Report

Permit application for the recovery of lithium and other minerals from water and black mass

Supplementary technical information report

For Watercycle Technologies Ltd

18 June 2026

Document Control

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Prepared By:	Adam Clegg
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Registered Office: 3rd Floor St Augustine's Court, 1 St. Augustine's Place Bristol BS1 4UD Tel: +44(0)117 974 1086

24 Greville Street, Farringdon, London, EC1N 8SS Tel: +44(0)20 3873 4780

First Floor, Patten House, Moulders Lane, Warrington WA1 2BA Tel: +44(0)1925 937 195

8-9 Ship St, Brighton and Hove, Brighton BN1 1AD Tel: +44(0)20 3873 4780

Avenue du Port, 86c Box 204, 1000 Bruxelles Tel: +44(0)20 3873 47840

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1 Introduction

1.1 Purpose of this document

This report supports Watercycle Technologies Ltd's ("Watercycle") application under the Environmental Permitting (England and Wales) Regulations 2016, as amended (EPR) for a new bespoke installations permit to allow the recovery of lithium and other critical minerals from waste and non-waste product waters, and battery black mass.

The activities taking place at the Site will need to comply with the requirements of the EPR, including the obligation to demonstrate the application of Best Available Techniques (BAT). This report has been produced to satisfy those requirements.

This document provides supplementary information to support the application and should be read in conjunction with EA application forms which are provided as Appendix A12 to this report

1.2 Application structure

The application process as prescribed by the EA requires the completion of forms Part A, B2, B3 and F1. This requires information on the Operator, technical information about the operations, issues for the application and the financial implications for the Operator.

The nature of the information required for several sections of these forms means that a more comprehensive response, in terms of detailed descriptions and assessments, is needed than can be entered onto the form. Therefore, in order to submit coherent and logical descriptions of the application to the EA, this report contains appropriate supporting information which provides responses to the application form sections

Table 1-1 outlines the structure of this report.

Table 1-1: Supplementary technical information report structure

Section reference	Title	Description of content
2	About the application	Provides a description of the Operator, the site, the activities taking place at the installation and guidance reviewed when developing the application.
3	Operations	Provides process descriptions of the activities that will be performed at the site.
4	Managing the activities	Provides a description of the environmental management system arrangements and information on the use of raw materials and water, waste management, energy efficiency, accidents, fire prevention, site restoration, and security measures.
5	Emissions and monitoring	Provides information on the point source and fugitive emissions to air, water and land, odour and noise, and the monitoring procedures in place.
6	Environmental risk assessment	Assesses the environmental risks of emissions from the Site
Appendix A1	Site plans and drawings	Provides plans and drawings including the installation boundary, drainage plans, emission location plans etc.

Section reference	Title	Description of content
Appendix A2	Pre-application advice	Provides pre-application feedback from the EA.
Appendix A3	IMS Certificate and Technical Competence	Provides the ISO 14001 certification for the operator's IMS, and the Environmental Permitting Operators Certificate (EPOC) for the nominated Technically Competent Manager
Appendix A4	Standard operating procedures	Standard operating procedures describing start-up, shutdown and maintenance of the process lines
Appendix A5	Best Available Techniques Assessment	Compares the design and operation of the installation against relevant BAT Conclusions and appropriate measures
Appendix A6	Fire Prevention Plan	Provides the Fire Prevention Plan which describes the measures in place to minimise the likelihood of a fire happening, for a extinguishing a fire within 4 hours and minimise the spread of fire within the site and to neighbouring sites.
Appendix A7	Accident Management Plan	Provides the plan for controlling and responding to accident scenarios which may harm the environment
Appendix A8	Environmental risk assessment supporting information	Copies of the H1 software tool and Noise Advisory Tool (NAT)
Appendix A9	Air quality assessment	Provides the air quality assessment report which uses dispersion modelling to quantify the impact of emission to air from the installation
Appendix A10	Site Condition Report	The report that establishes the baseline soil and groundwater conditions within the permitted boundary.
Appendix A11	MSDS	Material safety data sheets for the main raw materials
Appendix A12	Application Forms	Completed forms Part A, B2, B3 and F1.

2 About the application

2.1 The operator

The Site will be operated by Watercycle Technologies Ltd. Watercycle design and build high-yield, low-cost, mineral recovery systems that extract saleable products from a wide range of inputs, including sub-surface brines, industrial wastewater and end-of-life battery recycling by-products.

With an ability to treat both solid wastes and highly concentrated water, their core technology spans mineral extraction, concentration and crystallisation. This technology is essential for enabling the transition towards a Circular Economy.

2.2 The site

The Site details are as follows:

Address:	Watercycle Critical Minerals Recovery Plant Block 8 The Heath Business and Technical Park Runcorn Cheshire WA7 4QX
Grid reference:	SJ 51297 80974

The Site is located in the Heath Business and Technical Park in Runcorn, Cheshire. The Heath is one of the UK's leading business and science parks providing serviced laboratories, technical process buildings and office spaces. It has operated as an independent business park for more than 23 years, providing business and technical support to cutting-edge businesses, including those operating in the chemicals sector. It has its own on-site security and emergency response teams managed by the site owners, SOG.

The immediate surroundings external to the business park would largely be classed as suburban, with larger areas of industrial land use adjacent to the River Mersey to the west, south and north of the Site in Weston Point and Runcorn.

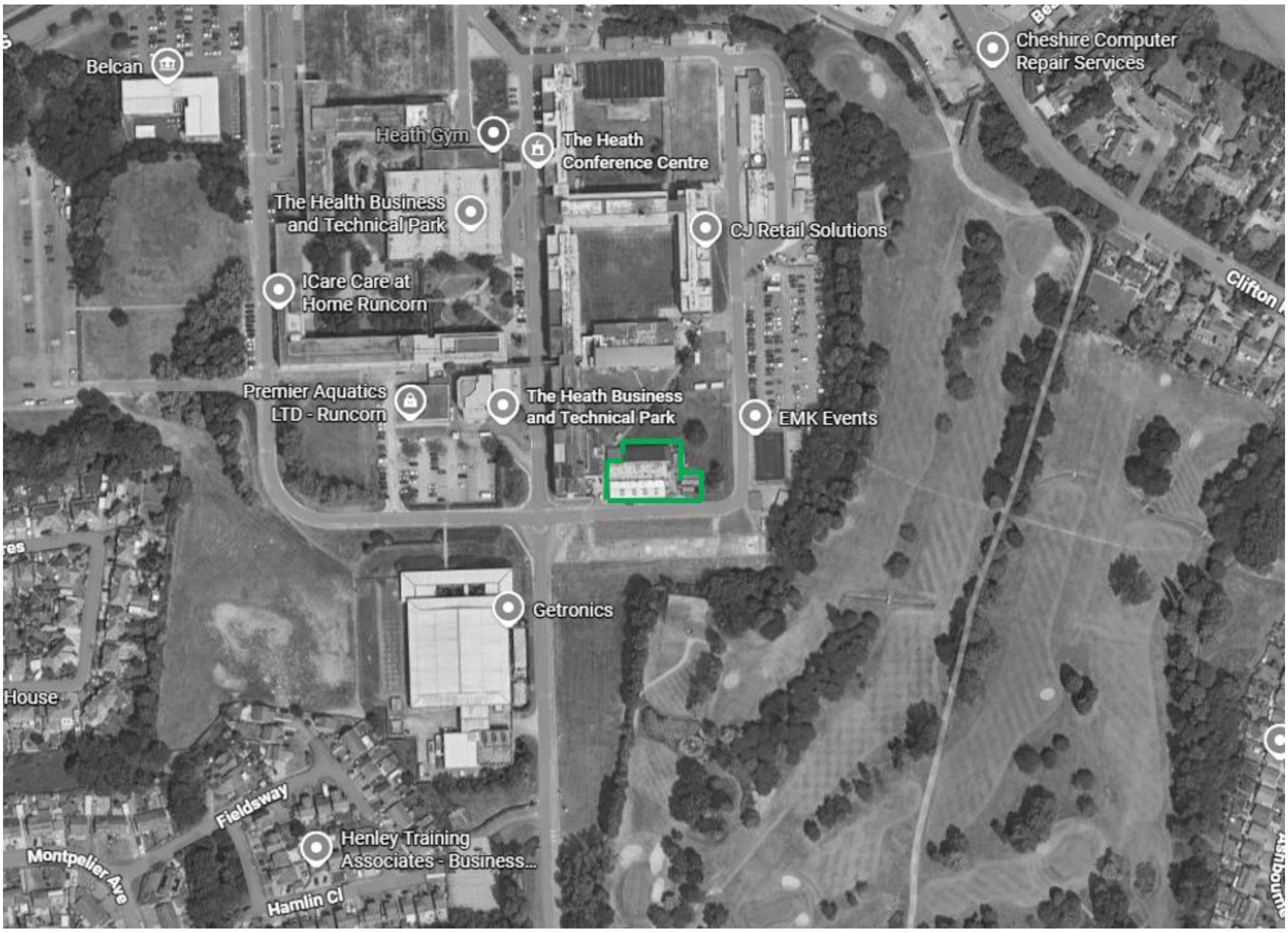
The nearest residential properties are located approximately 210 m to the south-west, and 250 m to the north-east and west. Weston Primary School is located approximately 325 m to the south-west. Within 100 m to the east runs a golf course in a north-south orientation.

The nearest protected habitat site under the Habitats Regulations is the Mersey Estuary Special Protection Area/Ramsar, which at its nearest point is 1.6 km to the south-west. This is also the nearest Site of Special Scientific Interest (SSSI). The nearest local wildlife site is the Runcorn Hill Local Nature Reserve (LNR), which is approximately 700 m to the north-west.

There are no Air Quality Management Areas (AQMA) within the Halton Borough Council area, with the two AQMAs that were previously established for nitrogen dioxide concentrations revoked in 2023.

Figure 2-1 provides a site location map with a general approximation of the site boundary in green. The finer detail for the proposed installation boundary is provided in the installation boundary plan in Appendix A2.

Figure 2-1: Site Location



2.3 Pre-application consultation

Pre-application enquiries were made to the EA on 10/07/2025 and written responses received by the EA on 24/11/2025[1] following a meeting held on 05/11/2025. Further consultation was held and a follow-up response received on 23/03/2026[2]. Topics that were discussed included:

- Confirmation of the proposed regulated and directly associated activities;
- The applicable guidance and forms that the EA consider relevant for the application;
- The requirement for technical assessments and management plans accounting for Site-specific aspects of the design and Site location.
- Approaches to pre-operational and/or improvement conditions.

A copy of the EA's pre application advice can be found in Appendix A2. Amongst other feedback, the pre-application advice confirmed that the operations at the Site would principally be regulated as an inorganic chemicals production activity under Schedule 1, Chapter 4, Section 4.2 of the EPR, with the relevant Part A(1) activity being dependent on the type of chemical produced i.e., whether as a salt e.g., lithium carbonate (Part A(1)(iv)) or a base (Part A(1)(iii)).

[1] Environment Agency Pre-Application Reference EPR/YP3928LM/P001
[2] Email from Susan Anderson, Principal Permitting Officer, 23/03/2026

Other activities may apply e.g., those described under Section 2.2, if metals are recovered in elemental form or in a form that does not require further processing to extract a metal in its elemental form. However, this will not be the case, as the Site will only produce metal salts and bases, so Section 2.2 is not applicable.

In terms of relevant BAT Conclusions, it was confirmed that there is are specific BAT standards for the recovery of materials from black mass using acid leaching, but that the Environment Agency would have regard to the BAT Conclusions for common waste gas management and treatment systems in the chemical sector (WGC BATC), and the UK equivalent which is currently undergoing consultation at the time of drafting this document. BAT Conclusions for precious metal production using hydrometallurgical processes in the non-ferrous metals BAT Conclusions (NFM BATC) may also provide suitable BAT Associated Emission Levels (BAT-AELs) for the acid leaching process, this being the most analogous set of BATC available for this type of process.

Although the Site will not accept waste batteries, the waste batteries appropriate measures for permitted facilities was also considered to represent a suitable proxy standard for the pre-acceptance, acceptance, storage and handling of the black mass.

2.4 Activities

The Site will recover critical minerals from refined black mass (RBM) and water (product water and industrial wastewater) as metal salts and/or hydroxides. There will be two process lines, one for the black mass process and a second process line for the water process. Process descriptions for each of these processes are provided in Section 3.

Watercycle has developed a novel, proprietary technique that allows the selective extraction, concentration and crystallisation of metals present in these input streams. The water process includes the addition of solid inorganic materials to blend, filter, crystallise, precipitate and dry the finished product, producing metal salts e.g., lithium carbonate or lithium phosphate. There are currently no other processes in operation within the UK which can process this aqueous waste stream to produce these critical minerals and, as such, this represents a unique, innovative process.

The black mass process involves the leaching of the black mass with sulphuric acid and hydrogen peroxide to precipitate out the relevant minerals at different stages. The materials are washed, concentrated, crystallised, processed via a filter press and dried to produce the required mineral products. Neither process produces metals in their elemental form.

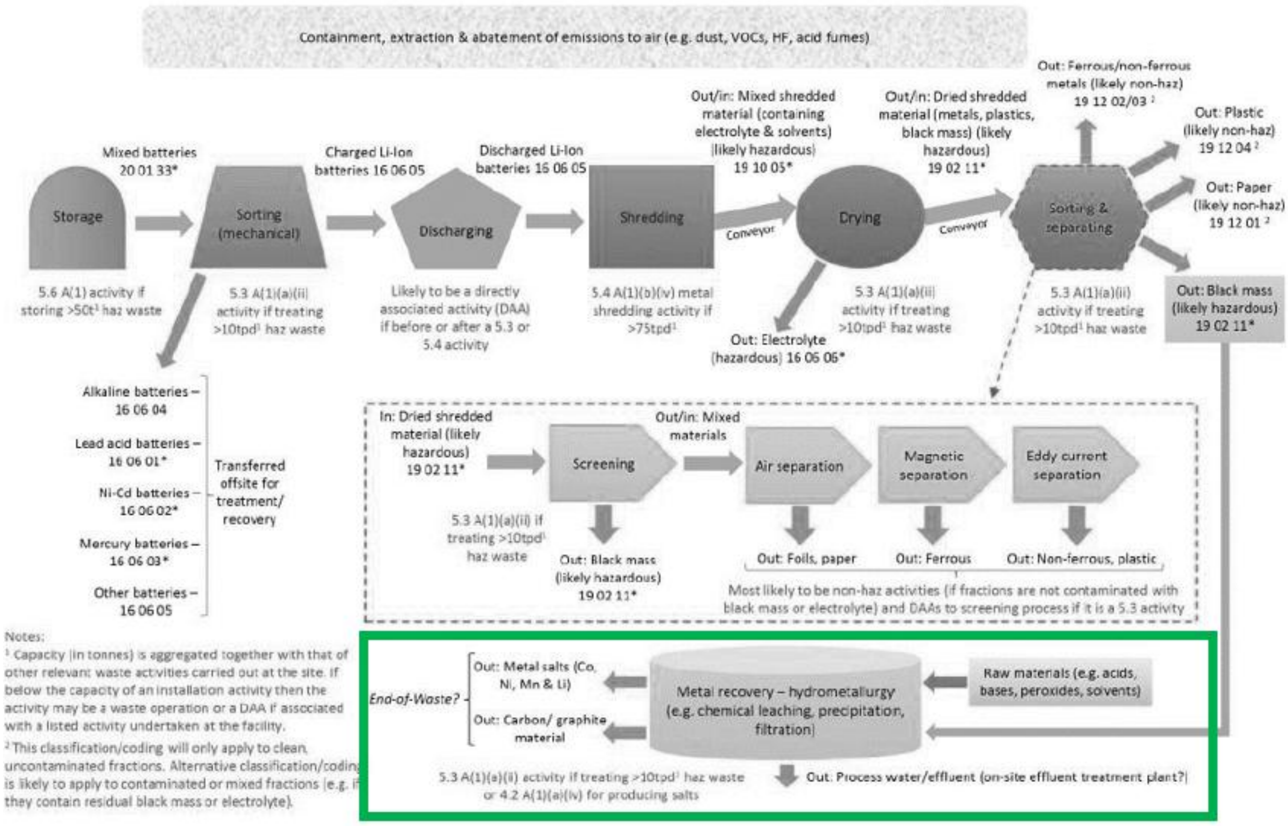
The output products include:

- Lithium salts (carbonates or phosphates dependent on reagent used); and
- Mixed metal hydroxides (iron, aluminium, copper, nickel, manganese, cobalt);

No lithium-ion batteries (LIBs) or batteries of any other kind will be accepted at the Site. The Site will only accept refined black mass that has been produced and subject to pre-treatment at other off-site battery recycling facilities to remove other components of shredded battery material. There will be no further pre-treatment of the black mass at the site before it is introduced into the process.

Figure 2-2 clarifies the scope of the proposed black mass activities in relation to the Environment Agency's pre-application advice for a theoretical lithium-ion battery recycling process with hydrometallurgical metal recovery. Only the activities within the green box will be performed at the Site.

Figure 2-2: Scope of black mass activities to be performed compared to wider Li-ion battery recycling facilities



Notes: Only those activities within the green box will be performed at the Site.

The Site will, therefore, consist of several Schedule 1 installation activities and multiple Directly Associated Activities (DAA), as described in Table 2-1

Table 2-1: Proposed regulated activities

Activity reference	Schedule 1 reference	Description of specified activity
AR1	Section 4.2 Part A(1)(a)(iv) – Producing inorganic chemicals such as salts (water process)	Production of lithium carbonate and lithium phosphate by selective extraction and crystallisation from product water and industrial wastewater.
AR2	Section 4.2 Part A(1)(a)(iv) – Producing inorganic chemicals such as salts (black mass process)	Production of lithium carbonate and lithium phosphate from the acid leaching of black mass.
AR3	Section 4.2 Part A(1)(a)(iii) – Producing inorganic chemicals such as bases (black mass process)	Production of mixed metal hydroxides (containing iron, aluminium, copper, nickel, manganese and cobalt) from the acid leaching of black mass

Activity reference	Schedule 1 reference	Description of specified activity
Directly Associated Activities		
AR4	Surface water drainage	Collection and discharge of uncontaminated surface run-off to sewer
AR5	Raw material handling and storage	Storage and handling of raw materials including refined black mass, product and industrial wastewater and other supporting raw materials
AR6	Storage and handling of waste	Handling and temporary storage of wastes and residues produced at the installation
AR7	Air abatement	Operation of abatement equipment to reduce emissions to air
AR8	Product drying, packaging and storage	Operation of filter press and electrical pan dryers to remove moisture from lithium salts, and packaging and storage of the finished product

2.5 Applicable guidance

Table 2-2 describes the applicable legislation, guidance and technical standards that has been reviewed when developing this report. Identification of the relevant guidance has been informed by initial pre-application consultation with the Environment Agency.

Table 2-2: Applicable legislation, guidance and technical standards

Publisher/Document Type	Title
European Legislation and Guidance	Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
	Best Available Techniques Reference Document for Non-Ferrous Metals Industries
	Commission Implementing Decision (EU) 2016/1032 of 13 June 2016 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the non-ferrous metals industries
	Best Available Techniques Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector
	Commission Implementing Decision (EU) 2016/902 of 30 May 2016 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for common waste water and waste gas treatment/management systems in the chemical sector
	Reference Document on Best Available Techniques for Energy Efficiency
	JRC Reference Report on Monitoring of Emissions to Air and Water from IED Installations
Defra Legislation and Guidance	Environmental Permitting (England and Wales) Regulations 2016 as amended
	Environmental Permitting Guidance, Core Guidance for the Environmental Permitting (England and Wales) Regulations 2016

Publisher/Document Type	Title
	UK BATC Common Waste Gas Management and Treatment Systems in the Chemical Sector (formal draft)
	UK BATC Common Waste Gas Management and Treatment Systems in the Chemical Sector formal draft interpretation guidance and supplementary information
Environment Agency Guidance	Guidance: A1 installations: environmental permits https://www.gov.uk/guidance/a1-installations-environmental-permits
	Guidance: Legal operator and competence requirements: environmental permits
	Guidance: RGN2: Understanding the meaning of regulated facility
	Guidance: Best available techniques: environmental permits
	Guidance: Risk assessments for your environmental permit
	Guidance: Air emissions risk assessment for your environmental permit
	Guidance: Noise and vibration management: environmental permits
	Guidance: Control and monitor emissions for your environmental permit
	Guidance: Odour management: comply with your environmental permit
	Guidance: Monitoring stack emissions: techniques and standards for periodic monitoring
	Guidance: Monitoring stack emissions: measurement locations
	Guidance: Develop a management system: environmental permits
	Guidance: Fire prevention plans: environmental permits
	Additional guidance for the inorganic chemicals sector (EPR 4.03)
	Waste batteries: appropriate measures for permitted facilities (consultation draft)
	Environmental permitting: H5 Site condition report
	Guidance: Environmental permitting charges guidance

3 Operations

3.1 Overview

Process descriptions for each of the processes are provided in the sections below. In summary, the water process involves the addition of solid inorganic materials to blend, filter, crystallise, precipitate and dry the finished product, producing metal salts e.g., lithium carbonate or lithium phosphate. The black mass process involves the leaching of the black mass with sulphuric acid and hydrogen peroxide to precipitate out the relevant minerals at different stages. The materials are washed, concentrated, crystallised, processed via a filter press and dried to produce the required mineral products. Neither process produces metals in their elemental form.

The design capacity is to produce up to 60 tonnes per annum of lithium salts, and 605 tonnes per annum of mixed metal hydroxides, although actual production quantities will be dependent on the variable composition of the black mass.

Process flow diagrams and P&IDs are provided in Appendix A1. Example standard operating procedures for start-up, shutdown and maintenance are provided in Appendix A4.

3.2 Recovery of critical minerals from waters

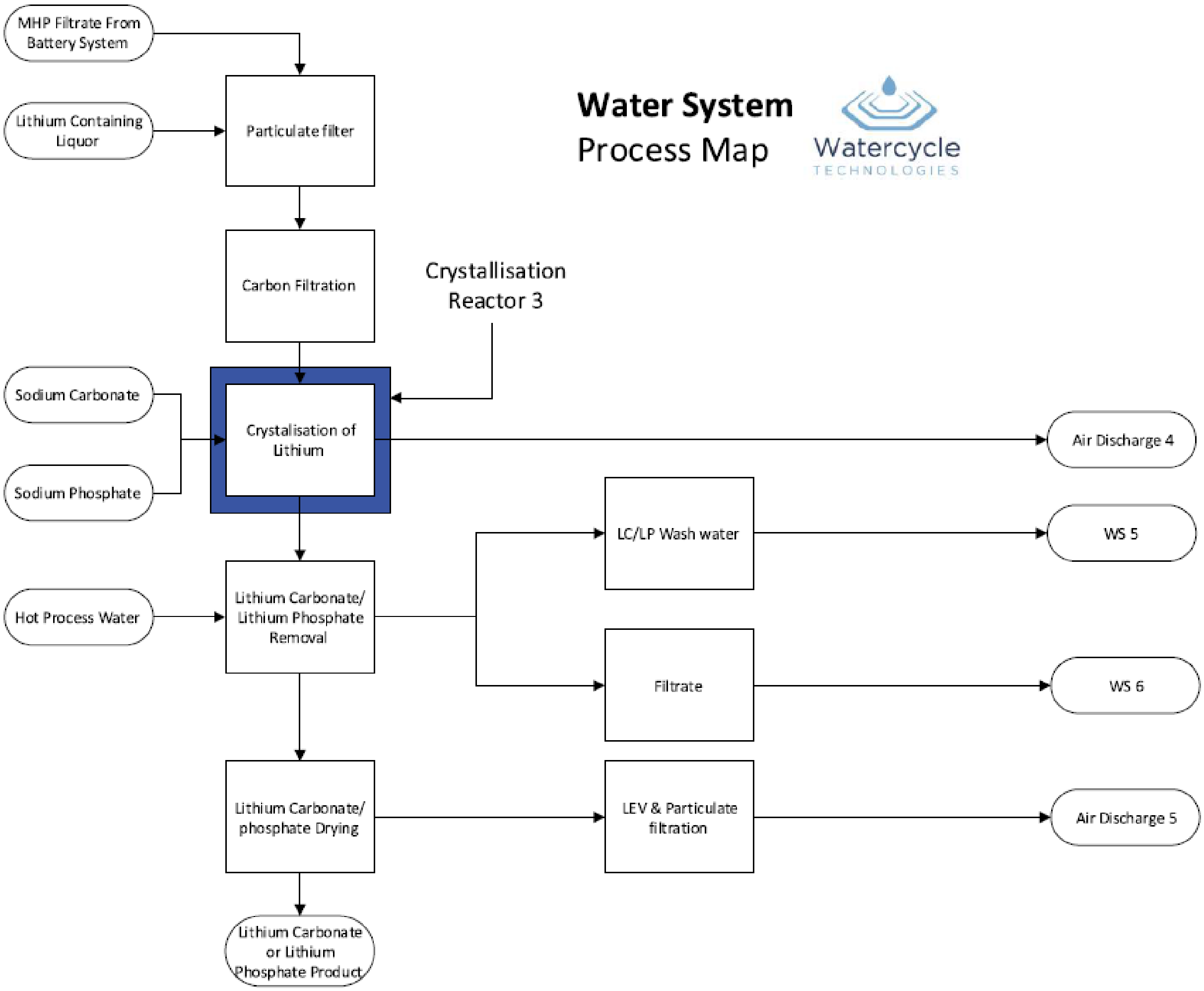
3.2.1 System overview

The Water System is designed to process lithium-containing non-waste product waters, industrial wastewater, and filtrates generated by the black mass process plant. The purpose of the Water System is to selectively recover lithium as lithium carbonate (or lithium phosphate) through a controlled crystallisation process, allowing this valuable material to be recycled and reintroduced into the battery supply chain.

The water system is a batch process, and it is anticipated that two batches per day will be run between the hours of 08.00 – 17.00 during weekdays only. Each batch will process up to 8,000 litres of waters containing lithium.

Figure 3-1 provides a process flow diagram for the Water System.

Figure 3-1: Process flow diagram for Water System



3.2.2 Feed handling

Representative samples of each batch are taken to verify lithium content, check organic loading, assess particulate concentration, and identify any additional contaminants, prior to transfer into the crystallisation stage. If the batch does not meet the specifications of the system, it will be rejected and transferred off-site as a waste to a suitably permitted waste management facility. Results from the batch sampling are also used to optimise and adjust the crystallisation process in terms of the amount of reagent added to the crystallisation reactor.

Feedwaters which do meet criteria are then supplied either directly from the black mass processing system or transferred from individual intermediate bulk containers (IBCs) via a dedicated pumping station. All feed streams first pass through a filter to remove residual suspended solids. An activated carbon filter is also used to remove organic contaminants commonly present in hydrometallurgical liquors.

3.2.3 Crystallisation process

Once passed through the filters, the feed solution enters a 9 m³ crystallisation reactor. When the solution level exceeds the reactor's minimum operating volume, a mechanical agitator is activated to ensure homogeneity.

After the reactor has reached full working volume and the solution is fully mixed, sodium carbonate powder (or sodium phosphate dependent on the source of the water) is added to the reactor via a powder vacuum system. An extraction system collects any dust generated from the addition of the reagent and routes this to a fabric filter prior to being discharged to atmosphere. The dosage quantity is calculated stoichiometrically based on the measured lithium concentration. The mixture is then agitated for a number of hours to allow lithium carbonate or phosphate crystals if sodium phosphate is used) to nucleate and grow.

On completion of the reaction period, the slurry is discharged from the base of the reactor and transferred to a filter press.

3.2.4 Solid-liquid separation and washing

The filter press separates lithium carbonate or lithium phosphate crystals (cake) from the process liquor (filtrate). Pressure is applied to remove as much liquid as possible, producing a consolidated filter cake.

Once the press is full, a washing stage is initiated. Hot water supplied from an electric hot water system is pumped through the press. This wash step removes sodium residues from the lithium carbonate cake and transfers them into the filtrate stream. All filtrate and wash liquors are collected into IBCs and disposed of by an approved third-party waste management contractor.

3.2.5 Drying and product handling

After washing, the press is opened and the lithium carbonate or lithium phosphate cake is discharged into a collection container. The cake is then transferred to an agitated pan dryer, where it is dried and mechanically broken down into a free-flowing powder suitable for packaging and off-site commercial use. Each batch is estimated to produce ~135 kg of product, although this will be dependent on the composition of the specific black mass processed during any batch run.

3.3 Recovery of critical minerals from black mass

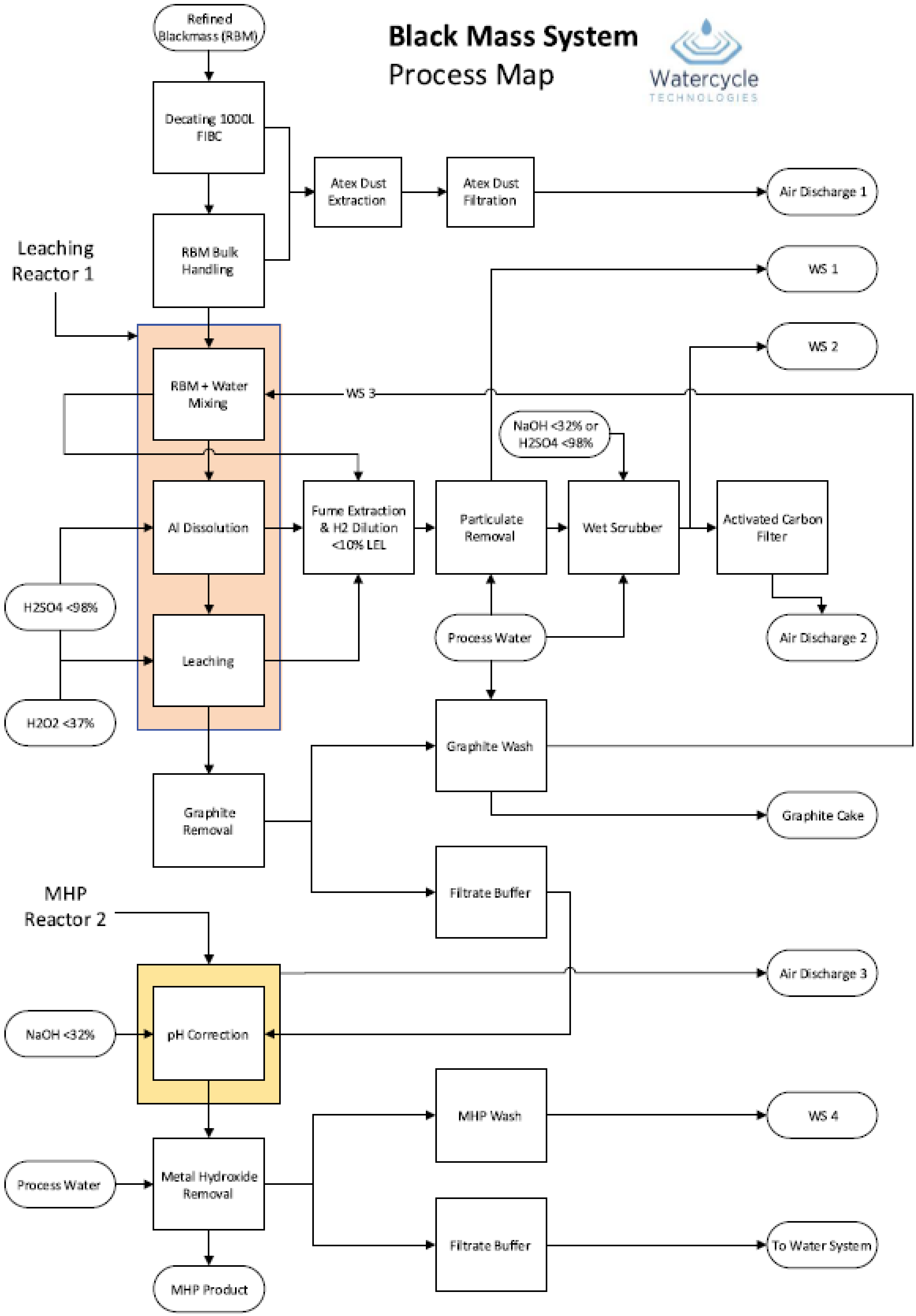
3.3.1 Overview

The black mass system is designed to recover lithium as an inorganic salt, and other metals as mixed hydroxides, from refined black mass produced at off-site battery recycling facilities. It consists of an initial transport and decanting stage, an acid leaching stage, selective extraction and crystallisation.

Like the water process, the black mass process is a batch process (with each batch processing 500 kg of black mass), and it is anticipated that two batches will be run per day between the hours of 08.00 – 17.00 during weekdays only. In addition to the production of lithium salts already estimated above, each batch is also estimated to produce between 625 – 1,250 kg of mixed metal hydroxides per batch. The additional mass relative to the input material accounted for by the addition of the hydroxide groups to the metals and remaining water in the metal hydroxide cake (up to 50% moisture content). The amount of mixed metal hydroxide cake produced per batch will be highly dependent on the composition of the black mass being processed.

Figure 3-2 provides a process flow diagram for the black mass system. Appendix A1 provides a higher resolution PDF of the figure.

Figure 3-2: Process flow diagram for Black Mass System



3.3.2 Transport and decanting

1,000 litre flexible intermediate bulk containers (FIBCs) will be delivered to the site by road transport. On arrival at the site, and after completion of the waste acceptance procedures described in Section 4.2.2, the bags will be offloaded by forklift truck (FLT) and placed in the designated black mass storage area pending compositional analysis prior to processing. Only once the composition has been confirmed will the black mass be released for processing.

Each FIBC will be loaded into a decanting-station hopper fitted with a guillotine which uses an actuated type mechanism. The guillotine slices the bags open inside the fully enclosed hopper connected to an LEV system. The bag hopper system is designed to meet all required Hazardous Area Classification (HAC) requirements, and also removes manual intervention and exposure risk for the operatives. The LEV will capture and filter any dust generated during this stage. VOCs may also be present, so an activated-carbon stage will be used after particulate filtration. Material will then discharge into an enclosed chute feeding a series of screw conveyors. A rotary valve will regulate the volumetric feed and provide isolation, preventing the extraction system from drawing the reactor freeboard and any potential fumes. DSEAR assessments will be completed to establish area classifications and required ATEX rating of equipment for potentially explosive dust.

3.3.3 Acid leaching

Water is pumped into the 9 m^3 Leaching Reactor 1 to form the base of the leach solution at a liquid-to-solid (L:S) ratio of 5:1 (five parts water to one part RBM). Once the required volume is reached, an agitator will be started and mixed with four equally spaced baffles to promote uniform suspension. 500 kg of RBM will then be added intermittently to the reactor via the rotary valve to ensure the solution is homogeneous.

Concentrated (typically 96-98%) sulphuric acid (H_2SO_4) will be slowly dosed into the agitating RBM water mixture in the reactor with the interval controlled by temperature thresholds. Hydrogen (H_2), oxygen (O_2), VOCs, sulphur dioxide (SO_2), carbon dioxide (CO_2), carbon monoxide (CO) and hydrogen fluoride (HF) will be evolved during the reaction. An extraction system will dilute the H_2 well below the lower explosive limit (LEL) and an abatement system incorporating a wet scrubber and carbon filter will be used to control off-gases containing acid gases and VOCs.

The sulphuric acid will be continually added to the solution. The volume of sulphuric acid to be added will be calculated based on the RBM composition and inputted to the PLC/HMI prior to the batch starting.

Hydrogen peroxide (max. 37%; H_2O_2) will also be pumped and dosed into the reactor solution at up to 10% of the volume of the sulphuric acid addition. There will be a two stage acid addition, starting with a slow addition for the dissolution of aluminium, followed by a second fast addition, dosing sulphuric acid and hydrogen peroxide concurrently and proportionally to raise and then maintain the temperature at 60°C. Mixing will continue and another timer will allow for the reaction to fully complete before moving on to the next stage.

3.3.4 Solids removal

A diaphragm pump will be used to decant the contents of the leaching reactor (leachate) into a filter press at pressure (single pass), to remove any undissolved particulate from the leach solution. This is expected to be graphite by majority. The graphite solids cake will be pH 0 so will be rinsed in-situ with water or a mild alkaline solution to increase the pH to make it safer to handle from an operational perspective. The filtrate from the rinsing will be captured and stored separately and reused for processing the next batch of RBM.

The filtrate from the leachate solids removal will be collected in a filtrate tank which will now contain the target minerals for extraction. This filtrate is then into pumped to the next reactor (Reactor 2 MHP) to allow the selective extraction of lithium from other metals in the filtrate.

3.3.5 Selective extraction

The 4.9m^3 Reactor 2 MHP will be used to remove target metals (e.g. Fe, Al, Cu, Ni, Co, Mn) as a metal hydroxide cake from the leachate by a simple pH correction. The process solution within the MHP reactor is continuously mixed and monitored using an agitator and immersed pH probe connected to the control system. Sodium hydroxide solution is dosed from an IBC station via a chemical dosing pump to maintain the process at the target pH of 11.5. The dosing rate is automatically adjusted based on the measured pH to maintain the required setpoint. Once the target pH is reached, the solution is held at pH 11.5 for a defined reaction period to ensure complete chemical reaction and stabilisation of the process conditions.

A filtration step will then be used to separate these precipitated hydroxides from the minerals still dissolved in the solution (Li). The metal hydroxide cake will be washed with water, and then transferred into a container for off-site transport. The wash water will be collected and disposed of as waste.

The Lithium-rich filtrate will be collected in a filtrate buffer/storage tank and transferred via pump through a filter to the crystallisation reactor on the Water System

3.3.6 Crystallisation

This process will make use of the Water System to recover lithium carbonate from the lithium rich filtrate output from Reactor 3 MHP 2. The process description for this stage is as described in Section 3.2.

4 Managing the activities

4.1 Management systems

4.1.1 Overview

Watercycle operates an Integrated Management System (IMS) certified to ISO 9001:2015 and ISO 14001:2015 (certification number 411942022). The scope of the certification covers:

"*The development, design and provision of mineral extraction & water treatment systems*".

The scope of the IMS applies to the following geographical location(s):

CityLabs 1.0, Oxford Road,
Manchester,
Greater Manchester,
M13 9NQ.
United Kingdom

Block 8, The Heath Business & Technical Park,
Heath Road South,
Runcorn, Cheshire,
WA7 4QX.
United Kingdom

Appendix A3 provides a copy of the IMS certificate. The objectives of the environmental aspects of the management system include the following:

- Identifying potential environmental impacts;
- Development of standard procedures to control and/or mitigate these impacts and adhere with legal requirements;
- Ensuring adequate responsibility, authority and resources necessary to support the IMS;
- Establishing key performance indicators to measure the effectiveness of the IMS procedures;
- Monitoring, measuring and analysing the procedures for effectiveness; and
- Implementing actions as required based on the outcomes of routine audits to ensure ongoing improvement across all processes.

4.1.2 Operations and maintenance

Operations will be delivered by a dedicated Operations department. This will include a highly skilled team of engineers to provide adequate resourcing to operate the process in a safe and effective manner. The process will take place during the hours of 08.00 to 17.00, five days per week, with no waste acceptance or processing at weekends. The operational team will be overseen by an Operations Technician who reports directly to the Site Manager. Also reporting to the Site Manager will be a HSE Manager and a Technically Competent Manager (TCM) who have responsibility for the initial pre-acceptance and acceptance of waste material.

The IMS and its associated procedures will describe how to operate the facility in order to comply with relevant legal obligations and avoid, or minimise, the environmental risks during both normal and other than normal operational conditions of the facility. This includes start-up and shut-down periods. The procedures will also include contingency plans to ensure minimal impact on the environment in the case of breakdown or enforced shutdown.

In particular, these standard operating procedures will include:

- Processes covering waste reception and handling, including waste acceptance and pre-acceptance procedures.

- Processes and associated procedures for controlling the water process to ensure optimal performance and compliance with all relevant emission limits.

- Processes and associated procedures for controlling the black mass process to ensure optimal performance and compliance with all relevant emission limits.

- Processes covering the storage, handling and removal of wastes and residues from the site.

In addition to these operational procedures, the IMS will also include procedures relating to the inspection of environmentally critical equipment and operational logs which support compliance with legal requirements and minimise environmental impact.

Planned maintenance procedures will be established in accordance with the IMS procedures to ensure all key plant components that have the potential to affect the environmental performance of the facility remain in good working order. These maintenance procedures will apply to all individual items of main operating plant and equipment, environmentally critical equipment such as the caustic scrubber, and also minor items and components such as nozzles, seals, electric motors etc. The maintenance procedures and instructions will define the frequency and nature of testing, servicing, inspections, checks, cleaning needs, calibration and adjustment etc.

All maintenance activities will require the appropriate permits to work from the Senior Authorised Person issued in accordance with the IMS procedures. These range from work permits for general maintenance, to specific permits covering, for example, hot work, electrical isolation, working at heights etc.

Maintenance of the facility is expected to be undertaken by internal resources or specialist external contractors dependent on the specific activity, the skills and experience required, and availability. Where maintenance is required to be performed by external contractors, it will be undertaken in accordance with the IMS procedures for the management of contractors.

Prior to any work being undertaken by external contractors, the contractor will be required to submit for approval a method statement, risk assessment, liability insurance, company health, safety and environmental policies and how compliance with the site operating procedures will be met. The contractor will be required to sign a form to confirm that they understand and will comply with the permit to work system described above.

4.1.3 Competence and training

The competency of resources to operate the process to control and minimise environmental impact requires a number of steps linked to operational procedures. These include:

- Defining roles and responsibilities;

- Defining competency requirements;

- Competency assessment;

- Training needs analysis;

- Training provision;

- Training records and register; and

- Periodic competency and operational review and assessment.

Procedures will be in place to identify the minimum competencies required for each role at the facility. These will then be applied to recruitment and training processes for both internal resources and external contractors.

Job specifications will be defined which, amongst others, will provide details on relevant qualifications and experience required.

Initial training of personnel on certain components of the facility may be delivered by the equipment suppliers. This training will address both normal plant operation, but also actions to be taken in the event of abnormal operation or emergency scenarios.

From this point, Managers will identify and monitor staff training needs and competency levels as part of an ongoing appraisal system. Training will be delivered using a combination of on-the-job training, mentoring, internal training courses and external training courses/events as required. These training programmes will also make employees aware of:

- The IMS and the importance of operating in line with the policies and procedures contained therein;
- Their individual role and responsibilities in achieving compliance with the IMS;
- The environmental aspects associated with their role and site operations; and
- The consequences of departing from the procedures in the IMS.

Staff induction programmes will be specific to each role but will cover, as a minimum:

- Watercycle's environmental policy; and
- IMS awareness raising.

Training records will be stored and maintained on the HR system. These records will include, as a minimum, the date, type of training, training provider and any associated assessment scores. The IMS will specify a procedure for archiving records to ensure all training is recorded and training outcomes retained.

Procurement procedures will be implemented to ensure that contractors are suitably qualified and experienced for the task they will be performing. This requirement will be enforced by the terms and conditions of contract with the contractor.

All relevant internal resources and contractors involved in the construction, commissioning or operation of the facility will be briefed on the requirements of the IMS. The IMS will be available in electronic format for all employees on the internal intranet site and a hard copy will be available at the Site.

In terms of the pre-acceptance, acceptance, storage and handling of waste, these activities will be overseen by a dedicated TCM. This role is proposed to be delivered by Shaun Yoxall, who has 10 years of experience in the lithium-ion battery industry and 20 years in industrial manufacturing in general. Shaun Yoxall has commenced the process to achieve formal Certification of Technical Competence under the competency scheme run jointly by the Chartered Institution of Wastes Management (CIWM) and Waste Management Industry Training and Advisory Board (WAMITAB), and has already received his Environmental Permitting Operator's Certificate (EPOC), a copy of which is included in Appendix A3.

4.1.4 Accidents, incidences and non-conformances

The IMS procedures on non-conformity and corrective action will provide a process which addresses the detection, response and investigation of the causes of abnormal operating conditions that may give rise to incidents, or any non-conformances with the procedures in the IMS. This will define the short-term actions to return the facility to normal operation, and long-term actions to prevent the same incident or non-conformance occurring again.

The IMS procedures on management of communications and complaints will determine the process to be followed in respect of managing complaints concerning the environmental impact of the activities. Any complaints will be referred to the appropriate Manager (as defined by the IMS), or a nominated responsible individual in their absence who will initiate an investigation of the complaint as soon as possible. The complaint will be recorded on a complaint log form.

The complainant will be contacted by the appropriate Manager to confirm the details of the complaint, the outcome of the subsequent investigation and any remedial steps taken. This feedback and communication will be recorded on the incident management reporting system. Contact will also be made with the Environment Agency concerning any justifiable complaints that can be attributed to site operations.

An Accident Management Plan (AMP) has been developed and is provided in Appendix A7. Summary details of the relevant control measures in place to prevent, or where that is not possible, mitigate the effect of potential accident scenarios is provided in Section 6.4.

All parts of the process, including systems and equipment, will be subject to a formal, systematic HAZOP study as part of the detailed design stage. The outcomes from the HAZOP study will be used to refine and, where necessary, update the initial risk assessment and control measures provided in the AMP and Section 6.4.

4.1.5 A changing climate

Environment Agency management system guidance includes the integration of climate change adaptation into the Site's management system. This should consider:

- Risks to the operation from climate change
- Risks the operation creates due to climate change
- How to embed controls

Watercycle will prepare a climate change risk assessment and plan of action in the IMS which reflects the risk that climate change creates for the Site. A summary of the expected measures to be considered in this plan are presented below.

Table 4-1: Climate Change design adaptations

Climate Change Risk	Consequence	Design and operational mitigation
Extreme rainfall, leading to more frequent and severe floods	High surface water flows on site	Design of the drainage system with attenuation tanks to handle a 1 in 100 year rainfall event. Storage of all potentially polluting substances in containers constructed of suitable materials for the contents with secondary containment and stored within an enclosed building.
Heat waves	Elevated temperatures (both winter and summer) increasing the risk of self-combustion	Storage of RBM internally in unheated buildings and shielded from direct sunlight. Low quantities of RBM stored on-site at any time (6no. 1,000 litre FIBCs) with maximum storage time for any FIBC less than 72 hours.
Drought	Availability of water due to drought conditions	Water system requires minimal additional water supply due to the nature of the input. Black mass process uses mains water supply rather than abstraction with the potential to re-use wash water from the water process as the water input to the black mass process.

Climate Change Risk	Consequence	Design and operational mitigation
Storm	Extreme rainfall events resulting in high surface water flows on site; loss of power to site	Design of the drainage system with attenuation tanks to handle a 1 in 100 year rainfall event. Environmentally-critical equipment e.g., scrubber pumps have uninterruptable power supplies allowing safe shutdown in the event of loss of off-site power.

4.1.6 Record Keeping

Watercycle will keep a record of all complaints, maintenance records, waste movements and site wide policies using the IMS.

Records will be securely stored on Site and made available to the EA on request.

- In addition, the records described below will be maintained at the Site office and will be made available to warranted officers of the EA on request:
- The pre-acceptance record for each waste stream and copies of related transfer notes.
- Details of all waste taken off site with a copy of the appropriate transfer note.
- A Site log will be maintained with the results of daily amenity inspections and any actions taken as a consequence and a record of attendance by the TCM.
- A copy of the preventative maintenance programme showing plant has been properly inspected and maintained and when.
- A log will be maintained detailing any complaints received and the actions taken to resolve them.
- A log will be maintained of any pollution incidents and the action taken to remediate them.
- Records will also be kept regarding staff training.

Records will be kept for a minimum of six years and/or in line with any other requirements of the permit. Records of pollution incidents will be maintained indefinitely in order to inform any eventual surrender application.

4.1.7 Organisation and environmental responsibilities

Figure 4-1 provides an organogram that displays the proposed organisational structure in respect of key management and operational roles that have responsibility for discharging the safe operation of the facility and managing environmental impacts. The key organisational and environmental management roles and responsibilities are described below:

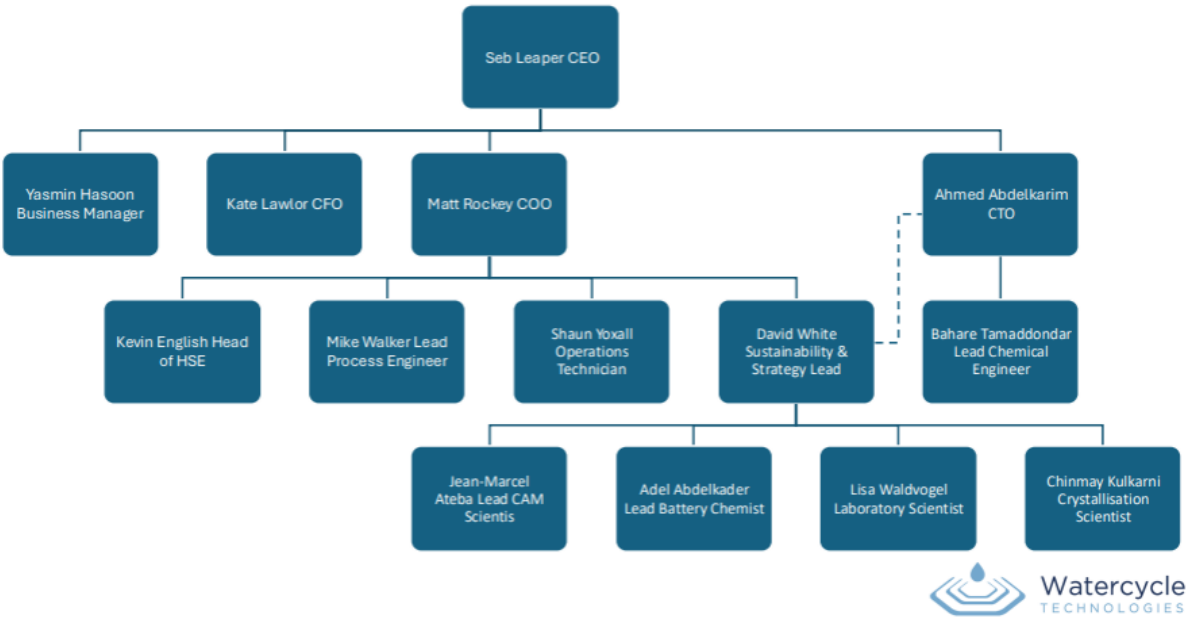
- The Chief Operations Officer will act as Site Manager and have overall responsibility for the management of the facility and compliance with the IMS. This will be an individual with significant experience and track record of managing the operation of similar facilities;
- The Operations Technician will have day-to-day responsibility for the operation of the plant, ensuring that the plant is operated and maintained to the standard operating procedures and requirements of the IMS;
- The Head of HSE will be responsible for tracking compliance with the IMS, development of key performance indicators (KPIs) and their assessment, and producing any periodic reporting required by the Environment Agency under the conditions of the permit. They will also be responsible for managing and implementing the waste pre-acceptance and acceptance procedures, supported by the TCM.

The above individuals will be supported by a Business Support function, including an Administration/HR Manager, Finance Manager, IT Support Technician etc.

An important role of the Senior Management team described above is the continual review and assessment of the IMS. As a minimum this review takes place annually but will be supplemented by regular internal and external audits to assess the effectiveness of the management system. These reviews address:

- Compliance and future regulatory requirements;
- Performance levels with respect to KPIs;
- Root cause analysis with respect to any accidents, incidences or non-conformances;
- Abnormal operating scenarios and response planning;
- Staff succession; and
- Competency, development and training provisions.

Figure 4-1: Organisational organogram



4.1.8 Summary

The Environment Agency's guidance and indicative standards for EMS[3] is summarised below, along with a comparison of how the installation will be managed by the Operator against this guidance.

[3] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits

Table 4-2: High-level summary of Environment Agency standards for Environmental Management Systems

No	Indicative Standard	Controls expected to be adopted by the Operator
1	The EMS and associated management arrangements must have the means available to provide the required standards of environmental protection.	Watercycle has an existing EMS in place certified to ISO 14001:2015 as part of an integrated management system (IMS). The IMS reflects the specific requirements for environmental management systems in the Environment Agency's guidance. This will ensure that compliance with the required standards of environmental protection are achieved.
2	Equipment must be designed and installed to a suitable standard.	The design and operation of the facility takes in to account all relevant requirements concerning BAT and/or relevant appropriate measures.
3	All equipment whose failure may lead to pollution must be operated and maintained so that it continues to operate effectively.	Planned maintenance procedures will be established to ensure all key plant components that have the potential to affect the environmental performance of the facility, or compliance with any legal obligations, remain in good working order.
4	Potential accidents must be identified, any necessary measures to minimise the chances of them happening put in place and plans to minimise the effects if the worst occurs put in place.	An initial appraisal of the potential accident scenarios, associated environmental risks, and relevant mitigation measures appropriate for the design and operation of facility is provided in Section 6.4. An Accident Management Plan (AMP) has been developed and is provided in Appendix A7
5	Sufficient staff must be provided, they must be adequately trained in those aspects which could lead to pollution and they must know how to deal with accidents and understand the responsibilities of the permit.	Staffing levels for the facility have been identified based on the experience of the senior management team and skilled engineers. Formal training will take place, both during induction, but also as part of ongoing refresher training, that will explain the importance of operating the facility in accordance with the requirements of the operational procedures in the IMS, including responding to any accident, incident or operational non-conformance that may have an associated environmental impact. Ongoing training needs will be identified as part of ongoing employee appraisals.
6	All of the necessary written operating instructions must be in place to ensure that staff know how to operate any equipment or plant under normal and abnormal situations. To demonstrate this and ensure auditability, written records must be kept.	The operating instructions and procedures for the installation will be documented in the IMS and this will be available to all employees on the internal intranet site. The procedures will address both normal and abnormal operating scenarios.

4.2 Waste acceptance, handling and storage

The following sections describe the procedures and arrangements for waste pre-acceptance, acceptance, handling and storage taking account of the Environment Agency's *Waste batteries: appropriate measures for permitted facilities* guidance. Many of these requirements are relevant to the storage of batteries only, and not to black mass specifically. Consequently, only those measures which are generic or equally applicable to black mass have been considered.

The facility will only accept industrial wastewaters and battery black mass described by the EWC codes in Table 4-3. These wastes would be received from UK battery recycling facilities (in the case of black mass) and, by majority for the waters, other industrial processes, although a potential supplier has been identified who would be prepared to supply wastewater from its battery recycling process. Non-waste product water from e.g., brines would also be processed.

Table 4-3: Waste types to be accepted at the facility

EWC code	Description of waste
06	INORGANIC CHEMICAL PROCESSES
06 03	**Manufacture – formulation – supply and use of salts and their solutions and metallic oxides**
06 03 14	Solid salts and solutions other than those mentioned in 06 03 11 and 06 03 13
16	OTHER WASTES FROM INDUSTRIAL PROCESSES
16 10	**Aqueous liquid wastes destined for off-site treatment**
16 10 01*	Aqueous liquid wastes containing hazardous substances
19	MATERIALS FROM WASTE AND WATER TREATMENT
19 02	**Physico/chemical treatments of waste**
19 02 11*	Other wastes containing hazardous substances (black mass)

Watercycle has developed a waste management policy as part of its IMS that covers operations at the Heath Business & Technical Park in Runcorn and its laboratories in Manchester. Further details on the pre-acceptance, acceptance and handling and storage arrangements specific to the Runcorn site are provided below.

4.2.1 Pre-acceptance measures

Prior to any waste materials being accepted at the site, the organisation responsible for supplying the waste materials will be required to complete a waste pre-acceptance form. This form will need to be completed for each and every waste delivery to the site.

The form will require the waste supplier to provide the following information:

- General information about the waste producer e.g., company name, address, contact details etc.
- Description of the waste and its composition.
- The physical form of the waste e.g., solid, liquid, sludge.
- Relevant EWC code(s).
- The type of containers, packaging and size of containers used to transport the waste.

- Any specific characteristics about the waste in terms of hazardous properties e.g., potential presence of POPs etc.

The HSE Manager, with support from the TCM, will review the waste pre-acceptance form to assess the suitability of the waste for the processes taking place at the site and confirm there is suitable storage capacity for the waste to be supplied. Only once the waste pre-acceptance form has been approved, and the available storage capacity confirmed, will the waste delivery be booked in.

Where a waste pre-acceptance form is received from a new waste supplier, the supplier will be contacted in advance of accepting the delivery to confirm information on the form and validate that the nature of the waste is suitable for acceptance at the site.

Product specification criteria have been established for the black mass system which are summarised in Table 4-4. New waste suppliers of black mass will be required to confirm that the waste material to be supplied is within these criteria by providing sample analysis reports.

Electronic pre-acceptance records will be maintained on a computerised waste tracking system. These records will be maintained for a minimum period of three years, or as long as mandated by conditions in the permit.

Table 4-4: Contractual product specification for refined black mass

Parameter	Minimum	Maximum
Graphite wt%	10	50
Carbon powder wt%	0	20
Lithium, nickel, cobalt, manganese oxide wt%	20	60
Copper wt%	0	10
Aluminimum wt%	0	10
Organic solvents wt%	0	10
Lithium hexafluorophosphate wt%	0	2
Iron wt%	0	5
Density (bulk) kg/m^3	700	1,300
Density (tapped) kg/m^3	1000	1,600
Hausner ratio	1	1.3
Flow character	Excellent flow	Passable

4.2.2 Waste acceptance measures

Waste acceptance procedures will be implemented to verify that the characteristics of the waste received is consistent with the information on the associated waste pre-acceptance form. Should this not be the case, the waste will be rejected or, if non-conformance is identified once the waste has been cleared to enter the process building, treated as non-conforming and moved to the quarantine area. Only pre-booked wastes that have met the pre-acceptance criteria will be accepted at the site.

Upon arrival at site, all waste vehicles will be temporarily held in the offsite layby adjacent to the site entrance until the security gates to the external off-loading area are opened. Once admitted to the external off-loading area, initial acceptance checks will take place by a suitably trained operator to confirm that:

- A completed waste pre-acceptance form is in place.
- All containers are labelled with the correct product name, quantity and relevant waste classification details in accordance with the waste pre-acceptance form.
- All containers are intact, not leaking and in a suitable condition for storage on site.
- Where the materials contain hazardous waste (e.g. solid black mass) the packaging used is UN approved and the relevant dangerous goods transport information is included on the labels and consignment notes.

Should any of these requirements not be met, the waste delivery will be rejected. This will be logged as a non-conforming event under the procedures established within the IMS, and the supplier of the waste will be notified of the non-conformance. Should repeated non-conforming loads be received from the same waste supplier, the contractual arrangements with that supplier may be terminated.

Due to the nature of the waste and type of storage container (IBCs for the liquid waste and sealed FIBCs for the black mass), visual checks will be limited to the black mass only. To prevent fugitive emissions of wind-blown particles of black mass from opening the black mass FIBCs in the external off-loading area, visual checks will only take place once the acceptance checks above have been completed and the waste accepted into the relevant designated storage area in the enclosed process building. Should these visual checks identify components in the black mass that are not consistent with the pre-acceptance criteria and process requirements e.g., if visible plastic material or larger particles of unknown composition are evident, the delivery will be logged as non-conforming and moved to the quarantine area pending its removal from site.

All waste material will be sampled and submitted for appropriate analytical tests to validate its composition meets the contractual product specification and standard operating procedure for the process. Should the composition of the waste be inconsistent with the contractual specifications, the waste will be moved in its entirety from its dedicated storage area to the quarantine area and treated as non-conforming waste, and the waste supplier will be notified. Should multiple instances of non-conformance be observed, the contractual arrangements with that supplier may be terminated.

The quarantine area is located in a dedicated, segregated and clearly labelled area within the process building. Its location is shown on the waste and raw material storage plan in Appendix A1. It has the capacity to store six FIBC pallets containing black mass or six IBCs containing waste water, although the capacity for storing IBCs may be increased to twelve by double stacking the pallets (FIBCs will not be double stacked). The quarantine area will be bunded and meet the requirements of CIRIA C736. Waste moved to the quarantine area will be transferred offsite to a suitably permitted waste management facility or returned to the originator in the shortest possible timeframe. This will be one week as an absolute maximum. Records will be maintained of any non-conforming waste moved to the quarantine area and removed from the site.

All waste offloading, reception and quarantine areas have impermeable surfaces with connections to a sealed drainage system and/or containment kerbing. The surface drainage system contains interceptor tanks that can be isolated in the event of a spillage. Spill kits will be positioned in key areas and operators will be trained in how to manage spillages in accordance with the spill response plan.

A computerised tracking system will be used to monitor the available capacity in the dedicated storage areas and the quarantine area. Due to the standardised nature of the storage containers in which waste is received, and which are of fixed volume, weighing of incoming waste will not take place. The total quantity of waste in storage will, instead, be calculated from the number of containers in storage/number of pallet spaces remaining.

This tracking system will also store all records generated during pre-acceptance, acceptance, rejection/non-conformance and removal of wastes from site. These records will be maintained for a minimum period of three years, or as required by the conditions of the permit.

4.2.3 Storage and handling of waste

Incoming and outgoing wastes will be stored in dedicated, segregated and appropriately labelled (including stating any hazardous properties) storage areas within the secure process building to prevent unauthorised access and vandalism. Black mass will be stored within sealed 1,000 litre FIBC bags, whilst the waste water will be stored in 1,000 litre rigid IBCs. Each material will be stored in its own dedicated and labelled location, and will be kept separate from each other with no mixed storage in line with HSG71 best practices. The dedicated storage areas are physically separated by walls.

Waste materials will be moved from the offloading area to the storage areas, and from the storage areas to the dedicated discharge stations on each process line, using either fork lift trucks or hand pallet trucks. Only trained operators holding current fork lift truck (FLT) licences will be permitted to move waste materials.

The black mass storage area has the capacity for six 1,000 litre FIBCs. The bulk density of black mass will vary by supplier in the range 0.7 – 1.3 t/m^3. Hence, the maximum storage capacity in mass terms is 7.8 tonnes of black mass. It is expected that the maximum storage time for each black mass FIBC will be one week. FIBCs will not be stacked on one another and will be subject to regular daily checks for any damage e.g., splits, leaks etc. Written records of these inspections will be maintained. Any spillages will be dealt with immediately using spill kits appropriate for the nature of the waste in line with the Spill Response Plans for the specific type of waste spilt. All relevant personnel will receive appropriate training on these plans.

The incoming wastewater storage area has a maximum storage capacity for 48 pallets of 1,000 litre IBCs (48 tonnes). To conserve space, IBC pallets may be stacked on one another but no more than two containers high. The storage room will have appropriate bunding meeting the requirements of CIRIA C736. The IBCs and bund will be subject to daily checks to ensure loss of containment has not occurred. Should liquid waste be observed during these checks, it will be pumped into an appropriate container for offsite disposal at a suitably permitted waste management facility.

The storage areas are shown in the waste and raw materials storage plan in Appendix A1, whilst Table 4-5 provides further information on storage arrangements for the incoming waste.

Table 4-5: Storage arrangements for incoming waste material

Waste type	Where / how stored	Containment measures	Storage capacity	Maximum quantity stored at any one time	Expected annual waste throughput
Industrial wastewater for processing	Stored within 1,000 litre rigid IBCs in a dedicated and appropriately labelled storage area within the enclosed process building	Storage area will be bunded meeting the requirements of CIRIA C736	48 tonnes	48 tonnes	400 tonnes
Black mass	Stored within 1,000 litre (max 1,300 kg) FIBCs in a dedicated and appropriately labelled storage area within the process building	Physically separated from other waste and raw material storage areas using walls	7.8 tonnes	7.8 tonnes	240 tonnes

4.2.4 Measures specific to waste containing persistent organic pollutants

POPs, including PFAS, may be present in the materials brought to the site for processing that have originated from the upstream recycling of LIBs at other off-site facilities.

Polymeric PFAS are typically found in the binder material of LIB electrodes to allow better interconnectivity between the components. The most common binder used in LIBs is PVDF, although PTFE and FEP have also been cited as less common binder materials.

PFAS may also be found in the electrolyte or electrolyte additives. The electrolyte in a LIB consists of a fluorinated salt in one, or several, solvents. The most common salt used has typically been lithium hexafluorophosphate ($LiPF_6$). However, the hexafluorophosphate ion is sensitive to hydrolysis in many common solvents, so battery manufacturers have been introducing new electrolytes based on bis-perfluoroalkyl sulfonimides (bis-FASIs) including, for example, lithium bis-(trifluoromethylsulfonyl)imide (LiTFSI).

Importantly, the Site will not accept LIBs or battery shred from LIB recycling. It will only accept refined black mass from off-site LIB battery recycling processes that has already been through off-site pre-treatment to remove the binder material and electrolyte. Hence, the potential for PFAS to be present in the black mass is much reduced. However, there remains the possibility that some residual PFAS may be present in the black mass, with recent research on the PFAS content of black mass from battery recycling facilities in Australia indicating PFAS concentrations averaging between 12,000 – 17,000 µg/kg with one sample exceeding 50,000 µg/kg. The PFAS content was dominated by bis-perfluoromethanesulfonimide (bis-FMeSI)[4].

It is difficult to draw a conclusion from one research paper on the potential presence and quantity of PFAS in the black mass to be accepted at the installation as different battery chemistries and upstream treatment process will significantly affect the PFAS content and composition of the black mass, whilst there is no data in the reviewed literature for UK facilities. However, given there is a potential presence, all black mass received at the installation will be treated as potentially containing POPs until such a time that sufficient analytical data is available to exclude its presence, or otherwise, in the incoming waste material.

Samples of all waste inputs to the site (i.e., black mass and industrial wastewater) will be analysed for the presence of POPs, including PFAS, and appropriate measures will be taken to ensure their segregation and identification as POPs containing waste on the site plans and on-site labelling systems.

The black mass and industrial wastewater will be stored in sealed or enclosed FIBCs and IBCs in separate rooms/storage areas within the building to ensure segregation between different waste types and other raw materials. No other materials will be stored within these rooms. The rooms will be provided with appropriate signage that clearly defines the materials that can be stored within the rooms and the storage capacity. Appendix A1 provides the Materials Storage Plan indicating the defined storage areas.

Within these rooms, the IBCs containing wastewater will be stored in an appropriate bund which meets the requirements of CIRIA C736 to contain any loss of primary containment. Under no circumstances will material collected in the bunds be discharged to surface water or sewer.

The black mass loading extraction system will capture any fugitive emissions of dust from loading of black mass into the process and direct this to a fabric filter and carbon adsorption unit. Extraction systems will be designed in accordance with HSG258.

By necessity because of space constraints, the initial offloading of waste materials from delivery vehicles will take place on the external yard in front of the enclosed building. All waste materials will be delivered in enclosed IBCs or covered FIBCs to limit any fugitive emissions during the offloading process and transport to the building. The offloading area is constructed of impermeable hardstanding with connections to the sealed drainage

[4] Vo et al. (2026). PFAS released from the metals recovery process of the lithium-ion battery black mass. Journal of Hazardous Materials, 509, 141978

system. Kerbs, drain mats and containment berms will be in place to prevent any spillages entering the drainage system or leaving the offloading area.

However, should these measures fail, the surface water drainage system contains two interceptor tanks in series. Whilst the first interceptor is gravity-fed, the contents from the final tank is pumped, providing a means of isolating the system should an accident occur during offloading which may result in loss of containment. Run-off collected in the interceptor would be pumped to a collection vehicle for appropriate disposal at a suitably permitted off-site facility.

4.2.5 Fire prevention

The only combustible waste accepted at the Site will be the black mass. By its very nature, the wastewater effluent accepted at the Site is not combustible. The risk of fire is limited by the small storage capacity for black mass (7.8 tonnes). Appropriate detection and manual suppression systems will also be in place. The site owners (SOG) also have dedicated emergency response teams.

Appendix A6 provides the Fire Prevention Plan which will be used to minimise the likelihood of a fire happening, aim for the fire to be extinguished within four hours, and minimise the spread of fire within the site and to neighbouring areas.

4.3 Energy efficiency

4.3.1 Basic design measures

The Environment Agency's energy efficiency standards for industrial plants requires that an installation be operated under basic energy efficiency measures. This requires evidence to be provided that basic, low-cost, physical energy efficiency techniques have been included in the design to avoid gross inefficiencies relating to excessive heating or cooling losses. This includes the identification and elimination of all excessive heating or cooling losses from, for example, hot water pipes, heated vessels, ovens, chillers and other temperature-controlled zones or equipment through the implementation of basic insulation and containment methods. Examples of how such requirements will be addressed are provided below.

Insulation of warm/hot fluid systems

Good basic engineering design, including appropriate insulation levels, will be used throughout the facility on warm/hot fluid systems as relevant. In particular, the initial reactors in the black mass process will have appropriate levels of insulation to reduce thermal losses, whilst the hot rinse system on the water process will contain appropriate insulation on the cylinder tank and pipework.

Provision of hoods, lids, air-tight seals and self-closing doors to maintain temperatures

The main process area of the building is only minimally heated to ensure the temperature does not drop below 7°C as this will cause issues with the handling of some raw materials. To reduce energy consumption from space heating, all internal doors in the office area where space heating/air conditioning is provided will be self-closing. All will be fully draught proofed with windows with a reflective coating.

Avoidance of unnecessary discharge of heated water or air by fitting simple timers or sensors

The office area will be operated under a control system that considers both internal and external temperatures to determine the heat/cooling demand, working times and occupancy.

Use of high efficiency lighting

All internal and external lighting at the facility will make use of high efficiency LED lighting. Lighting in internal office areas and corridors will be equipped with time switches or motion sensors. The exterior lighting will be controlled by adjustable electric switches and/or controlled via a timer with manual override where necessary.

Design of motors

Energy efficient motors will be used and sized appropriately for their duty and, where appropriate, will be variable speed drive.

4.3.2 Energy consumption

Table 4-6 provides an expected breakdown of energy consumption at the installation.

Table 4-6: Expected breakdown of delivered and primary energy consumption

Energy source	Energy consumption – delivered (MWh) [A]	Energy consumption – primary (MWh) [B]	% of total	CO_2 emissions (tCO_{2e}/y) [C]	Specific energy consumption (tCO_2 / t product)
Electricity from Grid	256	614	100	109	0.17
TOTAL					

[A] Based on a peak electrical demand of 1,061 kW/day, 241 days operation per year

[B] Factor of 2.4 applied to derive primary energy consumption of imported Grid electricity in accordance with Environment Agency Guidance: *Assess the impact of air emissions on global warming*

[C] Emissions calculated using emission factors in *Greenhouse gas reporting: conversion factors 2025* (https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2025)

4.4 Efficient use of raw materials and water

4.4.1 Raw materials

The main raw materials anticipated to be used at the installation include:

- Non-waste product water
- Sulphuric acid
- Hydrogen peroxide
- Sodium hydroxide
- Sodium carbonate
- Sodium phosphate

In general, raw materials are selected according to three key areas – cost, quality and performance, which includes potential environmental effects. Watercycle frequently reviews the market to ensure it is securing not only the best quality and value from its raw materials, but that information concerning significantly advanced new materials (potentially with improved technical properties or which are associated with a lower environmental impact) is obtained and fed into the decision making process for raw material procurement.

Consumption of raw materials will be optimised and minimised by the use of an automated control system on the black mass processing line. The automated control system monitors e.g., temperature and pH at various stages of the process and automatically adjusts dosing rates to maintain optimum conditions within the reactors, and in the scrubbing liquor of the caustic scrubber.

Operation of the water process has a greater input of manual operator involvement, with fixed quantities of sodium carbonate (or sodium phosphate) in the form of 25 kg bags added to the crystallisation reactor via a powder vacuum system. The dosage quantity is calculated stoichiometrically based on the measured lithium concentration in the feed water. Filter cake containing sodium carbonate from the extraction system of water process raw material decanting stage will be recovered and re-used in the water process.

All storage tanks and containers containing liquids potentially hazardous to the environment will have appropriate containment systems in place per the guidance in CIRIA C736 *Containment systems for the prevention of pollution*. As a minimum, bunds will be designed to accommodate 110% of the storage capacity and constructed of materials that are impervious to the content of material being stored. Alternatively, if more than one vessel is located within a common bund, the bund storage capacity will be a minimum of 110% of the capacity of the largest vessel, or 25% of the total vessel storage capacity, whichever is greatest.

Raw materials will be stored to ensure non-compatible materials e.g., acids and alkalis are adequately segregated. All raw material storage areas will be clearly labelled to ensure incompatibility does not occur.

Table 4-7 provides an estimated inventory of raw materials to be used at the installation. Material Safety Data Sheets for the raw materials are provided in Appendix A11.

Table 4-7: Main raw material inventory

Raw material	Nature and composition	Estimated annual usage (tonnes)	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Non-waste product water	Product waters and brines containing lithium e.g., lithium chloride solutions	400	Stored in 1,000 litre IBCs in the enclosed process building with secondary containment measures in place meeting CIRIA C736 (maximum stored at any time = 48,000 litres)	Residual water (filtrate) transferred off-site in IBCs to a suitably permitted waste management facility	Non-hazardous product water, although may contain certain substances with defined EQS	No alternatives – the rationale of the operation is to recover lithium from such waters
Sulphuric acid	96 - 98% aqueous solution	443	Stored in 1,000 litre IBCs in the enclosed process building with secondary containment measures in place meeting CIRIA C736 (maximum stored at any time = 4,000 litres)	Consumed during the reaction in the black mass process generating sulphite or sulphate salts.	Causes severe skin burns and eye damage	Other acids such as hydrofluoric acid or nitric acid but these have additional health and safety implications

Raw material	Nature and composition	Estimated annual usage (tonnes)	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Hydrogen peroxide	Max. 37% aqueous solution	134	Stored in 1,000 litre IBC in the enclosed process building with secondary containment measures in place meeting CIRIA C736 (maximum stored at any time = 2,000 litres)	Hydrogen peroxide will decompose to water and oxygen in the reaction vessels	The product is classified as a Category 3 acute hazard to the aquatic environment and Category 1 serious eye damage substance. It will readily degrade in the environment to oxygen and water	Acids (e.g., nitric) can be used as an alternative oxidising agent. However, these generate additional emissions which have environmental effects (e.g., NOx)
Sodium hydroxide	32% aqueous solution	976	Stored in 1,000 litre IBC in the enclosed process building with secondary containment measures in place meeting CIRIA C736 (maximum stored at any time = 8,000 litres)	Consumed during neutralisation reactions to form water and sodium salts	Causes severe skin burns and eye damage	Other hydroxide bases e.g., potassium hydroxide. However, this is more corrosive than sodium hydroxide

Raw material	Nature and composition	Estimated annual usage (tonnes)	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Sodium carbonate	Anhydrous sodium carbonate	93	Stored in 25 kg bags in the enclosed process building. Dry powder with any spillages cleaned up with spill kits. Maximum stored at any time = 3 tonnes	Forms lithium carbonate in the end product and sodium salts in filtrate	Causes severe eye irritation	None – intrinsic to the proprietary water process
Sodium phosphate	Hydrated sodium phosphate	180	Stored in 25 kg bags in the enclosed process building. Dry powder with any spillages cleaned up with spill kits. Maximum stored at any time = 3 tonnes	Forms lithium phosphate in the end product and sodium salts in filtrate	Causes serious eye irritation, irritating to skin	None – intrinsic to the proprietary water process

4.4.2 Water use

Water will be used at various stages of the process including as process water in the leach reactor on the black mass process, makeup water in the caustic scrubber, safety systems e.g., safety showers and potable uses in office kitchens and washrooms. Watercycle will apply the following general techniques in sequence to reduce water consumption:

- Use water-efficient techniques at source wherever possible;
- Recycle water within the process where possible (e.g., wash water from the water process will be recycled multiple times before disposal, and its evaluation for use as the water requirement for the black mass process will be made during commissioning);
- Directly measure and record fresh water consumption regularly; and
- As part of the ongoing cleaning/management include general efficiency techniques such as vacuuming, scraping or mopping in preference to hosing down. Where dry methods are not suitable, trigger controls on all hoses, hand lances and washing equipment will be in place.

The indicative annual consumption of water is estimated at 4,300 m^3.

Water flows and volumes will be monitored and confirmed during commissioning and water balances will be submitted to the Environment Agency as part of a proposed post commissioning environmental report introduced by way of a permit improvement condition. Water efficiency audits will be carried out routinely as part of the IMS.

4.5 Avoidance, recovery and disposal of wastes

As the Operator of a process that aims to contribute towards achievement of a Circular Economy, Watercycle is committed to the avoidance and recovery of wastes, with disposal routes used only where there is no viable alternative for recycling or recovery.

Wastes generated on-site will be minimised through efficient management and control procedures, with effluents and residues re-used for other purposes where possible. For example, wash water from the water process will be recycled multiple times before disposal and could be used as the water input to the black mass process with this use being further evaluated during commissioning.

Solid residues from the fabric filters containing metals or other raw materials will be re-used in the process. For example, particulate matter collected from the black mass extraction system filters will be returned back into the leaching reactor, whilst any lithium carbonate fines collected from the product handling extraction system filter would be returned to the product handling stage.

Watercycle sets out to optimise the reuse, regeneration, recycling and/or recovery of each waste stream and, where relevant, ensure the proper disposal route in accordance with the waste hierarchy. Waste audits and regular reviews of alternative options for recovering or disposing waste will take place under the procedures established by the IMS.

The main wastes/residues generated are identified in Table 4-8. The higher quantities of liquid effluents generated relative to wastewater and non-waste product water inputs is accounted for by the additional mains water input to the process.

Table 4-8: Residues management plan

Waste type	Estimated quantity produced per year	Storage location and capacity	Disposal/recovery route
General office waste e.g., paper, light bulbs etc.	< 1 tonne	Bins and containers in office area	Recycled where possible
Liquid effluent from black mass process	1,569 tonnes	1,000 litre IBCs in enclosed process building with bunding in place meeting the requirements of CIRIA C736	Disposal at suitably permitted off-site facility
Caustic scrubber bleed-off effluent	12 tonnes	1,000 litre IBCs in enclosed process building with bunding in place meeting the requirements of CIRIA C736	Disposal at suitably permitted off-site facility
Filtrate from water process	3,093 tonnes	1,000 litre IBCs in enclosed process building with bunding in place meeting the requirements of CIRIA C736	Disposal at suitably permitted off-site facility
Solid residues (graphite cake) from leach reactor	120 tonnes	Stored in 205 litre UN approved drums in enclosed process building	Energy recovery in incineration plant with R1 status
Spent carbon from carbon filtration units	< 3 tonnes	Stored in 205 litre UN approved drums in enclosed process building	Off-site regeneration or energy recovery in incineration plant with R1 status
Solid alkaline contaminated wastes (e.g., PPE, empty raw material bags, wipes, rags, filter cake)	< 5 tonnes	Stored in 205 litre UN approved drums in enclosed process building	Energy recovery in incineration plant with R1 status
Solid acid contaminated waste (e.g., PPE, wipes, rags)	< 2 tonnes	Stored in 205 litre UN approved drums in enclosed process building	Energy recovery in incineration plant with R1 status

All process wastes produced will be subject to a comprehensive WM3 assessment to characterise the waste stream. Prior to any waste process waste being removed from site, documentation from the waste management contractor will be reviewed to ensure:

- the waste transfer is covered by a Waste Transfer Note or Hazardous Waste Consignment Note (as relevant dependent on characterisation);
- the contractor has a valid Waste Carriers Licence; and
- the proposed recovery or disposal site is permitted to accept the waste.

4.6 Security

The Heath Business and Technical Park is enclosed by security fencing and accessed by security gates which are open during operational hours only. Security is controlled by the SOG Security guards who have a 24/7 presence on site. Live 24-hour CCTV cameras are located around the site, with site patrols taking place at a defined frequency.

Block 8, where the process building is located, is enclosed using fencing, with access to the Block 8 facility via swipe card activated gates or key card readers on doors to the building. Swipe cards are issued to authorised users only.

Site fencing is maintained by SOG who make regular weekly checks of the fencing to ensure security is maintained. Any defects or damage which may compromise the integrity of the enclosure will be made secure by temporary repair by the end of the working day. Permanent repairs will be affected as soon as practicable.

4.7 Site condition and restoration

This section describes the measures that will be taken by the Operator to ensure that the Site is eventually closed in an environmentally satisfactory manner and to safeguard against the deterioration of the environment during the operations undertaken whilst permitted.

The baseline conditions of soil and groundwater prior to the commencement of the regulated activities are described in the Site Condition Report in Appendix A10.

Whilst the unavoidable presence of waste, raw materials and residues does present some risk, however slight, of an impact to the soil or groundwater beneath the Site, the design and operational intent is to avoid such impacts occurring.

Guidance requires that the following areas are addressed:

- Steps to be taken at the design and build stage;
- Operations during the permit lifetime; and
- Development of a Site Closure Plan.

4.7.1 Design and build

To assist with Site closure, the design and planning activities for the facility will consider the following requirements:

- Other than the surface drainage system interceptor tanks and associated drainage pipework, there are no other underground tanks or pipelines associated with the process itself. The interceptor tanks are constructed in such a way to minimise the risk of containment failure and integrity inspections will be included as part of the operational procedures in the IMS;
- During initial commissioning, all structures will be tested to ensure they are impervious to water ingress. Any solid or liquid loss from any process systems will be contained within appropriately designed secondary containment systems;
- The process will use a number of vessels, tanks, reactors, etc., for either storage or process operations. Where appropriate, these will be designed for easy cleaning and dismantling, with ready and safe containment of both the process residues and the vessel components. Routine cleaning of some of these vessels will take place whilst, for others, this would be planned as a one-off operation at site closure, or where components

need replacing through premature failure. If any liquid requires disposal prior to maintenance or inspection, it will be retained on site until it can be disposed of via a suitable waste contractor;

- Tanks or other vessels storing liquid substances that are potentially hazardous to the environment will be located on impermeable hardstanding and with appropriate containment designed in accordance with the requirements of CIRIA C736 *Containment systems for the prevention of pollution*;

- Although the design and construction of the plant is primarily driven by factors such as safety, legal design codes, and commercial costs, many of the plant systems and infrastructure are likely to contain construction materials that are inherently recyclable. Established markets exist for steel piping, valves and other fittings, certainly where they can be put to use in less demanding future uses, low pressure regimes, etc. The design of the facility will aim to be as sustainable as possible, and potential for recycling material at the end of the facilities design life will be included during the design process.

4.7.2 Operational phase

Deterioration of soil and groundwater conditions during the operational phase is considered unlikely due to the mitigation measures included in the design specification and management procedures that will be in place. Nonetheless, should any accident, incident or pollution event take place, this will be recorded and monitoring of soil and groundwater will be performed to understand the extent of any contamination. Where relevant, remedial action may take place. These data will be supported by regular periodic monitoring of groundwater and soils as required by the environmental permit once granted.

4.7.3 Site closure

Watercycle recognises that there is a need to ensure that the design, operation and maintenance procedures support the decommissioning of the installation at the end of its operational life in a safe manner without risk of pollution, contamination or excessive disturbance. Watercycle will develop a Site Closure Plan that will be subject to continuous update during the operational phase. The Site Closure Plan will include, but will not be limited to, the following basic elements:

- Procedures and plans for the flushing of the process and safe removal of all fluids, chemicals and other hazardous materials from the site;

- A site plan of drains that will be left in place and any underground infrastructure to be avoided;

- Methods of dismantling machinery, materials handling equipment, fabric filters etc., without significant leakage, spillage or release of dust or other hazardous materials;

- Methods for the demolition or re-use of buildings (if applicable); and

- Identification of the recyclable materials/components which can be recovered or recycled (e.g., metals).

In the course of the demolition activities, materials, plant, equipment, etc., would be recovered for recycling as far as is practicable, bearing in mind their service life and ability to be refurbished/reused, design standards, etc. The demolition will use practices applicable and accepted at the time and will be consistent with safety requirements for demolition

5 Emissions and monitoring

5.1 Overview

This section describes how the release of any substance that might cause harm to human health or the environment will be prevented, or reduced, to achieve a high level of protection to the environment. The facility will, as a minimum, achieve the performance levels provided within this document and the minimum legislative requirements established in the relevant BAT Conclusions and Environment Agency's appropriate measures.

The overall design philosophy of the facility will be to:

- Achieve or exceed the environmental standards applicable under applicable legislation and/or guidance;
- Maximise the protection of human health and the environment by preventing or reducing emissions to a practicable minimum; and
- Be adaptable to changes or evolution in the design to identify further optimisation for emissions control.

5.2 Point source emissions to air

5.2.1 Location and nature of emissions to air

Table 5-1 summarises the main point source emissions to air and the nature of their emissions. A site plan showing the location of these emission points is provided in Appendix A2.

Table 5-1: Point source emission to air locations and nature of emission

Emission point reference	Source	Nature of emissions
A1	Extraction system from lithium carbonate pan dryer	Particulate matter, VOCs, lithium carbonate/phosphate
A2	Extraction system from water process raw material decanting stage	Particulate matter, VOCs
A3	Extraction system from MHP reactor pH correction	Moisture with trace VOCs
A4	Extraction system from refined black mass decanting stage	Particulate matter, metals (cobalt, copper, nickel, lead, zinc, lithium, sodium, potassium, magnesium, calcium, manganese, iron, aluminium), VOCs, PFAS (potentially)
A5	Extraction system from acid leaching reactor	Sulphur dioxide (SO_2), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen fluoride (HF), hexane, VOCs

5.2.2 Emission control techniques

The two process lines and product drying area will generate channelled emissions containing a range of pollutants. These emissions will be controlled by effective process design, optimisation of reaction conditions, and secondary end-of-pipe abatement.

Table 5-2 provides a summary of the techniques used to control point source emissions to air.

Table 5-2: Point source emission to air locations and nature of emission

Emission point reference	Source	Emission control technique(s)
A1	Extraction system from lithium carbonate pan dryer	Process design, pulse jet fabric filter and carbon adsorption unit
A2	Extraction system from water process raw material decanting stage	Process design, pulse jet fabric filter and carbon adsorption unit
A3	Extraction system from MHP reactor pH correction	Process design – discharge is primarily water vapour
A4	Extraction system from refined black mass decanting stage	Process design, pulse jet fabric filter and carbon adsorption unit
A5	Extraction system from acid leaching reactor	Process design, optimisation of reaction conditions, water/alkaline scrubber and carbon adsorption unit

Control of particulate matter and metal emissions

Several types of abatement technologies are available for the control of particulate matter in the flue gas:

- Cyclones or multi-cyclones;
- Electrostatic precipitators (ESPs);
- Fabric filters (or 'bag filters'); and
- Wet scrubbing.

Cyclones are generally not considered to be the BAT on their own as they cannot typically meet the BAT-AEL with removal efficiencies reducing considerably to near zero for particles less than 2.5 µm. Cyclones can generally achieve flue gas concentrations of no less than 200 – 300 mg/m^3, although this can be decreased to 100 –150 mg/m^3 through the application of a multi-cyclone.

ESPs can either be operated in dry or wet form; the latter typically being used when dry ESPs are not suitable, including where the material collected is wet, sticky, flammable or explosive. Modern ESPs, either dry or wet, will typically achieve removal efficiencies between 90 – 99%. ESPs consist of a series of high voltage electrodes and corresponding collector plate electrodes. The high voltage differential between the electrodes and collector plate causes the particulate matter to become charged and move towards the plate under the influence of the electric field. Periodically, the plate is cleaned by rapping, which dislodges the material before falling to a collection hopper for removal. ESPs are particularly suited for higher temperature applications with high flow rates, and have a lower pressure drop than fabric filters. The disadvantage is the high parasitic electrical load required by the unit. ESPs can achieve concentrations of 15-25 mg/m^3, although this is still in excess of the BAT-AEL.

There are various different designs of wet scrubbers, with removal efficiencies ranging from 40 – 60% for a packed tower design and up to 95% for a venturi scrubber. They are generally not considered to represent BAT for control of particulate matter in isolation since they cannot achieve the BAT-AEL, whilst also increasing the consumption of water.

Fabric filters are a barrier method, whereby the particulate matter collects on the surface of the filter bag. Over a short period of time, a filter 'cake' builds up on the surface of the filter media, further improving the collection efficiency. Collection efficiencies of 99.99% or greater can typically be achieved, even for the smallest (< 1 µm) particles. Fabric filters are proven technology and, in accordance with BAT 14 of draft WGC UK BATC and BAT 140 of the NFM BATC are considered BAT for control of channelled emissions of particulate matter and metals. Consequently, this technology will be used at the installation.

Extraction systems will be installed at key waste, raw material and product handling points within the process building to capture what would otherwise become fugitive emissions. The separate extraction systems will direct captured air flows to individual fabric filters which will control emissions of particulate matter, including metals and any residual particulate-bound PFAS compounds present in the black mass.

The fabric filters will contain multiple compartments, each with a set of filter bags allowing isolation for online maintenance or cleaning. Online cleaning will be achieved using a compressed air system to periodically dislodge the filter cake. The dislodged filter cake will fall into a hopper/drum beneath the filter and this discharge system will be fully enclosed. Cleaning of the filter bags will be initiated automatically based on the monitored pressure drop across the fabric filter bags. When a set point is reached (high pressure drop), cleaning will commence and, when the differential pressure returns to a further set point (low pressure drop), cleaning operations will cease.

Control of acid gas emissions

The only source of acid gas emissions will be from the extraction system of the leaching reactor on the black mass process line. As the leaching process uses sulphuric acid and hydrogen peroxide as the oxidising agents, the primary acid gas liberated during the leaching reaction will be SO_2, with the potential presence for small quantities of HF from residual fluorinated compounds in the black mass. BAT 143 of the NFM BATC establishes that BAT for the control of SO_2 emissions from a hydrometallurgical operation is to use a wet scrubber, whilst absorption (i.e., wet scrubbing) is listed as a candidate BAT technique in BAT 18 of the draft WGC UK BATC for the control of SO_2 and HF emissions.

Therefore, in accordance with both sets of BATC, wet scrubbing is considered BAT for the control of acid gas emissions from the hydrometallurgical processing of the black mass.

Process gases generated during the black mass acid leaching stage will be extracted and passed through a particulate washer designed to remove entrained solids and aerosols from the gas stream. The gas will then pass to a packed-bed wet scrubber for the removal of acid gases and other soluble contaminants.

The scrubber recirculation liquor will be maintained within a pH range of approximately 6.0–7.5 using an automated pH monitoring and control system. Operating within this pH range minimises the absorption of carbon dioxide from the process gas stream, thereby reducing carbonate formation, fouling potential, and unnecessary sodium hydroxide consumption. Sodium hydroxide will be dosed automatically if required to maintain the target pH range.

Conductivity monitoring of the scrubber liquor will be used to determine bleed rates and maintain dissolved solids within the operating limits recommended by the equipment supplier. Scrubber bleed-off will be discharged to a bunded 1,000-litre IBC fitted with level monitoring and high-level alarm systems.

Following the wet scrubber, the gas stream will pass through a demister to remove any residual moisture droplets before being treated by a granular activated carbon (GAC) unit for the removal of any remaining trace contaminants. The treated gas will then be discharged to atmosphere via the extraction fans.

An automated control and monitoring system will continuously monitor and record key operating parameters of the scrubbing system including pH, temperature, pressure and conductivity to ensure that the system operates with optimum performance. Interlocks on the control system will prevent the processing of the black mass if the scrubber is not operating within set performance requirements.

Laboratory-scale testing from leaching black mass using sulphuric acid has revealed concentrations of SO_2 and HF in the headspace which, with the additional dilution from the extraction system to ensure lower explosive limits are not exceeded, may be capable of meeting the BAT-AEL without the addition of sodium hydroxide to the scrubbing liquor. If this is replicated at full-scale operation, it may be possible to operate the scrubber using water only. This is advantageous since it reduces raw material consumption and reduces the sodium hydroxide storage requirement. The ability for the scrubber to meet the BAT-AEL using water only will be tested during commissioning, and the outcomes provided to the Environment Agency in a post-commissioning environmental report, which is proposed to be included in the permit by way of improvement condition.

Control of organic compound emissions

There are a variety of techniques available to control emissions of volatile organic compounds. Per BAT 11 of the draft WGC UK BATC, these include:

- Adsorption
- Absorption
- Catalytic oxidation
- Condensation
- Thermal oxidation
- Bioprocesses

Adsorption (use of activated carbon filters) has been selected as BAT for the installation from the list of candidate techniques for the following reasons:

- It has a guaranteed performance level that meets the BAT-AEL.
- It can operate efficiently on the diluted air streams that are produced by the extraction systems. By contrast, condensation is most suitable for very high concentration, low flow processes.
- It has fewer cross media effects than absorption or catalytic/thermal oxidation. The main cross media effects associated with adsorption are the consumption of raw materials and production of a solid waste stream. Absorption also has these cross media effects but additionally generates a liquid effluent that either needs to be treated or disposed of, whilst catalytic/thermal oxidation increases raw material and energy consumption (natural gas use) and results in emissions to air of combustion products.
- Unlike biological processes, it can treat non-biodegradable organic compounds. Therefore, it is more appropriate for controlling emissions of certain groups of organic compounds that have the potential to be found in some emission sources that are less amenable to biodegradation e.g., PFAS.
- It has been widely used in multiple sectors for reducing emissions of VOCs and is a known and tried-and-tested technique.

The carbon adsorption units to be installed a the installation are designed to remove up to 4,000 ppm of VOCs. The efficiency of the carbon adsorption unit will decrease with time as organic compounds become adsorbed on to the surface and pores within the carbon. Consequently, Watercycle will take regular samples of the carbon (on a quarterly basis) during first year of operation and submit this for CTC testing to identify the saturation rate of the carbon and ensure complete breakthrough does not occur. The CTC results will be supported by 6-monthly monitoring of VOCs (see Section 5.8.1).

Control of PFAS emissions to air

Point source emissions to air of PFAS will be controlled by a combination of in-process techniques and secondary abatement in the form of fabric filters, wet scrubbers and carbon adsorption.

The extraction system on the black mass decanting stage is considered to be the only emission point that has the potential to emit PFAS to air in any meaningful amount. The fabric filter connected to this system will support the control of particle-phase PFAS, whilst the carbon adsorption unit will control emissions of any volatile PFAS components.

The extraction system on the black mass leaching reactor is not expected to be a significant source of PFAS emissions to air as, at the reactor design conditions (i.e., temperatures < 65°C) there is no thermodynamic or kinetic pathway that would generate PFAS emissions to air.

As previously described in Section 4.2.4, if PFAS are present in the black mass, they are most likely to be present as bis-FASIs. Bis-FASIs are ionic, relatively high molecular weight compounds with low intrinsic vapour pressures compared with neutral, volatile PFAS compounds such as fluorotelomer alcohols. The leaching process is conducted at comparatively low temperatures, substantially below temperatures at which significant volatilisation or thermolysis of fluorinated ionic species would be expected. In addition, the process involves limited mechanical agitation due to a relatively low mixing intensity, thereby reducing the potential for aerosol generation, droplet entrainment, or stripping of dissolved species into the gas phase. Unlike thermal treatment or high-energy industrial processes, the reactor conditions are not conducive to the formation of volatile fluorinated degradation products and this is demonstrated in recent research which identifies most PFAS in the incoming black mass is subsequently found in the leachate and residual solids from the reactor[4].

Consequently, any potential transfer of bis-FASIs from the aqueous phase to air would be expected to occur primarily via minor aerosolisation mechanisms rather than volatilisation, and overall emissions to air are therefore expected to be negligible under normal operating conditions. Any minor quantities of PFAS that do partition to the vapour phase or entrained within aerosols will be captured by the wet scrubber, particularly for aerosol phase or acidic PFAS, or, in the case of any neutral/volatile PFAS, in the carbon adsorption polishing unit.

5.2.3 Emissions inventory

Table 5-3 provides an estimated emission inventory for point source emissions to air. The emission levels represent a combination of BAT-AELs (where these exist) or, where no BAT-AEL exists, represent data from laboratory scale trials that have sampled the head space formed from the leaching of a 20 g sample of black mass using sulphuric acid and hydrogen peroxide. Actual emission levels will be confirmed during commissioning.

Based on this initial laboratory-scale testing, it is expected that most of the VOCs associated with the unleached black mass would be accounted for by dimethyl carbonate (and/or methanol as a degradation product) associated with its use as a solvent in the electrolyte of LiBs. Speciation analysis of the VOCs liberated during leaching of the black mass indicates primarily C2 – C7 saturated and unsaturated aliphatic hydrocarbons e.g., n-hexane, with no aromatic compounds identified. Hence, whilst there is the potential for some compounds which are classed as CMR Category 2 to be present in the emissions from the black mass leaching reactor, there is not expected to be any VOCs present which are CMR Category 1A or 1B in the emissions.

Table 5-3: Emission inventory for point source emissions to air

Substance	Emissions			Calculated (C), Measured (M) or Estimated (E)	Benchmark emission limit (mg/Nm³)	Source of benchmark
	mg/Nm³	g/s	t/y			
Emission Point A1 (Extraction system from lithium carbonate pan dryer) [B]						
Particulate matter	5	0.0008	0.005	E	< 1 – 5	WGC UK BATC
Lithium	5	0.0008	0.005	E	N/A	No benchmark available
Total VOCs	20	0.003	0.02	E	< 1 – 20	WGC UK BATC
Emission point A2 (Extraction system from water process raw material decanting stage) [C]						
Particulate matter	5	0.002	0.007	E	< 1 – 5	WGC UK BATC
Total VOCs	20	0.009	0.030	E	< 1 – 20	WGC UK BATC
Emission Point A3 (Extraction system from MHP reactor pH correction) [D]						
Total VOCs	20	0.008	0.028	E	< 1 – 20	WGC UK BATC
Emission Point A4 (Extraction system from refined black mass decanting stage) [E]						
Particulate matter	5	0.005	0.007	E	< 1 – 5	WGC UK BATC
Total VOCs	20	0.02	0.03	E	< 1 – 20	WGC UK BATC
Cobalt	0.09	0.0001	0.0001	E	N/A	No benchmark available
Copper	0.17	0.0002	0.0002	E	N/A	No benchmark available
Nickel	0.1	0.0001	0.0001	E	< 0.02 – 0.1	WGC UK BATC
Lead	0.1	0.0001	0.0001	E	< 0.01 – 0.1	WGC UK BATC
Zinc	0.21	0.0002	0.0003	E	N/A	No benchmark available
Lithium	0.04	0.00004	0.00005	E	N/A	No benchmark available
Sodium	0.003	$3x10^{-6}$	$4x10^{-6}$	E	N/A	No benchmark available
Potassium	0.03	0.00003	0.00004	E	N/A	No benchmark available
Magnesium	0.0004	$4x10^{-7}$	$5x10^{-7}$	E	N/A	No benchmark available

Substance	Emissions			Calculated (C), Measured (M) or Estimated (E)	Benchmark emission limit (mg/Nm³)	Source of benchmark
	mg/Nm³	g/s	t/y			
Calcium	0.0003	$3x10^{-7}$	$4x10^{-7}$	E	N/A	No benchmark available
Manganese	0.27	0.0003	0.0004	E	N/A	No benchmark available
Iron	0.005	$5x10^{-6}$	$6x10^{-6}$	E	N/A	No benchmark available
Aluminium	0.10	0.0001	0.0001	E	N/A	No benchmark available
PFAS [A]	---	---	---	---	N/A	No benchmark available
Emission point A5 (Extraction system from acid leaching reactor) [F]						
Sulphur dioxide	100	0.08	0.27	E	50 - 100	NFM BATC
Carbon monoxide	21	0.02	0.06	E	N/A	No benchmark available
Hydrogen fluoride	1	0.001	0.003	E	≤ 1	WGC UK BATC
Hexane	0.4	0.0003	0.001	E	N/A	No benchmark available
Total VOCs	20	0.02	0.06	E	< 1 – 20	WGC UK BATC
Total VOCs (sum of CMR Category 2)	10	0.01	0.03	E	< 1 – 10	WGC UK BATC

[A] Although there is the theoretical potential for these compounds to be present in the emissions, there is currently no data (either from this specific process or other related sites) that allows these emissions to be quantified as PFAS emissions to air is still an emerging research area. Emissions monitoring will be performed during the commissioning period to identify the presence of these compounds and, if above LOD, an updated air quality assessment will be provided. It is proposed that the requirement to monitor and report the outcome of the PFAS emissions monitoring to the Environment Agency is added to the permit by way of an improvement condition.

[B] Annual emissions calculated based on a volumetric flow rate of 544 Nm³/h, drying process taking place 8 hours a day for 241 days a year (1,928 h/y) .

[C] Annual emissions calculated based on a volumetric flow rate of 1,548 Nm³/h, two batches per day with extraction operating for 2 hours per batch, 241 days a year (964 h/y).

[D] Annual emissions calculated based on a volumetric flow rate of 1,457 Nm³/h, two batches per day with extraction operating for 2 hours per batch, 241 days a year (964 h/y).

[E] Annual emissions calculated based on a volumetric flow rate of 3,791 Nm³/h, two batches per day with extraction operating for 45 minutes per batch, 241 days a year (362 h/y)

[F] Annual emissions calculated based on a volumetric flow rate of 2,834 Nm³/h, two batches per day with extraction operating for 2 hours per batch, 241 days a year (964 h/y)

5.3 Point source emissions to surface water and sewer

5.3.1 Surface water

There will be no point source emissions to surface water from the installation.

5.3.2 Sewer

The only point source emissions to sewer during normal operation will be uncontaminated run-off from roof gullies and hardstanding areas of the facility not storing waste or other potentially polluting substances, and domestic effluent from the office kitchen and toilets. The sealed surface drainage system incorporates interceptors which can be isolated prior to the final discharge points from the installation boundary.

Table 5-4: Point source emissions to sewer

Emission point reference	Nature of discharge
S1	Uncontaminated surface runoff and domestic foul water
S2	Uncontaminated runoff from roof areas
S3	Uncontaminated surface runoff

There will be no discharges of process effluents to sewer. Bleed liquor from the scrubber will primarily be an alkaline brine consisting of sodium sulphite and sodium carbonate/bi-carbonate. This will not be discharged to surface water or sewer but will be directed to a 1,000 litre rigid IBC with suitable bunding (minimum 110% of IBC volume) for subsequent transfer for off-site treatment at an appropriately permitted third party waste management facility. Other waste process waters will also be collected and disposed of in a similar manner as the scrubber liquors.

The surface drainage plan is provided in Appendix A2.

5.4 Emissions to land

There will be no emissions to land.

5.5 Fugitive emissions

5.5.1 Emissions to air

With the exception of the initial unloading of waste and raw materials from delivery vehicles, all other areas involving the handling and storage of wastes and other dusty materials will be enclosed within a building to minimise fugitive emissions to air of particulate matter. Waste and raw material deliveries will be enclosed or covered vehicles and containers and will not be opened in the external area.

Minimisation of fugitive emissions from material handling within the building will be aided by the maintenance of negative pressure in the enclosed building by means of the suction created by extracting air above the waste/raw material loading stations using an abated extraction system. Extracted air from these systems will be discharged to atmosphere after passing through a fabric filter and carbon adsorption unit.

Doors to the building will only be opened for access during loading and unloading operations and will default to the closed position at all other times.

Storage containers for any solid materials will be inspected upon arrival to detect any leaks/damage. These will be unloaded by trained operators who hold current FLT licences. Good housekeeping practices will be implemented to ensure that any spillages of potentially dusty materials are cleared up at the earliest opportunity.

Compared to other chemical processes which involve the use of highly volatile gases or liquid solvents, the nature of the raw materials and outputs i.e., solids and aqueous mixtures, means that there is a much lower potential for fugitive emissions of VOCs associated with the storage and handling of raw materials and products. There is the potential for VOCs to be liberated during processing of the raw materials, but extraction systems at key points in the process will capture and direct what would otherwise become fugitive emissions to abatement equipment with the treated extract air discharged through individual vents.

The small-scale size of the site and process means there is a much lower potential for fugitive emissions of VOCs due to lower numbers of reactors, storage tanks, connections etc., and smaller pipeline runs than other chemical works.

In addition to the above factors which prevent fugitive VOC emissions by limiting the number of emission sources, fugitive emissions of gaseous components will be further reduced through the following control measures:

- Reducing the number of pipe connections and using welded fittings where appropriate.
- Use of high integrity components (for example, seals or gaskets).
- Collection of off-gases containing VOCs and sending them to abatement devices.
- Operation of the black mass leaching process and equipment under negative pressure.

The residual solvent content of refined black mass will vary by supplier but is typically expected to be in a range between 0.5 – 3 wt% (although the specification in Table 4-4 does allow up to 10% solvent content without compromising the process). Based on the design black mass throughput of 240 t/y, the solvent input to the installation would be expected to be in the range 1 – 7 t/y. Most of this solvent input would be released when loaded into the reactor and during the leaching stage where the extraction systems described previously would capture the VOCs in the off-gases and direct them to abatement systems. Total fugitive emissions to air of VOCs are, consequently, expected to be less than 1 t/y.

5.5.2 Emissions to surface water, sewer or groundwater

Potential fugitive releases to surface water, sewer or groundwater are only likely to occur as a result of an accident or incident involving the loss of containment and Section 6.4 provides a risk assessment of these potential releases.

All storage vessels containing potentially polluting liquids will be stored within the enclosed process building in appropriate containers (e.g., rigid IBCs) constructed of material suitable for the contents, and stored on impermeable hardstanding with additional containment measures in place that meet the requirements of CIRIA C736 *Containment systems for the prevention of pollution*. Process tanks/reactors will also be used that will temporarily store potentially polluting substances. These tanks will be designed to be watertight and constructed out of materials suitable for the contents. Where necessary, these will include appropriate lining to prevent thermal shock or chemical corrosion.

Level monitors and/or leak detection systems will be installed within the process tanks and/or bunds to alert operators in the event of loss of containment from the primary storage vessels. Storage containers will be regularly inspected (daily) to ensure they remain fit for purpose and containment remains intact.

Other general measures to control fugitive emissions to water include:

- Spill kits will be available for the clean-up of all materials. The IMS will contain a Spill Response Plan and all site operators will be trained on how to respond to spillages.

- All waste storage, handling and process areas will be located on impermeable hardstanding connecting to a sealed drainage system. The integrity of these areas will be regularly checked as part of routine maintenance procedures established under the IMS.

- Drainage onto hard-standing without specific directional flow to a collection point will not be practiced.

- All areas where waste materials or chemicals will be delivered, or where residues are collected and loaded to vehicles, will be provided with suitable bunds or containment kerbs.

- All fluids stored in vessels which have a potential impact on the environment will be provided with impermeable secondary containment. Bund capacities will be a minimum of 110% of the vessel volume or, if more than one vessel is located within a common bund, will be a minimum of 110% of the capacity of the largest vessel, or 25% of the total vessel storage capacity, whichever is greatest.

- Storage vessels, reactors, pipework and fittings will be chemical resistant and using construction materials suitable for the fluid being handled.

5.6 Odour

Neither the black mass nor industrial wastewater is expected to have a strong, distinct odour when being stored. However, it is possible for residual organics in the black mass to generate a slight, solvent like odour when agitated during the process of loading this material into the process line. The following measures will be in place to control odour emissions:

- Black mass and industrial wastewater will be delivered to the site in enclosed IBCs or sealed FIBCs.

- The main storage and handling processes will take place within an enclosed building.

- Extraction systems will be used to capture any fugitive emissions during material handling operations which will be routed to a fabric filter and carbon adsorption unit to reduce the concentration of volatile organic compounds before being emitted to atmosphere via a stack.

- Emissions from the black mass acid leaching stage will be discharged through a caustic scrubber and carbon adsorption unit to remove acidic and organic compounds which may elicit an odour.

- Doors to the process building will normally be kept shut, with the exception of periods where access and egress to/from the building is required for waste deliveries/finished product transfers.

Due to the low potential to generate odour from the permitted activities, it is not considered necessary to develop an odour management plan.

5.7 Noise and vibration

There are a number of potential sources of noise and vibration associated with the operations. These include mobile sources e.g., delivery vehicles and forklift trucks, and stationary sources e.g., pumps and fans associated with the two process lines. The following measures are built into the design and operational procedures to control noise emissions:

- Deliveries and process operations will only take place during weekdays between the hours of 08.00 – 17.00.

- Site speed limits will be enforced.

- Use of broadband (white noise) vehicle reversing alarms rather than “beeping” reversing alarms.

- With the exception of raw material and waste unloading, all process operations will take place within an enclosed building providing significant attenuation.
- Doors to the building will normally be closed, with access limited only to times of waste deliveries or export of wastes produced by the process.
- Specification for and use of low-noise fans and pumps.
- All plant and equipment to be maintained per manufacturer recommendations.

Use of the Environment Agency's Noise Assessment Tool (NAT) indicates that with these measures in place, neither a detailed noise impact assessment nor noise management plan would be required. The completed NAT is provided in Appendix A8.

5.8 Monitoring and reporting

5.8.1 Point source emissions to air

Monitoring of point source emissions to air will involve periodic/extractive monitoring techniques in accordance with the Environment Agency's Monitoring Certification Scheme (MCERTS). Prior to any periodic sampling being carried out, a site specific protocol (SSP) will be developed by the test team under MCERTS requirements.

Sample ports to support the periodic monitoring will be installed taking account of guidance in the Environment Agency's *Monitoring stack emissions: measurement locations guidance* (formerly Technical Guidance Note (Monitoring) M1), and the requirements of BS EN 15259, including the Environment Agency's Method Implementation Document (MID) for EN 15259. To support the periodic monitoring, a sampling platform with appropriate access, power supplies, lighting and facilities for lifting heavy items of equipment will be provided where required.

Table 5-5: Summary of monitoring of emissions to air

Release point	Substance	Monitoring method	Monitoring frequency	MCERTS certified?
A1	Particulate matter	BS EN 13284-1	Once every year	Yes
	Total VOCs	BS EN 12619	Every 6 months	Yes
	PM_{10} and $PM_{2.5}$	BS EN ISO 23210	Once every year	Yes
	Metals (incl. lithium)	BS EN 14385	Every 6 months	Yes
A2	Particulate matter	BS EN 13284-1	Once every year	Yes
	Total VOCs	BS EN 12619	Every 6 months	Yes
	PM_{10} and $PM_{2.5}$	BS EN ISO 23210	Once every year	Yes
A3	Total VOCs	BS EN 12619	Every 6 months	Yes
A4	Particulate matter	BS EN 13284-1	Once every year	Yes

Release point	Substance	Monitoring method	Monitoring frequency	MCERTS certified?
	Total VOCs	BS EN 12619	Every 6 months	Yes
	PM_{10} and $PM_{2.5}$	BS EN ISO 23210	Once every year	Yes
	Lead and its compounds	BS EN 14385	Every 6 months	Yes
	Nickel and its compounds	BS EN 14385	Every 6 months	Yes
	Other metals (total)	BS EN 14385	Every 6 months	Yes
	PFAS [A]	US EPA OTM-45 and OTM-50	Once every year	Yes
A5	Total VOCs	BS EN 12619	Every 6 months	Yes
	Sulphur dioxide	BS EN 14791 or CEN/TS 17021	Every 6 months	Yes
	Hydrogen fluoride	CEN TS 17340	Every 6 months	Yes
	Carbon monoxide	BS EN 15058	Once every year	Yes
	Hexane	BS EN/TS 13649	Every 6 months	Yes
	PFAS [A]	US EPA OTM-45 and OTM-50	Once every year	Yes

[A] To include specific compounds covered by OTM-45 and OTM-50 only.

As Table 5-3 demonstrates that emissions to air of all compounds and from all emission sources are less than 1 kg/h, in accordance with the footnotes to Table 9 within BAT8 of the draft WGC UK BAT Conclusions, the monitoring frequency may be reduced to once every year, or once every 3 years, as appropriate, if emission levels are proven to be sufficiently stable. Watercycle would propose to review this position with the Environment Agency after the first 12 months of operation.

5.8.2 Fugitive emissions to air

As described in Section 5.5.1, the inherent scale of the site/processes, nature of the raw materials and products, and other control measures in place, means there is a considerably reduced potential for fugitive emissions to air of VOCs than other chemical works, with fugitive emissions to air of VOCs estimated at less than 1 t/y. Consequently, in accordance with BAT 22 of the draft WGC UK BATC which only requires monitoring of diffuse emissions of VOCs when these are estimated to be greater than 5 t/y, it is not proposed to perform routine monitoring of fugitive emissions of VOCs.

Notwithstanding the above, a Leak Detection and Repair (LDAR) programme will be established under the IMS to support the identification and reduction of fugitive emissions to air.

5.8.3 Emissions to water

As there will be no discharges to water other than uncontaminated surface run-off, it is not proposed to routinely monitor emissions to water. However, samples of the process effluent that will be temporarily stored on-site in IBCs before being transferred to a suitably permitted off-site facility will be collected to support WM3 classification and to determine the presence of POPs or PFAS.

The analysis of these samples will be performed by an appropriately accredited UKAS laboratory. The monitoring standard for PFAS is likely to be BS ISO 21675 but this will be confirmed during further consultation with the accredited laboratory based on the expected sample matrix.

5.8.4 Process monitoring

To ensure that the process is operating at optimum performance levels, and to record the consumption and support reporting of other environmentally relevant resources, monitoring of the following will be performed.

Table 5-6: Summary of monitoring of process variables

Process variable	Description and monitoring frequency
Reagent dosing	Continuous monitoring of flow, level indication and temperature to manage and control dosing rates
Pressure drop across fabric filters	Continuous monitoring to detect bag failures and initiate cleaning to maintain plant efficiency
Mass of waste delivered to the facility	Recording of the mass of each load delivered to the facility (using number of fixed volume storage containers as a proxy)
Scrubber pH, temperature, pressure and conductivity	Continuous monitoring to ensure optimum performance of the scrubber
Reactor temperature and level	Continuous monitoring during operation of the process lines to ensure the system is operating within defined parameters
Energy consumption	Continuous metering of electricity consumed at the Site
Water consumption	Continuous metering of total mains water consumed at the Site

6 Environmental risk assessment

6.1 Risk assessment framework

In accordance with the Environment Agency's guidance[5], the Environmental Risk Assessment (ERA) is structured as follows:

1. Identification and consideration of the risk/hazard at the Site and sources of the risks;
2. Identification of receptors (people, animals, property and anything else that could be affected by the hazard) at risk;
3. Identification of possible pathways from the sources of the risks to receptors;
4. Assessment of the risks relevant to the specific activities carried out at the Site and consideration of which risks can be screened out as negligible; and
5. Description of measures to control identified risks.

The risk assessment aims to determine the probability of exposure to the identified hazard/risk, and the consequence i.e., what is the harm that can be caused to a receptor if exposure occurs. The probability of exposure is an assessment of the probability of the selected source and receptor being linked by the identified pathway. The consequence provides an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is a worst-case classification and is based on full exposure via the particular linkage being examined.

Criteria which have been used to evaluate the probability of exposure and consequence are described in Table 6-1.

Table 6-1: Risk assessment criteria

Factor and definition	Description
Probability of exposure	
High likelihood	An event that could result in exposure of the contact/receptor is very likely to occur in the short-term and is almost inevitable over the long-term.
Likely	It is probable that an event that could result in exposure of the contact/receptor will occur. It is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	Circumstances are possible under which an event that could result in exposure of the contact/receptor could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short-term.
Unlikely	It is improbable that an event that could result in exposure of the contact/receptor would occur even in the very long-term.

[5] https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

Factor and definition	Description
Consequences	
Severe	Acute harm to human health. Immediate pollution impact of sensitive water resource (e.g., major spillage into controlled waters). Impact on controlled waters e.g., large-scale pollution or very high levels of contamination. Catastrophic damage to buildings or property (e.g., explosion causing building collapse). Ecological system effects – irreversible adverse changes to a protected location. Immediate risks.
Medium	Chronic harm to human health. Pollution of sensitive water resources (e.g., leaching of contaminants into controlled waters). Ecological system effects – substantial adverse changes to a protected location. Significant damage to buildings, structures and services (e.g., damage rendering a building unsafe to occupy, such as foundation damage).
Mild	Non-permanent health effects to human health. Pollution of non-sensitive water resources (e.g., pollution of non-classified groundwater). Damage to buildings, structures and services (e.g., damage rendering a building unsafe to occupy, such as foundation damage). Substantial damage to non-sensitive environments (unprotected ecosystems e.g., crops).
Minor/negligible	Non-permanent effects to human health or loss of amenity rather than health effects. Minor pollution to non-sensitive water resources. Minor damage to non-sensitive environments (unprotected ecosystems e.g., crops). Easily repairable effects of damage to buildings, structures, services or the environment (e.g., discoloration of concrete, loss of plants in a landscaping scheme).
Overall risk	
Very high risk	Severe harm to a receptor may already be occurring OR a high likelihood that severe harm will arise to a receptor, unless immediate remedial works/mitigation measures are undertaken.
High risk	Harm is likely to arise to a receptor, and is likely to be severe, unless appropriate remedial actions/mitigation measures are undertaken. Remedial works may be required in the short-term, but likely to be required over the long-term.
Moderate risk	Possible that harm could arise to a receptor, but lower likelihood that such harm would be severe. Harm is likely to be medium. Some remedial works may be required in the longer term.
Low risk	Possible that harm could arise to a receptor. Such harm would at worse normally be mild and temporary.
Very low risk	Low likelihood that harm could arise to a receptor. Such harm unlikely to be any worse than mild.

The potential overall risk for each accident is calculated from the following matrix included as Table 6-2. A classification of 'Moderate' overall risk and above is considered not acceptable and requires possible further remedial measures/control mechanisms to mitigate the overall risk to an acceptable level.

Table 6-2: Overall risk definition

Potential consequence	Probability of exposure			
	Unlikely	**Low likelihood**	**Likely**	**High likelihood**
Minor/negligible	Very Low	Very Low	Low	Moderate/Low
Mild	Very Low	Low	Moderate/Low	Moderate
Medium	Low	Moderate/Low	Moderate	High
Severe	Moderate/Low	Moderate	High	Very High

Notes: Unacceptable risk level shaded in red.

6.2 Hazard identification

Hazards and risks to be considered within this assessment are presented within Table 6-3.

Table 6-3: Identified Hazards

No	Hazard / Risk	Details	Further consideration in the assessment?
1	Amenity impacts	Potential dust emissions from normal operations and during routine maintenance	Yes
2	Noise and vibration	Potential noise sources include pumps and mobile plant	Yes
3	Odour	It is possible for residual organics in the black mass to generate a solvent like odour when agitated and/or being handled	Yes
4	Point source emissions to air	Point sources emissions from the extraction systems on both process lines and product handling area	Yes
5	Point source emissions to sewer	Other than uncontaminated run-off from roof and external hardstanding areas not storing or handling potentially polluting substances, there are no point source emissions to sewer from the Site	No (except for accident scenarios)
6	Point source emissions to surface water	There are no point source emissions to surface water from this site.	No (except for accident scenarios)
7	Point source emissions to land	There are no point source emissions to land from this site	No
8	Fugitive emissions	Potential fugitive emissions from waste and raw material handling and storage	Yes
9	PFAS	Whilst off-site pre-treatment processes will limit the amount of PFAS in the incoming waste streams, there is the theoretical potential for residual amounts to be	Yes

No	Hazard / Risk	Details	Further consideration in the assessment?
		present which could be emitted to air during waste storage and handling, and in the process discharges.	
10	Abnormal operations or accidents	Potential hazards include unwanted reactions from incompatible mixtures, fire, vandalism/arson, plant or equipment failure, spillages due to loss of containment, flooding and power loss	Yes

6.3 Sensitive receptors

As described in Section 2.2, the Site is located in the Heath Business and Technical Park in Runcorn, Cheshire. The immediate surroundings external to the business park would largely be classed as suburban, with larger areas of industrial land use adjacent to the River Mersey to the west, south and north of the Site in Weston Point and Runcorn.

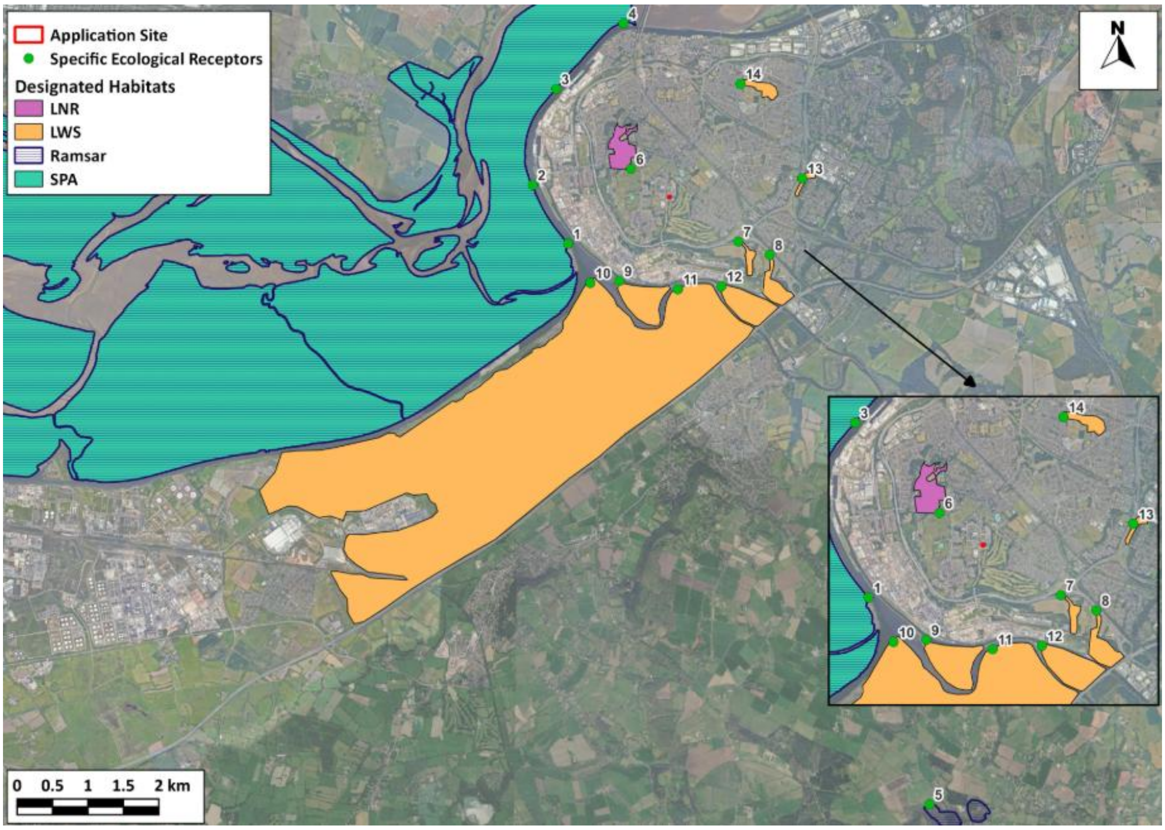
The nearest relevant receptors are summarised in Table 6-4, and Figure 6-1 through Figure 6-2.

Table 6-4: Identification of nearest relevant human and ecological receptors

Receptor Type	Receptor name	Approximate distance and direction from Site boundary (m)
Human (non-occupational) exposure	Golf course fairway Fieldsway Clifton Road Weston Crescent	100 m east 210 m south-west 250 m north-east 250 m west
Surface water	River Weaver	1.5 km south
Ground water	Source Protection Zone 3	4.5 km north-west
Receptors designated under the Habitats Regulations	Mersey Estuary SPA/Ramsar	1.6 km south-west
Local/non-statutory habitat sites	Runcorn Hill Local Nature Reserve	700 m north-west
Air Quality Management Areas	None within 10 km	

Figure 6-1: Nearest human receptors (receptors from air quality assessment report)

Figure 6-2: Nearest ecological receptors



6.4 Scope of quantitative assessments completed

A quantitative air quality assessment has been necessary to establish:

- if point source emissions from the proposed operations have the potential for a negative impact on nearby human and ecological receptors;
- to identify whether the level of risk is considered acceptable with appropriate mitigation; and
- to assess if further measures are required.

No other quantitative assessments have been judged necessary, with all other hazards and risks set out in Table 6-3 assessed qualitatively within a bespoke site-specific risk assessment, the details of which are described within Table 6-5.

The requirement for a quantitative noise impact assessment (and associated Noise Management Plan (NMP)) was assessed using the Environment Agency's Noise Assessment Tool (NAT). The outputs of this tool indicated that a quantitative noise impact assessment and NMP would not be required. Appendix A8 provides the completed NAT. Measures for controlling noise emissions have previously been described in Section 5.7.

As a decision has been made to proceed to dispersion modelling for all pollutants emitted from point source emission to air locations, a H1 database has not been completed. The process contributions and predicted environmental concentrations produced by the H1 database would just be overwritten by the equivalent results from the air quality assessment in Appendix A9, whilst Table 5-3 provides the point source emissions to air inventory.

6.4.1 Air quality assessment

Point source emissions of relevant pollutants emitted to air from the installation have been subject to further assessment using dispersion modelling. The dispersion modelling report presenting the methodology and results of the assessment is provided in Appendix A9.

The results from this assessment demonstrate there are no exceedances of the air quality standards, air quality objectives or environmental assessment levels at any human receptor. In addition, predicted deposition rates of metals and fluoride are below the respective maximum deposition rates in the Environment Agency's *Air emissions risk assessment for your environmental permit* guidance.

At all designated ecological receptors, annual mean SO_2 predicted environmental concentrations (PECs) are well below the most stringent critical level, and the HF process contributions (PCs) are well below 1% of the critical levels, regardless of averaging period (i.e. weekly mean or 24-hour mean).

With respect to acid deposition, the PECs at the Mersey Estuary SPA / Ramsar are below the critical load. At the local wildlife sites, whilst the PECs exceed the relevant critical load at some designated habitats due to the background deposition rate alone, the PCs are all well below 100% of the relevant critical loads and, under the Environment Agency's guidance, would not be considered significant.

Accounting for the worst-case assumptions adopted within this assessment, impacts on human receptors and ecological habitats are assessed as not significant.

6.4.2 The Conservation of Habitats and Species Regulations

Protection of certain habitat sites is provided via Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') and Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive'). These directives are transposed in England on land within 12 nautical miles of the coast through the Conservation of Habitats and Species Regulations 2017, as amended (the 'Habitats Regulations').

The Habitats Regulations implement the EU Bird and Habitats Directives, both of which aim to protect a network of sites in the UK that have rare or important habitats and species. The sites designated under the Birds Directive are known as SPAs and aim to conserve the habitats that support regularly occurring migratory, or certain rare or vulnerable birds, to ensure their survival and reproduction in their area of distribution. Prior to classification by the UK Government, the sites are known as potential SPAs (pSPAs).

The Habitats Directive establishes the process for the designation of SACs; these are sites that support habitats and/or species which are rare or threatened on a European scale. Before the SAC designation is ratified by the European Commission the sites are referred to as candidate SACs (cSACs).

SPAs and SACs are collectively known as 'European sites' or 'Habitats sites' and form part of a European network known as Natura 2000. It is also Government policy for sites designated under the Convention on Wetlands of International Importance (Ramsar sites) to be treated as having equivalent protection status as Natura 2000 sites.

The EPR require that the Habitats Regulations are taken into consideration and, if the installation activity may have a likely significant effect on any of the sites protected under these regulations, the Habitats Regulations require that competent authorities are satisfied that an appropriate assessment on such habitats has been conducted.

The Habitat Regulations define the process for the assessment of the implications of plans and projects on European sites. Whilst it is the responsibility of the competent authority to determine whether it can be concluded there is no significant adverse effect, it is the responsibility of applicants to ensure sufficient information is submitted to enable a robust determination of these issues.

Information that will allow the Environment Agency to reach a judgement on the potential significance of effects on Natura 2000 sites can be found in Appendix A9. These data do indicate that PCs and/or PECs of relevant concentrations in air acid deposition rates at sites designated under the Habitats Regulations can be screened as insignificant using the Environment Agency's *Air emissions risk assessment for your environmental permit* guidance.

6.5 Risk assessment summary

The summary qualitative risk assessment of the other potential impacts to the environment is provided in Table 6-5.

Table 6-5: Qualitative Environmental Risk Assessment

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Amenity impacts						
Fugitive release of particulate matter / dust from storage and handling of black mass and other solid raw materials	Local residents/ businesses	Transportation through the air or tracked via vehicle wheels leaving site	Limited quantity of battery black mass stored on-site at any time (maximum six 1,000 litre FIBC bags). Battery black mass will be delivered to the Site within fully enclosed vehicles and covered FIBCs. All other solid raw materials e.g., sodium carbonate will be delivered to site in sealed containers. All solid materials will be unloaded and handled by trained operators holding current FLT licences. With the exception of the initial offloading, all storage and handling of solid waste and raw materials will take place within a fully enclosed building. Extraction systems fitted with a multi-stage filtration system will capture any dust raised during loading of the material into the process line. Routine (daily) inspections of the storage areas will be carried out to identify any spillages or migration of dust beyond the site boundary. Spill kits will be in place at several locations within the building, and emergency response procedures will be in place to ensure any spillage is quickly dealt with.	Unlikely	Mild	Very low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Noise and vibration						
Excess noise or vibrations generated from mechanical equipment or plant used on site	Local residents/ businesses	Through the air and ground vibration.	The magnitude of noise emission will be limited by the relatively small-scale nature of the process and the EA's Noise Advisory Tool (see Appendix A8) confirms a noise impact assessment is not required. Specific control measures include: • Specification for low-noise generating pumps and fans. • All plant and machinery to be installed by competent persons. • All plant and machinery will be operated in accordance with operating instructions and the manufacturer's specification. • Regular ongoing inspection and maintenance of equipment, as defined by the manufacturer's recommendations. • Site speed limits will be enforced. • Use of broadband (white noise) vehicle reversing alarms • All process operations will take place within an enclosed building providing significant attenuation. • Doors to the building will normally be closed, with access limited only to times of waste deliveries or export of wastes produced by the process.	Unlikely	Mild	Very low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Odour						
Odour from operational processes	Local residents /businesses	Transportation through the air	Low residual solvents in black mass. Black mass and industrial wastewater will be delivered to the site in enclosed IBCs or covered FIBCs. The main storage and handling processes will take place within an enclosed building. The extraction system above the black mass loading station will capture fugitive emissions and extract these through a fabric filter and carbon adsorption unit to reduce the concentration of volatile organic compounds before being emitted to atmosphere via a stack. Extraction in this manner also helps to maintain a negative pressure within the building, reducing the potential for fugitive emissions. Emissions from the black mass acid leaching stage will be discharged through a caustic scrubber and carbon adsorption unit to remove acidic and organic compounds which may elicit an odour. Doors to the process building will normally be kept shut, with the exception of periods where access and egress to/from the building is required for waste deliveries/finished product transfer.	Unlikely	Mild	Very low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Point source emissions to atmosphere						
Emissions to air	Local residents /businesses	Transportation through the air	Off-gases from the battery black mass acid leaching process will be abated in a caustic scrubber and carbon filter prior to discharge to air. The scrubbing system will be managed in accordance with the operator's management systems and manufacturer specifications. This will include regular inspections and maintenance of equipment. Control and monitoring systems will be in place to ensure that the scrubber operates at optimum performance. Fabric filters and carbon adsorption units will be installed on the other extraction systems serving the water process and product handling areas. Stack heights are sufficient to ensure that emissions to air do not have a significant effect on nearby sensitive receptors. Emissions will comply with BAT-AELs or other relevant benchmarks.	Low	Mild	Low

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Point source emissions to sewer and surface water						
Contaminated run-off from site surfaces	Nearby natural habitats; Local Workforce at Site; Nearby Human Receptors	Percolation through soils, direct run-off from site across the ground and entering surface drainage system	Drainage across the site has been designed to separate clean surface water run-off from process effluents. There will be no discharge to surface water or sewer of process effluents. Uncontaminated clean run-off is collected from roof gullies and clean impermeable hard standing areas. Clean water run-off drains to the external surface water drainage system which leads to the main business park drainage system. The surface water drainage system includes interceptor tanks which can be isolated in the event of a spillage. All potentially polluting substances will be stored in an enclosed building on impermeable hardstanding with appropriate bunding or spill kerbs in place. All areas where waste materials or chemicals are delivered, or where residues are collected and loaded to vehicles, will be provided with suitable bunds or containment kerbs. Good housekeeping measures will be in place.	Unlikely	Mild	Very Low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Discharge of process effluents	Local residents /businesses	Percolation through soils, direct run-off from site across the ground and entering surface drainage system	There are no process effluent wastewater discharges from site. All process effluents will be discharged into appropriate storage vessels within the enclosed building and tankered off-site for disposal at a suitably permitted off-site facility. All storage vessels storing process effluents will have containment measures in place meeting the requirements of the CIRIA C736 guidance and located on an impermeable surface within the enclosed process building.	Unlikely	Mild	Very low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
PFAS						
Emissions to air, water and land of PFAS	Local residents' /businesses/ Nearby natural habitats; Local Workforce	Transportation through the air. Percolation through soils, direct run-off from site across the ground and entering existing drainage system	The site will not accept LiBs or shred from LiBs. Only refined black mass from off-site battery recycling sites that have used pre-treatment processes to remove the binder material and electrolyte will be accepted. The black mass will be stored in a dedicated area within an enclosed building, with suitable extraction through a fabric filter and carbon adsorption unit to control fugitive emissions during its loading into the process. The fabric filter will abate any PFAS present as particles or adsorbed to the surface of particles, whilst the carbon filter will abate any volatile PFAS. The leaching process is conducted at comparatively low temperatures, substantially below temperatures at which significant volatilisation or thermolysis of fluorinated species would be expected. In addition, the process involves limited mechanical agitation due to a relatively low mixing intensity, thereby reducing the potential for aerosol generation, droplet entrainment, or stripping of dissolved species into the gas phase.	Low	Mild	Low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
			This significantly reduces the potential for PFAS to be partitioned to air emissions from the leaching stage. However, any potential process emissions of PFAS from acid leaching will be abated by the caustic scrubber (removal of ionic PFAS) and/or a carbon filter for neutral, volatile PFAS. There will be no discharge of process effluents to surface water or sewer. All process effluents will be temporarily stored in bunded IBCs before being transferred for disposal at a suitably permitted off-site facility. All waste handling to take place on impermeable hardstanding connected to a sealed drainage system. Regular inspection and maintenance of the hardstanding areas. Spillage containment and management procedures will be in place. The surface water drainage system includes interceptor tanks. In the event of a spillage, the tanks can be isolated allowing their content to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal.			

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Abnormal operation or accidents						
Vehicle or LFT collision resulting in loss of containment of waste, or loss of containment of chemicals	Local residents' /businesses/ Nearby natural habitats; Local Workforce	Percolation through soils, direct run-off from site across the ground and entering existing drainage system	Site security measures to prevent unauthorised access. Use of trained FLT operators only. Robust road vehicles with loads covered/enclosed. Site speed limits enforced. All waste handling to take place on impermeable hardstanding connected to a sealed drainage system. Regular inspection and maintenance of the hardstanding areas. Spillage containment and management procedures will be in place. The surface water drainage system includes interceptor tanks. In the event of a spillage, the tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal.	Unlikely	Mild	Very low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Arson and / or vandalism causing the release of polluting materials to air (smoke or fumes), water or land.	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air	The site has security systems in place to prevent unauthorised access. All visitors and waste deliveries must report to the security gate for access. The site perimeter is subject to daily checks for defects. CCTV cameras cover the site. Activities will be managed and operated in accordance with a management system (which will include fire response procedures). Fire control processes and procedures are set out in the Fire Prevention Plan and emergency response plan developed as part of the IMS.	Low	Mild	Low
Flooding of site	Local residents /businesses	Percolation through soils, direct run-off from site across the ground and entering existing drainage system	The risk of flooding on site is considered very low as the site is not located within a defined flood zone (2 or 3), nor is there a risk of surface water flooding based on the Environment Agency's flood maps.	Unlikely	Mild	Very low

Hazard **What has the potential to cause harm?**	**Receptor** **What is at risk? What needs protection?**	**Pathway** **How can the hazard get to the receptor?**	**Risk management** **What measures are in place to reduce risk? If it occurs, who is responsible?**	**Probability of exposure** **How likely is this contact?**	**Consequence** **What is the harm that can be caused?**	**Overall Risk** **What is the risk that still remains? The balance of probability and consequence**
Combustion of waste resulting in the release of polluting materials to air (smoke or fumes), water or land (contaminated firefighting water.	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air or Percolation through soils, direct run-off from site across the ground and entering existing drainage system	The risk of accidental combustion of waste is lower than other waste management facilities due to the nature of the waste e.g., liquid wastewater and limited amount of combustible waste stored on-site at any one time (7 tonnes). Fire detection and manual suppression systems will be in place to detect and control a fire until the local FRS arrives. The site owner also has its own emergency response team. Active firefighting will be performed by the local FRS based in the boroughs of Halton and Warrington using fire hydrants located on the Heath. The nearest fire hydrant is ~35 m from the process building. When a fire is being tackled and extinguished, all possible efforts will be implemented to avoid firefighting water from entering the site drainage system and contained within the site itself. Control measures include directional kerbing, sealing of the gravity-fed interceptor with an inflatable drain seal, covering all exposed surface water drains with drain mats, and using mobile pumps to draw residual water in to a combination of empty 1000ltr IBCs, the 9 m^3	Low	Mild	Low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
			crystallisation reactor and bunding associated with the raw material and waste storage areas. The site surface water drainage system contains interceptors which can accommodate up to 3 m^3 of water from a fire. Whilst one interceptor is gravity-fed, the contents from the other is pumped, providing a means of isolating the system in the event of a fire. Additional storage volume is also available within the drainage pipework leading to the interceptors. An Emergency Management Plan will form part of the IMS covering responsibilities, communications, actions, incident control sheets, fire detection system overview, location of fire extinguishers, rendezvous points and location of fire hydrants. Support with dealing with the fire and subsequent run-off water can also be provided by the site owners, SOG, who have a detailed Site Major Incident Procedure detailed within Appendix A of the Fire Prevention Plan provided in Appendix A6.			

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Failure of primary containment	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air or Percolation through soils, direct run-off from site across the ground and entering existing drainage system	Appropriate secondary containment is provided for storage vessels containing potentially harmful substances in accordance with CIRIA C736. Secondary containment is subject to routine inspections and maintenance as defined in the IMS and Planned Preventative Maintenance Programme. Spill kits are placed strategically across the site and operators will be trained in spill response procedures. Surface water drainage system can be isolated in the event of loss of containment. All surface waters can be contained on-site during an incident, allowing testing of contents to determine potential level of contamination.	Low	Mild	Low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Failure of abatement systems	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air	The caustic scrubber serving the acid leaching reactor has an automated control and monitoring system which will initiate an automated emergency shutdown of the process if the scrubber fails or is operating outside of set parameters. Local UPS is applied to the scrubber pumps and ID fan ensuring continued operation during a power failure. Planned preventative maintenance reduces the risk of failure and an inventory of critical spare parts will be maintained at the site. The fabric filters will contain multiple compartments, each with a set of filter bags allowing isolation for online maintenance e.g., to replace a burst filter bag.	Low	Mild	Low
Power failure resulting in unabated emissions to air from leaching reactor	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air	The caustic scrubber serving the acid leaching reactor will be equipped with local UPS on the pumps and ID fan. In the event of a power failure, with material being processed in the leaching reactor, the UPS will enable continued extraction and abatement of off-gases until a controlled shutdown of the process can be made. SOG has reported no loss of power to Block 8 in at least the last 10 years.	Low	Mild	Low

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Cross contamination / addition of incompatible materials resulting in unwanted reactions	Local residents' /businesses/ Nearby natural habitats; Local Workforce the site	Transportation through the air or Percolation through soils, direct run-off from site across the ground and entering existing drainage system	Designated and clearly labelled storage areas for different waste types and raw materials. These areas are defined in the Waste and Raw Materials Storage Plan in Appendix A1. Implementation of documented waste pre-acceptance and acceptance measures reduce the potential for accepting incompatible waste. Implementation of documented standard operating procedures for the water and black mass process, and additional standard operating procedures for raw material acceptance and storage, finished product manufacture and storage reduce the likelihood of accepting, using, transferring or mixing incompatible materials.	Low	Mild	Low

7 Improvement programme

Due to the novel nature of the processes, in particular the water process which is the first of its kind in the UK, there is limited precedent from which quantitative emissions and performance data can be sourced, with the parameters specified in this application primarily derived from laboratory scale R&D testing that has been scaled up to full-scale commercial operation through estimation. Furthermore, certain aspects e.g., emissions of PFAS, are emerging issues with limited data in the literature that would allow quantified emissions to be estimated at this scale.

Consequently, the Operator is proposing that a small number of pre-operational and improvement conditions are incorporated into the permit to validate the performance levels described in this document and, where necessary, provide updated impact assessments and/or management plans.

7.1 Pre-operational conditions (prior to commissioning)

Prior to the commissioning of the installation, the Operator proposes to provide the following information to the Environment Agency:

- Submit a written protocol for the sampling and testing of PFAS in process inputs and outputs.
- Provide a written commissioning plan, including timelines for completion, expected emissions to the environment during different stages of commissioning, expected duration of specific commissioning activities, and actions to be taken to protect the environment and report to the Environment Agency in the event actual emissions exceed expected emissions.
- Provide a copies of the final IMS procedures.

7.2 Improvement conditions

- Provide the relevant CIWM/WAMITAB Certificate of Technical Competence for the appointed TCM.
- Submit a post commissioning environmental performance report which summarises the environmental performance of the installation against the design parameters set out in the Application.
- Within 6 months following the completion of commissioning of the black mass process, submit a report which provides the analysis of PFAS in process inputs and outputs, including a formal PFAS Management Plan. Where PFAS are identified in point source emissions to air above limits of detection, provide a methodology for approval detailing procedures for assessing the impact of these emissions including, where relevant, procedures for deriving Environmental Assessment Levels.
- Within 6 months following the completion of commissioning of the water and black mass process, submit a report which provides the results of emissions monitoring of metals from emission points A1 and A4.
- Where monitored emissions of metals are greater than estimated levels in Table 5-3, submit a revised air quality assessment that considers the impact of these emissions.

8 Appendices

A1 Site plans and drawings

A2 Pre-application consultation

A3 IMS certificate and evidence of technical competence

A4 Example standard operating procedure

A5 Best Available Techniques assessment

A5.1 WGC UK BAT Conclusions

Table A5-1 compares the design and operation of the installation against the requirements of the WGC UK BAT Conclusions.

Table A5-1: Comparison against draft WGC UK BAT Conclusions

BAT ref no.	Requirement	Comparison with proposed design and/or operation
1	To improve and maintain overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the features listed in the BATC	Watercycle has an existing EMS in place certified to ISO 14001:2015 as part of an integrated management system (IMS). The IMS reflects the specific requirements for environmental management systems in the BATC and Environment Agency's guidance. Procedures will be established under the EMS to account for the additional specific requirements for the chemical sector, including: • Maintenance of an inventory of channelled and diffuse emissions to air. • An other than normal operating conditions (OTNOC) management plan for emissions to air. • An integrated waste gas management and treatment strategy for emissions to air. • Management system for diffuse VOC emissions to air. • Provisions for the development of a Chemicals Management System (CMS). This will ensure that compliance with the required standards of environmental protection are achieved.
2	To facilitate the reduction of emissions to air, BAT is to establish, maintain and regularly review (including when a substantial change occurs) an inventory of channelled and diffuse emissions to air, as part of the EMS (see BAT 1), that incorporates all of the following features: • Information, as comprehensive as is reasonably possible, about the chemical production processes • Information, as comprehensive as is reasonably possible, about channelled emissions to air • Information, as comprehensive as is reasonably possible, about diffuse emissions to air	Inventories of point source and fugitive emissions are provided in Section 5 of this report. These will be added to the IMS and maintained/updated following any process change.

BAT ref no.	Requirement	Comparison with proposed design and/or operation
3	To reduce the frequency of the occurrence of OTNOC and to reduce emissions to air during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the environmental management system.	The IMS will contain an OTNOC plan that will consider, amongst others: • Identification of potential abnormal operation or accident scenarios • Details of the planned preventative maintenance programme • Details of monitoring and reporting of emissions during OTNOC events • Periodic review and assessment of scenarios contributing to OTNOC events • Requirements for the regular review and maintenance of the OTNOC plan
4	To reduce channelled emissions to air, BAT is to use an integrated waste gas management and treatment strategy that includes, in order of priority, process integrated recovery and abatement techniques	The design of the processes includes both process integrated recovery e.g., capture and recovery of metals in the filter cake of fabric filters, in addition to the use of abatement techniques on each emission point (including fabric filtration, carbon adsorption and/or wet scrubbing where relevant)
5	To facilitate the recovery of materials and the reduction of channelled emissions to air, as well as to increase energy efficiency, BAT is to combine waste gas streams with similar characteristics, thus minimising, where appropriate, the number of emission points	Due to potential incompatibility issues with emissions from the water and black mass processes e.g., off-gases from black mass leaching will contain acid gases, whilst off-gases from the water process may contain alkaline solids, each process line has its own dedicated abatement equipment and emission point.
6	To reduce channelled emissions to air, BAT is to ensure that the waste gas treatment systems are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design ranges, and maintained (through preventive, corrective, regular and unplanned maintenance) so as to ensure optimal availability, effectiveness and efficiency of the equipment.	The design and operation of all components of the process lines and ancillary operations will be to ensure that these requirements are met.
7	BAT is to continuously monitor key process parameters (e.g. waste gas flow and temperature) for waste gas streams being sent to pre-treatment and/or final treatment.	The scrubber on the black mass process will contain instrumentation that allows for continuous monitoring of pH, temperature, pressure and conductivity to ensure it operates with optimum performance.

BAT ref no.	Requirement	Comparison with proposed design and/or operation
8	BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with BS EN standards. If BS EN standards are not available, BAT is to use BS ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality	Methods for monitoring point source emissions to air are described in Section 5.8.1. These will primarily use BS EN or BS ISO standards but for some pollutants e.g., PFAS, will make use of other international methods.
9	To increase resource efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to recover organic compounds from process off-gases by using one or a combination of the techniques given below and to reuse them	Neither process uses organic compounds or solvents as a raw material, although residual solvents may be present in small quantities in the black mass, whilst dissolved organic compounds may be present in the industrial wastewater used as raw materials. Hence, it is not considered relevant to recover and re-use organic compounds as there is no use for them in the process.
10	To increase energy efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to send process off-gases with a sufficient calorific value to a combustion unit that is, if technically possible, combined with heat recovery. BAT 9 has priority over sending process off-gases to a combustion unit.	The extraction systems produce a diluted air stream (dilution required to ensure LEL requirements are met) with insufficient calorific value to allow combustion without significant quantities of natural gas support fuel. Due to the additional cross media effects associated with the combustion of natural gas, it is not considered BAT to use combustion units for VOC control.
11	To reduce channelled emissions to air of organic compounds, BAT is to use one or a combination of the techniques given below: a. Adsorption b. Absorption c. Catalytic oxidation d. Condensation e. Thermal oxidation f. Bioprocesses	Extraction systems handling flue gases which have the potential to contain VOC concentrations above the BAT-AELs will be connected to carbon adsorption filters (BAT 11a).
12	To reduce channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds, BAT is to use techniques a. and b., and one or a combination of techniques c. to e. given below.	N/A – there are no sources of PCDD/Fs at this installation

BAT ref no.	Requirement	Comparison with proposed design and/or operation
13	To increase resource efficiency and to reduce the mass flow of dust and particulate-bound metals sent to the final waste gas treatment, BAT is to recover materials from process off-gases by using one or a combination of the dust reduction techniques given in table 4.	Solid residues from the fabric filters containing metals or other raw materials will be re-used in the process. For example, particulate matter collected from the black mass extraction system filters will be returned back into the leaching reactor, whilst any lithium carbonate fines collected from the product handling extraction system filter would be returned to the product handling stage.
14	To reduce channelled emissions to air of dust and particulate-bound metals, BAT is to use one or a combination of the techniques given below: a. Absolute filter b. Absorption c. Fabric filter d. High efficiency air filter (HEAF) e. Cyclone f. Electrostatic precipitator	All extraction systems that have the potential to handle flue gases containing dust and particulate-bound metal will be equipped with a fabric filter (BAT 14c).
15	To increase resource efficiency and to reduce the mass flow of inorganic compounds sent to the final waste gas treatment, BAT is to recover inorganic compounds from process off-gases by using absorption and to reuse them.	It is not possible to re-use inorganic compounds that may be present in the scrubbing liquors as it will not meet input quality specifications. However, as above, solid residues from the fabric filters containing metals or other raw materials will be re-used in the process.
16	To reduce channelled emissions to air of CO, NO_X and SO_X from thermal treatment, BAT is to use technique c. and one or a combination of the other techniques given below	N/A – there is no thermal treatment processes at this installation
17	In order to reduce channelled emissions to air of ammonia from the use of selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for the abatement of NOX emissions (ammonia slip), BAT is to optimise the design and/or operation of SCR or SNCR (e.g. optimised reagent to NOX ratio, homogeneous reagent distribution and optimum size of the reagent drops).	N/A – SCR/SNCR is not used at this installation

BAT ref no.	Requirement	Comparison with proposed design and/or operation
18	To reduce channelled emissions to air of inorganic compounds other than channelled emissions to air of ammonia from the use of SCR or SNCR for the abatement of NOX emissions, channelled emissions to air of CO, NOX and SOX from the use of thermal treatment, and channelled emissions to air of NOX from process furnaces/heaters, BAT is to use one or a combination of the techniques given below. a. Absorption b. Adsorption c. SCR d. SNCR e. Catalytic oxidation f. Thermal oxidation	Emissions of SO2 and HF from the acid leaching of black mass will be controlled by means of a wet or alkaline scrubber (BAT 18c) or, if testing during commissioning indicates emissions of SO2 and HF comfortably meet the BAT-AEL without the use of sodium hydroxide, the scrubber will operate as a water scrubber only.
19	To prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to elaborate and implement a management system for diffuse VOC emissions, as part of the EMS (see BAT 1).	Whilst diffuse emissions for VOC emissions are expected to be negligible (estimated at < 1 t/y) as the process does not use solvents, and where residual solvent may still be present in limited quantities in the black mass, extraction and abatement techniques will be used to control diffuse emissions, the IMS will contain a fugitive emissions management procedure which, amongst others, will define: • Procedures for identifying relevant sources of VOC emissions and estimating emissions from these sources • Procedures for establishing and implementing a LDAR programme
20	BAT is to estimate fugitive and non-fugitive VOC emissions to air separately at least once every year by using one or a combination of the techniques given below, as well as to determine the uncertainty of this estimation. The estimation distinguishes between VOCs classified as CMR 1A or 1B and VOCs that are not classified as CMR 1A or 1B.	Estimates of point source and diffuse emissions of VOCs will be made on an annual basis using the results of the periodic stack emissions monitoring on the point source releases, and mass balance approaches for fugitive releases.

BAT ref no.	Requirement	Comparison with proposed design and/or operation
21	BAT is to monitor diffuse VOC emissions from the use of solvents by compiling, at least once every year, a solvent mass-balance of the solvent inputs and outputs of the plant, as defined in Part 7 of Annex VII to Directive 2010/75/EU and to minimise the uncertainty of the solvent mass-balance data by using all the techniques given below.	Although there may be residual organics in the black mass, the installation will not "use" solvents as a raw material. The estimated annual input of residual solvents in the black mass in the range 1 – 6 t/y. This is below the 50 t/y applicability threshold associated with this BAT.
22	BAT is to monitor diffuse VOC emissions to air with at least the frequency given below and in accordance with BS EN standards. If BS EN standards are not available, BAT is to use BS ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	This BAT is not considered applicable as the estimated diffuse emissions of VOCs are less than 1 t/y. The applicability threshold for non-CMR 1A or 1B VOCs is 5 t/y.
23	To prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to use a combination of the techniques given in the table below, with the following order of priority: 1a. Prevention techniques – limiting the number of emission sources 1b. Prevention techniques – use of high-integrity equipment 1c. Prevention techniques – collecting diffuse emissions and treating off-gases 2a. Other techniques - facilitating access and/or monitoring activities 2b. Other techniques – tightening 2c. Other techniques – replacement of leaky equipment and/or parts 2d. Other techniques – reviewing and updating process design 2e. Other techniques – reviewing and updating operating conditions 2f. Other techniques – using closed systems 2g. Other techniques – using techniques to minimise emissions from surfaces	The small-scale size of the site and process means there is a much lower potential for fugitive emissions of VOCs due to lower numbers of reactors, storage tanks, connections etc., and smaller pipeline runs than other chemical works. In addition to the above factors which prevent fugitive VOC emissions by limiting the number of emission sources, fugitive emissions of VOCs will be further reduced through the following control measures: • Reducing the number of pipe connections and using welded fittings where appropriate. • Use of high integrity components (for example, seals or gaskets). • Collection of off-gases containing VOCs and sending them to abatement devices. • Operation of the black mass leaching process and equipment under negative pressure • Operation of a planned preventative maintenance programme to prevent equipment leaks occurring or, where they do occur, that new parts are fitted. The design and operating conditions will be periodically reviewed on an annual basis or after any process change.

BAT ref no.	Requirement	Comparison with proposed design and/or operation
24	To prevent or, where that is not practicable, to reduce channelled emissions to air [from process furnaces/heaters] of CO, dust, NOX and SOX, BAT is to use technique c. and one or a combination of the other techniques given below	N/A – there are no process furnaces or heaters at the installation
25 - 36	These BAT are not relevant as they concern sub-sector chemical activities that are not performed at the installation.	

A5.2 NFM BAT Conclusions

Table A5-2 compares the design and operation of the installation against the requirements of the NFM BAT Conclusions for precious metal production. Other general BAT in the NFM BATC are not compared as the general measures draft WGC UK BATC are considered to take primacy above these general measures.

Table A5-2: Comparison against NFM BAT Conclusions for precious metal production

BAT ref no.	Requirement	Comparison with proposed design and/or operation
134	In order to reduce diffuse emissions to air from a pretreatment operation (such as crushing, sieving and mixing), BAT is to use one or a combination of the techniques given below	N/A – there are no pre-treatment operations involving crushing, sieving and mixing at the installation
135	In order to reduce diffuse emissions to air from smelting and melting (both Doré and non-Doré operations), BAT is to use all of the techniques given below	N/A – there are no smelting or melting operations at the installation
136	In order to reduce diffuse emissions to air from leaching and gold electrolysis, BAT is to use one or a combination of the techniques given below.	N/A – there is no leaching or electrolysis of gold at the installation
137	In order to reduce diffuse emissions from a hydrometallurgical operation, BAT is to use all of the techniques given below: a. Containment measures, such as sealed or enclosed reaction vessels, storage tanks, solvent extraction equipment and filters, vessels and tanks fitted with level control, closed pipes, sealed drainage systems, and planned maintenance programmes b. Reaction vessels and tanks connected to a common ductwork system with off-gas extraction (automatic standby/back-up unit available in case of failure)	Measures consistent with BAT 137a and 137b are built into the design. The leaching reactor is an enclosed reaction vessel, all other vessels/tanks are equipped with level control and alarming, all pipes are closed, the installation has a sealed drainage system and a planned preventative maintenance programme will be in place. The leaching reactor connects to an extraction system which is routed to an abatement plant with standby/duty fans.
138	In order to reduce diffuse emissions to air from incineration, calcining and drying, BAT is to use all of the techniques given below	N/A – there are no incineration, calcining or thermal process drying at the installation. The product pan dryers are electrically powered.
139	In order to reduce diffuse emissions to air from the melting of final metal products during refining, BAT is to use both of the techniques given below	N/A/ - there are no melting processes at the installation

BAT ref no.	Requirement	Comparison with proposed design and/or operation
140	In order to reduce dust and metal emissions to air from all dusty operations, such as crushing, sieving, mixing, melting, smelting, incineration, calcining, drying and refining, BAT is to use one of the techniques given below: a. Bag filter b. Wet scrubber in combination with an ESP	Fabric filters will be installed on all point source emissions.
141	In order to reduce NOX emissions to air from a hydrometallurgical operation involving dissolving/leaching with nitric acid, BAT is to use one or both of the techniques given below	N/A – the leaching process uses sulphuric acid and hydrogen peroxide rather than nitric acid
142	In order to reduce SO_2 emissions to air (other than those that are routed to the sulphuric acid plant) from a melting and smelting operation for the production of Doré metal, including the associated incineration, calcining and drying operations, BAT is to use one or a combination of the techniques given below	N/A – there are no melting or smelting operations at the installation
143	In order to reduce SO_2 emissions to air from a hydrometallurgical operation, including the associated incineration, calcining and drying operations, BAT is to use a wet scrubber	The leaching reactor contains an extraction system which routes off-gases to abatement plant containing a wet scrubber.
144	In order to reduce HCl and Cl_2 emissions to air from a hydrometallurgical operation, including the associated incineration, calcining and drying operations, BAT is to use an alkaline scrubber	N/A – HCl or Cl_2 are only likely to be present in the off-gases when leaching with hydrochloric acid, not sulphuric. Regardless, the leaching reactor off-gases are routed through an alkaline scrubber.
145	In order to reduce NH3 emissions to air from a hydrometallurgical operation using ammonia or ammonium chloride, BAT is to use a wet scrubber with sulphuric acid	N/A – ammonia or ammonium chloride is not used in the hydrometallurgical operations
146	In order to reduce PCDD/F emissions to air from a drying operation where the raw materials contain organic compounds, halogens or other PCDD/F precursors, from an incineration operation, and from a calcining operation, BAT is to use one or a combination of the techniques given below	N/A – there is no drying of raw materials containing organics, or an incineration or calcining process at the installation.

BAT ref no.	Requirement	Comparison with proposed design and/or operation
147	In order to prevent soil and groundwater contamination, BAT is to use a combination of the techniques given below: a. use of sealed drainage systems b. use of double walled tanks or placement in resistant bunds c. use of impermeable and acid-resistant floors d. automatic level control of reaction vessels	All techniques described by BAT 147a, b, c and d are incorporated into the design of the installation.
148	In order to prevent the generation of waste water, BAT is to use one or both of the techniques given below: a. Recycling of spent/recovered scrubbing liquids and other hydrometallurgical reagents in leaching and other refining operations b. Recycling of solutions from leaching, extraction and precipitation operations	Wash water from the water process will be recycled multiple times before disposal, and its evaluation for use as the water requirement for the black mass process will be made during commissioning.
149	In order to reduce the quantities of waste sent for disposal, BAT is to organise operations on site so as to facilitate process residues reuse or, failing that, process residues recycling, including by using one or a combination of the techniques given below	Solid residues from the fabric filters containing metals or other raw materials will be re-used in the process. For example, particulate matter collected from the black mass extraction system filters will be returned back into the leaching reactor, whilst any lithium carbonate fines collected from the product handling extraction system filter would be returned to the product handling stage.

A5.3 Waste batteries appropriate measures

Table A5-3 compares the design and operation of the installation against certain requirements of the waste batteries appropriate measures. Although the installation will not accept waste batteries, the Environment Agency has confirmed during pre-application discussions that the waste pre-acceptance, acceptance, storage and handling requirements of this guidance would be appropriate for defining appropriate measures for the acceptance of black mass at the installation. Relevant comparisons are, consequently, made against these requirements. However, where it is clear that particular appropriate measures are only applicable to the acceptance of batteries, these requirements have been excluded.

Comparisons against the waste treatment aspects of the waste batteries appropriate measures have not been made. As stated in Section 1 of the appropriate measures guidance:

"*This guidance includes measures for the storage and handling of wastes resulting from waste battery treatment activities and controlling associated emissions. However, it does not cover the further treatment of these wastes, such as:*

- *the treatment of black mass (a material recovered from battery electrodes containing metals, such as nickel, cobalt and lithium) using hydrometallurgical or pyrometallurgical processes*
- *the treatment of other chemical wastes, such as electrolytes or solvents.*"

Table A5-3: Comparison against waste batteries appropriate measures

Ref no.	Requirement	Comparison with proposed design and/or operation
3. Waste pre-acceptance, acceptance and tracking appropriate measures		
3.1 Waste pre-acceptance		
1	You must implement waste pre-acceptance procedures so that you know enough about a waste before it arrives at your facility. You need to do this to assess and confirm the waste is technically and legally suitable for your facility. Your procedures must follow a risk-based approach	Waste pre-acceptance procedures will be in place and these will be documented and maintained through the IMS. Section 4.2.1 describes the pre-acceptance measures in more detail.
2	You must get the following information (in writing or electronic form) when you receive a customer query and before their waste arrives at your facility: • details of the waste producer (who you are receiving the waste from) including organisation name, address and contact details • where the waste is coming from • full description of the waste including the quantity • where relevant, its physical form and composition (for example, from safety data sheets or laboratory analysis) • any hazardous properties and presence of any regulated chemicals, for example, POPs • the List of Waste codes (European Waste Classification (EWC) code) • the type of containers and packaging used for the waste • where available, information regarding the age and condition of the waste and, where relevant, potential for self-heating, self-reactivity or reactivity to moisture or air You can verify the pre-acceptance information by contacting or visiting the waste producer. Dealing with staff directly involved in waste production can help to fully characterise a waste.	As described in Section 4.2.1, the organisation responsible for supplying the waste materials will be required to complete a waste pre-acceptance form. This form will need to be completed for each and every waste delivery to the site. The form will contain all the information requirements as specified in this appropriate measure. Periodic audits of waste suppliers and waste off-takers will be made under the IMS procedures.

Ref no.	Requirement	Comparison with proposed design and/or operation
3	You must assess the information obtained at the waste pre-acceptance stage to make sure you: • only accept wastes that are suitable for treatment or storage • avoid unnecessarily accumulating waste • have enough storage and treatment capacity • prevent waste arriving at the site in inappropriate containers or packaging • identify waste that may require additional safety measures or precautions to be taken • meet any relevant Control of Major Accident Hazards (COMAH) requirements, because wastes, raw materials and end-of-waste materials all contribute to COMAH limits	The HSE Manager, with support from the TCM, will review each waste pre-acceptance form to assess the suitability of the waste for the processes taking place at the site and confirm there is suitable storage capacity for the waste to be supplied. Only once the waste pre-acceptance form has been approved, and the available storage capacity confirmed, will the waste delivery be booked in.
4	Where relevant, you should consider with your customer whether waste batteries are suitable for preparing for reuse (for example, re-using electric vehicle batteries for other energy storage applications). Where that remains a possibility, you should ensure the waste batteries are handled and transported with care to avoid any damage or loss that could affect reuse	N/A – the installation will not accept batteries
5	If there is a risk of radioactive contamination or presence of a radioactive source you must obtain confirmation that the waste is not radioactive unless your facility is permitted to accept such waste	Due to the nature of the waste input, there is negligible potential for this to be contaminated with radionuclides
6	You must consider whether specific wastes, from among those you are permitted to receive, have properties that can pose unacceptable risks to the site or process. For example, due to risk of: • fire or explosion • corrosion • uncontrolled reactions, for example, involving self-heating or gas evolution You should establish a list of such wastes and procedures for managing the risks from them.	The installation will only accept two types of waste i.e., industrial wastewater and refined black mass. Each of these waste types, and their inherent risks, has been thoroughly appraised by Watercycle when designing the facility and the relevant operational procedures.

Ref no.	Requirement	Comparison with proposed design and/or operation
7	You must keep pre-acceptance records for at least 3 years in a computerised waste tracking system following receipt of the waste. If an enquiry from a waste producer does not lead to the receipt of waste, you do not need to keep records	Waste pre-acceptance records will be maintained for a minimum period of three years on an electronic waste tracking system.
8	You must reassess the information required at pre-acceptance if the: • waste changes • process giving rise to the waste changes • waste received does not conform to the pre-acceptance information	Pre-acceptance procedures will be reviewed and updated where necessary in the event any of these changes take place. This will be progressed under the management of change procedures in the IMS.
9	In all cases you must reassess the information required at pre-acceptance on an annual basis	This will take place as part of the Senior Management Team's annual review of the IMS.
3.2 Waste acceptance		
1	You must implement waste acceptance procedures to check that the characteristics of the waste received matches the information you obtained during waste pre-acceptance. This is to confirm that the waste is as expected, and you can accept it. If it is not, you must confirm that you can accept it as a non-conforming waste, or you must reject it. If you are rejecting hazardous waste you must follow the guidance on the procedure for rejecting hazardous waste. Procedures should be documented and auditable	Waste acceptance procedures will be in place and maintained under the IMS. Section 4.2.2 provides further details on waste acceptance procedures.
2	Your procedures must follow a risk-based approach, considering: • the source, nature (including type and chemistry of batteries), condition and age of the waste • any hazardous properties of the waste • any persistent organic pollutant content in the waste • potential risks to process safety, occupational safety and the environment (for example, the presence of Li-ion batteries) • knowledge about the previous waste holders	The waste acceptance procedure has been developed accounting for the specific risks posed by the two types of waste to be accepted at the installation.

Ref no.	Requirement	Comparison with proposed design and/or operation
3	You must weigh each load of waste on arrival to confirm the quantities against the accompanying paperwork, unless alternative reliable systems are available (for example, based upon volume). You must record the weight in the waste tracking system	As all waste types will be delivered in uniform and fixed volume storage containers i.e., 1,000 litre rigid IBCs for the wastewater and 1,000 litre FIBCs for the black mass, it is not proposed to weight each waste delivery. Rather the number of storage containers will be used to quantify the waste of waste received and stored on-site at any time.
4	You must visually check wastes and verify them against pre-acceptance information and transfer documentation before you accept them on site. The extent of the initial visual check should be determined by the waste type and how it is packaged.	Each waste delivery will be reviewed against the waste pre-acceptance paperwork and transfer documentation upon its arrival at site. If these information are not available or inconsistent, the delivery will be rejected. Due to the nature of the waste and type of storage container (IBCs for the liquid waste and sealed FIBCs for the black mass), visual checks will be limited to the black mass only. To prevent fugitive emissions of wind-blown particles of black mass from opening the black mass FIBCs in the external off-loading area, visual checks will only take place once the acceptance checks above have been completed and the waste accepted into the relevant designated storage area in the enclosed process building. Should these visual checks identify components in the black mass that are not consistent with the pre-acceptance criteria and process requirements e.g., if visible plastic material or larger particles of unknown composition are evident, the delivery will be logged as non-conforming and moved to the quarantine area pending its removal from site
5	You must check and validate all transfer documentation and resolve discrepancies before you accept the waste. If you believe the incoming waste classification and description is incorrect or incomplete, then you must address this with the customer during waste acceptance. You must record any non-conformances. If you have assessed the waste as acceptable for on-site storage or treatment, you must document this	Each waste delivery will be reviewed against the waste pre-acceptance paperwork and transfer documentation upon its arrival at site. If these information are not available or inconsistent, the delivery will be rejected and recorded as a non-conforming delivery.

Ref no.	Requirement	Comparison with proposed design and/or operation
6	You must have clear criteria that you use to identify and safely manage non-conforming wastes, including its quarantine or rejection. You must also have written procedures for recording, reporting and tracking non-conforming and rejected wastes. These must include: • using appropriate dedicated quarantine storage • notifying the relevant customer or waste producer • recording a summary of your justification for accepting non-conforming waste in your electronic (or equivalent) system You must take measures to prevent the recurrence of non-conforming or rejected wastes.	The waste acceptance procedure defines the procedure to follow in the event of non-conforming waste being received and operation and management of the waste quarantine area.
7	The person carrying out waste acceptance checks must be trained to effectively identify and manage any non-conformances in the loads received, complying with this guidance and your permit conditions (for example, including the different types, properties and chemistries of waste batteries or similar wastes that may be received at the facility).	All individuals involved in the acceptance of waste at the installation will receive full training in the implementation of the waste acceptance procedures. Training procedures and records will be maintained as part of the IMS.
8	If there is a known risk of radioactive contamination, you must check the waste to determine that it does not include radioactive material, unless you are permitted to accept these materials.	Due to the nature of the waste input, there is negligible potential for this to be contaminated with radionuclides.
9	You must minimise the manual handling of waste. You should use mechanical unloading technologies where it is possible, safe and practicable to do so.	Manual handling of waste will be minimised. Waste materials will be moved from the offloading area to the storage areas, and from the storage areas to the dedicated discharge stations on each process line, using either fork lift trucks or hand pallet trucks. Only trained operators holding current fork lift truck (FLT) licences will be permitted to move waste materials.
10	Wastes must be visually inspected to check that they are as expected and match accompanying paperwork (for example, regarding battery types, quantity and packaging). Loads must be checked for non-conforming wastes (for example, batteries that are of a non-conforming type or chemistry, or that show signs of damage, or other non-battery wastes) prior to being accepted and moved to a dedicated storage	Each waste delivery will be reviewed against the waste pre-acceptance paperwork and transfer documentation upon its arrival at site. Due to the nature of the waste and type of storage container (IBCs for the liquid waste and sealed FIBCs for the black mass), visual checks will be limited to the black mass only. However, each delivery of wastewater will be sampled prior to its introduction to the process. If the analysis indicates components which are

Ref no.	Requirement	Comparison with proposed design and/or operation
	area. For example, damaged batteries could be identified by signs of physical damage (dents, puncture, cracks), swelling, smoking, leaking or overheating. Loads identified as containing non-confirming waste must be identified and moved to a quarantine storage area at the earliest opportunity, where you can investigate and manage the non-conformance.	not within the specification for the water process, the wastewater IBC will be moved to the quarantine area and returned to the waste supplier as non-conforming waste.
11	Waste batteries must be received and handled in appropriate containers or packages that are secure, prevent damage and leakage of materials, and are resistant to any corrosive chemicals contained in them (for example, battery electrolyte). This must be a requirement of your waste pre-acceptance and acceptance procedures.	N/A – the installation will not accept waste batteries.
12	You must check all waste containers and packages to make sure they are fit for purpose, including that they are: • in sound condition • undamaged • not corroded • suitable for the contents (for example, its mass and other physical or chemical properties) • provided with well-fitting lids, where relevant • provided with caps, valves and bungs in place and secure, where relevant • certified to relevant UN standards, where relevant • You must risk assess containers, particularly those made of plastic, if they have exceeded the manufacturer's use by date. You must quarantine non-conforming containers and deal with them immediately and appropriately. You must record all non-conformances.	All waste containers will be subject to visual checks upon their arrival at site and prior to acceptance in the enclosed storage building. If the integrity of the containers is not complete, or otherwise not fit for purpose, the delivery will be rejected and logged as non-conforming.
13	If waste batteries are not received in appropriate containers, they must be risk assessed and, if safe to do so, repackaged as soon as it is practicable and before being moved to the general waste storage area. If they cannot be safely repackaged for storage, they must remain in the	N/A – the installation will not accept waste batteries.

Ref no.	Requirement	Comparison with proposed design and/or operation
	quarantine area whilst you investigate and manage the non-conformance	
14	All waste packages and containers received must be marked or labelled with relevant information, including: • a description of the waste • the date of arrival on site • relevant hazard codes The mark or label must also enable you to identify the waste producer and comply with relevant appropriate measures for waste tracking	All waste deliveries will be suitably labelled to allow operators to understand the nature of the waste, its arrival date on-site and relevant hazard codes.
15	The site must have written procedures for safely managing non-conforming or quarantined wastes, including, for example, other types or chemistries of batteries that you are not permitted to accept, other unexpected non-battery wastes or damaged waste batteries. At treatment facilities, this could include the prioritisation of damaged batteries for treatment, where permitted and it is possible and safe to do so, supported by an appropriate risk assessment	The waste acceptance procedure defines the response for managing non-conforming and quarantined waste.
16	If identified during acceptance or storage, damaged batteries must be risk assessed (for example, considering the risk of potential emissions, fire and electrical hazards) and, where necessary and safe to do so, placed in appropriate rigid, lidded, leak-proof and chemically-resistant containers and segregated from other waste batteries.	N/A – the installation will not accept batteries.
17	Following assessment, and where safe to do so, damaged batteries that are assessed as posing an increased risk of fire (for example, Li-ion batteries) should be segregated and: • placed in an appropriate fireproof container (for example, a UN approved steel drum or container, filled with an inert packing material, such as vermiculite or sand, and designed to safely vent any released gases)	N/A – the installation will not accept batteries.

Ref no.	Requirement	Comparison with proposed design and/or operation
	• moved to a dedicated location or quarantine area that is a safe distance from combustible or flammable materials, possible sources of ignition, buildings, equipment and site perimeters • kept under cover in a cool, dry and well-ventilated location • subject to regular checks and monitoring (for example, to identify changes in temperature or thermal runaway) • If the damaged batteries are not in fire-resistant containers and it is not safe to remove them, the containers should be held in enclosed steel cages, or similar resistant structure, to minimise the risk of battery ejection and propagation in the event of a fire. Large Li-ion battery packs or modules (for example, from electric vehicles (EVs) or battery energy storage systems (BESS)) that are damaged and assessed as posing a risk of thermal runaway or fire should be isolated within an appropriate exclusion zone or in a dedicated, fully enclosed and ventilated fire-resistant container or enclosure provided with appropriate fire detection (for example, gas, heat or thermal) and suppression systems	
18	All relevant waste storage areas (quarantine, reception and general) and treatment processes in your facility must have the physical capacity needed for the waste you receive. You must not receive wastes if this capacity is not available. The amount of waste you receive must also comply with storage limits in your permit.	The available capacity of the storage areas will be continuously monitored as part of the electronic waste tracking system. Only when there is sufficient capacity for waste to be accepted within the pre-defined storage limits will a waste delivery be booked in.
19	The waste offloading, reception and quarantine areas must have impermeable surfaces with a sealed drainage system. This system must collect all surface water run-off from these areas and channel it to a blind sump unless you can lawfully discharge it.	All waste offloading, reception and quarantine areas are located on impermeable surfaces connecting to a sealed drainage system and/or with directional flow control and containment kerbs. Should loss of containment occur, the drainage system contains several interceptors, the final of which is actively pumped to the final discharge point rather than being gravity fed. This allows the drainage system to be isolated by shutting down the pump. The contents of the drainage system will then be tested and only if demonstrated to be uncontaminated would discharge re-commence. If found to be contaminated, the contents would be pumped out to a tanker for off-site disposal at a suitably permitted waste management facility.

Ref no.	Requirement	Comparison with proposed design and/or operation
20	You must clearly designate a waste reception area (or areas). Staff controlling the inspection, reception and validation of waste at the facility, must be trained in their respective roles	The waste reception and storage areas are clearly marked on the plan contained in Appendix A1. All individuals involved in the acceptance and handling of waste at the installation will be appropriately trained.
21	Your facility must have a dedicated waste quarantine area or areas, which you use to temporarily store waste being rejected, or non-conforming waste whilst it is being inspected or assessed.	The installation has a dedicated quarantine area for non-conforming waste within the enclosed process building. Its location is marked on the plan in Appendix A1.
22	Quarantine storage must be for a maximum of fourteen days. Records must be maintained of the removal of quarantined waste from site. For some limited and specific cases (for example the detection of radioactivity), you can extend quarantine storage time if the Environment Agency agrees	It is expected that quarantined waste will be temporarily stored for no longer than one week, and certainly no longer than 14 days.
23	You must have written procedures in place for dealing with wastes held in quarantine, and a maximum storage volume	The waste acceptance procedure defines procedures for managing quarantined waste and defines the maximum storage volume.
24	Quarantine storage must be separate from all other storage and clearly marked as a quarantine area	The quarantine area will be clearly marked and segregated from other waste storage areas.
25	You must store the waste in quarantine in appropriate closed containers or under weatherproof covering. You must segregate or isolate incompatible wastes.	The quarantine area is located within the enclosed process building.
3.3 Waste tracking		
1	You must use an electronic or computerised waste tracking system to hold up-to-date information about the available capacity of the waste quarantine, reception, general and bulk storage areas of your facility including treatment residues and end of waste product materials	A computerised tracking system will be used to monitor the available capacity in the dedicated storage areas and the quarantine area. Due to the standardised nature of the storage containers in which waste is received, and which are of fixed volume, weighing of incoming waste will not take place. The total quantity of waste in storage will, instead, be calculated from the number of containers in storage/number of pallet spaces remaining. This tracking system will also store all records generated during pre-acceptance, acceptance, rejection/non-conformance and removal of

Ref no.	Requirement	Comparison with proposed design and/or operation
		wastes from site. These records will be maintained for a minimum period of 3 years, or as required by the conditions of the permit.
2	Your waste tracking system must hold all the information generated during: • pre-acceptance • acceptance • non-conformance or rejection • storage • treatment • removal off site This information must be readily accessible.	The computerised waste tracking system will hold all of this information and will be readily accessible to operators and the Environment Agency upon request.
3	You must create records and update them to reflect deliveries, on-site treatment and dispatches. This can be done on a 'loads received' basis. Your tracking system will also operate as a waste inventory and stock control system. It must include this information as a minimum: • the date the waste arrived on-site • the producer's details (or unique identifier) • a unique reference number • waste pre-acceptance and acceptance information (including non-conformances and rejections) • the quantity delivered • the intended treatment or transfer route • accurate records of the nature and quantity of wastes held on site, including all hazards – and identifying the primary hazards and presence of any regulated chemicals such as POPs • where the waste is physically located on site	The waste tracking system will contain all of this information and be regularly updated.

Ref no.	Requirement	Comparison with proposed design and/or operation
4	The tracking system must be able to report: • the total quantity of waste present on site at any one time • a breakdown by type of the waste quantities you are storing pending treatment or transfer • the quantity of waste on site compared with the limits authorised by your permit • the length of time the waste has been on site • the quantity of end-of-waste product materials on site at any one time, and, where applicable details of any non-conformances and rejections	The tracking system has the capability for reporting this information.
5	You must store back-up copies of electronic records off site. Records must be readily accessible in an emergency	Back-up copies of the electronic records will be stored at Watercycle's head office in CityLabs 1.0, Oxford Road, Manchester.
6	You must hold pre-acceptance and acceptance records for a minimum of 2 years after you have treated the waste or removed it off site. You may have to keep some records for longer if they are required for other purposes, for example, hazardous waste consignment notes	All pre-acceptance and acceptance records will be stored for a minimum of 3 years or as required by conditions of the permit.
4 Waste storage and handling appropriate measures		
4.1 General waste storage and handling		
1	You must have waste storage and handling procedures. You must store and handle waste in a way that makes sure you prevent and minimise pollution risks by using appropriate measures. Waste handling must be carried out by competent staff using appropriate equipment.	Waste storage and handling procedures will be in place and established under the IMS. Waste handling will only be performed by appropriately trained and competent staff. Only trained operators holding current fork lift truck (FLT) licences will be permitted to move waste materials.

Ref no.	Requirement	Comparison with proposed design and/or operation
2	You should design and operate your facility in a way that minimises the handling of waste, for example, by storing waste in locations that minimise waste handling and using mechanical loading and unloading technologies and conveyors where it is safe and practicable to do so	The design of the facility has been optimised to ensure that manual handling and distances from storage areas to processing areas are reduced as far as practicable.
3	Where possible, you should locate storage areas away from watercourses and sensitive perimeters (for example, those close to public rights of way, housing or schools).	All storage areas are internal to the process building and, as such, away from watercourses or sensitive perimeters.
4	You must store all waste within the secure area of your facility to prevent unauthorised access and vandalism	The Heath Business and Technical Park is enclosed by security fencing and accessed by security gates which are open during operational hours only. Security is controlled by the SOG Security guards who have a 24/7 presence on site. Live 24-hour CCTV cameras are located around the site, with site patrols taking place at a defined frequency. Block 8, where the process building is located, is enclosed using fencing, with access to the Block 8 facility via swipe card activated gates or key card readers on doors to the building. Swipe cards are issued to authorised users only. Site fencing is maintained by SOG who make regular weekly checks of the fencing to ensure security is maintained. Any defects or damage which may compromise the integrity of the enclosure will be made secure by temporary repair by the end of the working day. Permanent repairs will be affected as soon as practicable
5	Where relevant, you must conform to Health and Safety Executive (HSE) guidance and standards, for example: • HSG51 The storage of flammable liquids in containers • HSG71 Chemical warehousing: The storage of packaged dangerous substances • HSG76 Warehousing and storage • HSG140 Safe use and handling of flammable liquids • HSG176 The storage of flammable liquids in tanks	These guidance and standards will be followed where relevant.

Ref no.	Requirement	Comparison with proposed design and/or operation
	• HSG85 Electricity at work: Safe working practices • HSG258 Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV) • INDG139 Using electric storage batteries safely • L138 Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) Approved Code of Practice	
6	You must clearly document the maximum storage capacity of your site and designated storage areas. You must not exceed these maximum capacities. You should define capacity in terms of, for example, maximum tank or vessel capacities, tonnage, numbers of skips, pallets or containers. You must regularly monitor the quantities of stored waste on site and designated areas and check against the allowed maximum capacities. You must also monitor the quantities of relevant wastes against limits set out in your management plans, for example, fire prevention plan	The maximum storage capacity of the individual waste areas is provided in Table 4-5. Available remaining capacity will be regularly checked using the computerised waste tracking system.
7	You must clearly mark waste storage areas and provide signs showing the maximum quantity and types of waste (including any hazardous properties) that can be stored there	Waste storage areas will be segregated and appropriately labelled in terms of waste type, storage capacity and any hazardous properties.
8	The design and arrangement of storage areas must provide and maintain appropriate separation distances to prevent fire spreading and access for fire-fighting measures, considering the use of other measures such as fire walls and bays, in accordance with an agreed fire prevention plan	Waste storage areas are segregated in different rooms within the process building. Further details are provided in the Fire Prevention Plan.
9	You must maintain adequate access and separation distances between and within storage areas to allow for easy inspection. You must maintain safe access, with a gap of at least 0.7m between rows of containers or palletised wastes.	Adequate access and separation distances will be maintained to allow easy inspection of waste in storage.

Ref no.	Requirement	Comparison with proposed design and/or operation
10	You must not accumulate waste unnecessarily and should prioritise the oldest waste for treatment or transfer. If you accept mixed loads of waste batteries for sorting, they should be moved to a dedicated area of a building and sorted as soon as it is practicable to do so, especially if they contain lithium batteries.	Waste will not be accumulated unnecessarily and will be managed on a first in first out (FIFO) basis. Black mass will not be stored on-site for more than one week in normal conditions.
11	Up-to-date records must be kept of the on-site storage duration and inventory of waste. Storage duration and inventory should be minimised, for example, by ensuring that they are transferred or treated once a viable load has been established and managed on a first-in first-out basis to prevent the accumulation of aged stock	An inventory of waste in storage will be maintained and continuously updated using the computerised waste tracking system. Waste will be managed on a FIFO basis.
12	You must not handle waste or its packaging in a way that might damage its integrity. You must not, for example, walk on, throw or drop waste or waste packages or cause damage from the use of mobile machinery or vehicles	Waste will be handled in a manner that minimises damage and loss of integrity. Waste handling procedures and appropriate training will support these requirements.
13	You must train forklift drivers in the handling of palletised goods, to minimise forklift truck damage to the integrity of containers and infrastructure.	Only trained FLT drivers with current licences will be permitted to handle waste materials.
14	Storage area drainage infrastructure must: • contain all possible contaminated run-off • prevent incompatible wastes coming into contact with each other • make sure that fire cannot spread	Storage areas will include impermeable surfaces and are designed to contain potentially contaminated run-off through directional draining, containment kerbs and/or sealed drainage systems that can be isolated in the event of a spillage.
15	You must: • contain wash waters within an impermeable area and either discharge them to foul sewer under a trade effluent consent or dispose of them appropriately off site. • prevent run-off into external areas or to surface water drains	Potentially contaminated run-off will be contained through directional draining, containment kerbs and/or sealed drainage systems that can be isolated in the event of a spillage. If confirmed as contaminated, it will be pumped to a tanker for off-site disposal at a suitably permitted off-site waste management facility.

Ref no.	Requirement	Comparison with proposed design and/or operation
16	Any liquids removed from waste must be collected and stored in lidded, leakproof containers or dedicated tanks provided with appropriate secondary and tertiary containment. Containers must be kept closed when not being filled and must be stored within a dedicated area that will contain any leakage or spillage. Containers and tanks must be chemically resistant to the liquids stored in them.	All liquid wastes or raw materials containing potentially polluting substances will be stored in leakproof containers that are chemically resistant to the material being stored and will have containment infrastructure in place in accordance with CIRIA C736.
17	Secondary and tertiary containment systems of waste storage areas must conform to CIRIA guidance C736 Containment systems for the prevention of pollution.	Secondary containment will conform to CIRIA C736.
18	You must store wastes that are sensitive to air, light, heat, moisture or extreme ambient temperatures under appropriate weatherproof covering protected from such ambient conditions (for example, waste lithium metal must be protected from exposure to water, including the moisture in air or other substances) The type of covering will depend on the types and quantities of waste. It could be as simple as a lid or cover over a container for small items but in other cases may require the construction of a roofed building. Covered areas must have good ventilation. This includes containers: • held in general storage, reception storage (pending acceptance) or quarantine • being emptied, repackaged or otherwise managed For example, waste held in fibre or cardboard primary or secondary packaging must be stored: • in a cool, dry and well-ventilated area of a building and not exposed to rain or moisture • be kept off the floor to prevent damage caused by damp	All wastes will be stored in the enclosed process building, shielded from direct sunlight and protected from rain or moisture. The process building is unheated with good ventilation.

Ref no.	Requirement	Comparison with proposed design and/or operation
19	Wherever practicable you should store all other wastes under cover. Covered areas must have good ventilation. Under cover storage provides better protection for containers than open air storage and minimises the generation of contaminated water. Covered storage also: • lowers temperature fluctuations that wastes are subjected to • reduces the degradation of containers through weathering	All waste materials will be stored in the enclosed process building.
20	You must not store hazardous chemical wastes (for example, produced from battery treatment activities) in open-topped containers. Empty open-topped containers should be kept in a building or under cover to prevent rainwater ingress. Wastes that have the potential for self-heating or self-reactivity must be stored in sealed metal containers under cover and monitored for heat build-up.	No waste materials will be stored in open-topped containers.
21	All containers used for the storage and handling of waste must be assessed to ensure they are suitable for the waste stored within them and their intended storage configuration and are used in accordance with the manufacturer guidelines and safe working loads. All waste storage containers and packages must remain fit for purpose and: • in sound condition • undamaged • not corroded • suitable for the contents (for example, its mass and other physical or chemical properties) • have well-fitting lids, where relevant • with caps, valves and bungs in place and secure, where relevant	These requirements will be ensured through the waste acceptance procedure, where the initial suitability and integrity of the waste containers will be assessed upon arrival to site, and as part of the daily visual checks under the IMS to ensure the integrity of the waste containers remains intact and suitable for continued use once the waste has been transferred to the storage areas.

Ref no.	Requirement	Comparison with proposed design and/or operation
22	You must check the condition of containers and the pallets they may be stored on as part of routine site inspections and record non-conformances. Non-compliant containers and pallets must be made safe. You must immediately and appropriately manage any unsound, poorly labelled or unlabelled containers (for example, by relabelling, over drumming or transferring the container's contents). You must risk assess, approve and record the use of storage containers, tanks or vessels: • beyond their specified design life • where you use them for a purpose, or substances, other than the ones they were designed for	Checks on the condition of waste containers will initially be made as part of the waste acceptance procedure and then on a daily basis once accepted to the storage area. Any waste arriving at site that is in a container whose integrity is not intact will be rejected and logged as non-conforming.
23	All containers must be clearly labelled with relevant information, including their contents, date of filling or receipt and relevant hazards. They should keep the labelling they had at acceptance unless they have been repackaged and relabelled. If the label is damaged or no longer legible you should replace the label with the same information. You must handle and store containers of waste so that the label is easily visible and continues to be legible.	All waste materials in storage will be appropriately labelled.
24	Containers must be held in designated areas of the site marked with maximum stack footprint and minimum separation distances. The containers should be stored in rows and must be arranged in a way that ensures they can be safely and easily accessed for inspection or retrieval at all times without having to move others that may be blocking access, other than those in the same row.	Waste materials will be stored in designated storage areas which are clearly labelled and separated by walls from other wastes and raw materials. The waste and raw material storage areas are shown in the plan in Appendix A1.
25	All containers must be stored on a pallet (unless they have an integral pallet at the base). Containers of waste that are designed for stacking (for example, heavy duty battery boxes) must not be stacked more than 2.4m high. All other containers must not be stacked more than 1m high. Palletised containers must not be stacked more than 2 pallets high, except for empty containers which can be stacked 3 high.	FIBCs of black mass will not be stacked. IBCs containing waste water will be palletised. To conserve space, IBC pallets may be stacked on one another but no more than two containers high.

Ref no.	Requirement	Comparison with proposed design and/or operation
26	Stacked containers must be stable. They must be secured, for example, with banding or shrink-wrap, if required. The containers must not extend beyond (over-hang) the sides of the pallet. If shrink-wrap is used, it must be clear or transparent so that you can identify waste types, damaged containers, leaks or spillages and incorrectly stacked containers. You must be careful not to damage any packages during stacking.	Containers will not extend beyond the sides of the pallet and, where stacked, will be secured using clear shrink-wrap or banding.
27	If wastes are stored in flexible intermediate bulk containers (FIBCs) (subject to appropriate measure 8 of section 4.2 'Additional measures for the storage and handling of waste batteries', on this page), they must not be handled or stored in way that could cause damage to the container or its contents (for example, from being dropped, lifted or lowered too quickly, or impacted by machinery or sharp edges) or that would exceed its safe working load or carrying capacity. They must only be moved using equipment designed to lift and handle FIBCs and which do not have any sharp edges or protrusions that could damage the container. They must be stored inside a building (if containing waste batteries) or under cover, and in a cool, dry location away from direct sunlight. All FIBCs must be stored in a way that means they can be accessed safely and easily for inspection or retrieval. They must be inspected regularly to identify and address any signs of damage (for example, including loss of containment, fraying, splits, leaks, or signs of chemical contamination).	FIBCs will only be handled using equipment appropriate for these type of containers i.e., not containing sharp edges. They will be stored inside the enclosed process building away from direct sunlight and will be subject to daily inspection checks to assess any signs of damage or loss of containment.
28	FIBCs must not be stacked on top of each other unless designed and approved for stacking and they are stacked in a manner that is secure and stable and in accordance with the manufacturer's guidelines, including safe working loads, and other relevant industry guidance (for example, from the FIBCA and the HSE). FIBCs must not be stacked more than 2 high or if it could cause damage to the containers or their content, including, for example, waste at the base of a container.	FIBCs will not be stacked on top of each other.

Ref no.	Requirement	Comparison with proposed design and/or operation
29	You must keep incompatible chemical wastes segregated so that they cannot come into contact with one another. You must store flammable wastes apart from other wastes to prevent fire spreading between them and other materials. You must use sealed drainage systems to prevent leaks and spillages contaminating other wastes.	The only flammable waste accepted at the installation will be refined black mass. This will be stored in a dedicated room, segregated from other waste types and raw materials.
30	You should, where applicable and based on a recorded risk assessment, make inert the atmosphere of tanks containing liquid waste with a flashpoint less than 21°C (for example, tanks containing flammable waste solvents). This can be done, for example, by using nitrogen gas.	The installation will not accept flammable liquid waste.
31	You should pay particular attention to avoid the build-up of static electricity when you are storing or handling flammable wastes and materials. You should use leak detection systems and alarms (for example volatile organic compound (VOC) alarms) and automatic fire suppression equipment based on a recorded risk assessment.	DSEAR assessments will be performed which consider the risks from the build-up of static electricity and define appropriate control measures, including classification of areas into defined ATEX zones.
32	You must not store or hold wastes on site in vehicles or vehicle trailers unless you are receiving them or preparing them for imminent transfer (meaning that you will remove them from site within 24 hours, or 72 hours if over a weekend).	Wastes will not be stored in vehicles or trailers, except where they are being unloaded during acceptance at the site.
33	Waste storage areas, containers and infrastructure must be subject to daily inspection to make sure that any leaks, spillages of liquids, dust or loose material are identified and managed appropriately, and fire breaks are maintained. You must keep written records of the inspections. You must rectify and log any spillages of waste.	Daily checks under procedures established under the IMS will be in place. Spillages will be rectified immediately upon detection using spill kits, with all relevant staff trained in the relevant spill procedure dependent on the type of waste/raw material that has spilt.
34	Any spillage or leakage resulting from the storage or handling of waste must be collected without delay using equipment and procedures appropriate to the type of spillage. The collected residues must be stored in an appropriate lidded, leakproof container. Any containers or surfaces affected by the spillage must be cleaned. Sand or neutralising granules, or other equivalent materials, must be available to deal with any leaks or spills.	Spillages of waste material will be rectified without delay upon first detection using spill kits appropriate for the type of spillage. All relevant personnel will be trained in the spill procedure response.

Ref no.	Requirement	Comparison with proposed design and/or operation
35	You must not carry out activities that represent a clear fire risk within waste storage areas. Examples include: • hot works, including grinding, welding, or brazing of metalwork, unless risk assessed and approved, for example, under a permit to work scheme • smoking • parking normal road vehicles, except while unloading or loading • pressure washing • recharging forklift truck or power tool batteries • recharging or discharging batteries	None of these activities will be performed in waste storage areas. Should any hot works be required, this will only be permitted after a risk assessment has been produced and approved, and relevant permit to work issued.
36	All waste storage areas must have an impermeable surface which is resistant to the materials being stored. Outdoor waste storage areas must have a sealed drainage system to collect all surface water run-off and channel it to a blind sump unless it may be lawfully discharged. Indoor waste storage areas must be provided with appropriate spillage collection facilities.	All waste storage areas will be internal to the process building on impermeable surfaces resistant to the material being stored. Spill collection infrastructure and spill kits will be in place.
37	You must keep clean water (for example, uncontaminated rainwater) separate from wastes and waste waters.	Uncontaminated surface run-off will be segregated from process effluent and other waste waters.
38	You must use weatherproof covering in areas used for the storage of waste containing hazardous material or fluids where this is necessary to avoid contamination of surface water, including, for example, shredded waste or plastic containing fractions that may contain persistent organic pollutants (POPs). The type of covering will depend on the types and quantities of waste but must ensure the waste is protected from the weather. It could be as simple as a lid or cover over a container for small items but in other cases may require the construction of a roofed building.	All wastes will be stored in the enclosed process building.

Ref no.	Requirement	Comparison with proposed design and/or operation
39	If racking systems are used to store waste, their design and construction must be in accordance with HSG76 Warehousing and storage and consider the need for: • waste separation and segregation (including separation distances for fire prevention) • the inspection and retrieval of waste • fire prevention and suppression measures Where racking systems are used for the storage of combustible or flammable wastes (for example, Li-ion batteries or wastes resulting from the treatment of Li-ion batteries), they should be made of non-combustible materials, with solid fire-resistant barriers in place to prevent the spread of fire (horizontally and vertically). The use of in-rack sprinkler systems and anti-static measures should also be considered, where appropriate.	Racking systems where used will be compliant with HSG76. They will not be used for the storage of flammable waste.
40	Bulk storage systems (for example, used for liquids and powders), including tanks and silos, must meet the relevant requirements for Bulk storage provided in section 4 of Chemical waste: appropriate measures for permitted facilities.	Liquid waste will be stored on an impermeable surface in 1,000 litre IBCs with integral bunds meeting the requirements of CIRIA C736.
41	You must manage waste in a way that prevents pests or vermin. You must have specific measures and procedures in place to deal with wastes that are identified as causing pests or vermin.	Neither waste type is considered attractive to pests or vermin.
4.2 Additional measures for the storage and handling of waste batteries		
The requirements of this section are not considered applicable as the site will not accept waste batteries		

A6 Fire Prevention Plan

A7 Accident Management Plan

A8 Environmental risk assessment supporting information

A9 Air quality assessment

A10 Site condition report

A11 MSDS

A12 Application forms

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