Blackburn WwTW EPR/XP3638LJ
BAT Improvement Programme December 2023

Contents

1. Introduction

United Utilities Water Limited (UUW) submitted a permit application for the biological treatment of waste at an anaerobic digestion facility co-located at Blackburn Wastewater Treatment Works (WwTW). The application was required due to the implementation of the Industrial Emission Directive (IED) for the biological treatment of waste following the issue of the waste treatment Best Available Technique Reference (BREF) document.

The permit variation application was refused on 25th August 2022 as it was considered that UUW had not demonstrated that the proposals meet all of the Best Available Techniques (BAT) requirements or proposed suitable alternative measures to provide the same level of environmental protection. This document supplies outline information regarding proposed improvements at the site.

2. Containment

2.1. Secondary Containment Assessment and Solutions

A review of our previous Blackburn WwTW secondary containment assessment submission has been undertaken and as such we are proposing to construct permanent containment solutions, in relation to these assets, in order to meet the requirements of BAT conclusion 19.

Attached with this permit application is the updated Blackburn Secondary Containment Modelling Assessment prepared by Stantec, dated 31 October 2022. The assessment has been undertaken using the Anaerobic Digestion & Bioresources Association (ADBA) Risk Assessment Tool, which is based on CIRIA C736: Containment systems for the prevention of pollution. Based on the ADBA risk assessment tool, the class of secondary containment for the site is Class 2 (moderate risk, intermediate degree of containment integrity required).

The ADBA risk assessment was used to inform the hydraulic 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.

In order to manage and monitor the risk of potential leakages from the existing sealed drainage system, in particular the underground components in use, we have assessed the risk rating of all below or partially below ground assets.

The assets listed in Table 2.1.1 were modelled under a catastrophic failure scenario. The tanks were grouped into seven areas and each group of tanks assessed separately using the 2D model. It should be noted that the tanks in Group 7 (drum thickener feed tanks) do not form part of the installation but have been assessed due to their proximity to the IED assets. A separate containment solution has been considered for the Group 7 tanks which do not form part of the installation.

Table 2.1.1: Tank Capacities

Group	Asset Description	No. of units	Total Capacity above ground (m^3)	110% of largest tank	25% of aggregate
1	Digester No. 1	1	2,500	2,750	2,800
	Digester No. 2	1	2,500	2,750	
	Digester No. 3	1	2,500	2,750	
	Digester No. 4	1	2,500	2,750	
	Post Digestion Tank No. 3	1	1,200	1,320	

Group	Asset Description	No. of units	Total Capacity above ground (m^3)	110% of largest tank	25% of aggregate
2	Post Digestion Tank No. 1	1	350	385	175
	Post Digestion Tank No. 2	1	350	385	
3	EEH Feed Tank	1	1,400	1,540	355
	Lamella Plant	1	19	4.75	
4	High Rate Enzymic Hydrolysis (EEH) No. 1	1		308	420
	High Rate Enzymic Hydrolysis (EEH) No. 2	1	280	308	
	High Rate Enzymic Hydrolysis (EEH) No. 3	1	280	308	
	High Rate Enzymic Hydrolysis (EEH) No. 4	1	280	308	
	High Rate Enzymic Hydrolysis (EEH) No. 5	1	280	308	
	High Rate Enzymic Hydrolysis (EEH) No. 6	1	280	308	
5	Unthickened Sludge Storage tank	1	1,800	1,980	N/A
6	Centrate and Filtrate Tank	1	540	594	N/A
7*	Drum Thickener Feed Tank 1	1	400	440	100
	Drum Thickener Feed Tank 2	1	400	440	
*Non IED assets					

The worst-case scenario is highlighted in green in Table 2.1.1 above. Tanks in Group 1 and 4 are all hydraulically independent to each other and therefore the CIRIA 25% rule has been applied.

A simulation was carried out for each group of tanks representing the release of 110% of the largest tank within the group or 25% of the aggregate volume, as appropriate to represent the 'worst case' scenario. Results from the simulations indicate that the spilled flows from these tanks could reach surface water 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 at Blackburn to comply with Class 2 storage requirements are as follows:

- Containment walls
- Sacrificial areas
- Flood gate
- Existing hardstanding area containment
- Leak and spillage detection monitoring

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.

UU 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 (Sarah Raymond), UU understand that this risk assessment can be provided under a permit Improvement Condition. The permit Improvement Condition will require UU to submit finalised designs, specifications and an implementation schedule to the EA for their consideration and approval. UU are committed to meeting BAT, or justified BAT equivalent, for the final containment solution at the Blackburn Sludge Treatment Facility.

2.2. Secondary Containment Conceptual Design

Based upon the conceptual design, the following containment measure approximate quantities will be required for the installation. Detailed design will be necessary to confirm the final quantities.

Table 2.2.1: Containment Measure Approximate Quantities

Mitigation	Length (m)	Area (m^2)
Retaining Wall (1.5m)	107	N/A
Retaining Wall (1.0m)	305	N/A
Flood gate	6	N/A
Sacrificial area	N/A	15,250
Existing hardstanding	N/A	7,710

Further detail on the design of the containment system is provided below.

2.1.2 Containment Walls

Where containment walls have been proposed, these will be in accordance with Chapter 7 of CIRIA C736. Liquid retaining and containment structures". Detailed design will determine the best design solution (i.e. in-situ reinforced concrete or pre-cast units) including material, dimensions and finishes. Following installation, detailed inspection shall be completed by a competent person every five years and following a spill event.

2.1.4 Sacrificial Areas

All sacrificial areas will be reprofiled to include an impermeable membrane which will prevent spilled sludge entering the soil until the clean up operation can be completed. The final solution will be determined in detailed design with the most likely options being impermeable geosynthetic membrane or concrete.

2.1.5 Flood Gate

The proposed flood gate on the south western boundary of the installation has been provided to comply with the containment requirement and provide a fully contained bund, whilst allowing operational and maintenance vehicular access to the assets.

The gate will be designed in accordance with various and relevant standards. Following installation, routine inspection shall be undertaken by the operational team during regular site walkovers and following a spill event.

2.1.6 Existing Hardstanding Area Containment

All existing hardstanding areas being used for secondary/ tertiary containment will be routinely checked for cracks and defects to ensure they are compliant with CIRIA C736 secondary containment Class 2. Site inspection tours of the impermeable surface are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Adviser (ERA).

2.1.7 Leak and Spillage Detection

A programme of leak and spillage detection monitoring, which for Blackburn, includes the following:

- Pipework: where no flow meters are currently installed, pipework with buried mechanical fittings will be surveyed every 2 years and every 5 years where not present, using techniques such as thermal cameras, magnetic flux leakage and in pipe crack detection technology.
- Sludge storage tanks: the high level alarms installed on the sludge storage tanks (which do not currently inhibit feeds) will, where possible be interlocked to the feed pumps to allow automatic shut offs to prevent tank overflow when a high level alarm is triggered.

As well as undertaking the monitoring identified above, site inspection tours of the impermeable surface, storage tanks and above ground drainage system are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Adviser (ERA). These tours include visual inspection of the site drains to ensure they are working as expected. Regular CCTV inspections will also 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.

2.3. Timescales to Achieve BAT

To reduce the timeline for delivery of improvements UU has had to split the site works into individual small projects. This is not our normal approach to delivery of a site programme of works as it leads to inefficiencies and multiple site contractor establishments. In developing dates for delivery our standard approach is to model the timeline for completion and use our P50 estimate (50% likelihood of completion) as the target date. We have applied this approach to the revised delivery model.

The timescale for completion of the spill containment improvements is December 2024 and is based on our P10 (10% likelihood of completion) forecast which means it is the best-case date for completion. Our P50 date, which is based on construction programme norms is 2027. We will endeavour to deliver the improvements as quickly as possible but, as with any construction project involving ground works there are unknowns, e.g. ground conditions, constraints from underground services etc., that can impact the timeline. It is important to note that there are also supply chain shortages currently which are impacting all industries. We will, as part of our implementation, work with the relevant EA officers to keep them informed of progress and, if required, any change in the delivery timeline.

Table 2.2.1 sets out the programme of works to achieve BAT compliance, regarding secondary containment at Blackburn Sludge Treatment Installation.

Table 2.3.1: Containment Improvement Programme to Achieve BAT

Activity	Timescale – Expected Completion (P10 Estimate)	Interim Actions/Measures until BAT Compliant
Provision of quantitative risk assessment to demonstrate that the containment solution provides sufficient secondary containment in accordance with the CIRIA C736 (2014) guidance methodology. Secondary containment provision – installation of containment walls, sacrificial areas and flood gate where risk of overflows and failures from mass breach has been identified, in order to meet the requirements of BAT conclusion 19d.	December 2024	Ongoing maintenance and inspection of tanks to ensure that integrity is maintained. Daily housekeeping tours by site based staff, including checks for any evidence of leaks or spills. The site is either manned, or when not, monitored by the Integrated Control Centre (ICC) on a 24/7 basis using SCADA and critical process alarms.

3. Odour Management

3.1. Odour Abatement Assessment and Solutions

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 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 further stage which contains dry media selected to remove other odorous compounds that maybe present.

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

   The OCU comprises catalytic iron filtration (CIF) and an activated carbon adsorption odour control unit. The CIF 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.

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

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

Adsorption is identified in BAT 34 as a suitable technique for abating channelled emissions to air. To further support this, odour modelling of the OCU channelled emission points to air has been undertaken, to demonstrate the effectiveness of the odour abatement solutions.

The odour dispersion modelling (supplied with this permit application) 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. As such OCUs A10 to A12 will be reinstated.

3.2. Timescales to Achieve BAT

To reduce the timeline for delivery of improvements UU has had to split the site works into individual small projects. This is not our normal approach to delivery of a site programme of works as it leads to inefficiencies and multiple site contractor establishments. In developing dates for delivery our standard approach is to model the timeline for completion and use our P50 estimate (50% likelihood of completion) as the target date. We have applied this approach to the revised delivery model. For the delivery of improvements, the dates presented are based on our P50 estimate for odour emissions (refurbishment of three odour control units).

We will endeavour to deliver the improvements as quickly as possible. It is important to note that there are also supply chain shortages currently which is impacting all industries. We will, as part of our implementation, work with the relevant EA officers to keep them informed of progress and, if required, any change in the delivery timeline.

Table 3.2.1 sets out the programme of works to achieve BAT compliance for the OCUs.

Table 3.2.1: Improvement Programme to Achieve BAT

Activity	Timescale – Expected Completion (P50 estimate)	Interim Actions/Measures until BAT Compliant
Odour abatement systems – reinstatement of suitable OCU's, in order to meet the requirements of BAT conclusion 14d and 34.	June 2024	See Odour Management Plan included with this permit application.

4. Open Tanks

4.1. Diffuse Emission Assessment and Solutions

BAT 14 requires control measures to be used to reduce diffuse emissions to air, and containment/ enclosure (BAT 14d) is identified as being most relevant depending on the risk posed by the waste. However, BAT 14d also acknowledges that the use of enclosed equipment may be restricted by safety considerations (e.g. due to the risk of explosion). The installation has six open tanks as detailed in Table 4.1.1 below.

Table 4.1.1: Sludge Storage/Treatment Tank Construction and Capacities

Tank Name	Construction	Tank Emplacement	Tank Capacity
Mixing and balancing tank No.1	Reinforced concrete	Below ground	500m^3
Mixing and balancing tank No.2	Reinforced concrete	Below ground	500m^3
Mixing and balancing tank No.3	Reinforced concrete	Below ground	500m^3
Mixing and balancing tank No.4	Reinforced concrete	Below ground	500m^3
Centrate/ filtrate tank	Concrete	Partially below ground	1,200m^3
Drum thickeners emergency storage tank	Concrete	Below ground	700m^3
Sludge chamber	Concrete	Below ground	10m^3

In order 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 either as grab samples or using handheld 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 will be carried out on at least two occasions over a 6-month period in order to consider seasonality (i.e. summer and winter conditions). In determining the most appropriate monitoring methodology for diffuse emission, guidance will be sought from The JRC Reference Report on Monitoring of Emissions to Air and Water from IED Installations, 2018.

The proposed sampling methods and standards for off-site analysis are:

- Ammonia (NH3) - EN ISO 21877
- Hydrogen Sulphide (H2S)- CEN TS 13649 for sampling, NIOSH 6013 for analysis
- VOCs GCMS - CEN TS 13649
- Methane – EN 2513

- Oxygen – electrochemical cell

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. This is one of a number of potential solutions for mitigating emissions. Our approach will be to confirm the need and then, if required, develop an appropriate solution to reduce emissions. The design solution will need to satisfy all relevant legislative and UUW safety criteria.

4.2. Timescales to Achieve BAT

The monitoring programme will be completed and confirmation of the need to meet BAT14, along with the proposed solution for the tanks will be submitted to the EA as per the permit improvement conditions.

The Sector EA/WaSC's IED Workshop 29th September 2022 (via MS Teams) provided the following feedback to WASCs:

1. "EA's approach will be to permit facilities and add improvement conditions until the end of 2024. There will be no deadlines beyond this".
2. "If best endeavours are being undertaken to comply then recommendation to area colleagues not to implement enforcement post December 2024".

The challenge of managing emissions from open tanks is complex and has been raised by the Sector as a concern in terms of timescales and ensuring it does not introduce safety concerns. Our proposed timeline for delivery of a solution, if required, is December 2024. This is to align with Point 1 above. We will use best endeavours to deliver any required solution in order to meet obligations referenced in point 1 but delivery of assets by December 2024 cannot be guaranteed. The delivery time is subject to confirmation of the solution and supply chain capability to deliver this over the appropriate timescale. Delivery needs to take into account, timescales for procurement of equipment, pre-construction risk reviews (HAZOPs etc.) and construction. The risk reviews to ensure safe delivery and future operation and maintainability are critical stages in ensuring the final solution is safe and effective.

Table 4.2.1 sets out the programme of works to achieve BAT compliance for open tanks.

Table 4.2.1: Improvement Programme to Achieve BAT

Activity	Timescale –Best Endeavours Completion	Interim Actions/Measures until BAT Compliant
Monitoring to confirm the need for mitigation under BAT14 and then, if required, develop an appropriate solution to reduce emissions.	December 2024	A monitoring programme as per the permit improvement condition requirements