need to satisfy all relevant legislative and UUW safety criteria. Further information and timescales for the monitoring are contained in the Blackburn Improvement Programme provided as supplementary information to this application document.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		Any leaks or spills of sludge that may be a source of odour emissions are cleaned up promptly as part of the spill response procedure.
BAT 15.	Flaring	*BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using the correct plant design and by plant management.* Operation of the flare is detailed in the existing permit.
BAT 16.	Flaring	*In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the correct design of flaring devices and monitoring and recording.* Operation of the flare is detailed in the existing permit. A modern enclosed flare is used that meets the standards required by LFTGN05. The flare is monitored in accordance with the requirements of LFTGN05. The flare was designed, constructed and installed by a specialist contractor in accordance with the UUW asset standard to ensure correct operation over the complete range of ambient conditions that can be experienced at the stack location, including the maximum recorded wind speed and precipitation. All component parts are adequately heat resistant and designed to a modern standard to minimise noise emissions. The operation of the flare and its running time are recorded. The quantity of biogas combusted can be approximated from the running time.
BAT 17.	Noise and vibration	*In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the EMS. However, the applicability is restricted to cases where a noise or vibration nuisance at sensitive receptors is expected and/or has been substantiated.* The facility does not currently operate a formal noise and vibration management plan. The permitted activity is not inherently noisy and there is no history of noise complaints at the site; therefore a noise and vibration plan is not required.
BAT 18.	Noise and vibration	*In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of these techniques; appropriate location of equipment and buildings; operational measures, low-noise equipment, noise and vibration control equipment, noise attenuation.* The permitted activity is not inherently noisy, although the centrifuges and CHP Plant can be sources of localised noise. In mitigation, the CHP engine is housed in an ISO container which is clad to achieve a noise emission level of 65 dB(A) at 10m and the centrifuges are also contained within individual steel enclosures. Vibration calibration is undertaken on the centrifuges to check their performance.
BAT 19.	Emissions to water	*In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce*

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		emissions to soil and water, BAT is to use an appropriate combination of the techniques given below. • *Water management* – potable water is used for mixing with polyelectrolyte and for cleaning. Where water is required for dilution, final effluent is used instead of potable water. The opportunity to use final effluent instead of potable water for polyelectrolyte dilution has been considered but it cannot meet the required quality standards. • *Water recirculation* – all wastewater streams are recirculated back to the head of the works for full biological treatment (see BAT 20). • *Impermeable surface* - the majority of the installation area is hard surfaced so that it is impermeable. However, there are some gravelled and grassed areas which are vulnerable to leaks and spillages. Hydraulic spill modelling has been undertaken and identifies permeable areas at risk from potential catastrophic tank failure. Findings of the modelling/assessment include improvements identified to ensure appropriate measures to meet equivalent BAT containment. A copy of the Secondary Containment Modelling Assessment Report is provided with this application. Areas at risk will be upgraded to the timescales supplied in the Blackburn BAT Improvement Programme. • *Techniques to reduce the likelihood and impact of overflows and failures from tanks and vessels* – the sludge treatment process is fully automated and process tanks are fitted with level indicators connected to PLCs that allow tank levels to be monitored on SCADA. The Digesters are provided with overfill protection, including hydrostatic level and foam radar sensors. An overfill limit stops all pumping if the maximum feed capacity has been pumped into the digester in a 24-hour period. The final overfill protection is provided by via an overfill pipe that discharges the overflow into the normal post-digestion route. • *Roofing of waste storage and treatment areas* – most treatment tanks and pipework are enclosed, however the centrate/ filtrate tank, unthickened sludge chamber and the mixing and balancing tanks are open tanks. Other open storage of waste consists of the screening solids (stored in a skip) and digestate cake. The sludge screens or strainpresses skip is housed in a building. Run off from the digestate storage areas is returned to the WwTW for biological treatment via the surface water drainage system. Drainage from the storage areas has been identified on the Emissions Points Plan in Appendix D. Monitoring of these emission is proposed, as detailed in Section 5.22. • *Segregation of water streams* – uncontaminated surface water run-off is not segregated; it is returned to the WwTW flow to full biological treatment. This forms part of the containment strategy for the site.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		• *Adequate drainage infrastructure* – all surface water drains in the waste treatment area discharge back into the WwTW flow. Monitoring of the surface water returns is proposed, as detailed in Section 5.22. • *Design and maintenance provisions to allow detection and repair of leaks* – regular visual checks of above ground pipework, pumps and tanks is undertaken. Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). These tours include tank level monitoring, visual inspection of asset integrity, where possible, and general ground conditions. If any evidence of leaks or ground contamination is seen further investigations or remedial actions will be instigated immediately. There is currently no secondary containment for below ground tanks and pipework. A programme of monitoring to allow detection of leaks from below ground assets has been proposed and is included with this application in the Blackburn BAT Site Improvement Programme document. • *Appropriate buffer storage capacity* – the tank used to hold liquid centrate from the centrifuges is adequately sized. There are mixing and balancing tanks to manage sludge inputs. There is an emergency thickened sludge storage tank serving the drum thickeners.
BAT 20.	Treatment of waste water	*In order to reduce emissions to water, BAT is to treat wastewater using an appropriate combination of the techniques stated.* The principle wastewater streams generated are liquid centrate from the dewatering centrifuges and filtrate from the GBTs and the drum thickeners. The centrate and GBT filtrate are combined and passed through a Lamella Tank for solids removal prior to return to the WwTW Nereda System, via the Tertiary Filter Pumping Station. The filtrate from the new drum thickeners goes into a small circular well and is also pumped back to the Nereda System. Small quantities of process wastewater are generated from biogas condensate and boiler blowdown. The wastewater streams are discharged into the site drainage system which is returned to the WwTW flow for full biological treatment, in order to achieve the consented discharge limits. This is a circular process and is considered to represent BAT. With the exception of solids removal in the Lamella Tank, there is no pre-treatment of the wastewater streams. All wastewater emissions receive full biological treatment at the WwTW, through the Nereda reactors which utilise an aerobic granular biomass technology. Wastewater leaving the Nereda plant passes through a cloth filter bank for fine solids removal and a UV treatment plant. UV treatment ensures that pathogens/bacteria in the treated wastewater are unable to reproduce before the final effluent is discharged from the site, effectively disinfecting the effluent.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		The only other wastewater generated routinely is from cleaning activities. This is also returned to the WwTW for biological treatment via the site drainage system. This is a circular process and is considered to represent BAT.
BAT 21.	Accidents and incidents	*In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques given below, as part of the accident management plan.* A summary of accident risks is presented in Section 9.4 of this document. There is a site-specific Accident Management Plan for the WwTW, including the sludge treatment processes. A copy of the Accident Management Plan is included with this application, along with the relevant Standard Operation procedures (SOP). These live documents form part of the site's Environmental Management System, which is regularly reviewed and updated. The gas bag and all digesters are fitted with lightning protection to mitigate the risks associated with lightning strike. In the event of a strike, the resulting incident would be managed in accordance with the most relevant section of the Accident Management Plan, e.g. fire, power loss etc. Any operational problem that cannot be dealt with by normal operational procedures is classed as an Incident and the UU Incident Management Procedure and associated Standard Operating Procedure (WP/S/001/30/01 Incident Response) followed. All actions and communications are recorded using form WwP/F/001/31/08 Site Diary Log. There is also an Emergency Procedure specifically detailing the actions to be followed in the event of an emergency situation associated with the digester or biogas assets (boiler, flare stacks or CHP units). The Blackburn Digestion and Biogas Emergency Plan (WwP/I/3006/17/18) is provided with the Accident Management Plan in Attachment 10.
BAT 22.	Material efficiency	*In order to use materials efficiently, BAT is to substitute materials with waste.* Materials used in the treatment process are potable water, polyelectrolyte, antifoaming agents and anti-corrosives in the boilers/heat exchangers. Where water is required for dilution, final effluent is used instead of potable water. Final effluent is also used to wash out the GBTs. Potable water is required however for polyelectrolyte dilution as final effluent cannot meet the required quality. The polyelectrolyte, other antifoaming agents and Ferric Sulphate cannot be substituted by any waste materials.
BAT 23.	Energy efficiency	*In order to use energy efficiently, BAT is to maintain an energy efficiency plan and an energy balance record.* The thickening process is not an inherently energy intensive process, with electricity supplied by the site / National Grid being used for operating the centrifuges or other site-specific terminology and associated pumps and motors.

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		When selecting new and/or replacement pumps and motors, energy efficiency is one of the factors considered. As part of the permit requirements, UUW will report annual energy consumption to the EA and will conduct periodic reviews to consider where future energy savings can be delivered. The biogas is used to fuel the CHP plant and the boilers. Electricity produced is used for the installation and other power requirements at the WwTW.
BAT 24.	Re-use of packaging	*In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan.* Very little packaging waste is generated at the installation. Spent polyelectrolyte bags are disposed of as general waste in the WwTW skips. Empty boiler treatment chemical containers are disposed of by the servicing contractor. The empty polyelectrolyte and antifoaming agents IBCs are returned to the supplier.
BAT 25 - 32	Mechanical treatment of waste	Not applicable
BAT 33.	Biological treatment	*In order to reduce odour emissions and to improve the overall environmental performance, BAT is to select the waste input. The technique consists of carrying out the pre-acceptance, acceptance and sorting of the waste input (see BAT 2) so as to ensure the suitability of the waste input for the waste treatment.* Not applicable as only indigenous and imported sludges from wastewater treatment works will be accepted.
BAT 34.	Biological treatment, emissions to air	*In order to reduce channelled emissions to air of dust, organic compounds and odorous compounds, including H_2S and NH_3, BAT is to use one or a combination of these techniques; adsorption, biofilter, wet scrubbing.* Once the OCUs are reinstated they will treat odours from the unthickened sludge tank, the EEH feed tank and the centrate buffer tank. A combination of adsorption technologies were chosen for this facility. The OCUs serving the unthickened sludge and EEH feed tanks utilise a two-stage system of catalytic iron filtration (CIF) and activated carbon. The OCU serving the centrate buffer tank has only a single stage of adsorption treatment comprising an activated carbon unit, due to lower contaminant loading. The installation of these techniques complies with BAT.
BAT 35.	Biological treatment, water usage	*In order to reduce the generation of wastewater and to reduce water usage, BAT is to recirculate water.* See BAT 20.
BAT 36 & 37.	Biological treatment	Not applicable – relates to composting

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
BAT 38.	Anaerobic treatment of waste, emissions to air	*In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.* Process information on gas levels, tank levels, gas quality and temperature are continuously monitored and displayed on the SCADA panels in the control room. Routine process sampling and testing is undertaken for the FOS/TAC ratio (volatile acid to alkalinity ratio), pH and dry solids. A daily visual tour is also undertaken of the process, including a visual check for foaming in the digesters. See Section 5.22 of this ASD for key process parameter measurements for the primary digesters. A series of SOPs and SSIs related to the primary digestion are also available, which set out recommended actions based on the results of key parameters.
BAT 39.	Segregation and recirculation of waste gas	*In order to reduce emissions to air, BAT is to:* • *segregate waste gas streams with a high and low pollutant content* – not applicable. Only one gas stream produced. • *recirculate waste gas with a low pollutant content in the biological process followed by waste gas treatment adapted to the concentration of pollutants* – not applicable. All biogas generated in the process is combusted to generate power and heat to sustain the process.
BAT 40.	Physico-chemical treatment, waste input	*In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures.* Not applicable as only indigenous sludge from the Blackburn WwTW and imported sludge or cake from other WwTW sites will be accepted.
BAT 41.	Physico-chemical treatment, emissions to air	*In order to reduce emissions of dust, organic compounds and NH_3 to air is to use one or a combination of adsorption, biofilter, wet scrubbing, fabric filter.* See BAT 34.
BAT 42. – BAT 52.	Various	Not applicable – relate to waste oil, solvent waste, contaminated soils, PCB containing equipment and liquid wastes.
BAT 53.	Emissions to air	*In order to reduce emissions of HCl, NH_3 and organic compounds to air, BAT is to apply BAT 14d and to use one or a combination of the techniques given below.* • *Adsorption* • *Biofilter* • *Thermal oxidation* • *Wet scrubbing* Refer to BAT 14 and BAT 34. For all OCUs, total volatile organic compounds (TVOC) and HCL will be monitored on one occasion to check for their presence in the emissions from each stack and the results provided to the EA. The sampling will be undertaken three times over the course of one day. Dependent upon the

BAT conclusions for waste treatment reference:		Treatment of Best Available Technique (BAT)
		results, TVOCs and/or HCL may be added to the bi-annual monitoring schedule for OCU emissions.

9. Environmental Risk Assessment and Management Plan

9.1. Odour Risk Assessment

Regular inspections of the facility for fugitive emissions will be undertaken by site staff.

Table 9.1.1: Odour Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk***
Fugitive emissions from unthickened sludge pump chamber	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Air	This chamber is below ground but is open to the atmosphere. The capacity of the chamber is relatively small (approximately 10m^3). An emissions monitoring programme for open tanks, to include this chamber, will be instigated. UUW's proposed timeline for delivery of a solution to enclose this chamber, if required, is provided in the Site Improvement Programme (see Attachment 9).	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from unthickened sludge tank		Air	This tank is covered and connected to an OCU (A10), which will be reinstated in line with the Site	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk***
			Improvement Programme (see Attachment 9). The odour control system consists of a catalytic iron filtration (CIF) and an activated carbon unit.			
Fugitive emissions from screenings waste skip		Air	The skip is housed within an enclosure building which provides some odour attenuation.	Low	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from mixing and balancing tanks		Air	These tanks are below ground but are open to the atmosphere. The capacity of the tanks is 500m^3 each. An emissions monitoring programme for open tanks will be instigated. UUW's proposed timeline for delivery of a solution to monitor and manage emissions from these tanks, if required, is detailed in the Site Improvement Programme (see Attachment 9).	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from press house (GBTs and centrifuges)		Air	The centrifuge and GBT units are enclosed and housed within a building.	Very Low	Localised odour annoyance	Not significant

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk***
Fugitive emissions from drum thickeners		Air	The drum thickeners are located externally but are enclosed units with low potential for fugitive releases.	Very Low	Localised odour annoyance	Not significant
Fugitive emissions from centrate buffer tank		Air	This tank is covered and connected to an OCU (A12), which will be reinstated in line with the Site Improvement Programme (see Attachment 9). The odour control system consists of an activated carbon adsorption unit.	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from EEH feed tank		Air	This tank is covered and connected to an OCU (A11), which will be reinstated in line with the Site Improvement Programme (see Attachment 9). The odour control system consists of a catalytic iron filtration (CIF) and an activated carbon unit.	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from activation of		Air	The PVRV's are inspected and calibrated on a periodic basis to	Very Low	Localised odour annoyance	Not significant

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk***
PVRVs on gassing tanks			ensure they are operating at the correct set points.			
Fugitive emissions from post digestion tanks		Air	The tanks are enclosed and there is low potential for fugitive releases.	Low	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from centrate/ filtrate tank		Air	This tank is partially below ground but is open to the atmosphere. The capacity of the tank is 1,200m^3. An emissions monitoring programme for open tanks will be instigated. UUW's proposed timeline for delivery of a solution to monitor and manage emissions from these tanks, if required, is detailed in the Site Improvement Programme (see Attachment 9).	Moderate	Localised odour annoyance	Low – given the distance to the closest residential receptors
Fugitive emissions from Lamella Tank		Air	The tank is enclosed and there is low potential for fugitive releases.	Very Low	Localised odour annoyance	Not significant
Fugitive emissions from cake storage		Air	The cake is stored temporarily on a cake pad. This is inspected and monitored regularly by staff.	Very Low	Localised odour annoyance	Not significant

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk***
Fugitive emissions from cake liming		Air	Mixing digested cake with lime in an open hopper.	Low to Moderate	Localised odour annoyance	Not significant
Fugitive emissions from leaks in gas pipework e.g. around flanges		Air	Leak detection for biogas is not currently undertaken unless a fault is suspected.	Low	Localised odour annoyance	Not significant
*Once the OCUs are reinstated, the overall risk will reduce to 'Not Significant' for those sources						

9.2. Fugitive Emissions Risk Assessment

Regular inspections of the facility for fugitive emissions will be undertaken by site staff.

Should any spills of sludges or liquids occur within the installation, appropriate actions will be undertaken to isolate and remove the spillage in accordance with the Site Operational Procedures.

Table 9.2.1: Fugitive Emissions Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
Open process tanks - four mixing and balancing tanks and a sludge chamber holding undigested imported sludge and a centrate/ filtrate holding tank	The closest receptor (a residential property) is approximately 160m to the south of the closest open tank. There are no other receptors within 250m of the open tanks	Fugitive releases of compounds to air e.g. ammonia and hydrogen sulphide	An emissions monitoring programme for open tanks will be instigated. UUW's proposed timeline for delivery of a solution to monitor and manage emissions from these tanks is detailed in the Site Improvement Programme (Attachment 9).	Low	Localised odour annoyance	Low

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
Fugitive emissions from activation of PVRVs on gassing	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Air	The PVRVs are inspected and calibrated on a periodic basis to ensure they are operating at the correct set points.	Very Low	Localised odour annoyance	Not significant
Leaks in gassing tanks and biogas pipework e.g. around flanges	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Air	A site specific leak detection and repair plan has been developed for the site and is included with this application. Assets (such as the digesters, gas bag, PVRV's, CHP engine and flare stack) are scheduled for routine proactive inspection by thermal imaging camera on an annual basis. Refer to the LDAR Plan (Attachment 5).	Low	Localised odour annoyance	Not significant

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
Open storage of digestate cake generating bioaerosols	There are no off site receptors within 250m of the cake storage area	Air	On-site storage time of the cake is minimised as far as possible. The water/wastewater industry understands that there is a low level of risk of bioaerosols from this material.	Low	Potential impacts upon human health	Not Significant
Dust from stockpiles of cake	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Wind-blown dust	The cake is inherently a moist substance and will not be stored for long periods.	Very low as long as the risk management measure is adhered to.	Complaints from local residents.	Very low
Dust from roads on site	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the	Wind-blown dust	Regular maintenance and visual inspections will be undertaken on the roads. During periods of hot, dry and / or windy weather, should any dusts be identified as arising from site roads then the roads will be sprayed to dampen down any dust.	Very low as long as the risk management measure is adhered to	Complaints from local residents	Very low

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
	installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage					
Run-off from stockpiles of cake	Surrounding drainage	Surface water drainage	The hard-standing areas the cake is stored on and surrounding drainage system acts as an effective barrier to prevent any run-off reaching the groundwater. All drainage leads to the surface water drainage sump from where it is pumped to the Nereda inlet channel to receive full biological treatment.	Very low	Pollution of surface water and/or groundwater	Very low
Vermin and birds	Local residents and on-site workers	Airborne transportation and potential contact (Weil's disease)	Appropriate measures include setting traps and other measures to prevent and minimise nuisance from scavenging birds and animals if necessary. An external Contractor (Rentokill) is contracted to monitor the site.	Low	Harm to human health	Low
Waste and/or mud on local roads	Road users outside of Blackburn WwTW	Vehicles transporting sludge and cake to and from site	Appropriate measures include clearing waste and mud arising from the activities from affected areas outside the site.	Very low	Complaints from users of	Very low

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
					the public highway. Accidents	
Leaks/spillages from treatment process and plant	Surface waters	Surface run off and entry into drainage system	The majority of the site is hard surfaced with good quality concrete. See site surfacing plan in Appendix F. Sludge storage tanks do not currently have secondary containment and rely on tertiary containment provided by the site drainage system. The surface water drains provide a 'self-contained' sealed system, i.e. all drains on site are connected to private drainage leading to the WwTW treatment process. Hydraulic spill modelling indicates that in the event of a catastrophic tank failure the spilled flows could reach surface water receptors. High-level containment solutions for each critical asset have therefore been developed to meet the requirements set out in CIRIA c736. The proposed mitigation measures to be installed and timescales for installation are detailed in the Blackburn BAT Improvement Programme document	Low	Contamination of surface waters	Not significant following containment mitigation works

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
			submitted with this application (see Attachment 9). In the interim period, site inspection tours of the impermeable surface, storage tanks and drainage system will be carried out on a daily basis by site-based staff and monthly by the site's ERA. Pipework is installed in accordance with United Utilities asset standards that applied at the time of construction.			
Leaks/spillages from below ground tanks and pipework	Ground and groundwater	Seepage into ground/ groundwater	A programme of leak detection improvement measures is proposed in the Site Improvement Programme (refer to Attachment 9). Pipework is installed in accordance with United Utilities asset standards that applied at the time of construction. Clayey glacial till is present at thicknesses exceeding 22.5m beneath the site and the risk to groundwater from a leaking sludge asset at Blackburn is considered to be insignificant.	Low	Contamination of soils and ground	Low following implementation of mitigation measures

9.3. Noise and Vibration Risk Assessment

Table 9.3.1: Noise and Vibration Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
Vehicle movements associated with the delivery of sludge and removal of cake.	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Air	Appropriate measures taken to ensure levels of noise and vibration likely to cause annoyance outside the site are prevented or minimised.	Very low, likely to be unnoticeable.	Complaints if noise excessive	Very low
Treatment process and associated activities including machinery noise	Local residents: the closest properties are approximately 160m to the south (Darwen Side Farm) with others within a 500m radius of the installation boundary: Spring Lane Properties, Upland Farm, Hole Bottom Cottage	Air	Many audible operations are contained within buildings. Site activities are not inherently noisy, very low level of noise complaints	Very low, likely to be unnoticeable	Complaints if noise excessive	Very low

9.4. Accidents

Table 9.4.1: Accidents

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk**
Spillage of sludge	Groundwater Site surface	Runoff through site surface	The majority of the installation area is hard surfaced so that it is impermeable. Please refer to Section 5 of this document for further detail. Should any spills of sludges or liquids occur within the installation, appropriate actions will be undertaken to isolate and remove the spillage in accordance with the SOP. Clayey glacial till is present at thicknesses exceeding 22.5m beneath the site and the risk to controlled waters from a leaking sludge asset at Blackburn is considered to be insignificant.	Very low	Pollution of the environment, harm to human health	Very low
Accidental fire causing the release of polluting material to air (smoke or	Local human population and local environment.	Air transport of smoke. Contaminated firewater by direct	Sludges are at 93% water and are not a likely combustion risk. Biogas system captured under original permit application.	Very low	Pollution of the environment, harm to human health	Very low

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk**
fumes) water or land.		run-off from site and via surface water drains.				
Failure of any of the transfer pipework on the installation	Ground / Groundwater / surface water	Ground	Regular inspections of the facility will be undertaken by site staff. Should any spills of sludges or liquids occur within the installation, appropriate actions will be undertaken to isolate and remove the spillage in accordance with the Site Operational Procedures.	Very low	Minor localised odour Contamination of soils, ground and surface waters	Not significant
	Local residents	Air				
Loss of containment of vessels	Ground / Groundwater / surface water	Ground	Containment is provided for oil and chemical storage. Staff are trained in the operation of spillage kits to ensure that prompt and effective action is taken in the event of accidental spillage. A release of sludge arising from a catastrophic tank failure has been modelled. Findings of the modelling/ assessment, including improvements identified to ensure appropriate measures to meet	Very low	Minor localised odour Contamination of soils, ground and surface waters	Not significant
	Local Residents	Air				

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk**
			equivalent BAT containment, are supplied with this application. The site is visually inspected on a daily basis and any leaks are identified and rectified promptly. Clayey glacial till is present at thicknesses exceeding 22.5m beneath the site and the risk to controlled waters from a leaking sludge asset at Blackburn is considered to be insignificant.			
Polyelectrolyte spillage or leakage of powder &/or liquid polyelectrolyte	Ground / Groundwater / surface water	Ground	Regular inspections of the facility will be undertaken by site staff. The polyelectrolyte is kept within the GBT building which has an impermeable concrete floor. Should any spills of sludges or liquids occur within the installation, appropriate actions will be undertaken to isolate and remove the spillage in accordance with the SOP.	Very low	Minor localised odour Contamination of soils, ground and surface waters	Not significant
	Local Residents	Air				

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk**
Equipment / plant item fire or explosion	Staff, local residents	Equipment / plant item fire or explosion	A hazardous areas risk classification has been undertaken in accordance with DSEAR and equipment is being adequately rated in accordance with the zoning classification. Fixed gas detectors and alarms installed in the boiler house. The Digester tanks, EEH tanks and gas storage bag are fitted with lightning protection. Risk is also managed by the removal of ignition sources and a rigorous permit to work system, backed up by appropriate purging and isolation procedures and staff training. Firefighting systems are in place at the site. Emergency Response procedure	Very low	Possible toxic hazard	Very low
Flood	Ground / Groundwater / surface water	Ground	Regular inspections of the facility will be undertaken by site staff. Weather is monitored and appropriate actions will be	Low	Permitted waste types are non-hazardous so any waste washed off site will add to the volume of the local post-flood clean-up	Not significant

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of exposure**	**Consequence**	**Overall Risk**
			undertaken in accordance with the Site Operational Procedures.		workload, rather than the hazard.	
Lightning strike	Air/ ground/ groundwater/ surface water	Air/ site drainage/ overland flow	Lightning protection already installed on the Digester tanks, EEH tanks and Gas Bag	Very low	Possible toxic hazard Fire/ explosion Potential contamination of soils, ground and surface waters	Low

9.5. Designated/Protected Sites

Table 9.5.1: Designated/Protected Sites

Table 9.5.1 details the location of designated/protected sites within the conservation screening report provided by the Environment Agency dated 26 January 2021.

Site Type	Site Name	Distance from Installation	At Risk from Activities?
European Habitats Sites	Marine Conservation Zone (MCZ) Ripple Estuary	10 km	No – see Table 9.5.2
SSSIs	Beeston Brook Pasture and Darwen River Section	Within 500 metres	As above
Ramsar	NA	-	-
Local Nature Sites	NA	-	-
Local Wildlife Sites	• Wild Bottom's Wood • Coppice Farm Pasture • Crook Hey Wood • Heatley Wood • Knight's Farm • Darwen River Section Woods (Including Sharples Wood and Kiln Wood) • Mason's Wood • Knipe Wood • Hermitage Meadows • Huntley Wood • Goose House Wood • Bezza Brook Woods • River Ribble from London Road Bridge Preston, in West, to County Boundary, in East • Brewery Wood • Preston New Road A59T • Brockholes Quarry • Wood by St. Mary's Church, Samlesbury Wood	2 km	As above

Site Type	Site Name	Distance from Installation	At Risk from Activities?
	• Seed Park • Bezza Lane • Spring Wood • Beeston Wood • Beeston • Brook Fields • Carr Wood • Paradise Wood and Fleetwood Hall Wood • Roach Bridge Woods • Roach Road Wood • Cuerdale and Walmsley Fold Woods		
Ancient Woodland	• Cuerdale Wood East • Samlesbury Wood • Seed Park • Spring Wood • Goose House Wood • Riverside Wood • Smith Fold Wood • Carr Wood • Beeston Wood • Jeffery Wood • Heatley Wood	2km	As above
Air Quality Designation	NA	-	-

Table 9.5.2: Risk from onsite activities

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk Management**	**Probability of Exposure**	**Consequence**	**Overall Risk**
Treatment process and associated activities	Beeston Brook Pasture and Darwen River Section is a SSSI within 500m of the site. Protected species - European eel anguilla migratory route	Water	The site drainage is sent to the head of the works. Process liquors, boiler blowdown and gas condensate are also sent to the Nereda inlet flow for full biological treatment.	Low	Damage to vegetation and potential toxicity to animal species (European eel Anguilla and migration.)	Not significant
Treatment process and associated activities	Local Wildlife Sites and Ancient Woods (see Table 14). Local residents within a (500m radius) - Spring Lane Properties Upland Farm Hole Bottom Cottage Darwen Side Farm	Air	Combustion emissions from the CHP engine, boiler and flare comprise oxides of nitrogen, carbon monoxide, VOCs and sulphur dioxide. The combustion activities are already permitted and this variation does not change the risks.	Low	Damage to vegetation and potential toxicity to animal species	Not significant

10. Site Condition Report

1.0 Site Details	
Name of the applicant	United Utilities Water Ltd
Activity address	Blackburn WwTW Sludge Treatment Facility Cuerdale Lane, Samlesbury, Lancashire. PR5 0UY
National grid reference	SD 60385 29537
Document reference and dates for Site Condition Report at permit application and surrender	This is the permit application SCR for the extension to the permit boundary and addition of activities.
Document references for site plans (including location and boundaries)	See Appendices C and D to Application Support Document.

2.0 Condition of the Land at Permit Issue	
Environmental setting including: • geology • hydrogeology • surface waters	BGS geological mapping shows the site to be underlain by the Triassic Sherwood Sandstone Group and the Carboniferous Millstone Grit Group (Figure 3.2) overlain by Glacial Till (Referred to as Boulder Clay on older maps) (Figure 3.1). The area to the east of the site where the Carboniferous Millstone Grit Group dominates is highly faulted; however, no faults lie directly beneath the site. To the west of the site the Triassic Sherwood Sandstone group is widespread. Glacial till is shown to underlie the site and much of the surrounding area. River terrace deposits and alluvium are present along the banks of the River Ribble and River Darwen to the north and south of the Site. There are no surface water features within the site boundary. The Hole Brook, a tributary of the River Darwen flows north east to south west to the east of the site (Figure 1.1). At its closest point it is approximately 50m from the south east corner of the site, it is here that discharge from the WwTW is pumped to surface water. The confluence with the River Darwen is approximately 500m downstream of the site.

	The glacial till superficial deposits immediately beneath the site are classified as Unproductive Strata with very limited permeability and groundwater flow potential. The permeability of the Millstone Grit is likely to be highly variable due to the range of lithologies present and the characteristic mudstone and siltstone layers. It is designated as a Secondary A aquifer by the Environment Agency (EA, 2014). A source protection zone (SPZ) zone 3 is present from the boundary of the sandstone to the west and from the River Darwen northwards within the sandstone aquifer. This SPZ zone 3 is located beneath the extreme north west corner of the site, but not beneath the sludge treatment facility. The abstraction associated with this source protection zone is approximately 2km north west of the site.
Pollution history including: 1. pollution incidents that may have affected land 2. historical land-uses and associated contaminants 3. any visual/olfactory evidence of existing contamination 4. evidence of damage to pollution prevention measures	None known. No visual evidence of land pollution.
Evidence of historic contamination, for example, historical site investigation, assessment, remediation and verification reports (where available)	None known
Baseline soil and groundwater reference data	A ground investigation undertaken in 2010 (ESG Report F0305-10 August 2010) included two trial pits (TPA & TPB) and two boreholes (BH03 and BH04) that were located just south of the sludge treatment area. These are considered to provide representative samples of the likely ground conditions within the permitted area.

Client Sample Description	SO4-- (acid sol)	Boron (H20 Soluble)	Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)	Manganese (MS)	Mercury (MS)	Nickel (MS)	Selenium (MS)	Zinc (MS)	SO4-- (H2O sol) mg/l
TPA ES 1 0.50	199	<0.5	2.0	0.29	14.0	11.7	7.6	808.3	<0.1	8.4	0.6	15.6	30
TPA ES 3 1.80	401	<0.5	7.0	0.23	51.5	23.2	30.8	560.2	<0.1	29.5	0.5	59.7	115
TPB ES 1 0.80	318	<0.5	7.2	0.27	59.2	24.3	32.8	390.5	0.12	30.4	0.5	60.6	69
TPB ES 2 2.10	472	<0.5	8.6	0.33	68.4	32.6	58.3	358.7	0.2	29.6	0.7	79.5	146

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BH03/10 ES 2 0.10	833	0.9	9.7	0.26	19.4	33.3	105.5	308.3	0.16	17.4	<0.5	91.2	37
BH03/10 ES 5 1.00	987	<0.5	2.8	0.29	14.4	11.2	14.6	380.2	<0.1	8.6	<0.5	26.7	208
BH03/10 ES 8 1.50	692	<0.5	3.7	0.33	21.4	12.6	17.2	516.9	0.11	11.4	<0.5	30.5	116
BH03/10 ES 13 3.50	639	0.7	8.4	0.45	51.6	36.4	54.1	556.3	0.18	30.9	<0.5	79.9	129
BH03/10 ES 18 5.00	730	12.2	18.1	1.1	68.5	79.8	125.3	57000	0.21	38.4	0.7	244.3	204
BH04/10 ES 2 0.50	467	1.4	7.5	0.32	47.4	61.6	37.7	1387	0.12	25.6	<0.5	67.5	72
BH04/10 ES 4 1.00	678	0.9	7.9	0.39	62.9	33.9	49.8	787.2	0.21	27.5	<0.5	68.8	138
BH04/10 ES 15 3.50	525	0.8	9.2	0.77	104.1	48.2	94.5	703.9	0.38	30.2	<0.5	117.8	75
BH04/10 ES 16 4.00	524	0.9	9.7	0.86	116	53.3	111.2	601.8	0.42	29.9	<0.5	123.1	55
BH04/10 ES 22 5.70	240	0.7	8.6	0.2	32.9	18.5	12.5	577.6	<0.1	29.1	<0.5	44.9	22

3.0 Permitted Activities	
Permitted activities	As detailed in the Environmental Permit application and this variation application.
Non-permitted activities undertaken	Outside of the sludge treatment installation, that is the subject of the permit application, there are the wider UUW WwTW operations.
Document references for: 1. plan showing activity layout; and 2. environmental risk assessment.	1. See Appendix C to Application Support Document. 2. See Section 9 to the Application Support Document.

Appendix A: Certificate of Technical Competence (CoTC)

As previously supplied

Appendix B: Management System Summary & ISO14001 Certificate

As previously supplied

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Appendix C: Site Boundary Plan

As previously supplied

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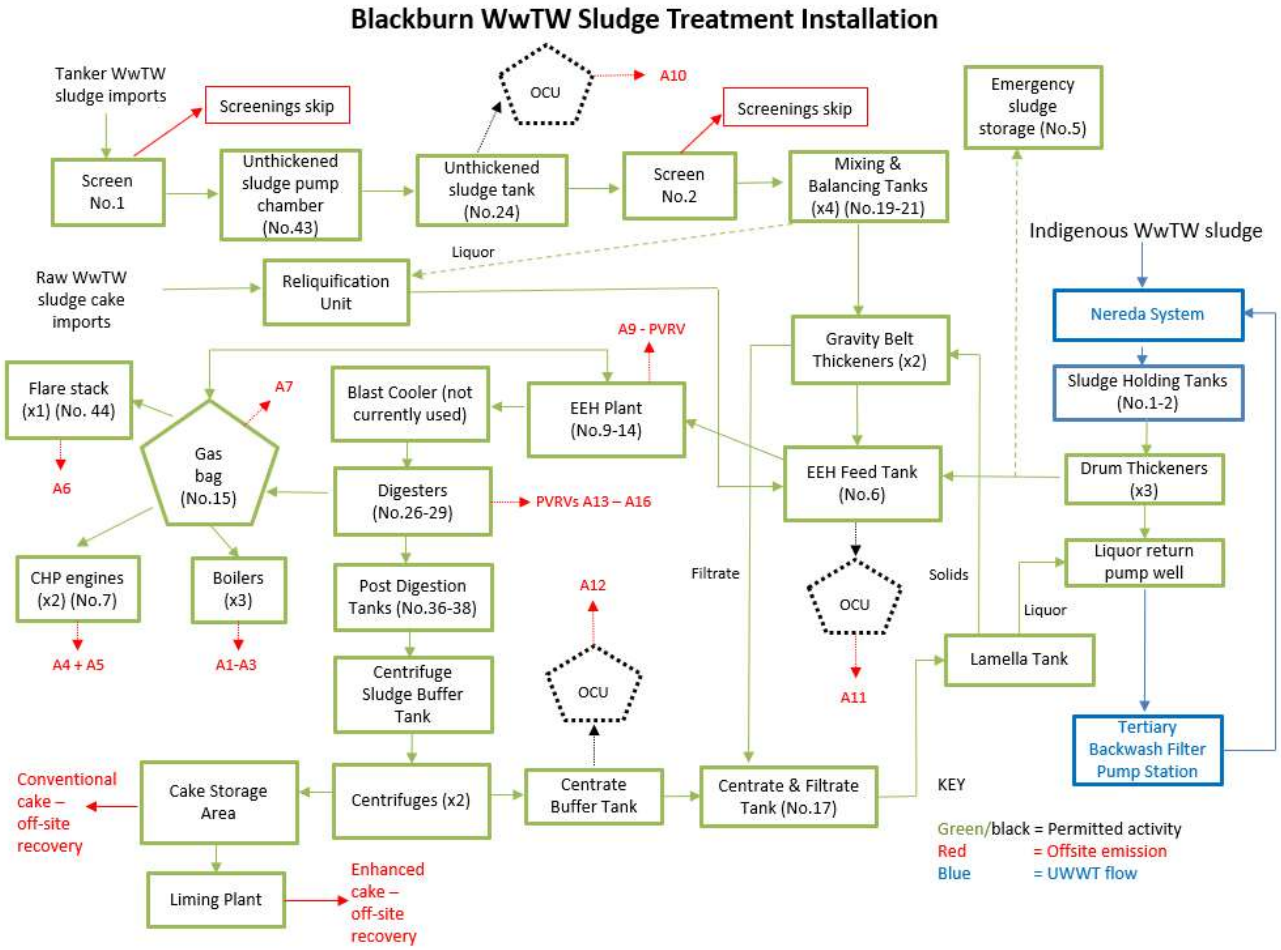
Appendix D: Site Layout and Emissions Points Plans

As previously supplied

Appendix E: Block Process Flow Diagram



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Appendix F: Site Surfacing Plan

As previously supplied

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Appendix G: Site Drainage Plan

As previously supplied

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Appendix H: Material Safety Data Sheets

As previously supplied

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Appendix I: Installations Monitoring SSI

As previously supplied

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Appendix J: UU UKAS Accreditation Certificate

As previously supplied