Best Available Techniques & Operating Techniques

Shotton Mill Permit Variation Application

Shotton Mill Limited

Weighbridge Road
Deeside Industrial Park
CH5 2LW

Prepared by:

SLR Consulting Limited

5th Floor, 35 Dale Street, Manchester, M1 2HF

SLR Project No.: 410.065169.00001

5 June 2025

Revision: 1

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
Draft	12 August 2024	P Wright	C Berryman	
01	5 June 2025	P Wright	C Berryman	P Wright

Basis of Report

This document has been prepared by SLR Consulting Limited (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Shotton Mill Limited (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

Table of Contents

Tables in Text

Figures in Text

Appendices

Acronyms and Abbreviations

AERA	Air Emissions Risk Assessment
AMP	Accident Management Plan
BAT	Best Available Techniques
BAT-AELs	BAT-Associated Emission Levels
BATOT	Best Available Techniques and Operating Techniques
BRef	Best Available Techniques Reference
CCGT	Combined-Cycle Gas Turbine
CEMP	Construction Environmental Management Plan
CEP	Construction Execution Plan
CHP	Combined Heat and Power
COD	Chemical Oxygen Demand
COSHH	Control of Substances Hazardous to Health
CPAM	Cationic Polymer
DAA	Directly Associated Activities
DAF	Dissolved Air Flotation
DCS	Distributed Control System
DLN	Dry low-NO_x
DTPA	Diethylene-Triamine-Pentaacetic Acid
EDTA	Ethylenediaminetetraacetic Acid
EMS	Environmental Management System
EP	Environmental Permit
ERA	Environmental Risk Assessment
ESOS	Energy Savings Opportunity Scheme
ETP	Effluent Treatment Plant
FCA	Flood Consequences Assessment
FGC	Flue Gas Cleaning
FPMP	Fire Prevention and Mitigation Plan
HC	High Consistency
HDPE	High-density polyethylene
HRSGs	Heat Recovery Steam Generators
LC	Low Consistency
LDAR	Leak Detection and Repair
LEL	Lower Explosive Limit
LF	Long Fibre
LNB	Low-NO_x burners
MC	Medium Consistency

MSDS	Material Safety Data Sheets
NMVOC	Non-Methane Volatile Organic Compounds
NRW	Natural Resources Wales
OCC	Old Corrugated Cardboard
OTNOC	Other Than Normal Operating Conditions
PCBs	Polychlorinated Biphenyls
PM	Paper Machine
PLCs	Programmable Logic Controllers
RO	Reverse Osmosis
RCF	Recycled Fibre
SCADA	Supervisory Control and Data Acquisition
SCR	Selective catalytic reduction
SEC	Specific Energy Control
SF	Short Fibre
SLR	SLR Consulting Limited
SML	Shotton Mill Limited
SNCR	Selective non-catalytic reduction
SOP	Standard Operating Procedures
SU/SD	Start-up and Shutdown
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UK	UPM Kymmene
VFA	Volatile Fatty Acids
WTP	Water Treatment Plant

1.0 Introduction

SLR Consulting Limited (SLR) have been instructed by Shotton Mill Limited (SML) to prepare an application for a variation to the existing Environmental Permit (EP), reference EPR/BT4885IT for the Shotton Mill site located at Weighbridge Road, Deeside Industrial Park, Flintshire, CH5 2LW, hereafter referred to as 'the site'. The EP was issued by Natural Resources Wales (NRW).

The site was acquired by Modern Karton, part of Eren Holdings, from UPM Kymmene (UK) Limited in late 2021.

The existing site is permitted for the following listed activities under the Environmental Permitting Regulations (England and Wales) 2016 (as amended):

- Section 6.1, Part A(1)(b) – producing in an industrial plant, paper and board where the plant has a production capacity of more than 20 tonnes per day.
- Section 1.1, Part A(1)(a) – burning any fuel in an appliance with a rated thermal input of 50MW or more.
- Section 5.1, Part A(1)(b) – the incineration of non-hazardous waste in an incineration or co-incineration plant in a facility with a capacity exceeding 3 tonnes per hour.
- Section 5.4, Part A(1)(a)(i) – disposal of non-hazardous waste in a facility exceeding 50 tonnes per day by biological treatment.

The following Directly Associated Activities (DAA) are also permitted:

- Discharge of site drainage from the installation.
- Materials recovery facility.
- Wood recycling facility.

SML propose to repurpose the site to produce containerboard and tissue paper, rather than newsprint. The listed activities and DAAs will remain unchanged, however the plant and operation on site will change because of the following new plant being installed as part of the repurposing:

- new paper machine (PM3) for containerboard;
- new pulp preparation equipment;
- new Effluent Treatment Plant (ETP);
- new Tissue paper mill; and
- new Combined Heat and Power (CHP) plant.

1.1 The Site

The site is located within the Deeside Industrial Park, approximately 3km north of Shotton and approximately 10km northwest of Chester city centre. The site is centred on National Grid Reference SJ 3046 7150, the site location is shown in 416.065169.00001_Drawing 001 Site Location.

1.2 The Site Boundary

The site boundary remains the same as per the existing EP. The site boundary is shown on 416.065169.00001_Drawing 002 Site Layout and Environmental Permit Boundary.

2.0 Management of the Activities

2.1 Management Systems

SML will continue to operate the redeveloped site in accordance with the existing ISO14001 accredited Environmental Management System (EMS). The EMS will be updated to reflect the redevelopment of the site within 12 months of the site becoming fully operational.

The EMS will ensure that:

- the risks that the activities pose to the environment are identified;
- the measures that are required to minimise the risk are identified;
- the activities are managed in accordance with the EMS;
- performance against the EMS is audited at regular intervals; and
- the EP is complied with.

The management system will be reviewed at least once every four years or in response to significant changes to the activities, accidents or non-compliance. The management system will be supplemented by this BATOT document which outlines the proposed operating techniques at the Site and demonstrates conformance with the requirements of NRW guidance.

2.2 Environmental Policy, Objectives and Targets

Details of SML's environmental policy including environmental targets and objectives and improvement programme will be contained within the updated EMS.

2.3 Management Techniques

2.3.1 Operational Control, Preventative Maintenance and Calibration

Compliance with operating procedures will ensure effective control of site operations.

As part of the EMS, procedures will be established covering the following general topics:

- management and training;
- environmental protection and risk assessment;
- equipment registers and calibration;
- defects, non-conformance and complaints; and
- operations control and equipment maintenance.

A maintenance programme for all equipment will be implemented at the Site. This will follow the inspection and maintenance schedule recommended by the equipment manufacturer(s). The maintenance programme will be reviewed annually to ensure any necessary changes are implemented.

Also held on site will be any operation and maintenance manuals as provided by the equipment manufacturer(s) covering:

- equipment associated with the preparation of pulp and production of containerboard;
- equipment relating to the treatment of process effluent;
- equipment associated with the production of tissue paper;
- equipment relating to new combustion plant;

- routine maintenance procedures and requirements;
- environmental protection; and
- emergency procedures.

Where necessary, all monitoring and process control equipment will be calibrated in accordance with manufacturers' recommendations.

2.3.2 Monitoring, Measuring and Reviewing Environmental Performance

A formalised management structure will review environmental performance and ensure any necessary actions are taken.

The General Manager, or their appointed deputy, will review the facility's environmental performance on a regular basis to ensure policy commitments are met, that policy remains relevant, and to ensure that actions to improve environmental performance are identified. Records of environmental performance will be maintained within an appropriate filing system on an electronic system.

2.3.3 Staffing, Competence and Training

The General Manager will be responsible for ensuring that training levels for operational staff are adequate, relevant and up to date.

All staff will be under the supervision of a technically competent manager at all times.

Staff employed on site will benefit from training, which will ensure their professional and technical development continues. There will be a commitment for staff at all levels to continual improvement, prevention of pollution and compliance with legislation. The training will ensure that staff are aware of:

- skills and competencies required for each job;
- regulatory implications of the permit for the Site and activities;
- potential environmental effects from operations under normal and abnormal circumstances;
- prevention of accidental emissions and actions to be taken in response to accidents;
- control of point source and fugitive emissions to air;
- control of odour;
- raw material and waste handling, waste minimisation, recovery and/or disposal;
- noise;
- environmental monitoring; and
- health and safety.

The EMS and BATOT document will be available at all times for site personnel to access. Furthermore, refresher training will be provided on site policies annually. This will reduce accidents and minimise the impact of the installation on the environment, by ensuring the Site operates correctly.

Training records will be maintained by the General Manager , or a nominated deputy and held in the Site office.

2.3.4 Communication and reporting of actual or potential non-compliances and complaints

In the event that actual or potential non-compliances occur on site, these will be recorded and communicated to the General Manager or a nominated deputy. The General Manager or nominated deputy will investigate each event and identify a solution to remedy it and prevent it from reoccurring. If the non-compliance event is sustained, the operations may be stopped until a solution can be found, to minimise harm to the environment.

The remedial actions taken in response to the non-compliance may include:

- obtaining additional information on the nature and extent of the non-compliance;
- discussing and testing alternative solutions;
- modifying procedures and responsibilities;
- seeking approval for additional resources and training;
- contacting suppliers and contractors to seek alterations to the way they operate; and
- informing NRW.

Members of the public can file complaints by contacting the site. All complaints received by the General Manager or nominated deputy will be recorded and investigated within one working day, with a follow up response communicated to the complainant within 10 working days.

2.3.5 Auditing

The Site will benefit from regular auditing to ensure that it is compliant with the conditions of its EP, namely record keeping, monitoring and emission levels. The audits will be carried out by the General Manager, nominated deputy, or other Technically Competent Person, to ensure that all activities on site are in accordance with the conditions of the EP. The outcome of the audits will be reviewed and tracked to identify any frequent non-compliances.

2.3.6 Corrective action to analyse faults and prevent reoccurrence

The General Manager or nominated deputy will deal with all environmental complaints and other incidents of non-conformance. These include:

- system failure discovered at internal audit;
- incidents, accidents, and emergencies; and
- other operational system failures.

Environmental non-compliances, including remedial action taken and any changes to operation made to avoid re-occurrence will be recorded. Complaints will be reported to and investigated by the General Manager or nominated deputy and remedial measures implemented as required. Changes to prevent future complaints will be proposed and implemented where appropriate. Written records of non-conformances, complaints and other incidents will be maintained in which the date, time and nature of the event, together with the results of investigations and remedial action taken, will be recorded.

2.3.7 Reviewing and reporting environmental performance

Senior management will review environmental performance annually and take actions to ensure that policy commitments are met and that policy remains relevant.

2.3.8 Managing documentation and records

The General Manager or nominated deputy will be responsible for ensuring commitments to site audits and reviews and for ensuring that documents relevant to the EP are issued, revised and maintained in a consistent fashion.

An appropriate filing system will be maintained to ensure that all records relating to environmental monitoring, maintenance, reviews and audits are adequately maintained and updated. All records will be held within the Site office.

2.4 Accident Management Plan

SML recognise the importance of the prevention of accidents that may have environmental consequences and that it is crucial to limit those consequences.

The existing Accident Management Plan (AMP) will be updated and maintained at the Site to ensure the Site's staff are fully prepared for such incidents. The AMP will be reviewed every three years as a minimum, and after any reportable incident on Site. The document will be continually improved in these reviews to include best practice and minimise the risk of accidents occurring.

An initial assessment of the risk of accidents and abnormal operating conditions posed to the environment and site personal is provided in the Environmental Risk Assessment (ERA), document reference 416.065169.00001_ERA enclosed in Section 06 of this application. The mitigation measures identified within the ERA will be implemented to limit the consequences of accidents on the environment and site personnel.

2.4.1 Action to minimise the potential causes and consequences of accidents

Action will be taken at the Site to minimise the potential causes and consequences of accidents. These actions will include:

- maintaining a list of substances that would harm the environment if they were to escape;
- raw materials and waste will be checked for compatibility with other substances with which they may come into contact;
- raw materials, products and wastes will be stored to prevent their escape into the environment;
- vehicles will follow designated routes;
- where appropriate, barriers will be constructed to prevent vehicles from damaging equipment;
- primary and secondary containment will be provided to prevent the escape of potentially polluting materials;
- tanks for the containment of products will be fitted with level measurements to prevent overfilling;
- CCTV will be installed to minimise the risk of unauthorised access;
- a log will be maintained of all incidents and near misses;
- responsibilities for managing accidents will be clearly defined. Clear instructions on the management of accidents will be maintained; and
- appropriate equipment will be maintained to limit the consequences of an accident.

2.4.2 Hazard identification

The following hazards have been identified with the redevelopment of the site:

- odour;
- noise;
- fugitive emissions; and
- accidents.

For information on how these risks will be mitigated at the facility, please refer to the ERA in Section 06 of this application.

3.0 Site Infrastructure

3.1 Existing site

The repurposing of the site requires the demolition of the following existing main infrastructure:

- PM1 building;
- Office block;
- Finished goods warehouse; and
- Associated ancillaries.

3.2 New site

The following infrastructure will be constructed as part of the repurposing of the site:

- Containerboard machine building;
- Finished goods warehousing and despatch area;
- CHP;
- Effluent Treatment Plant;
- Raw materials storage area;
- Modification to the existing PM2 building to redevelop it into the Tissue machine building; and
- Associated ancillaries.

3.2.1 Process Design

The redevelopment of the Site has been designed for a life of 20 years and in accordance with recognised standards, methodologies and practices in every aspect.

Environmental issues have and will be taken into account during the design, construction and operational phases of the plant. Emissions of contaminants and waste production will be kept to a minimum and the waste hierarchy will be adhered to at all times. Where possible, environmentally friendly products will be used.

The Environmental Risk Assessment, enclosed as Section 06 of this application, has assessed the risk to the environment associated with operational activities and has identified corresponding measures to minimise these risks to within acceptable levels.

3.2.2 Construction

A Construction Execution Plan (CEP) will govern all construction and quality assurance activities. The CEP will be prepared by technically competent persons and detail the assurance and validation process for relevant elements of the facility, including:

- material selection;
- handling, storage and installation;
- conformance and performance testing; and
- inspection and validation.

A competent and suitably qualified person will supervise the construction activities and will prepare a validation report confirming that the construction activities have been carried out in accordance with CEP.

A Construction Environmental Management Plan (CEMP) will be implemented for the purposes of construction. This will cover aspects such as noise, dust and fugitive emissions to minimise them as far as possible.

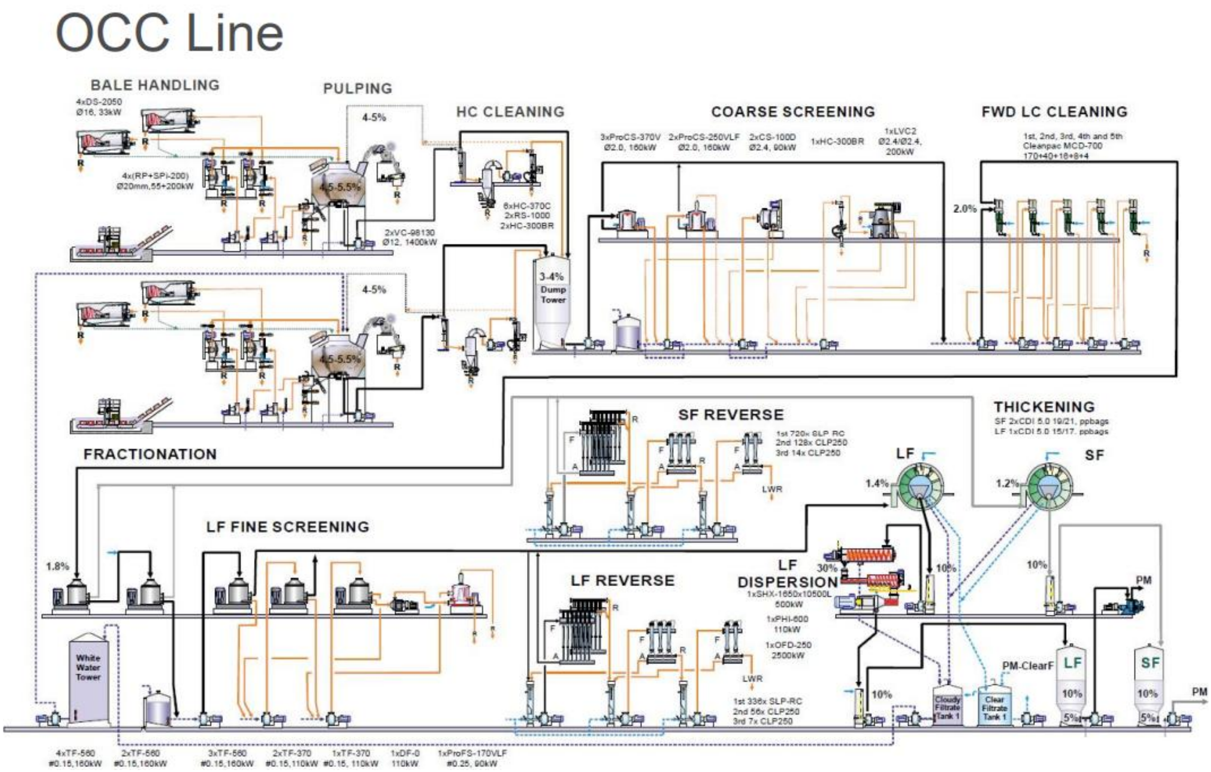
4.0 Containerboard Process Description

4.1 Raw Materials

Raw materials for papermaking are either recovered paper delivered directly to site, or fibre obtained from the on-site Materials Recovery Facility. These materials are stored either in the OCC storage warehouse or the external raw materials storage area.

Figure 1 shows a schematic of the OCC production line.

Figure 1: OCC Production line



4.2 Pulp Preparation

Pulp preparation takes place within the Recovered Fibre building, the process being designed to produce 2,500 BD t/day. Pulp preparation consists of the following sections:

a) bale handling, 2 lines;

b) pulping, 2 lines;

c) High Consistency (HC) cleaning, 2 lines;

d) coarse screening, 4 stages;

e) Low Consistency (LC) cleaning, 5 stages;

f) fractionation, 2 stages;

g) Long Fibre (LF) fine screening, 4 stages;

h) Short Fibre (SF) and LF reverse cleaning, 3 stages;

i) SF and LF thickening;

j) LF dispersion;

k) SF and LF storage; and

l) reject handling system.

4.2.1 Bale handling

Both lines have identical bale handling conveyors onto which bales are loaded. Baling wires will be cut before the bales traverse the inclined pulper feed conveyor. Any broken bales or loose paper is fed onto the separate loose paper conveyor that feed Pulper line 2.

4.2.2 Pulping

There are two identical pulpers, with identical processes. The infeed conveyor system feeds both the bales and cut baling wires into the pulper where the action of the rotor makes the bales disintegrate and defiberise the material. Larger rejects such as bale wires and lighter rejects are removed by a ragger rope. The raw material feed to the pulper is controlled by the infeed conveyor system speed, defined by the Operator.

Dilution water flow is controlled by a flow controller and consistency controller to achieve a consistency within the pulper of 4.5 to 5% solids in water. Dilution water is supplied from the OCC white water tank.

Pulp exits the pulper via the screen plate in the bottom of the vessel and is then pumped to the HC cleaning stage.

4.2.3 HC cleaning

There are three parallel connected HC cleaners which the pulp flows through before entering the dump tower. Any reject is diverted to the reject separator from where it is pumped to the second HC cleaner which is equipped with junk traps and reprocessed. Reprocessed pulp from the second HC cleaner is pumped to the dump tower.

4.2.4 Coarse screening

From the dump tower pulp enters the coarse screening section where further debris and sand are removed. The coarse screening is a four stage screening process to minimise fibre loss, with a HC cleaner between screens 3 (tertiary) and 4 (tail).

4.2.4.1 Primary coarse screening

The dump tower has a capacity of 3,000m³ for pulp that leaves the pulping stage with a consistency of approximately 4%. The dump tower is equipped with an agitator at its base and tower washer at the top.

There are 3 parallel connected screens fed from the dump tower by variable speed pumps controlled to ensure a feed consistency of 3.5%. The consistency is controlled by additions of water from the cloudy filtrate tank.

Pulp flow from the primary screens is controlled by the Operator to achieve the desired OCC output. Any rejects from the primary screens are pumped to the secondary screens.

4.2.4.2 Secondary coarse screening

Rejects from the primary screens are diluted on the suction side of the secondary screens using cloudy filtrate to achieve a consistency of 3%. Flow to and from the secondary screens are set by the Operator.

Output from the secondary screens is pumped to the LC cleaning section, whilst rejects are pumped to the tertiary screens.

4.2.4.3 Tertiary coarse screening

Rejects from the secondary screens, recirculated pulp from the coarse HC cleaner and tail screen pulp are all diluted on the suction side of the tertiary screens using cloudy filtrate to achieve a consistency of 2.5%.

Output from the tertiary screens is pumped to the infeed of the secondary coarse screens. Rejects are pumped to the coarse HC cleaner.

4.2.4.4 HC cleaning

Rejects from the tertiary screens are diluted with cloudy filtrate to a consistency of below 2% on the suction side of the HC cleaners feed pumps. Rejects from the HC cleaners are rejected through the junk traps which activate intermittently.

4.2.4.5 Tail screening

Output from the HC cleaners is fed to the tail screen and diluted with flow control water. Output from the tail screen is pumped to the tertiary screen feed, any heavy rejects are pumped to the HC cleaners, whilst light rejects are pumped to the reject handling system.

4.2.5 LC cleaning

Very small abrasive materials are removed in the LC cleaners. Output from the coarse screens are diluted to a low consistency and treated in a system of cleaners in five stages.

4.2.5.1 Stage 1

Output from the coarse primary and secondary screens are diluted with cloudy filtrate on the suction side of the LC cleaner feed pump.

The first stage has a total of 170 cleaners in two banks. The pressures across the cleaners are measured and controlled to achieve a consistency of 2% and a pressure of 175kPa. Output is pumped to the fractionators, whilst rejects are pumped to stage 2.

4.2.5.2 Stage 2

Stage 2 has 40 cleaners in a single bank. Rejects from stage 1 are diluted with cloudy filtrate on the suction side of stage 2 feed pump. The pressure across the cleaners is measured and controlled to achieve a consistency of 1.5% and a pressure of 150kPa. Output is pumped back to stage 1 feed, whilst rejects are pumped to stage 3.

4.2.5.3 Stage 3

Stage 3 has 16 cleaners in a single bank. Rejects from stage 2 are diluted with cloudy filtrate on the suction side of stage 3 feed pump. The pressure across the cleaners is measured and controlled to achieve a consistency of 1.0% and a pressure of 150kPa. Output is pumped back to stage 2 feed, whilst rejects are pumped to stage 4.

4.2.5.4 Stage 4

Stage 4 has 8 cleaners in a single bank. Rejects from stage 3 are diluted with cloudy filtrate on the suction side of stage 4 feed pump. The pressure across the cleaners is measured and controlled to achieve a consistency of 1.0% and a pressure of 150kPa. Output is pumped back to stage 3 feed, whilst rejects are pumped to stage 5.

4.2.5.5 Stage 5

Stage 5 has 4 cleaners in a single bank. Rejects from stage 4 are diluted with cloudy filtrate on the suction side of stage 5 feed pump. The pressure across the cleaners is measured and controlled to achieve a consistency of 1.3% and a pressure of 150kPa. Output is pumped back to stage 4 feed, whilst rejects are pumped to reject handling system.

4.2.6 Fractionation

The purpose of fractionation is to divide the fibres in two fractions; long and short. This is done in two stages. The first stage consists of two parallel connected primary fractionators and one secondary fractionator. The output from primary fractioning is short fibre and the reject is long fibre.

4.2.6.1 Stage 1

Pulp from LC cleaning is pumped to the primary fractionators at a consistency of 1.8%. There are two primary fractionators in both lines. Short fibre from the primary fractionators is feed for short fibre thickening. The remainder of the flow will consist of long fibres is sent to the secondary fractionators.

4.2.6.2 Stage 2

Pulp from stage 1 at a consistency of 1.8% is pumped to stage 2. Long fibre fractions are pumped to long fibre screening. Any short fibres are pumped back to stage 1.

4.2.7 Long fibre screening

After fractionation, the long fibre fraction consists of a concentrated amount of physical contaminants, therefore the pulp is screened with a four stage slotted fine screening system. Output from the primary and secondary screens are pumped to the long fibre disc filter. Rejects from the tail screen are pumped to the fine rejects handling system.

The first stage consists of 3 screens, the second stage 2 screens and the third and fourth stages have a single screen each. There is also a fibre deflaker between the third and fourth stages.

4.2.7.1 Primary fine screening

Pulp from fractionation is fed to the three primary fine screens which operate in parallel. Feed consistency to the screens is 1.8%. Dilution water is taken from the fine screening dilution tank which is fed from the cloudy filtrate tank.

Output from the primary screens is pumped to long fibre thickening, whilst rejects are pumped to the secondary stage fine filter.

4.2.7.2 Secondary fine screening

Rejects from the primary screen and output from the tertiary screen are diluted with cloudy filtrate to a consistency of 1.5% on the suction side of the secondary screen feed pump. Output of the secondary screen is pumped to long fibre thickening, whilst rejects are pumped to the tertiary screen.

4.2.7.3 Tertiary fine screening

Rejects from the secondary screen and output from the tail screen are diluted with cloudy filtrate to a consistency of 1.3% on the suction side of the tertiary screen feed pump. Output of the tertiary screen is pumped to the secondary screen, whilst rejects are pumped to the tail screen.

4.2.7.4 Deflaking and tail fine screening

Large particle size rejects form the tertiary screen are pumped to the deflaker before being pumped to the tail screen. The feed consistency to the tail screen is controlled to 1.2%. Rejects from the tail screen are either pumped to the tertiary screen or the reject handling system depending on their weight.

4.2.8 Reverse cleaning, thickening, dispersing and storing systems

Both the LF and SF fractions have similar processes in the reverse cleaning, thickening and storage systems. Reverse cleaning stages are used when required. The thickening of SF consists of two disc filters, two MC pumps and a storage tower. The thickening of the LF consists of one disc filter, one MC pump and a storage tower. In addition, the LF line is equipped with a disperger between the thickener and storage tower.

4.2.8.1 SF reverse cleaning

The first stage has 720 cleaners in two banks equipped with their own feed pumps. The pressures within the systems are measured and control the speed of the feed pumps. Consistency of the feed is 0.9% with a pressure of 280kPa. Pulp from fractionation is diluted on the suction side of the first stage feed pump using cloudy filtrate. Output from the first stage is pumped to the SF disc filters. Rejects are treated further in the second stage cleaner plant.

The second stage has 128 cleaners in two banks equipped with their own feed pumps. Rejects from the first stage are diluted on the suction side of the second stage feed pump using cloudy filtrate. The consistency of the feed is 0.3% with a pressure of 120kPa. Output from the second stage is pumped back to the first stage feed. Rejects are treated further in the third stage cleaner plant.

The third stage has 14 cleaners in two banks equipped with their own feed pumps. Rejects from the second stage are diluted on the suction side of the third stage feed pump using cloudy filtrate. The consistency of the feed is 0.2% with a pressure of 120kPa. Output from the third stage is pumped back to the second stage feed. Rejects are treated further in the reject handling system.

4.2.8.2 LF reverse cleaning

The first stage has 336 cleaners in a single bank. The consistency of the feed is 0.9% with a pressure of 250kPa. Pulp from fractionation is diluted on the suction side of the first stage pump using cloudy filtrate. Output from first stage is pumped to the LF disc filter. Rejects are treated further in the second stage cleaner plant.

The second stage has 56 cleaners in a single bank. Rejects from the first stage are diluted on the suction side of the second stage feed pump using cloudy filtrate. The consistency of the feed is 0.3% with a pressure of 120kPa. Output from the second stage is pumped back to the first stage feed. Rejects are treated further in the third stage cleaner plant.

The third stage has 7 cleaners in a single bank. Rejects from the second stage are diluted on the suction side of the third stage feed pump using cloudy filtrate. The consistency of the feed is 0.2% with a pressure of 120kPa. Output from the third stage is pumped back to the second stage feed. Rejects are treated further in the reject handling system.

4.2.8.3 Thickening

From fractioning, SF consistency is increased from 1.4 to 10% and pumped to the SF storage tower. The storage tower has a capacity of 2800m³ and equipped with a stock spreader at the top of the tower. The stock spreader is integrated with the washing system. At the bottom of the tower, pulp is diluted with bottom section dilution from 10 to 5%.

LF is thickening in a similar manner to SF, but after the thickener pulp is steam heated and dispersed. LF pulp is pumped to the screw press at 10% consistency, where it is pressed to 30% consistency. Filtrate from the screw press is pumped to the cloudy filtrate tank. After the screw press, LF is steam heated and pumped to the disperger. From the disperger, the MC pump pumps the LF fibre to the LF fibre storage tower. The LF storage tower has a capacity of 1200m³ and is equipped with a stock spreader at the top of the tower. The stock spreader is integrated with the washing system. At the bottom of the tower, pulp is diluted with bottom section dilution from 10 to 5%.

Clear filtrate from the thickeners is pumped to the clear filtrate tank and used as OCC dilution water. Make up and pick up water for the OCC plant is taken from the board machine white water tower. The amount of the water is controlled by the level of the clear filtrate tank 1. Pick-up water is used to dilute the MC pumps, storage towers and, if necessary, with LF refiners. There is a constant overflow from the clear filtrate tank to the cloudy filtrate tank 1.

Cloudy filtrate from the thickeners is pumped to the cloudy filtrate tank. There is constant overflow from the cloudy filtrate tank 1 to cloudy filtrate tank 2. Water from cloudy filtrate tank 2 is used as OCC dilution water.

The OCC white water storage total volume is 3200m³ consisting of one 1600m³ and two 800m³ volume towers interconnected by pipe. All three towers are equipped with agitators. Excess water from thickening is pumped to the first 800m³ tower. From the second 800m³ tower, water is pumped to the 1600m³ tower from where all process water is taken. The OCC white water tower is used as a buffer for pulper dilutions. Pulper dilution water can be warmed up by heat exchanger using excess hot water from the boiler and/or directly by steam. Make up water into the OCC white water tower is taken from the cloudy filtrate tank. The level of the OCC white water tower correlates to the level of the dump tower. When the level of the dump tower is low, the level of the OCC white water tower is high enough to fill the dump tower. Therefore, when the level of the dump tower is high, the level of the OCC white water tower is sufficient to ensure OCC plant dilutions.

4.2.9 Reject Handling

Rejects from the OCC process are sent to reject handling for further processing. Depending on the type of reject, these fall into two categories, off-site disposal and those suitable to be used as fuel in the onsite biomass power plant, i.e. paper mill sludge.

Off-site disposal rejects mainly consist of:

- rejects from the secondary pulper junk traps;
- rejects from the reject separator junk traps; and
- rejects from the HC cleaner junk traps.

Fuel type rejects (paper mill sludge) mainly consist of:

- rejects from the drum screens;
- rejects from the raggers;
- light rejects from the screens;
- rejects from the tertiary fine screen;
- rejects from the reverse cleaner plant; and
- rejects from the floor channels.

4.2.10 Disposal rejects

Disposal rejects are sent to the inclined reject screws and sand separators to separate water from the solids.

Overflow from the reject screws and sand separators enter the floor channels.

4.2.11 Fuel type rejects

Drum screens rejects from pulping station 1 are fed to conveyor 3 and metal particles are removed by metal separator 1 before dropping on to conveyor 12. Drum screens rejects from pulping station 2 are fed to conveyor 4 and metal particles are removed with metal separator 1 before dropping on to conveyor 13.

From conveyors 12 and 13 the rejects are dropped on to conveyor 5 where reject from coarse tail screen is also fed. Reject from conveyor 5 (two-way conveyor) can be dropped on to either of conveyor 6 or conveyor 7.

From conveyor 6 (two-way conveyor) reject can be fed to either reject press 1 or 2 and from conveyor 7 (two-way conveyor) reject can be fed to either reject press 3 or 4. After the reject presses, rejects are pressed to a of consistency 60%. Rejects from the presses drop on to conveyor 8.

The OCC grappler lifts reject from the surfaces of both pulper lines. This reject is then shredded in shredder 3 and dropped on to conveyor 1. From conveyor 1, the reject is dropped on to conveyor 2 and metal particles are removed by metal separator 3. Conveyor 2 transfers reject to conveyor 8.

From conveyor 14 (two-way conveyor) rejects can be dropped on to either conveyor 9 or the OCC reject bunker (by-passing shredders 1 and 2). From conveyor 9 (two-way conveyor) rejects can be dropped to either shredder 1 or 2.

From shredders 2 and 3, reject is transferred by conveyor 10 through magnet separator 3 and dropped on to conveyor 11. Conveyor 11 transfers rejects through the vibrating chute and eddy current separator where metals and non-metals are separated before entering the reject bunker.

Filtrate from the reject presses, sludge from the clarifiers, rejects from the LC cleaner plant, rejects from reverse cleaner plant and rejects from fine screening are all fed to the OCC microflotator feed tank.

Press water from the board machine is pumped to the press water microflotator, located in OCC building. Here polymer is dosed to flotator feed in a ratio to feed flow. Clarified filtrate from flotator is pumped to the suction side of the OCC cloudy filtrate tank pump. Sludge from the flotator is pumped to the OCC reject tank.

Water in the floor trench flows through step screens. There are two step screens, one in operation and the other in stand-by. Rejects from the step screens are fed to the reject bin. From the OCC canal pumping pit, water is pumped to the OCC effluent tower by level controlled pump. There are 180m^3 and 21m^3 canal pumping pits in the OCC building.

The OCC effluent tower has a volume of 4000m^3 and is equipped with an agitator and tower washer. The purpose of the tower is to act as buffer supply when process interruptions occur. Water from the OCC effluent tower is pumped by pressure controlled pump to the OCC microflotator feed tank.

Water is pumped from the OCC microflotator feed tank to the OCC microflotator. Feed water is flow controlled and feed consistency controlled. Polymer is dosed to the flotator feed in a ratio to feed flow. Clarified water from the OCC microflotator is pumped to the ETP plant. Sludge from the OCC microflotator is pumped to the OCC reject tank. From the OCC reject tank sludge is pumped to the sludge handling system.

4.3 Board production

The board machine, also known as Paper Machine 3 (PM3) has been designed to achieve the following parameters:

- paper grades = board and test liner;

- paperweight range = 70 to 130g/m²;
- production rate = 103.125t/hr;
- maximum board width = 10.222m; and
- maximum machine speed = 2,000m/min.

4.3.1 Stock preparation

SF stock is pumped from the stock tower to the SF stock tank. The SF stock tank has a capacity of 190m³ and is equipped with an agitator. Consistency of the pulp in the tank is controlled to 4.5%. Stock is pumped from the tank to the back ply and top ply mixing tank manifolds and is proportion controlled. The system is controlled by the Operator to achieve the desired stock recipe.

LF stock is pumped from the stock tower to the LF stock tank. The LF stock tank has a capacity of 130m³ and is equipped with an agitator. Consistency of the pulp in the tank is controlled to 4.5%. Stock is pumped from the tank to the back ply and top ply mixing tank manifolds and is proportion controlled by the LF refiners. The system is controlled by the Operator to achieve the desired stock recipe.

There are three LF refiners which are of the disc type and are connected in series. The refining total flows are calculated from forward flows and from recirculation flow. Flow and consistency values are used for SEC calculation (specific energy control). The refiners loading is controlled by SEC. SEC control means that regardless of flow volumes, the same amount of refining energy (kWh) is used per dry weight unit (BDt) of stock.

Flow and consistency are controlled and kept constant. Flow to the refiners is controlled via motor loading so that SEC measurement reaches the desired SEC setpoint.

Other loading control modes are:

- Manual control (power request)
- Constant power control (kW)

Refined stock flows to the top and back ply mixing tanks is measured and adjusted by control valves. The flow setpoints are calculated based on the stock dosing ratio, consistency measurement and the mixing tank level. Stock productions to the top ply mixing tank and back ply mixing tank are also calculated.

The refiners recirculation flow is measured and controlled by control valve. The recirculation is fed to the LF dosing tank pump suction pipe.

Sweetener pulp feed to the save all disc filter is taken from the end of the back ply mixing tank manifold and pumped to the save all disc filter feed. Recovered stock is measured and is returned to the back layer mixing tanks manifold.

Consistency control water is fed to the mixing manifold proportional to stock flows and is taken from the white water tank by a pressure controlled pump.

The back ply mixing tank has a volume of 250m³ and the top ply mixing tank has a volume of 180m³, both are equipped with agitators. There is a constant overflow from the machine tanks to the mixing tanks to prevent pressure variations on the approach flow system feed. Biocide is dosed to the mixing tanks.

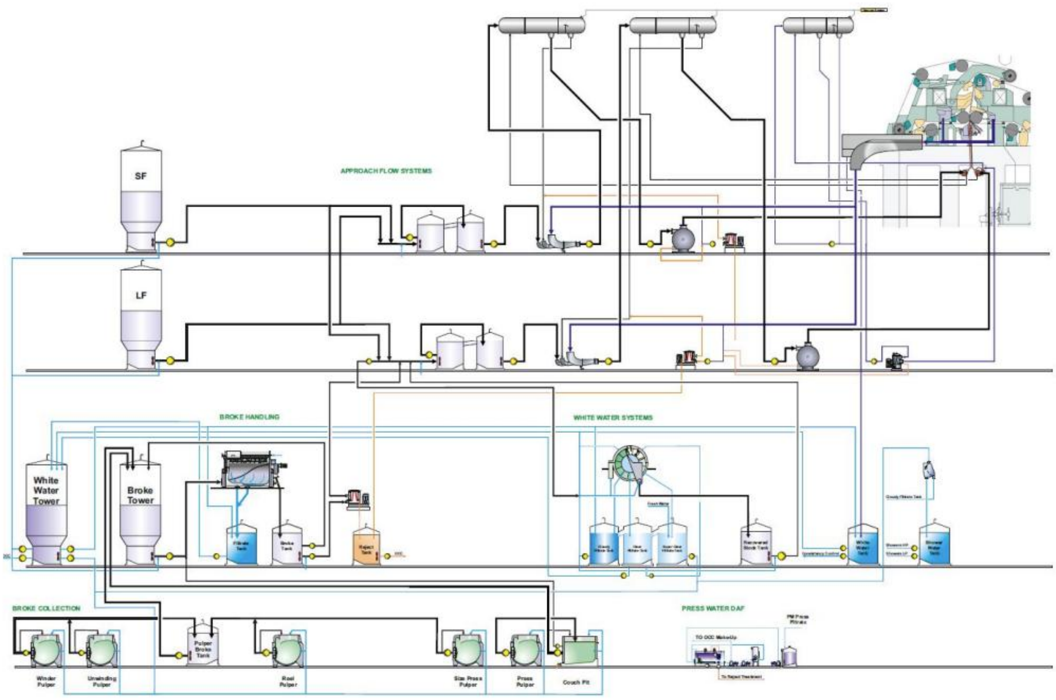
From the mixing tanks, the stock consistency is controlled and pumped to the machine tanks. The mixing tanks pumps are speed controlled and lines are equipped with adjustable valves.

The back ply machine tank has a volume of 180m³ and top ply machine tank has volume of 130m³, both are equipped with agitators. Both back ply and top ply layers have their own flow controller, which controls the speed of the machine tank pumps. The set point for the flow control loop comes from the QCS. The QCS receives board machine basis weight measurement from the board machine. Brown dye is dosed to the suction side of the machine tank pump.

Stock consistency is 3,0% before feeding into to the thick stock mixer. The stocks flows through the thick stock mixer where it is diluted with white water from the flume to the consistency required by the headbox. Both machine stock lines are equipped with shut off valves, which prevent the flume emptying if the pumps stop. The shut-off valve also operates as the pumps start valve.

Figure 2 shows a schematic of the stock preparation process.

Figure 2: Stock preparation process



4.3.1.1 Flume

The top ply and back ply thick stock mixer receives water from the flume. The flume level is kept stable with a constant overflow to the white water tank. The flume water is heated directly with steam. The flume is equipped with cleaning showers fed from shower water tank 3bar line. The flume is also dosed with biocide and defoamer.

4.3.1.2 Top ply

Feed from the top ply machine tank is diluted at the thick stock mixer with wire water and pumped to the top ply deaeration tank, where entrained air and gas are removed by vacuum. The consistency of the deaeration tank feed is approximately 1.6%. The deaeration tank is divided into two sections, the main (stock) section and the overflow section.

Stock is fed into the main section along with headbox re-circulation where they are sprayed against the roof of the tank forming a liquid layer. The deaeration tank is equipped with cleaning showers fed from the shower water tank 3bar line.

Stock flows from the deaeration tank to the top ply headbox feed pump. There is a CPAM (cationic polymer) feed station before top ply machine screen. Machine screen feed is fed to the top ply headbox inlet header. It is possible to dose micropolymer or bentonite to the headbox feed line via a retention aid mixer if required.

The headbox feed pump is equipped with rotation speed control. The rotation speed of the top ply headbox feed pump is controlled by the headbox total pressure. The top ply flow in ratio (%) to the total headbox flow is set.

The reject from the machine screen is fed to the top ply reject tank. The reject flow is flow controlled. The machine screen is equipped with a constantly open deaeration pipe, which feeds to the top layer reject tank. The machine screen feed and accept pressure are measured and the pressure difference is calculated.

The top ply reject tank is connected with the flume. The reject is diluted with wire water from the flume and pumped to the top ply reject screen. Feed from the top layer reject screen is fed to the top ply thick stock mixer flow and any reject is fed back to the back ply reject tank. Reject is flow controlled in relation to accept flow.

4.3.1.3 Back ply

Stock for the back ply headbox is fed from the deaeration tank. There is a CPAM (cationic polymer) feed station before the back ply machine screen. Machine screen feed is fed to the back ply headbox inlet header. It is possible to dose micropolymer or bentonite to the headbox feed line via a retention aid mixer if required.

The reject from the machine screen is fed to the back ply reject tank. The reject flow is flow controlled. The machine screen is equipped with a constantly open deaeration pipe, which feeds to the back layer reject tank. The machine screen feed and accept pressure are measured and the pressure difference is calculated.

The back ply reject tank is connected with the flume. The reject is diluted with wire water from the flume and pumped to the back ply reject screen. Feed from the back layer reject screen is fed to the back ply thick stock mixer flow and any reject is fed back to the broke reject tank. Reject is flow controlled in relation to accept flow.

4.3.1.4 Dilution water circulation

The purpose of the dilution system is to control the paper web cross sectional weight profile. The profile measurement controls the amount of dilution water, the maximum amount of which is 15% of the back ply flow.

Dilution water is taken from towards the top of the flume to avoid disturbance of the machine stock dilution of the thick stock mixers. Water is pumped to the dilution deaeration tank where entrained air and gas are removed by vacuum.

The dilution deaeration tank is divided into two sections, the main (stock) section and the overflow section. Stock is fed into the main section along with headbox re-circulation where they are sprayed against the roof of the tank forming a liquid layer.

Recirculation from the dilution header is pumped back to the deaerator tank at a constant rate of 18l/s. The dilution screen feed and stock pressure are measured and the pressure difference calculated. The dilution feed is 200kPa higher than the pressure of the back ply headbox inlet header. Rejects from the dilution screen is fed back to the back ply reject tank.

4.3.1.5 Approach flow vacuum system

The deaeration tank vacuum system is equipped with two vacuum pumps are installed in series to create a vacuum of 3 to 4kPa over the saturation pressure in relation to water temperature. Evacuated air from the deaeration tank is cooled by a spiral indirect condenser to increase the deaeration capacity. Cooling water for the condenser is taken from fresh water and is fed to the warm water tank, whilst condensate is removed through the vacuum system seal pit.

4.3.1.6 Headbox function and controls

The back and top ply machine screens feed pulp to the corresponding headbox ply header which also allow for recirculation to the corresponding deaerator. The volume of recirculation is controlled to ensure the pressure difference between both ends of the header is zero, which normally equates to approximately 10% recirculation.

4.3.2 Paper machine (PM3)

Pulp is sprayed out of the headbox slice lips onto the wire (forming section) where water is mechanically drained through the screening of the wire and drawn off by vacuum.

4.3.2.1 Forming section

The forming section vacuum system consists of the following equipment.

Vacushoe

The Vacushoe consists of two chambers with different vacuum levels, chamber 1 at -10kPa and chamber 2 at -20kPa. Both chambers have vacuum controls and pre-separators. The water legs of the separators are combined and pumped to the white water tank.

Curved suction box

The curved suction box consists of two chambers with different vacuum levels, chamber 1 at -35kPa and chamber 2 at -45kPa. Both chambers have vacuum controls and pre-separators. The water legs of the separators are combined and pumped to the white water tank.

Flat suction boxes

There are two flat suction boxes, both with vacuum levels of -45kPa. Both boxes have vacuum controls and pre-separators. The water legs of the separators are combined and pumped to the white water tank.

High vacuum suction box

The high vacuum suction box has a vacuum level of -65kPa. The box has vacuum controls and a pre-separator. The water leg of the separator is pumped to the white water tank.

Trim suction box

The trim suction box has a vacuum level of -48kPa. The box has vacuum controls.

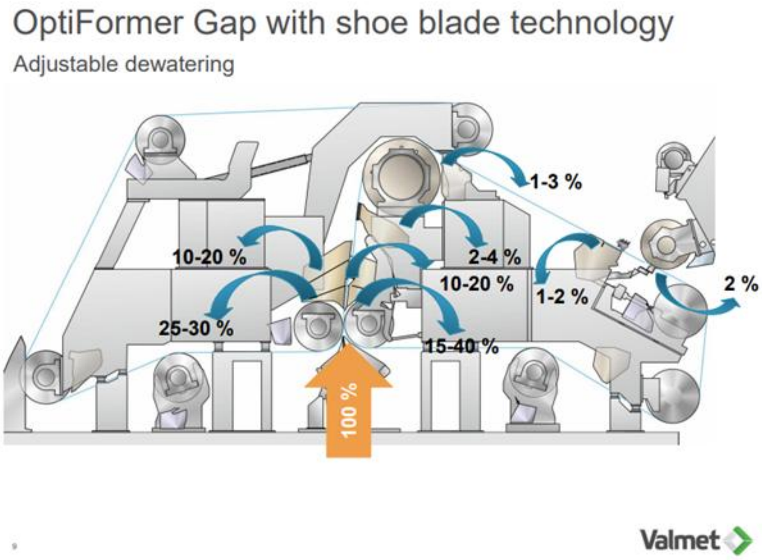
Couch roll

The couch roll section consists of two chambers with different vacuum levels, chamber 1 at -48kPa and chamber 2 at -65 to -70kPa. Both chambers have vacuum controls.

OptiFormer

The Forming section utilises OptiFormer technology, see Figure 3.

Figure 3: OptiFormer

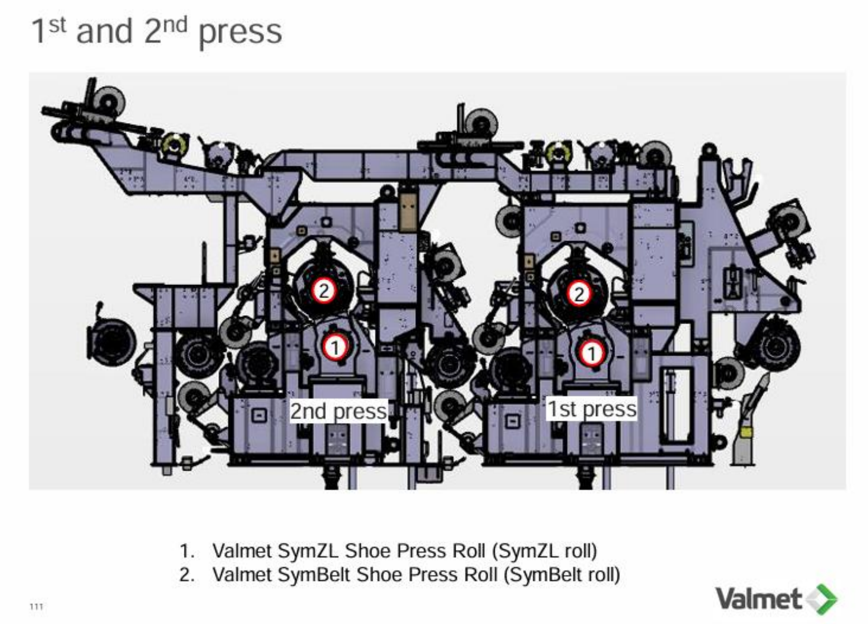


4.3.2.2 Press Section

The paper web is transferred from the Forming section to the Press section with the help of the pick-up suction roll which consists of two chambers with different vacuum levels, chamber 1 at -60kPa and chamber 2 at -25kPa. The web attaches to the bottom surface of the pick-up felt and is supported by the bottom felt, the web is transferred to the 1st Press nip.

The Press section utilises OptiPress Linear Shoe technology, see Figure 4.

Figure 4: OptiPress



After the 1st Press nip, the web continues to travel between the two felts to the 1st felt suction roll, where the vacuum of the roll (-50 to -60kPa) makes the web follow the bottom felt to the 1st transfer suction roll which consists of two chambers with different vacuum levels, chamber 1 at -45kPa and chamber 2 in the range of -35 to -45kPa. There is a suction box after the 1st transfer roll that operates at a vacuum level of -20kPa.

As the OptiPress utilises dual nip technology, there is a second set of press rolls identical to the first nip set up, but with different vacuum levels for the 2nd transfer suction roll which are chamber 1 at -45kPa and chamber 2 in the range of -25kPa. The dual extended nip technology results in a significantly longer pressing time compared to a conventional roll nip, which increases the dryness level of the web.

4.3.2.3 Drying section

From the Press section, the web travels through the OptiDry twin drying unit which consists of a transfer fabric and horizontal and vertical drying groups. The drying groups use hot combustion gases from natural gas burners to significantly reduce the moisture level of the web. This assists the efficiency of the pre-dryer and after dryer sections. The gas burners are of approximately 1.74MWth capacity each, with a total of 14 burners, 4 in the horizontal and 10 in the vertical. As the burners are used for direct drying, they are exempt from Medium Combustion Plant Directive controls.

After the OptiDry the web travels through the pre-dryer and after dryer sections where moisture is removed by evaporation due to direct heating from contacting steam heated rolls. A size press is situated between the pre-dryer and after dryer sections which coats the web with starch.

4.3.2.4 Reel and winder sections

Following the Drying section the web enters the reel section where it is wound on a spool to form a parent reel.

The parent reel is transferred to the winder section where it is cut into smaller reels to meet customer size requirements.

From the winder, the customer sized rolls are transferred to the Finished Products warehouse by conveyors to await dispatch.

4.3.3 Warm and Shower water system

4.3.3.1 Warm water system

Warm water is used throughout the PM3 process at various locations and pressures ranging from 3bar to 150bar. The warm water tank requires continuous filling to ensure adequate supply to cover process consumption. Make-up water is drawn from the following sources:

- cooling water from the PM3 steam condensers;
- approach flow deaerator condenser; and
- additional fresh mains water.

Heating of the warm water tank is by heat recovery towers. Additionally, the return line from the heat recovery towers is also equipped with a heat exchanger.

4.3.3.2 Shower water system

Shower water is used at various locations and pressures throughout the PM3. Pressures range from 3bar to 12bar. Shower water is produced by pumping super clear filtrate through the shower water bow screens into the shower water tank. If there is insufficient filtrate available, back-up water is drawn from the warm water tank or clear filtrate tank. The shower water tank has a capacity of 60m³, has 3 pumps and is dosed with biocide.

4.3.4 Ancillary systems

4.3.4.1 Fresh and Cooling water system

Both pulp preparation and the PM3 have a common closed water network. The cooling water tank has a capacity of 60m³ and make-up water is drawn from the fresh water main. Temperatures and flows within the system are measured. Cooling water is pumped around the system by three pumps, the pumping line is equipped with two 150µm filters.

The cooling water is equipped with oil content measurement. If oil contamination is detected, the pump for the cooling towers is shut down and cooling water system will be run on fresh water. A small quantity of water is constantly lost from the system to prevent contamination. The maximum cooling water temperature is 30ºC.

4.3.4.2 Compressed Air system

The compressed air system comprises of two networks: the mill air and the instrument air. Mill air is used mainly for the PM3 tail threading and broke blowing. Instrument air is used mainly by control instruments. Compressors feed both networks through common headers to the PM3 areas.

4.3.4.3 Broke system

Broke is the generic term given to rejected part of the paper web, including trims, which are re-pulped and fed back into the paper making process. Broke is collected and processed at various different locations of the PM3.

Couch pit

Broke from the wire section and press pulper are fed into the couch pit which is equipped with two pumps. The main pump runs in the event of a paper web break and the trim pump runs constantly when the PM3 is running. The couch pit is also equipped with two agitators which run when the pit level is above a set point.

During a paper web break, broke is pumped from the couch pit to the broke tower by the couch pit main pump. During normal running, trim is pumped under level control to the suction side of the broke thickener feed pump to ensure the broke tower consistency is kept as high as possible. Dilution water to the couch pit is taken from the white water tower. Shower water is fed to the couch pit through the shower pipe. Dilution is controlled by a flow controller, the setting of which is calculated according to production targets and the target consistency set for the pulper.

Press pulper

Broke from the press section is fed into the press pulper which is equipped a single pump. Broke is pumped from the press pit to the couch pit. The press pit is also equipped with two agitators which run when the pit level is above a set point. Dilution water for the press pit is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Loose broke from beneath the press section can be fed to the press pulper by broke conveyor 1. The conveyor is started manually and automatically opens the pulper broke hatch and the loose broke shower.

Size press pulper

Broke from the pre-dryer section is fed into the size press pulper which is equipped a single pump. Broke is pumped from the size press pulper to the broke collection tank. The press pit is also equipped with two agitators which run when the pit level is above a set point. Dilution water for the size press pit is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Loose broke from beneath the pre-dryer section can be fed to the press pulper by broke conveyor 2. The conveyor is started manually and automatically opens the pulper broke hatch and the loose broke shower.

Reel pulper

Broke from the reel is fed into the reel pulper which is equipped a single pump. Broke is pumped from the reel pulper to the broke collection tank. The reel pulper is also equipped with two agitators which run when the pulper level is above a set point. Dilution water for the size press pit is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Loose broke from beneath the after-dryer section can be fed to the reel pulper by broke conveyor 3. The conveyor is started manually and automatically opens the pulper broke hatch and the loose broke shower.

Slabbing pulper

Slabs from the parent reel surface are fed to the slabbing pulper which is equipped with a single pump. Broke is pumped from the slabbing pulper to the broke collection tank. The slabbing pulper is also equipped with two agitators which run when the pulper level is above a set point. Dilution water for the slabbing pulper is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Winder pulper

Slabs from the parent reel back surface and winder trims are fed to the winder pulper which is equipped with a single pump. Broke is pumped from the winder pulper to the broke collection tank. The slabbing pulper is also equipped with two agitators which run when the pulper level is above a set point. Dilution water for the winder pulper is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Broke roll pulper

Broke rolls are cut with the broke roll cutter and then fed to the broke roll pulper which is equipped with a single pump. Broke is pumped from the broke roll pulper to the broke collection tank. The broke roll pulper is also equipped with a single agitator which runs when the pulper level is above a set point. Dilution water for the broke roll pulper is drawn from the white water tower which is flow controlled according to production targets and target consistency.

Broke collection tank

Broke from the size press, reel, slabbing, winder and broke roll pulpers are all pumped to the broke collection tank. This tank has a volume of 40m³ and is equipped with an agitator and two pumps. The high capacity pump runs in the event of a paper web break whilst the lower capacity pump runs when the tank level is above a set point. Broke is pumped from the broke collection tank to the broke tower. Dilution water is drawn from the white water tower.

Broke handling

The broke storage tower has a capacity of 4000m³ and is equipped with an agitator. The consistency of pulp in the tower is approximately 3.5%. Biocide can be dosed via the top of the tower.

During an extended paper web break, broke can be pumped from the broke tower to the OCC dump tower. Broke from the broke tower and trims from the couch pit are pumped to the broke thickener. Dilution water is drawn from the white water tower.

The broke thickener is of the gravity type. Broke is thickened from feed consistency to between 2.5 and 4% before being pumped to the thickened broke tank. Filtrate form the broke thickener is pumped to the broke filtrate tank. The broke filtrate tank has a volume of 40m³. Filtrate is ultimately pumped to the white water tower.

The thickened broke tank has a volume of 70m³ and is equipped with an agitator. Broke is pumped from the thickened broke tank to broke screen at a maximum consistency of 4%. Broke can also be pumped to the broke tower. The screen is deaerated at start up and deaeration is fed to the broke reject tank.

The broke dosing tank has a volume of 35m³ and is equipped with an agitator. The consistency in the tank is approximately 3 to 4%. Broke is pumped from the broke dosing tank to the top and back ply mixing tanks.

The broke reject tank has a volume of 15m³ and is equipped with an agitator. The consistency in the tank is approximately 2 to 3%. Approach flow reject from the back ply reject screen is also pumped to the broke reject tank. reject is pumped from the broke reject tank to the OCC coarse screen.

4.3.4.4 White water system

White water collection and storage

The white water system consists of the white water tank and two white water towers and ancillary pumps and control systems.

The white water tank has a volume of 190m³ and the consistency within the tank is approximately 0.4%. Excess water from the tank is pumped to white water tower 1. Both biocide and defoamer can be dosed into the tank via the top. There are three pumps on the white water tank system:

- stock tower dilution pump – pumps water for the dilution of the broke tower and both the SF and LF towers;
- white water tank pump – pumps water to the disc filter, flume and to the white water tower; and
- consistency control pump – pumps water to the consistency main line.

The white water towers each have a volume of 4500m³ giving a combined capacity of 9000m³. Each are equipped with agitators and the consistency within the towers is approximately 0.1%. All the tower feed lines are connected to tower 1 whilst all the outgoing lines are connected to tower 2. The tower feed lines are clear filtrate from the clear filtrate tank, broke filtrate from the broke filtrate tank, excess white water from the white water tank and fresh water make-up. Biocide can be dosed via the top of white water tower 1.

The white water tower 2 system has three pumps:

- knock-off pump – pumps water to the PM3 paper web knock-off shower;
- pulper dilution pump – pumps water to the PM3 under machine pulpers; and
- OCC make-up pump - pumps water to the OCC dilutions, flushing and approach system dilutions, former/press water tank dilution and make-up water.

The level of the white water towers correlates to the level of the broke tower, i.e. when the level of the broke tower is low, the level of the white water towers will be high enough to fill the broke tower in the event of a paper web break. Make-up water is drawn from the fresh water main.

Save all disc filter

Fibres are recovered from the white water by a save all disc filter which is equipped with three motors, an oscillating shower and a repulped screw. The level of the disc filter is controlled by the disc filter rotational speed. The disc filter forms three filtration fractions, cloudy, clear and super clear, each of which is pumped to dedicated storage tanks.

4.4 Chemicals

The chemicals listed in Table 1 will be used in PM3.

Table 1: PM3 Chemicals

Chemical	Storage	Storage Capacity	Annual consumption	Usage description
Brown Dye	Bulk tank	60m³	6,935m³	Used to ensure final product quality
CPAM	Bulk tank	60m³	7,300m³	Aid retention
PAC	Bulk tank	100m³	730m³	
Defoamer	Bulk tank	30m³	1,460m³	De-aeration of stock
Bentonite	Bulk tank	150m³	13,140m³	Pacification of ‘stickies’
Starch	Bulk tanks (x2)	400m³ per tank	109,500m³	Used to ensure final product quality
Hypochlorite	Bulk tank	30m³	730m³	Biological control
Biocide	IBC	2.1m³	TBC	
Polymer	IBC	10m³	TBC	Wire cleaning and final product quality

4.4.1 Containment

The chemical storage area associated with PM3 has been designed and will be constructed to adhere to CIRIA C736 guidance.

5.0 Effluent Treatment Plant Process Description

The existing Effluent Treatment Plant (ETP) on site is to undergo a major redevelopment to meet the needs of the new paper production processes. Only the existing primary screens and clarifiers will be retained as part of the new ETP (the existing secondary clarifier will be retained as back-up containment only). The new ETP will incorporate anaerobic treatment techniques with associated biogas production. The redeveloped ETP has been designed for a throughput of 1,200m³/hr (28,800tpd) of process derived effluent.

Approximately 250-350m^3/hr of the treated water processed through the ETP will be returned to the OCC (pulp preparation plant).

The new ETP will include the following:

- reuse of existing primary treatment equipment;
- pre-cooling;
- buffer/pre-conditioning tank;

- anaerobic treatment reactors;
- biogas desulphurisation;
- biogas storage;
- biogas engines;
- flash aeration basins;
- calcium separation microflotation;
- activated sludge basin;
- secondary clarification;
- post cooling;
- sludge dewatering; and
- associated storage and dosing systems.

A new process control system will also be installed which will be connected to the main PM3 control system.

5.1 Primary treatment

The existing primary treatment system will be retained. Influent will initially be screened into a pumping pit from which it is pumped to the primary clarifiers. Clarified influent overflows V-notched weirs on the rim of the clarifiers to an overflow channel from where it is gravity fed to a new pumping pit located between the clarifiers.

Sludge from the bottom of the clarifiers is pumped to a sludge storage tank at the sludge dewatering area.

5.2 Pre-cooling

Clarified influent is pumped to the pre-cooling system. This system consists of two plate type heat exchangers, each sized to cool 50% of the design flow. The temperature of the influent is cooled to approximately 30 to 38ºC. The heated cooling water is transferred to six parallel induced draft cooling towers. Cooled water falls to a collection basis beneath the cooling towers from where it is pumped back to the heat exchangers. Water losses due to evaporation are made up with fresh water.

A low volume bleed flow is used to prevent a build-up of inorganic salts in the water system. This bleed flow is drained to the influent stream for treatment in the ETP. Antiscalant chemicals and biocide are added to the cooling water feed.

5.3 Pre-acidification tank

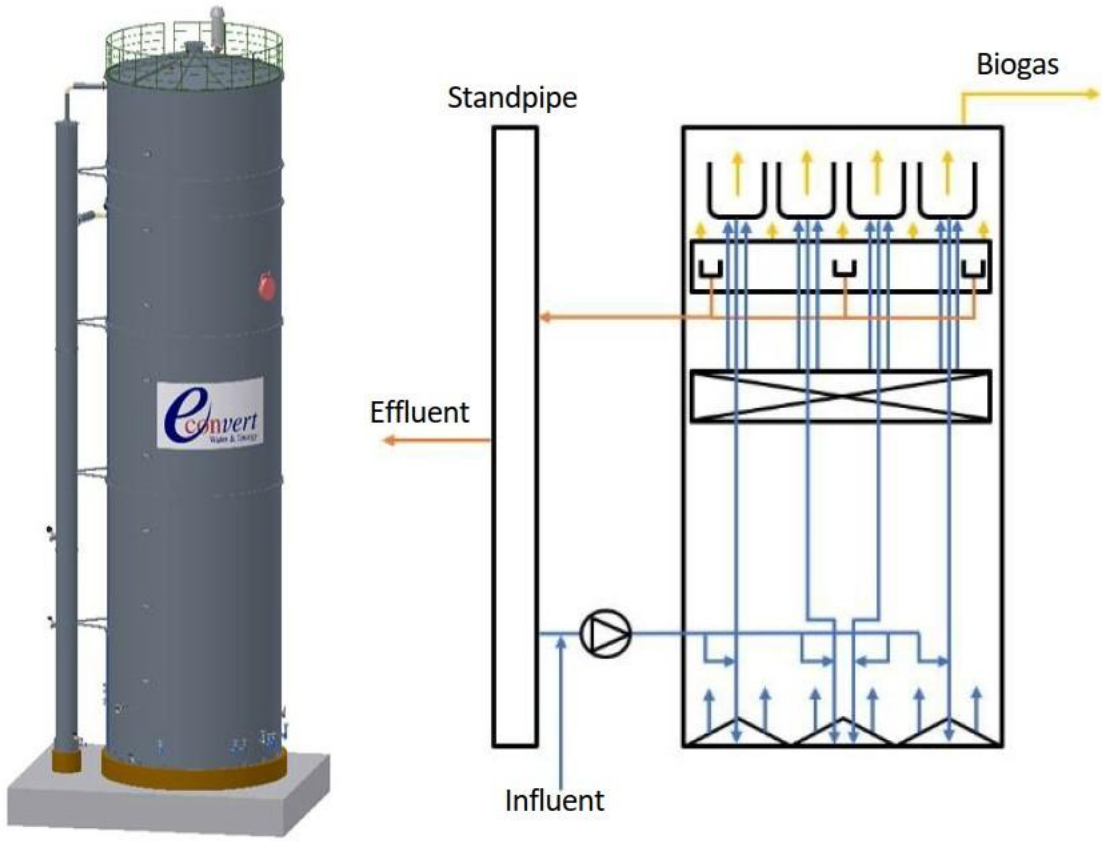
Pre-acidification is used to condition the influent to optimise the anaerobic treatment stage. The pre-acidification tank has two mixers and a volume of 4863m³ and provides approximately 4 hours retention time. Temperature and pH are measured and controlled and additional nutrients can be dosed to optimise the composition of the influent prior to anaerobic treatment.

5.4 Anaerobic Econvert-IRC® reactor

The Econvert-IRC® reactor is a gas tight design with external recirculation of the effluent which is mixed with the influent in order to decrease the Chemical Oxygen Demand (COD) concentration in the reactor. The external recirculation occurs in the standpipe. Figure 5 shows a schematic of the reactor. There will be 2 duty reactors and 1 standby reactor.

The anaerobic digestion stage will generate on average approximately 1422m³/hr of biogas, with a peak flow of approximately 1871m³/hr. The methane content of the biogas is approximately 70%, however this will vary depending on influent conditions and reactor operation.

Figure 5: Schematic of Econvert-IRC® reactor



Each reactor is designed and set-up to treat 56 tonnes COD per day, i.e. a total of 112 tonnes COD per day.

The influent feed is split 50% between each duty reactor and is mixed with the external recirculation from the standpipe and pumped to the mixing chamber at the bottom of the reactors. The influent distribution system is designed to ensure an equal distribution of the influent to prevent disturbance of the granular sludge bed.

Each reactor has two settling stages in two chambers. In the upper chamber effluent rises at 8m/hr and in the lower chamber at 16m/hr due to the internal recirculation. Therefore, the biomass is mainly present in the lower chamber which is under high COD loading. In the lower chamber the fluidised sludge bed converts COD into biogas and hence reduces the COD loading. Biomass grows in the lower chamber, but smaller granules can rise with the wastewater due to the relatively high velocity. The majority of these small granules are captured on the lower settler; however some will pass through to the upper chamber where due to the lower velocity they grow larger and hence sink back to the lower chamber.

Biogas generated in the lower chamber is captured and collected in a riser. Along with the biogas, wastewater is forced to the top of the reactor due to the 'airlift' principle. At the top of the reactor biogas and wastewater are separated in a degassing tank. The wastewater is forced back to the lower chamber through the downer pipe and recirculated.

The produced biogas flows through a flow meter to ensure optimum process control, as the production of biogas is proportional to the reactor COD loading. Hence the flow of influent to the reactor can be controlled to ensure optimum COD loading. The produced biogas is routed to the biogas buffer.

To ensure optimum conditions for the anaerobic bacteria, both pH and temperature are measured and controlled.

5.5 Biogas buffer and emergency flare

The buffer has a capacity of 970m³ and allows for fluctuations in biogas flow and maintains the biogas pressure at a constant 30mbar. The buffer is not designed for long-term biogas storage, rather to ensure an equalised flow which benefits the entire system and prevents over-pressurisation and therefore activation of the over-pressure protection device and associated loss of biogas.

A blower is used to maintain a constant pressure between the inner and outer skins of the buffer, thus ensuring the 30mbar in the system. Damage to the inner skin could result in a loss of biogas, therefore a Lower Explosive Limit (LEL) monitor is installed at the exhaust of the biogas buffer which will alarm if a level of 10% LEL is reached. The buffer is protected against excessive pressure by a safety valve filled with ethylene glycol.

The emergency flare will be used when the gas engine is not available. The flare is a high temperature unit with a combustion temperature of 850ºC able to burn a maximum of 2500Nm³/hr of biogas. Operating hours of the flare will be recorded on SCADA.

The biogas is sent to the desulphurisation unit and then to the gas engines by the biogas compressor.

5.6 Gas engines

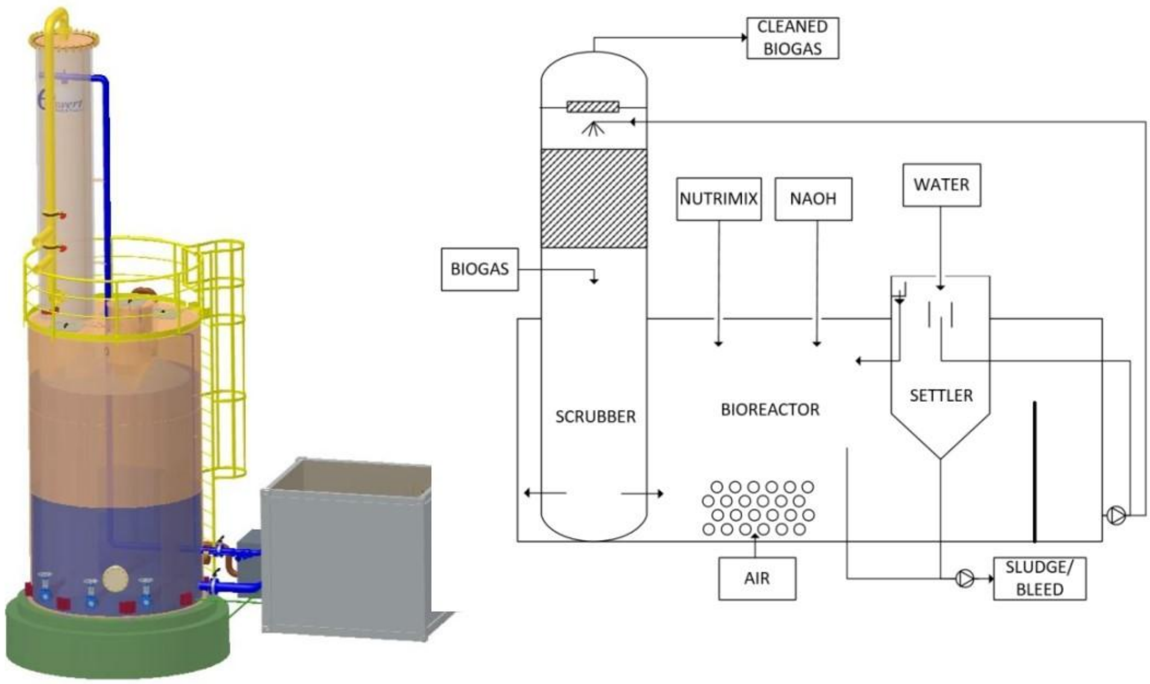
Produced biomethane will be used to fuel gas engines to produce heat and electricity that will be consumed by the ETP, thereby improving its overall energy efficiency.

The gas engines will be MTU 20V4000GS units. 2 units will be installed, the generators of each unit have will have a rated thermal input of 5.8MWth and are therefore, considered to be Medium Combustion Plant. They will vent via individual 24m high stacks within a common windshield.

5.7 Econvert-DSulph® reactor

The Econvert-DSulph® reactor is a biological desulphurisation reactor for the removal of hydrogen sulphide (H_2S) consisting of a biogas scrubber for H_2S absorption, a bioreactor for the production of elemental sulphur and regeneration of caustic soda (NaOH) and a settler for thickening of the produced sulphur. Figure 6 shows a schematic of the reactor.

Figure 6: Schematic of Econvert-DSulph® reactor



The transition of H_2S from the gaseous phase to the liquid phase takes place in the scrubber vessel. The biological conversion of sulphides into elemental sulphur and caustic soda takes place in the bioreactor. The settler removes the elemental sulphur from the liquid.

5.7.1 Gas Phase

The biogas is treated in the scrubber which contains a packing material of plastic pall rings which increase the transfer area to 175m²/m³. This increase in transfer area increases the contact time between the washing liquid and the biogas. The biogas is scrubbed by an alkaline washing liquid on a counter-current arrangement.

The majority of the process liquid from the bioreactor is sprayed into the top of the reactor, spray zone and the H_2S containing biogas is fed into the reactor just below the packing material. The biogas flows through the packing material where the majority of the H_2S is absorbed by the washing liquid resulting in a cleaned biogas that leaves the scrubber at the top through a demister. The demister removes the majority of water droplets in the gas stream to minimise carry-over.

5.7.2 Liquid Phase

The scrubber is connected to the bioreactor in continuity allowing the sulphur containing liquid from the lower chamber of the scrubber to flow directly to the bioreactor. Before the liquid enters the bioreactor, it is degassed in the lower chamber, which also acts as a water lock to ensure biogas does not flow into the bioreactor. The sulphide present in the liquid is biologically converted to elemental sulphur in the bioreactor. Aeration of the bioreactor is necessary for the biological oxidation of the sulphide by the biomass.

The oxidation reaction is exothermic, the heat produced being proportional to the sulphide load. The biological conversion of the sulphide regenerates the consumed caustic soda and increases alkalinity of the process liquid. The elemental sulphur does not settle inside the bioreactor due to the mixing caused by the aeration. A small proportion of the elemental sulphur is further oxidised to sulphate, this reaction causes a loss of caustic soda, which has to be made up by additions to the bioreactor. In order to limit the amount of sulphate generated, the amount of oxygen required for the sulphide reaction is minimised by controlling the amount of air drawn into the bioreactor for the aeration.

The addition of caustic soda results in an increase in conductivity which is balanced by adding fresh water to the bioreactor. This causes a rise in the level inside the reactor which is controlled by bleeding off a proportion of the process liquid. This bleeding prevents the build-up of sodium sulphate, sodium bisulphate and other salts. The bleed stream drains to the ETP.

5.7.3 Solid Phase

The produced elemental sulphur and the biomass from the bioreactor settle and separates from the process liquid in the settler. The settler is fed with a small flow of the process liquid from the bioreactor. The process liquid overflows via the weirs of the settler and returns to the bioreactor. Sulphur sludge is removed from the bottom of the settler with a high dry matter content of between 5 to 10% mass. A small flow of the concentrated sulphur sludge is pumped from the settler back to the bioreactor, the balance being discharged to the activated sludge basin where sulphur is converted to sulphate and ultimately will present itself in the Total Suspended Solids (TSS) of the final effluent. This allows for control of the TSS inside the bioreactor.

5.7.4 Heat exchanger

The DSulph® has an internal heat exchanger, primarily to cool the process liquid at high sulphur loads or high ambient temperatures, to protect the bacteria from too high temperatures. It can also be used for heating the process liquid before startup.

5.7.5 Nutrients

The bacteria for the biological process require certain conditions for cell growth and function. These include correct pH, temperatures, oxygen levels and sulphide levels. They also require nutrients for cell growth. These nutrients are not present in sufficient quantities in the process liquid and therefore have to be dosed continuously. Therefore, the system has a dosing station and a storage container for Econvert-Nutrimix.

5.8 Biogas dryer

A biogas dryer is needed to reduce the moisture content of the biogas to prevent condensation forming in the pipeline feeding the gas engine. Any condensate formed could flow back and forth in the pipeline, causing pressure fluctuations or blockages. Also, a reduction in moisture content increases the heating value of the biogas in the gas engine.

The biogas dryer consists of two heat exchangers and a cooler. The first, smaller heat exchanger cools the biogas in advance of the second heat exchanger and pre-heats the biogas coming from the second heat exchanger. In the second heat exchanger the biogas is cooled by 5ºC by the cooling liquid from the chiller. At this stage the biogas is completely saturated, however after the second pass in the first heat exchanger the biogas is re-heated to approximately 10ºC and the relative humidity is decreased. Biogas is then sent to the gas engine by a compressor which also results in heating of the biogas.

A condensate trap with a water lock is used to collect the condensate. The water level in the trap is maintained to ensure water lock.

5.9 Flash aeration

Anaerobically treated effluent may contain elevated levels of calcium which may cause operational issues in the overall process. Therefore, a process called flash aeration is used to precipitate the excess dissolved calcium.

Flash aeration takes place in an open top concrete basin. Effluent flows from the IR Reactors stand pipes through pipes to the flash aeration basins. There are two basins each with a volume of 2400m³, which results in a retention time of 4 hours. Both basins are in operation and in normal operation the flow will be divided equally between them, however in case of maintenance, the whole effluent flow can be directed to a single basin.

The principle of flash aeration is to aerate the effluent so that a relatively high dissolved oxygen concentration is achieved. Mechanical fine bubble aerators are used to aerate the effluent and also to ensure mixing, hence there are no separate mixers required in the basins. There are 3 aerators in each basin. Aeration will promote the precipitation of calcium as calcium carbonate and reduce the COD of the effluent.

Aeration air is generated with single-stage centrifugal turbo compressors, one per basin and a stand-by unit, making a total of 3 compressors.

Solid particles, mainly calcium precipitates formed during flash aeration are separated in the subsequent solids separation process. The aeration basins will be drained annually to remove the accumulated calcium sludge and maintain the aerators.

5.10 Calcium separation with FlooDaf® microflotation

Effluent from the flash aeration basins flows by gravity to the calcium separation FlooDaf® process. There are two parallel units each with capacity to treat 50% of the design flow from their respective basin. The efficient flotation surface area of each unit is 104m². Incoming effluent is treated with a suitable flocculant before entry to the basin. The dosed effluent is then mixed with dispersion water in the dispersion section of the basin.

Dispersion water is prepared by dissolving high pressure air into the clarified effluent in the dispersion water tank. Clarified effluent is pumped to the tank and injected through a special nozzle which creates a large contact surface area between the water and the air resulting in maximal dissolvement of the air. When the pressure of the dispersion water is released in the dispersion chamber, the over-saturation of air creates microbubbles which attach to the solid particles and raise these to the surface of the flotation basin.

The surface sludge is scraped to the sludge compartment with the aid of tow sludge rollers. Sludge is pumped from the sludge compartment to a sludge storage tank. Heavy particles that settle on the bottom of the basin form so called 'bottom sludge.' This sludge is removed by sludge scraping equipment to the bottom sludge collection compartment and then pumped to the sludge storage tank.

Clarified effluent from the FlooDaf® process flows by gravity to the activated sludge process. A flow control valve on the outlet pipe of the floatation basin controls the level of the floatation basin.

5.11 Activated sludge basin

The activated sludge basin is a plug flow type aerated concrete basin of 19000m³ capacity with a water depth of 7m. The basin consists of three parallel lines with U-turns at the end of the first two channels resulting in a total length of approximately 199m. The residence time of effluent in the basin is approximately 16 hours. Aerobic microorganisms living in the activated sludge remove soluble organic substances. The feed effluent to the activated sludge basin has low concentrations of nitrogen and phosphorous and therefore has to be dosed with these macronutrients in the feed to the basin. Oxygen for the microorganisms is provided by OKI type submersible aerators.

In the OKI type aerators compressed air is fed down a flexible hose and enters the stator before exiting at the tips of the rotating rotor. The low-speed rotation ensures that flocks are maintained and the turbulence at the rotor tips ensures a high oxygen transfer. There are 4 aerators in each line of the basin, totalling 12. Compressed air is provided by three single stage centrifugal turbo compressors, two in operation and one standby.

Return activated sludge is pumped from the bottom of the secondary clarifier to the feed of the activated sludge basin. Treated effluent from the basin overflows a weir at the end of the third line into a concrete launder which is connected to the feed pipe of the secondary clarifier.

5.12 Secondary clarifier

The secondary clarifier is a circular gravity sedimentation type, where the biological sludge is separated from the treated effluent. The effluent enters the centre of the clarifier inside an Energy Dissipation Inlet which dissipates the energy of the effluent before it enters the flocculation feed well. Inside the feed well the flow is equally distributed across the entire basin.

Solid particles settle at the bottom of the basin and form a sludge blanket. The clarified effluent overflows v-notched weirs on the rim of the basin to an overflow channel

The sludge blanket is continuously removed from the bottom of the basin by a suction scraping system. The sludge is lifted in a sludge compartment at the centre of the clarifier from where it is pumped back to the biological treatment stage as the return sludge. Part of the sludge blanket is scraped to a thickening pot in the centre of the basin. Sludge recovered from here is called excess sludge and is pumped to sludge dewatering.

5.13 Post cooling

Clarified effluent from the secondary clarifier flows to a pumping pit where it is pumped to final cooling. Final cooling is achieved with three parallel direct cooling towers of induced counter flow design. Clarified effluent flow is distributed evenly between the towers.

5.14 Sludge dewatering

Sludges from the various stages are pumped to sludge dewatering via the sludge storage tank. The sludge tank has a capacity of 1525m³ and is equipped with a mixer. All the sludge streams are mixed inside the tank to provide a homogenised feed to be pumped for further dewatering. It is anticipated that approximately 231,500tpa of dewatered sludge will be produced annually and used as a fuel source in the existing biomass plant (boiler 7).

5.14.1 Pre-thickening

Mixed sludge is pumped from the sludge tank to pre-thickening. Pre-thickening takes place in two gravity tables that each treat 50% of the sludge load. A flocculant is added to the sludge feed before the gravity tables. At the feed end of the gravity tables, the sludge is distributed by a spreader plate evenly onto a moving continuous belt made of filter cloth. The solids retain on the top of the cloth, whilst the liquid (filtrate) drains through into a closed tray.

The retained solids (thickened sludge) are deflected and arranged by several rows of ploughs across the cloth, resulting in loosening up of the dewatered sludge and creation of clear zones on the cloth for better drainage of water. The thickened sludge is discharged by a scraper at the end of the cloth belt, down into a hopper from where it is pumped for further dewatering. The cloth belt is then washed by a spray bar before more sludge is fed onto it.

5.14.2 Decanter centrifuge

The thickened sludge is pumped to two decanter centrifuge hoppers which feed the three eccentric screw pumps to the decanter centrifuges. The three centrifuges operate in parallel. The thickened sludge is dosed with flocculant in the inlet pipes to the centrifuges.

Dewatered sludge falls from the centrifuges to a dedicated screw conveyor that transfers the dewatered cake to a common conveyor that transfer the cake to a storage bunker outside the dewatering building. The dewatered cake is used as a fuel source in the existing biomass power plant (boiler 7).

Filtrate waters from both the pre-thickening and decanter centrifuges are collected in the filtrate pit from where they are pumped back to the activated sludge basin.

5.15 Chemicals

The chemicals listed in Table 2 will be consumed in the ETP.

Table 2: ETP Chemicals

Chemical	Storage	Storage Capacity	Annual consumption	Usage description
Hydrochloric acid (30%)	Bulk tank	50 tonnes	9,100 tonnes	pH control in pre-acidification stage.
Urea (30%)	Bulk tank	50 tonnes	1,810 tonnes	Bacteria nutrient support
Phosphoric acid (75%)	Bulk tank	30 tonnes	450 tonnes	Bacteria nutrient support
Caustic soda (20%)	Bulk tank	50 tonnes	610 tonnes	pH control in pre-acidification stage and desulphurisation stage.
Econvert-Nutrimix	IBC	$1m^3$	$14m^3$	Bacteria nutrient support
Anti-foam	IBC	$1m^3$	33 tonnes	Flash aeration and activated sludge basin.
Anti-scalant	IBC	$1m^3$	2 tonnes	Cooling system
Biocide	IBC	$1m^3$	4.5 tonnes	Cooling system
Polymer	25kg bags	10 tonnes	190 tonnes	Microflotation unit and sludge dewatering.

5.16 Containment

The design basis of the containment features of the ETP is alignment to CIRIA C736 guidance. Please see CIRIA risk assessment for more details, document reference 410.0650169.00001_CIRIA RA, see Section 10 of this application.

The containment features of the ETP are summarised below.

Road tanker off-loading facilities will have individual sumps. Off-loading control cabinets and chemical dosing system controls will be housed in cabinets and mounted over the bunds to contain any spillages. The bulk chemical storage tanks for urea, phosphoric acid, hydrochloric acid and sodium hydroxide will all be fabricated from HDPE and located within individual bunds of sufficient capacity and constructed to comply with CIRIA C736 guidance. Smaller quantities of chemicals stored in IBCs will be stored on individual bunded pallets.

Transfer pipework will be of dual contained (pipe within a pipe) construction with leak detection system.

The existing lagoon 2A (28,000m^3 capacity) will be repurposed as a containment facility. Any liquids entering this lagoon will be re-processed back through the ETP. The ETP will be located on a kerbed impermeable concrete slab levelled to ensure any spillages are routed to the containment lagoon, i.e. a spillway.

All plant and equipment will be water tested and all pipework will be pressure tested during ETP commissioning.

6.0 Tissue Manufacturing Process Description

6.1 Stock preparation

6.1.1 Bale Handling

There will be three lines in parallel for bale handling, 2 will serve virgin bales and the third will serve broke paper arising from the tissue and converting machines. The 2 virgin bale lines are each dedicated to a specific type of fibres, hardwood or softwood.

Virgin bales will be loaded onto a dedicated de-wiring conveyor by forklift truck where the wires will be manually cut and removed. The de-wired baled will then transfer to inclined conveyors in advance of the pulpers. Broke paper does not require de-wiring and will therefore be fed directly onto a dedicated inclined conveyor in advance of the pulper.

Each of the inclined conveyors can hold a maximum of 8 bales which are required for each batch of tissue production.

6.1.2 Pulp Preparation

In each of the three pulpers, fibres are dissolved in water assisted by a mixer. As pulp is discharged from the pulpers it will pass through magnetic screens to remove ferrous metals.

Pulp will then be pumped to the dedicated dump chests of each pulp stream. From the dump chests, pulp will be pumped to high density cleaners to remove dirt and debris. In the softwood pulp preparation stream there will be two refiners, whilst in the hardwood pulp preparation stream there will be a single refiner. The refiners defibrillate the fibres enhancing the strength of the final paper. Both the hardwood and broke streams will also have a deflaker before their refiners to eliminate fibre flakes.

After refining, the various pulps will be mixed in tanks for both the Yankee Layer and the Hood Layer. The pulp composition will be adjusted to provide the required final paper quality, e.g. 40% SW, 40% HW, 20% Broke etc in the respective tanks. The mixed stock will then be pumped via thick stock screens to the Machine Tanks.

6.2 Tissue Production

The tissue production process comprises the following sections:

- Wire section;
- Press section;
- Dryer section; and
- Reel section.

6.2.1 Wire section

The stock is sprayed out of the headbox slice lips onto the wire and felt (forming section) where water is mechanically removed through the wire screen.

6.2.2 Press section

From the wire section, the paper web continues to the press section where a suction roll removes water by the application of a vacuum and a shoe press presses the web to the dryer cylinder for additional water removal. Following the press section, the paper web will have a dryness of approximately 45%.

6.2.3 Dryer section

The dryer section comprises of two main components, the Yankee drying cylinder and the hot air hoods.

The Yankee drying cylinder is heated by steam at 205°C and 7.5bar pressure thereby heating the paper web from the underneath, whilst the hot air hoods blow hot air at 350 to 450°C at the paper heating the paper web from above. The combination of these drying methods dries the paper to approximately 95%. The hot air hoods employ direct heating by gas burners of approximately 6MWth capacity each. As the burners are used for direct drying, they are exempt from Medium Combustion Plant Directive controls.

The Yankee drying cylinder is rotating at an average speed of 1800m/min. The paper web is removed from the cylinder surface by the creping doctor blade.

6.2.4 Reeling section

Following the dryer section, the web transfers to the reeling section where it is wound on to a spool to form the parent reel. If smaller size reels or multilayers of paper are required, the parent reel can be transferred to the rewinder for slicing and multilayering. A maximum of 4 parent reels can be rewound simultaneously to form 4-ply tissue paper.

Finished reels will be stretch wrapped and stored in the warehouse ready for dispatch.

6.3 Chemicals

The chemicals listed in Table 3 will be used in Tissue production.

Table 3: Tissue Chemicals

Chemical	Storage	Storage Capacity	Annual consumption	Usage description
Anti pitch	IBC	3 tonnes	25 tonnes	Removal of excess lignin and stickies
Enzyme	IBC	3 tonnes	22 tonnes	Enhance fibre properties
Caustic soda	IBC	11 tonnes	50 tonnes	Assists the pulping of broke
Starch	Fabric IBC	27 tonnes	250 tonnes	Improves paper properties
Wet strength resin	Bulk tanks x2	30m³ each tank	1,100m³	Improves paper properties
Softener	IBC	1 tonnes	12 tonnes	Increases paper softness
Biocide	IBC	2 tonnes	12 tonnes	Prevent bacterial growth
Yankee coatings	IBC	9 tonnes	99 tonnes	For coating of drying cylinder
Coagulant	IBC	3 tonnes	18 tonnes	Used as a retention aid
Flocculant	IBC	2 tonnes	36 tonnes	Used as a retention aid
Anti-foam	IBC	7 tonnes	60 tonnes	Foam suppressant

7.0 Combined Heat and Power (CHP) Plant Description

To meet the steam and power requirements of the new containerboard and tissue production facilities, SML will be constructing a new CHP plant to operate in addition to the existing biomass power plant. The CHP will be fuelled by natural gas, but will be ready to use hydrogen when a supply becomes available.

7.1 Natural Gas Supply

Natural gas will be supplied to the CHP via a new high-pressure connection to the National Grid. The high pressure gas will enter a pressure reduction site where the pressure will be reduced down to 7bar before being piped to a conditioning station where the natural gas will be pre-heated to temperatures suitable for use in the CHP and other off-takers and filtered to remove any entrained liquid.

7.2 Water Treatment Plant

A new Water treatment Plant (WTP) is proposed to supply demineralised water to the CHP. The new WTP will be interconnected to the existing WTP that serves the existing biomass boiler.

The new WTP will consist of the following plant:

- multimedia filters;
- activated carbon filters;
- ultrafiltration units;
- Reverse Osmosis (RO) units;
- degassifier unit; and
- dosing and neutralisation units.

7.3 CHP Plant

The CHP will initially consist of the following plant items:

- x2 Solar Turbines Titan T250 gas turbines (23MW each) venting via 75m high stacks;
- x2 Heat Recovery Steam Generators (HRSGs);
- x2 conventional back-up boilers venting via 30m high stacks;
- feedwater system;
- cooling water system (adiabatic cooling towers); and
- ancillary systems.

It is envisaged that a third Titan T250 gas turbine will be installed in the near future. The x3 gas turbines are considered to be Large Combustion Plant on aggregation.

The Titan T250 gas turbines are equipped with Solar Turbines patented SoLoNOx© burner technology and are natural gas fired.

7.3.1 Back-up Boilers

The two back-up boilers are natural gas fired units rated at 34MW each venting via 30m high stacks. During normal operation the back-up boilers will only operate during outages of the CHP gas turbines, operating for less than 500 hours per year. The two back-up boilers are considered to be Large Combustion Plant on aggregation.

7.3.2 Steam Production

Steam will be produced from the gas turbines and HRSGs at a rate of 75tph each at a pressure of 21bar, reduced down to 18bar and fed to the steam header. The existing biomass boiler also produces steam which will be fed to the steam header. 18bar steam is supplied to the containerboard and tissue processes from the steam header.

Further steam pressure reduction also takes place at the CHP to provide 5.5bar steam to site processes.

It is envisaged that the existing biomass boiler will provide a base load of steam at a rate of 32kg/s with the gas turbines running to meet the site electricity demand whilst the HRSGs will modulate to meet the overall site steam demand.

8.0 BAT Assessment

This section presents details of the EU BAT Conclusions applicable to the Shotton Mill site in tabular format.

Please note only the relevant BAT conclusions (BATc) from the relevant BRef notes/BAT conclusions have been included in the assessment. The BATc and BRef notes assessed include:

- Best Available Techniques Reference Document and BAT conclusions for Waste Treatment (2018);
- Best Available Techniques Reference Document and BAT conclusions for Waste Incineration (2019);
- Best Available Techniques Reference Document and BAT conclusions for the Production of Pulp, Paper and Board (2014); and
- Best Available Techniques Reference Document and BAT conclusions for Large Combustion Plants (2021).

Waste Treatment BATc

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td rowspan="8">BAT 1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:</td><td>I. commitment of the management, including senior management;</td><td rowspan="8">Shotton Mill operates under an Environmental Management System (EMS) that is certified to ISO14001.
The EMS incorporates all of the required features and will be updated to reflect the changes resulting from the re-development of the site.
The EMS has been audited by NRW.

OUTCOME = COMPLIANT</td></tr>
<tr><td>II. definition, by the management, of an environmental policy that includes the continuous improvement of the environmental performance of the installation;</td></tr>
<tr><td>III. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;</td></tr>
<tr><td>IV. implementation of procedures paying particular attention to: (a) structure and responsibility, (b) recruitment, training, awareness and competence, (c) communication, (d) employee involvement, (e) documentation, (f) effective process control, (g) maintenance programmes, (h) emergency preparedness and response, (i) safeguarding compliance with environmental legislation;</td></tr>
<tr><td>V. checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the JRC Reference Report on Monitoring of emissions to air and water from IED installations – ROM), (b) corrective and preventive action, (c) maintenance of records, (d) independent (where practicable) internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;</td></tr>
<tr><td>VI. review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;</td></tr>
<tr><td>VII. following the development of cleaner technologies;</td></tr>
<tr><td>VIII. consideration for the environmental impacts from the eventual decommissioning of the plant at the stage of designing a new plant, and throughout its operating life;</td></tr>
</table>

BATc Requirement	BATc Details	Specific Measure
	IX. application of sectoral benchmarking on a regular basis;	
	X. waste stream management (see BAT 2);	
	XI. an inventory of wastewater and waste gas streams (see BAT 3);	
	XII. residues management plan (see description in Section 6.5);	
	XIII. accident management plan (see description in Section 6.5);	
	XIV. odour management plan (see BAT 12);	
	XV. noise and vibration management plan (see BAT 17).	
BAT 2. In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given.	(a) Set up and implement waste characterisation and pre-acceptance procedures	Shotton Mill accepts certain wastes as feedstocks for its processes, i.e. waste paper and card for pulp production and waste wood for biomass combustion. The site operates waste acceptance procedures as part of its Quality Management System. Wastes are stored appropriately. **OUTCOME = COMPLIANT**
	(b) Set up and implement waste acceptance procedures	
	(c) Set up and implement a waste tracking system and inventory	
	(d) Set up and implement an output quality management system	
	(e) Ensure waste segregation	
	(f) Ensure waste compatibility prior to mixing or blending of waste	
	(g) Sort incoming solid waste	

BATc Requirement	BATc Details	Specific Measure
BAT 3. In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of wastewater and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the following features:	(i) information about the characteristics of the waste to be treated and the waste treatment processes, including: (a) simplified process flow sheets that show the origin of the emissions; (b) descriptions of process-integrated techniques and wastewater/waste gas treatment at source including their performances; (ii) information about the characteristics of the wastewater streams, such as: (a) average values and variability of flow, pH, temperature, and conductivity; (b) average concentration and load values of relevant substances and their variability (e.g. COD/TOC, nitrogen species, phosphorus, metals, priority substances/micropollutants); (c) data on bio-eliminability (e.g. BOD, BOD to COD ratio, Zahn-Wellens test, biological inhibition potential (e.g. inhibition of activated sludge)) (see BAT 52); (iii) information about the characteristics of the waste gas streams, such as: (a) average values and variability of flow and temperature; (b) average concentration and load values of relevant substances and their variability (e.g. organic compounds, POPs such as PCBs); (c) flammability, lower and higher explosive limits, reactivity; (d) presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, nitrogen, water vapour, dust).	The EMS will be updated to reflect the redevelopment of the site. This is usually also an Improvement Condition in the varied Environmental Permit to be issued by Natural Resources Wales (NRW). **OUTCOME = COMPLIANT**
BAT 4. In order to reduce the environmental risk	(a) Optimised storage location	
	(b) Adequate storage capacity	

BATc Requirement	BATc Details	Specific Measure
associated with the storage of waste, BAT is to use all of the techniques given.	(c) Safe storage operation (d) Separate area for storage and handling of packaged hazardous waste	Waste storage has been considered as part of the redevelopment of the site, resulting in defined storage areas for each waste type. The waste storage arrangements are compliant with NRW Fire Prevention and Mitigation Plan requirements. **OUTCOME = COMPLIANT**
BAT 5. In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.		Operational procedures are in place and will be updated to reflect any changes that result from the redevelopment of the site. All staff are trained to the required levels. **OUTCOME = COMPLIANT**
BAT 6. For relevant emissions to water as identified by the inventory of wastewater streams (see BAT 3), BAT is to monitor key process parameters (e.g. waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g. at the inlet and/or outlet of the pre-treatment, at the inlet to the final treatment, at the point where the emission leaves the installation).		Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW. **OUTCOME = COMPLIANT**

<table>
<tr><th>BATc Requirement</th><th colspan="5">BATc Details</th><th>Specific Measure</th></tr>
<tr><td rowspan="7">BAT 7. BAT is to monitor emissions to water with at least the frequency given below, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>Substance / parameter</td><td>Standard (s)</td><td>Waste treatment process</td><td>Minimum monitoring frequency (1) (2)</td><td>Monitoring associated with</td><td rowspan="7">Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
<tr><td>Adsorbable organically bound halogens</td><td>EN ISO 9562</td><td>Treatment of water-based liquid waste</td><td>Daily</td><td>BAT 20</td></tr>
<tr><td>Benzene, toluene, ethylbenzene, xylene</td><td>EN ISO 15680</td><td>Treatment of water-based liquid waste</td><td>Monthly</td><td>BAT 20</td></tr>
<tr><td>COD</td><td>No EN standard available</td><td>Treatment of water-based liquid waste</td><td>Daily</td><td>BAT 20</td></tr>
<tr><td>Free cyanide</td><td>Various</td><td>Treatment of water-based liquid waste</td><td>Daily</td><td>BAT 20</td></tr>
<tr><td>Hydrocarbon oil index</td><td>EN ISO 9377-2</td><td>Treatment of water-based liquid waste</td><td>Daily</td><td>BAT 20</td></tr>
<tr><td>Metals</td><td>Various</td><td>Treatment of water-based</td><td>Daily</td><td>BAT 20</td></tr>
</table>

BATc Requirement	BATc Details					Specific Measure
			liquid waste			
	Hexavalent Chromium	Various	Treatment of water-based liquid waste	Daily	BAT 20	
	Mercury	Various	Treatment of water-based liquid waste	Daily	BAT 20	
	PFOA & PFOS	No EN standard available	All waste treatments	Once every 6 months	BAT 20	
	Phenol index	EN ISO 14402	Treatment of water-based liquid waste	Daily	BAT 20	
	Total nitrogen	EN ISO 12260 & 11905-1	Treatment of water-based liquid waste	Daily	BAT 20	
	TOC	EN 1484	Treatment of water-based liquid waste	Daily	BAT 20	
	Total phosphorus	Various	Treatment of water-based	Daily	BAT 20	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>liquid waste</td><td></td><td></td></tr>
<tr><td>TSS</td><td>EN 872</td><td>Treatment of water-based liquid waste</td><td>Daily</td><td>BAT 20</td></tr>
</table>
(1) Monitoring frequencies may be reduced if the emission levels are proven to be sufficiently stable.
(2) The monitoring only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory mentioned in BAT 3.
(4) The odour concentration may be monitored instead.
(5) The monitoring of NH3 and H2S can be used as an alternative to the monitoring of the odour concentration.
</td><td></td></tr>
<tr><td>BAT 8. BAT is to monitor channelled emissions to air with at least the frequency given below, and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>
<table>
<tr><th>Substance / parameter</th><th>Standard (s)</th><th>Waste treatment process</th><th>Minimum monitoring frequency (1) (2)</th><th>Monitoring associated with</th></tr>
<tr><td>HCl</td><td>EN 1911</td><td>Treatment of water-based liquid waste</td><td>Once every six months</td><td>BAT 53</td></tr>
<tr><td>H_2S</td><td>No EN standard available</td><td>Biological treatment of waste (4)</td><td>Once every six months</td><td>BAT 34</td></tr>
<tr><td>NH_3</td><td>No EN standard available</td><td>Biological treatment of waste (4)</td><td>Once every six months</td><td>BAT 34</td></tr>
</table>
</td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td>Odour concentration</td><td>EN 13725</td><td>Biological treatment of waste (5)</td><td>Once every six months</td><td>BAT 34</td></tr>
<tr><td>TVOC</td><td>EN 12619</td><td>Treatment of water-based liquid wastes</td><td>Once every six months</td><td>BAT 53</td></tr>
<tr><td colspan="5">(1) Monitoring frequencies may be reduced if the emission levels are proven to be sufficiently stable.
(2) The monitoring only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory mentioned in BAT 3.
(4) The odour concentration may be monitored instead.
(5) The monitoring of NH_3 and H_2S can be used as an alternative to the monitoring of the odour concentration.</td></tr>
</table>
</td><td></td></tr>
<tr><td>BAT 10. BAT is to periodically monitor odour emissions.</td><td>Odour emissions can be monitored using:
— EN standards (e.g. dynamic olfactometry according to EN 13725 in order to determine the odour concentration or EN 16841-1 or -2 in order to determine the odour exposure);
— when applying alternative methods for which no EN standards are available (e.g. estimation of odour impact), ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.
The monitoring frequency is determined in the odour management plan (see BAT 12).</td><td>Only applicable where odour nuisance at sensitive receptors is expected and/or has been substantiated.
Odours are not expected for the redevelopment of the site.

OUTCOME = NOT APPLICABLE</td></tr>
<tr><td>BAT 11. BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of</td><td>Monitoring includes direct measurements, calculation or recording, e.g. using suitable meters or invoices. The monitoring is broken down at the most appropriate level (e.g. at process or plant/installation level) and considers any significant changes in the plant/installation.</td><td>Monitoring of annual consumptions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.
The ETP is expected to consume approximately 2,000m³ of fresh water/day.</td></tr>
</table>

BATc Requirement	BATc Details	Specific Measure
residues and wastewater, with a frequency of at least once per year.		The average electrical consumption of the ETP is expected to be approximately 3,500kW. The ETP is expected to consume approximately 8,500kgs of raw materials (chemicals) per day. The ETP is expected to generate approximately 61t of sludge/day. **OUTCOME = COMPLIANT**
BAT 12. In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:	— a protocol containing actions and timelines;	Only applicable where odour nuisance at sensitive receptors is expected and/or has been substantiated. Odours are not expected for the redevelopment of the site. **OUTCOME = NOT APPLICABLE**
	— a protocol for conducting odour monitoring as set out in BAT 10;	
	— a protocol for response to identified odour incidents, e.g. complaints;	
	— an odour prevention and reduction programme designed to identify the source(s); to characterise the contributions of the sources; and to implement prevention and/or reduction measures.	
BAT 13. In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of the techniques given.	(a) Minimising residence times	Waste types accepted on site are not inherently odorous. The aerobic treatment stage of the Effluent Treatment Plant will be optimised. **OUTCOME = COMPLIANT**
	(b) Using chemical treatment	
	(c) Optimising aerobic treatment	
BAT 14. In order to prevent or, where that is not	(a) Minimising the number of potential diffuse emission sources	
	(b) Selection and use of high integrity equipment	

BATc Requirement	BATc Details	Specific Measure
practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given.	(c) Corrosion prevention (d) Containment, collection and treatment of diffuse emissions (e) Dampening (f) Maintenance (g) Cleaning of waste treatment and storage areas (h) Leak detection and repair (LDAR) programme	The waste types accepted on site do not inherently generate diffuse emissions of dust, organic compounds or odour. The design of the site has considered the potential to generate diffuse emissions and systems have been designed appropriately, i.e. reducing the number of flanges on pipes, selection of high integrity plant, preventative maintenance programme and regular site cleaning. **OUTCOME = COMPLIANT**
BAT 15. BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using both of the techniques given.	(a) Correct plant design (b) Plant management	An emergency flare will be utilised at the Effluent Treatment Plant only for non-routine operating conditions only. Operation of the Effluent Treatment Plant will be controlled by a PLC and recorded in the SCADA system. **OUTCOME = COMPLIANT**
BAT 16. In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use both of the techniques given.	(a) Correct design of flaring devices (b) Monitoring and recording as part of flare management	The emergency flare at the Effluent Treatment Plant has been correctly designed to ensure clean combustion, i.e. multiple burners matched to the maximum flow of biogas, combusting at 850°C. Operation of the flare will be controlled by a PLC and recorded in the SCADA system. **OUTCOME = COMPLIANT**
	I. a protocol containing appropriate actions and timelines;	

BATc Requirement	BATc Details	Specific Measure
BAT 17. In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:	II. a protocol for conducting noise and vibration monitoring;	Only applicable where noise of vibration nuisance at sensitive receptors is expected and/or has been substantiated. A Noise Impact Assessment will be completed as part of the Environmental Permit variation. **OUTCOME = NOT APPLICABLE**
	II. a protocol for response to identified noise and vibration events, e.g. complaints;	
	IV. a noise and vibration reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.	
BAT 18. In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given.	(a) Appropriate location of equipment and buildings	The redevelopment of the site has considered the potential to generate noise and vibration, i.e. there will be no rooftop mounted fans. Potentially noise plant will be located within buildings wherever possible. Plant and equipment has been specified with the lowest possible noise levels, usually <80dBA at 1m. **OUTCOME = COMPLIANT**
	(b) Operational measures	
	(c) Low-noise equipment	
	(d) Noise and vibration control equipment	
	(e) Noise attenuation	
BAT 19. In order to optimise water consumption, to reduce the volume of wastewater generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given.	(a) Water management	Paper manufacturing is a large consumer of water, as such the redesign of the plant has maximised the re-use of water as much as possible. Containment measures will be in accordance with CIRIA C736 guidance. Separate drainage systems will be employed for surface water and process effluent. A Sustainable Urban Drainage system has been designed in accordance with UK requirements. On site lagoons provide appropriate buffer capacity.
	(b) Water recirculation	
	(c) Impermeable surface	
	(d) Techniques to reduce the likelihood and impact of overflows and failures from tanks and vessels	
	(e) Roofing of waste storage and treatment areas	
	(f) Segregation of water streams	
	(g) Adequate drainage infrastructure	

BATc Requirement	BATc Details	Specific Measure
	(h) Design and maintenance provisions to allow detection and repair of leaks (i) Appropriate buffer storage capacity	**OUTCOME = COMPLIANT**
BAT 20. In order to reduce emissions to water, BAT is to treat wastewater using an appropriate combination of the techniques given.	(a) Equalisation (b) Neutralisation (c) Physical separation, e.g. screens, sieves, grit separators, grease separators, oil/water separation or primary settlement tanks (l) Activated sludge process (m) Membrane bioreactor (o) Coagulation and flocculation (p) Sedimentation (q) Filtration (r) Flotation	The Effluent Treatment Plant process uses an appropriate combination of the identified techniques, including: Screening; Activated sludge; Coagulation and flocculation; Sedimentation; and Flotation **OUTCOME = COMPLIANT**
BAT 21. In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques given below, as part of the accident management plan (see BAT 1).	(a) Protection measures (b) Management of incidental / accidental emissions (c) Incident/accident registration and assessment system	An Accident Management Plan that addresses these issues forms part of the EMS which will be updated to reflect the redevelopment of the site. **OUTCOME = COMPLIANT**
BAT 22. In order to use materials efficiently, BAT is to substitute materials with waste.		Waste wood and ETP dewatered sludge are used as fuels for the Biomass combustion plant, displacing virgin fuel sources.

BATc Requirement	BATc Details	Specific Measure
		OUTCOME = COMPLIANT
BAT 23. In order to use energy efficiently, BAT is to use both of the techniques given.	(a) Energy efficiency plan (b) Energy balance record	The site is part of the Energy Savings Opportunity Scheme (ESOS). Energy usage will be a reporting requirement of the varied Environmental Permit issued by NRW. The Effluent Treatment Plant will be self-sufficient in terms of energy requirements, as the gas engine will produce all of the electricity demand. Any excess electricity will be exported to the main site. **OUTCOME = COMPLIANT**
BAT 24. In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan (see BAT 1).	Packaging (drums, containers, IBCs, pallets, etc.) is reused for containing waste, when it is in good condition and sufficiently clean, depending on a compatibility check between the substances contained (in consecutive uses). If necessary, packaging is sent for appropriate treatment prior to reuse (e.g. reconditioning, cleaning).	Wherever possible empty packaging will be returned to the original supplier for re-use and will be part of the material supply contracts. **OUTCOME = COMPLIANT**
BAT 38. In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters	Implementation of a manual and/or automatic monitoring system to: ensure a stable digester operation; minimise operational difficulties, such as foaming, which may lead to odour emissions; provide sufficient early warning of system failures which may lead to a loss of containment and explosions.	The Effluent Treatment Plant has a dedicated SCADA control system which utilises monitoring of key process parameters. **OUTCOME = COMPLIANT**

BATc Requirement	BATc Details	Specific Measure
	This includes monitoring and/or control of key waste and process parameters, e.g.: pH and alkalinity of the digester feed; — digester operating temperature; hydraulic and organic loading rates of the digester feed; concentration of volatile fatty acids (VFA) and ammonia within the digester and digestate; biogas quantity, composition (e.g. H2S) and pressure; liquid and foam levels in the digester.	

Waste Incineration BATc

BATc Requirement	BATc Details	Specific Measure
BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features.	i) commitment, leadership and accountability of the management, including senior management, for the implementation of an effective EMS;	Shotton Mill operates under an Environmental Management System (EMS) that is certified to ISO14001. The EMS incorporates all of the required features and will be updated to reflect the changes resulting from the re-development of the site. The EMS has been audited by NRW. **OUTCOME = COMPLIANT**
	ii) an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;	
	iii) development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;	
	iv) establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;	
	v) planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;	
	vi) determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;	
	vii) ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);	
	viii) internal and external communication;	
	ix) fostering employee involvement in good environmental management practices;	

BATc Requirement	BATc Details	Specific Measure
	x) establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;	
	xi) effective operational planning and process control;	
	xii) implementation of appropriate maintenance programmes;	
	xiii) emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;	
	xiv) when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning;	
	xv) implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;	
	xvi) application of sectoral benchmarking on a regular basis;	
	xvii) periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;	
	xviii) evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur;	
	xix) periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;	
	xx) following and taking into account the development of cleaner techniques.	

BATc Requirement	BATc Details	Specific Measure
	xxi) for incineration plants, waste stream management (see BAT 9);	
	xxii) for bottom ash treatment plants, output quality management (see BAT 10);	
	xxiii) a residues management plan including measures aiming to: (a) minimise the generation of residues; (b) optimise the reuse, regeneration, recycling of, and/or energy recovery from the residues; (c) ensure the proper disposal of residues	
	xxiv) for incineration plants, an OTNOC management plan (see BAT 18);	
	xxv) for incineration plants, an accident management plan (see Section 2.4);	
	xxvi) for bottom ash treatment plants, diffuse dust emissions management (see BAT 23);	
	xxvii) an odour management plan where an odour nuisance at sensitive receptors is expected and/or has been substantiated(see Section 2.4);	
	xxviii) a noise management plan (see also BAT 37) where a noise nuisance at sensitive receptors is expected and/ or has been substantiated (see Section 2.4).	
BAT 2. BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant.	In the case of a new incineration plant or after each modification of an existing incineration plant that could significantly affect the energy efficiency, the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency is determined by carrying out a performance test at full load. In the case of an existing incineration plant that has not carried out a performance test, or where a performance test at full load cannot be carried out for technical reasons, the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency can	The efficiency of the Biomass combustion plant will be calculated in accordance with BS EN 12952-15:2003 or ASME PTC 4. The boiler achieves an efficiency value of 90%. **OUTCOME = COMPLIANT**

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>be determined taking into account the design values at performance test conditions.
For the performance test, no EN standard is available for the determination of the boiler efficiency of incineration plants. For grate-fired incineration plants, the FDBR guideline RL 7 may be used.</td><td></td></tr>
<tr><td>BAT 3. BAT is to monitor key process parameters relevant for emissions to air and water including those specified.</td><td>
<table>
<tr><th>Stream/location</th><th>Parameter(s)</th><th>Monitoring</th></tr>
<tr><td>Flue-gas from the incineration of waste</td><td>Flow, O_2 content, temperature, pressure, water vapour content</td><td>Continuous</td></tr>
<tr><td>Combustion chamber</td><td>Temperature</td><td>Continuous</td></tr>
<tr><td>Waste water from wet FGC</td><td>Flow, pH, temperature</td><td>Continuous</td></tr>
<tr><td>Waste water from bottom ash treatment plants</td><td>Flow, pH, conductivity</td><td>Continuous</td></tr>
</table>
</td><td>The flue gas is monitored for all the identified parameters.
There are multiple temperature measurements within the combustion chamber.
Waste water from the FGC is monitored for all of the identified parameters.
Bottom ash is not treated on site.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 4. BAT is to monitor channelled emissions to air with at least the frequency specified and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>
<table>
<tr><th>Parameter</th><th>Standard(s)</th><th>Minimum monitoring frequency</th><th>Monitoring associated with</th></tr>
<tr><td>NO_x</td><td rowspan="2">Generic EN</td><td rowspan="2">Continuous</td><td rowspan="2">BAT 29</td></tr>
<tr><td>NH_3</td></tr>
<tr><td>N_20</td><td>EN 21258</td><td>Annual</td><td>BAT 29</td></tr>
<tr><td>CO</td><td rowspan="4">Generic EN</td><td rowspan="3">Continuous</td><td rowspan="2">BAT 29</td></tr>
<tr><td>SO_2</td></tr>
<tr><td>HCl</td><td>BAT 27</td></tr>
<tr><td>HF</td><td>Every 6 months</td><td>BAT 27</td></tr>
</table>
</td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td>Dust</td><td></td><td>Continuous</td><td>BAT 25</td></tr>
<tr><td>Metals & metalloids</td><td>EN 14385</td><td rowspan="2">Every 6 months</td><td>BAT 25</td></tr>
<tr><td>Hg</td><td rowspan="2">Generic EN</td><td>BAT 31</td></tr>
<tr><td>TVOC</td><td>Continuous</td><td>BAT 30</td></tr>
<tr><td>PBDD/F</td><td>No standard</td><td rowspan="3">Every 6 months</td><td rowspan="4">BAT 30</td></tr>
<tr><td>PCDD/F</td><td>Various</td></tr>
<tr><td>Dioxin like PCBs</td><td>Various</td></tr>
<tr><td>Benzo(a)pyrene</td><td>No standard</td><td>Annual</td></tr>
</table>
</td><td></td></tr>
<tr><td>BAT 5. BAT is to appropriately monitor channelled emissions to air from the incineration plant during OTNOC.</td><td>OTNOC = Other than normal operating conditions</td><td>The Continuous Emissions Monitoring system is operational during OTNOC. The data recorded during OTNOC is regarded as ‘not valid’ and not reported to NRW, as per the conditions of the existing permit.
SOP reference ‘RCID31045 NRW Air and Water Discharge Reporting requirements’ covers abnormal operating conditions.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 6. BAT is to monitor emissions to water from FGC and/or bottom ash treatment with at least the frequency specified and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of</td><td>Only applicable for Flue Gas Cleaning or Bottom Ash treatment processes, as per Table S3.6 of current permit.</td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td>data of an equivalent scientific quality.</td><td></td><td></td></tr>
<tr><td>BAT 7. BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency specified and in accordance with EN standards.</td><td><table>
<tr><th>Parameter</th><th>Standard(s)</th><th>Minimum monitoring frequency</th><th>Monitoring associated with</th></tr>
<tr><td>Loss on ignition</td><td rowspan="2">Various</td><td rowspan="2">Every 3 months</td><td rowspan="2">BAT 14</td></tr>
<tr><td>TOC</td></tr>
</table></td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 9. In order to improve the overall environmental performance of the incineration plant by waste stream management (see BAT 1), BAT is to use all of the techniques specified.</td><td>a) Determination of the types of waste that can be incinerated
b) Set-up and implementation of waste characterisation and pre-acceptance procedures
c) Set-up and implementation of waste acceptance procedures
d) Set-up and implementation of a waste tracking system and inventory
e) Waste segregation
f) Verification of waste compatibility prior to the mixing or blending of hazardous wastes</td><td>The varied Environmental Permit to be issued by NRW will document the types of waste that can be incinerated.
Waste wood acceptance procedures are managed by Tilhill.
Waste is segregated by type; only non-hazardous types of waste are accepted.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 10. In order to improve the overall environmental performance of the bottom ash treatment plant, BAT is to include output quality management features in the EMS (see BAT 1).</td><td>Output quality management features are included in the EMS, so as to ensure that the output of the bottom ash treatment is in line with expectations, using existing EN standards where available. This also allows the performance of the bottom ash treatment to be monitored and optimised.</td><td>Not applicable, bottom ash is not treated on site.

OUTCOME = NOT APPLICABLE</td></tr>
<tr><td>BAT 11. In order to improve the overall environmental performance of the incineration plant, BAT is to monitor the waste deliveries as part of the waste acceptance procedures</td><td>Radioactivity detection
Weighing of waste deliveries
Visual inspection
Periodic sampling</td><td>All waste wood deliveries are weighed on the site weighbridge and the weights recorded in RMPMS software.
Waste wood acceptance procedures are managed by Tilhill.</td></tr>
</table>

BATc Requirement	BATc Details	Specific Measure
(see BAT 9(c)) including, depending on the risk posed by the incoming waste, the elements specified.		Due to the low risk of the waste types, radiation is not monitored on acceptance. However, the Biomass combustion plant has 2 radiation devices fitted. **OUTCOME = COMPLIANT**
BAT 12. In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the techniques specified.	a) Impermeable surfaces with an adequate drainage infrastructure b) Adequate waste storage capacity	Waste wood is stored on an impermeable surfaced area with adequate drainage infrastructure and adequate storage capacity. This has been accepted by NRW. **OUTCOME = COMPLIANT**
BAT 14. In order to improve the overall environmental performance of the incineration of waste, to reduce the content of unburnt substances in slags and bottom ashes, and to reduce emissions to air from the incineration of waste, BAT is to use an appropriate combination of the techniques specified.	a) Waste blending and mixing b) Advanced control systems c) Optimisation of the incineration process	The Biomass combustion plant benefits from an advanced control system and the incineration process is optimised. Boiler combustion is controlled by Valmet 'fuzzy logic' optimisation software. The software contains a series of rules and algorithms which manage the emissions from the combustion process. The software looks at both 30 minute and daily ELVs and creates predictive set points to ensure these ELVs are not exceeded. The system was installed in 2012 and is periodically checked and updated by Valmet. **OUTCOME = COMPLIANT**
BAT 15. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement procedures for the adjustment of the plant's settings, e.g. through the advanced control system (see		The Biomass combustion plant is controlled to ensure optimised performance and minimisation of emissions. **OUTCOME = COMPLIANT**

BATc Requirement	BATc Details	Specific Measure
description in Section 2.1), as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).		
BAT 16. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement operational procedures (e.g. organisation of the supply chain, continuous rather than batch operation) to limit as far as practicable shutdown and start-up operations.		The Biomass combustion plant operates on a continuous basis apart from schedules maintenance or breakdown. The plant operates to 90% availability. Scheduled annual maintenance period is of 3 weeks duration. **OUTCOME = COMPLIANT**
BAT 17. In order to reduce emissions to air and, where relevant, to water from the incineration plant, BAT is to ensure that the FGC system and the waste water treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design range, and maintained so as to ensure optimal availability.		Waste water is routed via the onsite Effluent Treatment Plant which has been designed to treat 100% of process derived effluent. **OUTCOME = COMPLIANT**

BATc Requirement	BATc Details	Specific Measure
BAT 18. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions to air and, where relevant, to water from the incineration plant during OTNOC, BAT is to set up and implement a risk based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the specified elements.		An OTNOC management plan in accordance with relevant guidance has been produced and submitted to NRW for review. **OUTCOME = COMPLIANT**
BAT 19. In order to increase the resource efficiency of the incineration plant, BAT is to use a heat recovery boiler.	The energy contained in the flue-gas is recovered in a heat recovery boiler producing hot water and/or steam, which may be exported, used internally, and/or used to produce electricity.	The Biomass combustion plant boiler is a waterwall type tube boiler which comprises of furnace, superheaters, boilerbank, second pass waterwall, x4 economisers and an air preheater. This type of boiler has a high level of efficiency and heat recovery at 90%. **OUTCOME = COMPLIANT**
BAT 20. In order to increase the energy efficiency of the incineration plant, BAT is to use an appropriate combination of the techniques specified.	a) Drying of sludge	Sludges used as fuels in the Biomass combustion plant are dewatered. Low temperature flue gas heat exchange is achieved by the use of x4 economisers and air preheater. Bottom ash handling is dry. **OUTCOME = COMPLIANT**
	b) reduction of the flue-gas flow	
	c) Minimisation of heat losses	
	d) Optimisation of the boiler design	
	e) Low temperature flue-gas heat exchangers	
	f) High steam conditions	
	g) Cogeneration	
	h) Flue-gas condenser	

BATc Requirement	BATc Details	Specific Measure
	i) Dry bottom ash handling	
BAT 21. In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to use the techniques specified	Control the risk of odour during complete shutdown periods when no incineration capacity is available by: Minimising the amount of waste stored Storing waste in properly sealed bales	Waste wood is not an inherently odorous waste. **OUTCOME = NOT APPLICABLE**
BAT 23. In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to include in the environmental management system (see BAT 1) the specified diffuse dust emissions management features.	Identification of the most relevant diffuse dust emission sources	Not applicable, as no bottom ash treatment takes place on site. Fly ash is contained in a sealed tank before leaving site. **OUTCOME = NOT APPLICABLE**
	Definition and implementation of appropriate actions and techniques to prevent or reduce diffuse emissions over a given time frame.	
BAT 24. In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified.	a) Enclose and cover equipment	Not applicable, no bottom ash treatment takes place on site. Bottom ash storage is under cover and water sprays are used to minimise dust. **OUTCOME = NOT APPLICABLE**
	b) Limit height of discharges	
	c) Protect stockpiles against prevailing winds	
	d) Use water sprays	
	e) Optimise moisture content	
	f) Operate under sub-atmospheric pressure	
BAT 25. In order to reduce channelled emissions to air of dust, metals and metalloids from the incineration of waste, BAT is to use one or a combination of the techniques specified.	a) Bag filter	Bag filters, dry sorbent injection and wet scrubber techniques are employed. **OUTCOME = COMPLIANT**
	b) Electrostatic precipitator	
	c) Dry sorbent injection	
	d) Wet scrubber	
	e) Fixed or moving bed adsorption	
BAT 26. In order to reduce channelled dust emissions to		Not applicable, no bottom ash treatment takes place on site.

BATc Requirement	BATc Details	Specific Measure
air from the enclosed treatment of slags and bottom ashes with extraction of air (see BAT 24(f)), BAT is to treat the extracted air with a bag filter (see Section 2.2).		**OUTCOME = NOT APPLICABLE**
BAT 27. In order to reduce channelled emissions of HCl, HF and SO_2 to air from the incineration of waste, BAT is to use one or a combination of the techniques specified.	a) Wet scrubber b) Semi-wet scrubber c) Dry sorbent injection e) Boiler sorbent injection	Wet scrubber and dry sorbent techniques are employed. **OUTCOME = COMPLIANT**
BAT 28. In order to reduce channelled peak emissions of HCl, HF and SO_2 to air from the incineration of waste while limiting the consumption of reagents and the amount of residues generated from dry sorbent injection and semi-wet absorbers, BAT is to use the techniques specified.	Optimised and automated reagent dosage Recirculation of reagents	Both techniques are employed on site. **OUTCOME = COMPLIANT**
BAT 29. In order to reduce channelled NO_X emissions to air while limiting the emissions of CO and N_2O from the incineration of waste and the emissions of NH_3 from the use of SNCR and/or SCR, BAT is to use an appropriate combination of the techniques specified.	a) Optimisation of the incineration process b) Flue-gas recirculation c) Selective non-catalytic reduction (SNCR) d) Selective catalytic reduction (SCR) e) Catalytic filter bags f) Optimisation of the SNCR/SCR design and operation g) Wet scrubber	Not applicable, neither SCR nor SNCR are used. **OUTCOME = NOT APPLICABLE**
	a) Optimisation of the incineration process	

BATc Requirement	BATc Details	Specific Measure
BAT 30. In order to reduce channelled emissions to air of organic compounds including PCDD/F and PCBs from the incineration of waste, BAT is to use techniques specified.	b) Control of the waste feed c) On-line and off-line boiler cleaning d) Rapid flue gas cooling e) Dry sorbent injection f) Fixed or moving bed adsorption g) SCR h) Catalytic filter bags i) Carbon sorbent in a wet scrubber	The incineration is optimised by tuning software, which is periodically updated. Off-line boiler cleaning undertaken annually. Dry sorbent injection employed. **OUTCOME = COMPLIANT**
BAT 31. In order to reduce channelled mercury emissions to air (including mercury emission peaks) from the incineration of waste, BAT is to use one or a combination of the techniques specified.	a) Wet scrubber (low pH) b) Dry sorbent injection c) Injection of special highly reactive activated carbon d) Boiler bromine addition e) Fixed or moving bed adsorption	Wet scrubber and dry sorbent injection techniques employed. **OUTCOME = COMPLIANT**
BAT 32. In order to prevent the contamination of uncontaminated water, to reduce emissions to water, and to increase resource efficiency, BAT is to segregate wastewater streams and to treat them separately, depending on their characteristics.	Waste water streams (e.g. surface run-off water, cooling water, waste water from flue-gas treatment and from bottom ash treatment, drainage water collected from the waste reception, handling and storage areas (see BAT 12 (a)) are segregated to be treated separately based on their characteristics and on the combination of treatment techniques required. Uncontaminated water streams are segregated from waste water streams that require treatment.	Waste water streams are segregated into dedicated drainage systems. Process effluent is treated in the Effluent Treatment Plant. **OUTCOME = COMPLIANT**
BAT 33. In order to reduce water usage and to prevent or reduce the generation of wastewater from the	a) Waste water free FGC techniques b) Injection of waste water from FGC c) Water reuse/recycling	The varied Environmental Permit to be issued by NRW will contain a daily limit on wastewater generated by the Biomass Combustion plant. Dry bottom ash handling is employed.

BATc Requirement	BATc Details	Specific Measure
incineration plant, BAT is to use one or a combination of the techniques specified.	d) Dry bottom ash handling	**OUTCOME = COMPLIANT**
BAT 34. In order to reduce emissions to water from FGC and/or from the storage and treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified, and to use secondary techniques as close as possible to the source in order to avoid dilution.	a) Optimisation of the incineration process and/or the FGC system	The incineration process is optimised by tuning software. Waste water from the Biomass Combustion plant is routed via the Effluent Treatment Plant that utilises a combination of the identified techniques. **OUTCOME = COMPLIANT**
	b) Equalisation	
	c) Neutralisation	
	d) Physical separation e.g. screens, sieves etc	
	e) Adsorption on activated carbon	
	f) Precipitation	
	g) Oxidation	
	h) Ion exchange	
	i) Stripping	
	j) Reverse osmosis	
	k) Coagulation and flocculation	
	l) Sedimentation	
	m) Filtration	
	n) Flotation	
BAT 35. In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.		The varied Environmental Permit to be issued by NRW will prohibit the mixing of bottom ash and FGC residues. **OUTCOME = COMPLIANT**
	a) Screening and sieving	Not applicable, no bottom ash treatment on site.

BATc Requirement	BATc Details	Specific Measure
BAT 36. In order to increase resource efficiency for the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified based on a risk assessment depending on the hazardous properties of the slags and bottom ashes.	b) Crushing	**OUTCOME = NOT APPLICABLE**
	c) Aerulic separation	
	d) Recovery of ferrous and non-ferrous metals	
	e) Ageing	
	f) Washing	
BAT 37. In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques specified.	a) Appropriate location of equipment and buildings	The Biomass Combustion plant is housed within a building. All steam vents and main relief vent have silencers fitted. Operational procedures in place to minimise noise emissions. **OUTCOME = COMPLIANT**
	b) Operational measures	
	c) Low noise equipment	
	d) Noise attenuation	
	e) Noise control equipment/infrastructure	

Production of Pulp, Paper and Board BATc

BATc Requirement	BATc Details	Specific Measure
BAT 1. In order to improve the overall environmental performance of plants for the production of pulp, paper and board, BAT is to implement and adhere to an environmental management system (EMS that incorporates all of the following features.	commitment of the management, including senior management;	Shotton Mill operates under an Environmental Management System (EMS) that is certified to ISO14001. The EMS incorporates all of the required features and will be updated to reflect the changes resulting from the re-development of the site. The existing EMS has been audited by NRW. **OUTCOME = COMPLIANT**
	definition of an environmental policy that includes the continuous improvement of the installation by the management;	
	planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;	
	implementation of procedures paying particular attention to: structure and responsibility training, awareness and competence communication employee involvement documentation efficient process control maintenance programmes emergency preparedness and response safeguarding compliance with environmental legislation;	
	checking performance and taking corrective action, paying particular attention to: monitoring and measurement (see also the Reference Document on the General Principles of Monitoring) corrective and preventative action maintenance of records independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td rowspan="4"></td><td>review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;</td><td rowspan="4"></td></tr>
<tr><td>following the development of cleaner technologies;</td></tr>
<tr><td>consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life;</td></tr>
<tr><td>application of sectoral benchmarking on a regular basis.</td></tr>
<tr><td rowspan="7">BAT 2. BAT is to apply the principles of good housekeeping for minimising the environmental impact of the production process by using a combination of the techniques given.</td><td>careful selection and control of chemicals and additives;</td><td rowspan="7">Shotton Mill have existing housekeeping procedures in place which will be revised to reflect the redevelopment of the site.
Chemical usage is minimised and regular review of raw material types will be a condition in the varied Environmental Permit to be issued by NRW.

OUTCOME = COMPLIANT</td></tr>
<tr><td>input-output analysis with a chemical inventory, including quantities and toxicological properties;</td></tr>
<tr><td>minimise the use of chemicals to the minimum level required by the quality specifications of the final product;</td></tr>
<tr><td>avoid the use of harmful substances (e.g. nonylphenol ethoxylate-containing dispersion or cleaning agents or surfactants) and substitution by less harmful alternatives;</td></tr>
<tr><td>minimise the input of substances into the soil by leakage, aerial deposition and the inappropriate storage of raw materials, products or residues;</td></tr>
<tr><td>establish a spill management programme and extend the containment of relevant sources, thus preventing the contamination of soil and groundwater;</td></tr>
<tr><td>proper design of the piping and storage systems to keep the surfaces clean and to reduce the need for washing and cleaning;</td></tr>
<tr><td>BAT 3. In order to reduce the release of not readily biodegradable organic chelating agents such as EDTA or DTPA from peroxide bleaching, BAT is to use a</td><td><table><tr><th></th><th>Technique</th><th>Applicability</th></tr><tr><td>a</td><td>Determination of quantity of chelating agents released to the</td><td>Not applicable for mills that do not use chelating agents</td></tr></table></td><td>Not applicable, bleaching agents are not used in the production of containerboard or tissue.

OUTCOME = NOT APPLICABLE</td></tr>
</table>

BATc Requirement	BATc Details			Specific Measure
combination of the techniques given.		environment through periodic measurements		
	b	Process optimisation to reduce consumption and emission of not readily biodegradable chelating agents	Not applicable for plants that eliminate 70 % or more of EDTA/DTPA in their wastewater treatment plant or process	
	c	Preferential use of biodegradable or eliminable chelating agents, gradually phasing out non-degradable products	Applicability depends on the availability of appropriate substitutes (biodegradable agents meeting e.g. brightness requirements of pulp)	
BAT 4. In order to reduce the generation and the pollution load of wastewater from wood storage and preparation, BAT is to use a combination of the techniques given.		**Technique**	**Applicability**	Not applicable. Wood is not used as a feedstock in the paper production processes on site. Feedstocks are either recycled fibre for containerboard or virgin pulp for tissue. **OUTCOME = NOT APPLICABLE**
	a	Dry debarking (description see Section 1.7.2.1)	Restricted applicability when high purity and brightness is required with TCF bleaching	
	b	Handling of wood logs in such a way as to avoid the contamination of bark and wood with sand and stones	Generally applicable	
	c	Paving of the wood yard area and particularly the surfaces used for the storage of chips	Applicability may be restricted due to the size of the wood yard and storage area	

BATc Requirement	BATc Details			Specific Measure
	d	Controlling the flow of sprinkling water and minimising surface run-off water from the wood yard	Generally applicable	
	e	Collecting of contaminated run-off water from the wood yard and separating out suspended solids effluent before biological treatment	Applicability may be restricted by the degree of contamination of run-off water (low concentration) and/or the size of the waste water treatment plant (large volumes)	
BAT 5. In order to reduce fresh water use and generation of waste water, BAT is to close the water system to the degree technically feasible in line with the pulp and paper grade manufactured by using a combination of the techniques given.		**Technique**	**Applicability**	Water use minimisation has been a key consideration in the redevelopment of the site. Processes have been designed to minimise water consumption to as low as possible and maximise the recirculation/re-use of process water. The PM3 is expected to consume 8m³ of fresh water for every tonne of containerboard produced and the Tissue Mill is expected to consume 7m³ of fresh water for every tonne of tissue produced. Water will be recirculated from the PM3 process back to the OCC process and from the Effluent Treatment Plant following treatment. Turbo blowers will be used in the vacuum system rather than water ring pumps minimising water use. Process water will be filtered to allow its reuse in the process minimising fresh water use. The BAT-associated waste water flow at the point of discharge after waste water treatment as yearly averages are: • RCF paper mills (no de-inking) = 1.5 – 10m³/t
	a	Monitoring and optimising water usage	Generally applicable	
	b	Evaluation of water recirculation options		
	c	Balancing the degree of closure of water circuits and potential drawbacks; adding additional equipment if necessary		
	d	Separation of less contaminated sealing water from pumps for vacuum generation and reuse		
	e	Separation of clean cooling water from contaminated process water and reuse		
	f	Reusing process water to substitute for fresh water (water	Applicable to new plants and major	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>recirculation and closing of water loops)</td><td>refurbishments. Applicability may be limited due to water quality and/or product quality requirements or due to technical constraints (such as precipitation/incrustation in water system) or increase odour nuisance</td></tr>
<tr><td>g</td><td>In-line treatment of (parts of) process water to improve water quality to allow for recirculation or reuse</td><td>Generally applicable</td></tr>
</table>
</td><td>• RCF based tissue (de-inking) = 10 – 25m³/t
The Shotton Mill site operates a pumped discharge of treated waste water to the Dee Estuary at coincide with high tide. The details of the pumped discharge are conditions of the Environmental Permit and are as follows:
• Maximum instantaneous flow = 800l/s
• Maximum daily flow = 22,000m³/day
• Maximum tidal flow = 11,000m³/tide
Based on the maximum design throughput of the redeveloped site, 820,000 tonnes of paper will be produced per year (both containerboard and tissue). This equates to a yearly average flow of 9.8m³/t.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 6. In order to reduce fuel and energy consumption in pulp and paper mills, BAT is to use technique (a) and a combination of the other techniques given below.</td><td>
<table>
<tr><th></th><th>Technique</th><th>Applicability</th></tr>
<tr><td>a</td><td>Use an energy management system that includes all of the following features:
(i)Assessment of the mill's overall energy consumption and production
(ii) Locating, quantifying and optimising the potentials for energy recovery
(iii) Monitoring and safeguarding the optimised situation for energy consumption</td><td>Generally applicable</td></tr>
</table>
</td><td>The site has an energy management system that incorporates all of the requirements.
Suitable process residues are used as alternative fuels in the Biomass combustion plant.
Combined Heat and Power provides the majority of the process steam and electricity demand.
Excess heat is used for other purposes on site.
Steam and condensate pipes are insulated.
High efficiency pumps and motor have been specified wherever possible.
Steam pressure levels are aligned to actual pressure needs, i.e. low pressure steam at 500kPa and medium pressure steam at 1,700kPa.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details			Specific Measure
	b	Recover energy by incinerating those wastes and residues from the production of pulp and paper that have high organic content and calorific value, taking into account BAT 12	Only applicable if the recycling or reuse of wastes and residues from the production of pulp and paper with a high organic content and high calorific value is not possible	
	c	Cover the steam and power demand of the production processes as far as possible by the cogeneration of heat and power (CHP)	Applicable for all new plants and for major refurbishments of the energy plant. Applicability in existing plants may be limited due to the mill layout and available space	
	d	Use excess heat for the drying of biomass and sludge, to heat boiler feedwater and process water, to heat buildings, etc.	Applicability of this technique may be limited in cases where the heat sources and locations are far apart	
	e	Use thermo compressors	Applicable to both new and existing plants for all grades of paper and for coating machines, as long as medium pressure steam is available	

BATc Requirement	BATc Details			Specific Measure
	f	Insulate steam and condensate pipe fittings	Generally applicable	
	g	Use energy efficient vacuum systems for dewatering		
	h	Use high efficiency electrical motors, pumps and agitators		
	i	Use frequency inverters for fans, compressors and pumps		
	j	Match steam pressure levels with actual pressure needs		
BAT 7. In order to prevent and reduce the emission of odorous compounds originating from the wastewater system, BAT is to use a combination of the techniques given.		Technique		The design of the PM3 is the latest type available from Valmet and has been designed to minimise retention tomes in the water systems. The Effluent Treatment Plant has been designed to minimise potential odour generation and is suitably sized to process 100% of the generated process effluents. The anaerobic treatment stage is a fully sealed process. The activated sludge basin is a plug flow aeration process with a residence time of approximately 16 hours. 12 submersible aerators are used in total, ensuring sufficient aeration and mixing. The secondary clarifier operation will be part of the advanced control system of the Effluent Treatment Plant. Sludges are pumped to a storage tank prior to dewatering. This tank is sufficiently sized and is equipped with a mixer. Dewatering operations are in continuous operation. Sludge dryers are not used, dewatering is achieved by screw presses.
	Applicable for odours related to water systems closure			
	a	Design paper mill processes, stock and water storage tanks, pipes and chests in such a way as to avoid prolonged retention times, dead zones or areas with poor mixing in water circuits and related units, in order to avoid uncontrolled deposits and the decay and decomposition of organic and biological matter		
	b	Use biocides, dispersants or of oxidising agents (e.g. catalytic disinfection with hydrogen peroxide) to control odour and decaying bacteria growth		
	c	Install internal treatment processes (‘kidneys’) to reduce the concentrations of organic matter and consequently possible odour problems in the white water system		

BATc Requirement	BATc Details	Specific Measure
	Applicable for odours related to waste water treatment and sludge handling, in order to avoid conditions where waste water or sludge becomes anaerobic a – Implement closed sewer systems with controlled vents, using chemicals in some cases to reduce the formation of and to oxidise hydrogen sulphide in sewer systems b – Avoid over-aeration in equalisation basins but maintain sufficient mixing c – Ensure sufficient aeration capacity and mixing properties in aeration tanks; revise the aeration system regularly d – Guarantee proper operation of secondary clarifier sludge collection and return sludge pumping e – Limit the retention time of sludge in sludge storages by sending the sludge continuously to the dewatering units f – Avoid the storage of waste water in the spill basin longer than is necessary; keep the spill basin empty g – If sludge dryers are used, treatment of thermal sludge dryer vent gases by scrubbing and/or bio filtration (such as compost filters) h – Avoid air cooling towers for untreated water effluent by applying plate heat exchangers	Influent is cooled using plate heat exchangers. **OUTCOME = COMPLIANT**
BAT 8. BAT is to monitor the key process parameters according to the table given below.	**Monitoring key process parameters relevant for emissions to air** Parameter | Monitoring frequency	The emissions to air from the Biomass combustion plant are monitored continuously for the identified parameters. There are multiple temperature measurements within the combustion chamber. Monitoring of identified parameters will take place at the Effluent Treatment Plant in real time by the SCADA system.

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td>Pressure, temperature, oxygen, CO and water vapour content in flue-gas for combustion processes</td><td>Continuous</td></tr>
<tr><td colspan="2">Monitoring key process parameters and of emissions to water and air</td></tr>
<tr><td>Parameter</td><td>Monitoring frequency</td></tr>
<tr><td>Water flow, temperature and pH</td><td>Continuous</td></tr>
<tr><td>P and N content in biomass, sludge volume index, excess ammonia and ortho-phosphate in the effluent, and microscopy checks of the biomass</td><td>Periodic</td></tr>
<tr><td>Volume flow and CH_4 content of biogas produced in anaerobic waste water treatment</td><td>Continuous</td></tr>
<tr><td>H_2S and CO_2 contents of biogas produced in anaerobic waste water treatment</td><td>Periodic</td></tr>
</table>
</td><td>Sludge volume index, excess ammonia and ortho-phosphate will be monitored daily.
The P and N content and microscopy checks of the biomass will be completed weekly.
The volume flow, CH_4, H_2S and CO_2 content of the produced biogas will be monitored in real time by analyser.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 9. BAT is to carry out the monitoring and measurement of emissions to air, as indicated below, on a regular basis with the frequency indicated and according to EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards which ensure the provision of</td><td>
<table>
<tr><th></th><th>Parameter</th><th>Monitoring frequency</th><th>Emission source</th><th>Monitoring associated with</th></tr>
<tr><td>a</td><td>NO_x and SO_2</td><td>Continuous</td><td>Recovery boiler</td><td>BAT 21
BAT 22
BAT 36
BAT 37</td></tr>
</table>
</td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details					Specific Measure
data of an equivalent scientific quality.			Periodic or continuous	Lime kiln	BAT 24 BAT 26	
			Periodic or continuous	Dedicated TRS burner	BAT 28 BAT 29	
	b	Dust	Periodic or continuous	Recovery boiler (kraft) and lime kiln	BAT 23 BAT 27	
			Periodic	Recovery boiler (sulphite)	BAT 37	
	c	TRS (including H_2S)	Continuous	Recovery boiler	BAT 21	
			Periodic or continuous	Lime kiln and dedicated TRS burner	BAT 24 BAT 25 BAT 28	
			Periodic	Diffuse emissions from different sources (e.g. the fibre line, tanks, chip bins etc.) and residual weak gases	BAT 11 BAT 20	
	d	NH_3	Periodic	Recovery boiler equipped with SNCR	BAT 36	

BATc Requirement	BATc Details				Specific Measure
BAT 10. BAT is to carry out the monitoring of emissions to water, as indicated below, with the indicated frequency and according to EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.		**Parameter**	**Monitoring frequency**	**Monitoring associated with**	Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW. **OUTCOME = COMPLIANT**
	a	Chemical oxygen demand (COD) or Total organic carbon (TOC) ([1])	Daily ([2]) ([3])	BAT 19 BAT 33 BAT 40 BAT 45 BAT 50	
	b	BOD_5 or BOD_7	Weekly (once a week)		
	c	Total suspended solids (TSS)	Daily ([2]) ([3])		
	d	Total nitrogen	Weekly (once a week)		
	e	Total phosphorus	Weekly (once a week)		
	f	EDTA, DTPA ([4])	Monthly (once a month)		
	g	AOX (according to EN ISO 9562:2004) ([5])	Monthly (once a month)	BAT 19: bleached kraft	
			Once every two months	BAT 33: except TCF and NSSC mills Bat 40: except CTMP and CMP mills BAT 45	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td></td><td>BAT 50</td></tr>
<tr><td>h</td><td>Relevant metals (e.g. Zn, Cu, Cd, Pb, Ni)</td><td>Once a year</td><td></td></tr>
</table>
(1) There is a trend to replace COD by TOC for economic and environmental reasons. If TOC is already measured as a key process parameter, there is no need to measure COD; however, a correlation between the two parameters should be established for the specific emission source and waste water treatment step.
(2) Rapid test methods can also be used. The results of rapid tests should be checked regularly (e.g. monthly) against EN standards or, if EN standards are not available, against ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality.
(3) For mills operating less than seven days a week, the monitoring frequency for COD and TSS may be reduced to cover the days the mill is in operation or to extend the sampling period to 48 or 72 hours.
(4) Applicable where EDTA or DTPA (chelating agents) are used in the process.
(5) Not applicable to plants that provide evidence that no AOX is generated or added via chemical additives and raw materials.
</td><td></td></tr>
<tr><td>BAT 11. BAT is to regularly monitor and assess diffuse total reduced sulphur emissions from relevant sources.</td><td>The assessment of diffuse total reduced sulphur emissions can be done by periodic measurement and assessment of diffuse emissions that are emitted from different sources (e.g. the fibre line, tanks, chip bins etc.) by direct measurements.</td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details				Specific Measure
		Technique	Description	Applicability	
BAT 12. In order to reduce the quantities of wastes sent for disposal, BAT is to implement a waste assessment (including waste inventories) and management system, so as to facilitate waste reuse, or failing that, waste recycling, or failing that, 'other recovery', including a combination of the techniques given.	a	Separate collection of different waste fractions (including separation and classification of hazardous waste)	See Section 1.7.3	Generally applicable	Waste management procedures are already in place on site. The Waste Hierarchy is adhered to ensuring the best environmental outcomes. Where possible wastes are sent for re-use. Welsh legislation requires separate collection of different waste fractions. Energy recovery will be employed for de-watered sludge from the Effluent Treatment Plant. **OUTCOME = COMPLIANT**
	b	Merging of suitable fractions of residues to obtain mixtures that can be better utilised		Generally applicable	
	c	Pretreatment of process residues before reuse or recycling		Generally applicable	
	d	Material recovery and recycling of process residues on site		Generally applicable	
	e	Energy recovery on- or off-site from wastes with high organic content		For off-site utilisation, the applicability depends on the availability of a third party	
	f	External material utilisation	See Section 1.7.3	Depending on the availability of a third party	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td><table><tr><td>g</td><td>Pretreatment of waste before disposal</td><td></td><td>Generally applicable</td></tr></table></td><td></td></tr>
<tr><td>BAT 13. In order to reduce nutrient (nitrogen and phosphorus) emissions into receiving waters, BAT is to substitute chemical additives with high nitrogen and phosphorus contents by additives containing low nitrogen and phosphorus contents.</td><td>Applicable if the nitrogen in the chemical additives is not bioavailable (i.e. it cannot serve as nutrient in biological treatment) or if the nutrient balance is in surplus.</td><td>The Effluent Treatment Plant has been designed to meet the relevant Emission Limit Values in the Waste Treatment BRef.
Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with BAT by NRW.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 14. In order to reduce emissions of pollutants into receiving waters, BAT is to use all of the techniques given.</td><td><table><tr><th></th><th>Technique</th><th>Description</th></tr><tr><td>a</td><td>Primary (physico-chemical) treatment</td><td rowspan="2">See Section 1.7.2.2</td></tr><tr><td>b</td><td>Secondary (biological) treatment (1)</td></tr></table>(1) Not applicable to plants where the biological load of waste water after the primary treatment is very low, e.g. some paper mills producing speciality paper.</td><td>The Effluent Treatment Plant uses all the identified techniques.
Primary treatment consists of clarifiers.
Secondary treatment comprises anaerobic treatment, aeration, calcium separation, aeration and secondary clarification.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 15. When further removal of organic substances, nitrogen or phosphorus is needed, BAT is to use tertiary treatment as described in Section 1.7.2.2.</td><td></td><td>The Effluent Treatment Plant has been designed to meet the relevant Emission Limit Values in the Waste Treatment BRef and utilises a variety of treatment techniques to achieve these limits.
The efficiency of the anaerobic treatment process in removing nitrogen and phosphorous, results in their</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td></td><td>dosing in the activated sludge basin, therefore tertiary treatments are not required.

OUTCOME = COMPLAINT</td></tr>
<tr><td>BAT 16. In order to reduce emissions of pollutants into receiving waters from biological waste water treatment plants, BAT is to use all of the techniques given.</td><td><table>
<tr><th></th><th>Technique</th></tr>
<tr><td>a</td><td>Proper design and operation of the biological treatment plant</td></tr>
<tr><td>b</td><td>Regularly controlling the active biomass</td></tr>
<tr><td>c</td><td>Adjustment of nutrition supply (nitrogen and phosphorus) to the actual need of the active biomass</td></tr>
</table></td><td>The Effluent Treatment Plant has been designed to meet the relevant Emission Limit Values in the Waste Treatment BRef.
The active biomass is suitably controlled to optimise plant performance.
Nitrogen and Phosphorus are added to the feed of the Activated Sludge basin.

OUTCOME = COMPLAINT</td></tr>
<tr><td>BAT 17. In order to reduce the emissions of noise from pulp and paper manufacturing, BAT is to use a combination of the techniques given.</td><td><table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a</td><td>Noise-reduction programme</td><td>A noise-reduction programme includes identification of sources and affected areas, calculations and measurements of noise levels in order to rank sources according to noise levels, and identification of the most cost</td><td>Generally applicable</td></tr>
</table></td><td>The redevelopment of the site has considered the potential to generate noise and vibration, i.e. there will be no rooftop mounted fans on the containerboard machine building. Associated potentially noise plant will be located within buildings wherever possible.
Plant and equipment has been specified with the lowest possible noise levels, usually <80dBA at 1m.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details				Specific Measure
			effective combination of techniques, their implementation and monitoring.		
	b	Strategic planning of the location of equipment, units and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens.	Generally applicable to new plants. In the case of existing plants, the relocation of equipment and production units may be restricted by the lack of space or by excess	
	c	Operational and management techniques in buildings containing noisy equipment	This includes: — improved inspection and maintenance of equipment to prevent failures — closing of doors and windows of covered areas — equipment operation by experienced staff — avoidance of noisy activities during night-time — provisions for noise control during	Generally applicable	

BATc Requirement	BATc Details				Specific Measure
			maintenance activities		
	d	Enclosing noisy equipment and units	Enclosure of noisy equipment, such as wood handling, hydraulic units, and compressors in separate structures, such as buildings or soundproofed cabinets, where internal-external lining is made of impact-absorbent material.	Generally applicable	
	e	Use of low-noise equipment and noise-reducers on equipment and ducts.			
	f	Vibration insulation	Vibration insulation of machinery and decoupled arrangement of noise sources and potentially resonant components.	Generally applicable	
	g	Soundproofing of buildings	This potentially includes use of: — sound-absorbing materials in walls and ceilings — sound-isolating		

BATc Requirement	BATc Details				Specific Measure
			doors — double-glazed windows		
	h	Noise abatement	Noise propagation can be reduced by inserting barriers between emitters and receivers. Appropriate barriers include protection walls, embankments and buildings. Suitable noise abatement techniques include fitting silencers and attenuators to noisy equipment such as steam releases and dryer vents.	Generally applicable to new plants. In the case of existing plants, the insertion of obstacles may be restricted by the lack of space.	
	i	Use of larger wood-handling machines to reduce lifting and transport times and noise from logs falling onto log piles or the feed table.		Generally applicable.	
	j	Improved ways of working, e.g. releasing logs from a lower height onto the log piles or the feed table; immediate feedback of the level of noise for the workers.			
BAT 18. In order to prevent pollution risks when decommissioning a plant, BAT	ensure that underground tanks and piping are either avoided in the design phase or that their location is well known and documented;				Site decommissioning and environmental permit surrender will be regulated by Natural Resources Wales to ensure that the site is returned to its pre-operational condition.
	establish instructions for emptying process equipment, vessels and piping;				

BATc Requirement	BATc Details	Specific Measure
is to use the general techniques given.	ensure a clean closure when the facility is shut down, e.g. to clean up and rehabilitate the site. Natural soil functions should be safeguarded, if feasible; use a monitoring programme, especially relative to groundwater, in order to detect possible future impacts on site or in neighbouring areas; and develop and maintain a site closure or cessation scheme, based on risk analysis, that includes a transparent organisation of the shutdown work, taking into account relevant local specific conditions.	The varied environmental permit to be issued by NRW, will contain a condition relating to site closure and requirements for soil and groundwater monitoring throughout the lifetime of the permit. All technical details of plant construction and the materials chosen will be kept to allow effective decommissioning of the plant in future. **OUTCOME = COMPLIANT**
BAT 42. In order to prevent the contamination of soil and groundwater or to reduce the risk thereof and in order to reduce wind drift of paper for recycling and diffuse dust emissions from the paper for recycling yard, BAT is to use one or a combination of the techniques given below.	(see table below)	Waste paper feedstock will be stored in either a covered warehouse for loose materials or in a hard surfaced external area for wrapped bales. The external area will also benefit from fencing to prevent wind drift. All surface water drainage from the external storage area will be routed to the Effluent Treatment Plant. The site will have a programme of roadway and gully pot cleaning. **OUTCOME = COMPLIANT**

	Technique	Applicability
a	Hard surfacing of the storage area for paper for recycling	Generally applicable
b	Collection of contaminated run-off water from the paper for recycling storage area and treatment in a waste water treatment plant (uncontaminated rainwater e.g. from roofs can be discharged separately)	Applicability may be restricted by the degree of contamination of run-off water (low concentration) and/or the size of the waste water treatment plants (large volumes)
c	Surrounding the terrain of the paper for recycling yard with fences against wind drift	Generally applicable
d	Regularly cleaning the storage area and sweeping associated roadways and emptying gully pots to reduce diffuse dust emissions. This reduces wind-blown paper	Generally applicable

BATc Requirement	BATc Details			Specific Measure
		debris, fibres and the crushing of paper by on-site traffic, which can cause additional dust emission, especially in the dry season		
	e	Storing of bales or loose paper under a roof to protect the material from weather influences (moisture, microbiological degradation processes, etc.)	Applicability may be restricted by the size of the area	
BAT 43. In order to reduce fresh water use, waste water flow, and the pollution load, BAT is to use a combination of the techniques given below.		**Technique**	**Description**	Water streams will be separate. Re-use of treated water has been designed into the redevelopment of the site. The PM3 process incorporates a Dissolved Air Flotation (DAF) treatment process for wastewater to allow it to be reused in the PM3 process. White water is re-used within the pulp preparation process. **OUTCOME = COMPLIANT**
	a	Separation of the water systems	See Section 1.7.2.1	
	b	Counter-current flow of process water and water recirculation		
	c	Partial recycling of treated waste water after biological treatment	Many RCF paper mills recycle a partial stream of biologically treated waste water back into the water circuit, especially mills producing corrugated medium or Testliner	
	d	Clarification of white water	See Section 1.7.2.1	

BATc Requirement	BATc Details	Specific Measure
BAT 44. In order to maintain advanced water circuit closure in mills processing paper for recycling and to avoid possible negative effects from the increased recycling of process water, BAT is to use one or a combination of the techniques given below.	**Technique** / **Description** a. Monitoring and continuous control of the process water quality — See Section 1.7.2.1 b. Prevention and elimination of biofilms by using methods that minimise emissions of biocides c. Removal of calcium from process water by a controlled precipitation of calcium carbonate	Daily monitoring by analysis will be undertaken for process water. To prevent biofilm formation and reduce biocide consumption, various process parameters will be monitored in the water loop to ensure adequate biocide dosing. Flash aeration and DAF techniques will be employed in the Effluent Treatment Plant to prevent calcium precipitation and lower the calcium levels. Additionally, pH will be continuously monitored and carbonate alkalinity will be analysed daily. **OUTCOME = COMPLIANT**
BAT 45. In order to prevent and reduce the pollution load of waste water into receiving waters from the whole mill, BAT is to use a suitable combination of the techniques specified in BAT 13, BAT 14, BAT 15, BAT 16, BAT 43 and BAT 44.	For integrated RCF paper mills, the BAT-AELs include emissions from papermaking, since the white water circuits of the paper machine are closely connected with those of the stock preparation.	The Effluent Treatment Plant uses an appropriate combination of techniques. Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with the relevant BAT by NRW. The Effluent Treatment Plant has been designed to meet the BAT-AELs in the Waste Treatment BRef. **OUTCOME = COMPLIANT**
BAT 46. BAT is to reduce electrical energy consumption within RCF processing paper mills by using a combination of the techniques given.	**Technique** / **Applicability** a. High consistency pulping for disintegrating paper for recycling into separated fibres — Generally applicable for new plants and for existing plants in the case of a major refurbishment b. Efficient coarse and fine screening by optimising rotor design, screens and screen	The pulp preparation process has been designed to minimise energy consumption by using a combination of the identified techniques, i.e. high consistency pulping, efficient screening and multiple cleaning stages. **OUTCOME = COMPLAINT**

BATc Requirement	BATc Details				Specific Measure
		operation, which allows the use of smaller equipment with lower specific energy consumption			
	c	Energy saving stock preparation concepts extracting impurities as early as possible in the re-pulping process, using fewer and optimised machine components, thus restricting the energy intensive processing of the fibres			
BAT 47. In order to reduce the generation of waste water, BAT is to use a combination of the techniques given.		**Technique**	**Description**	**Applicability**	To minimise waste water generation and enable fibre recovery, there will be DAF units and various screen units in the OCC plant. Also, to minimise fresh water use and therefore waste water generation, water circulation will be set from the outlet of the Effluent Treatment Plant to balance with the OCC requirement. **OUTCOME = COMPLIANT**
	a	Optimum design and construction of tanks and chests	See Section 1.7.2.1	Applicable to new plants and to existing plants in the case of a major refurbishment	
	b	Fibre and filler recovery and treatment of white water		Generally applicable	
	c	Water recirculation		Generally applicable. Dissolved organic, inorganic, and colloidal materials may restrict the water reuse in the wire section	

BATc Requirement	BATc Details				Specific Measure
	d	Optimisation of showers in the paper machine		Generally applicable	
BAT 49. In order to reduce emission loads of coating colours and binders which can disturb the biological waste water treatment plant, BAT is to use technique (a) given below or, in case this is technically not feasible, technique (b) given.		**Technique**	**Description**	**Applicability**	Not applicable, no coatings or binders in use. **OUTCOME = NOT APPLICABLE**
	a	Recovery of coating colours/recycling of pigments	Effluents containing coating colours are collected separately. The coating chemicals are recovered by e.g.: (i) ultrafiltration; (ii) screening-flocculation-dewatering process with return of the pigments to the coating process. The clarified water could be reused in the process	For ultrafiltration, the applicability may be restricted when: — effluent volumes are very small — coating effluents are generated in various places of the mill — many changes in coating occur; or — different coating colour recipes are incompatible	
	b	Pretreatment of effluents which contain coating colours	Effluents which contain coating colours are	Generally applicable	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td><table><tr><td></td><td></td><td>treated e.g. by flocculation to protect the subsequent biological waste water treatment</td><td></td></tr></table></td><td></td></tr>
<tr><td>BAT 50. In order to prevent and reduce the pollution load of waste water into receiving waters from the whole mill, BAT is to use a suitable combination of the techniques specified in BAT 13, BAT 14, BAT 15, BAT 47, BAT 48 and BAT 49.</td><td></td><td>The redevelopment of the site incorporates an upgraded Effluent Treatment Plant the design of which includes a suitable combination of the specified techniques, including:
primary treatment
secondary treatment
anaerobic treatment resulting in low P and N levels
fibre recovery
water recirculation

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 52. In order to minimise the amount of solid waste to be disposed of, BAT is to prevent waste generation and to carry out recycling operations by the use of a combination of the techniques given (see general BAT 20).</td><td><table><tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>a</td><td>Fibre and filler recovery and treatment of white water</td><td>See Section 1.7.2.1</td><td>Generally applicable</td></tr><tr><td>b</td><td>Broke recirculation system</td><td>Broke from different locations/phases of paper making process is collected,</td><td>Generally applicable</td></tr></table></td><td>White water is recovered and treated in the OCC process. Multiple screening and filtration steps are incorporated into the OCC process to ensure maximum fibre recovery, i.e.
HC and LC cleaning
primary, secondary and tertiary screening
reverse cleaning
Broke is collected and processed at various locations in the paper machine and re-pulped and integrated into the pulp feedstock.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>repulped and returned to the fibre feedstock</td><td></td></tr>
<tr><td>c</td><td>Recovery of coating colours/recycling of pigments</td><td>See Section 1.7.2.1</td><td></td></tr>
<tr><td>d</td><td>Reuse of fibre sludge from primary waste water treatment</td><td>Sludge with a high fibre content from the primary treatment of waste water can be reutilised in a production process</td><td>Applicability may be limited by product quality requirements</td></tr>
</table>
</td><td></td></tr>
<tr><td>BAT 53. In order to reduce the consumption of thermal and electrical energy, BAT is to use a combination of the techniques given below.</td><td>
<table>
<tr><th></th><th>Technique</th><th>Applicability</th></tr>
<tr><td>a</td><td>Energy saving screening techniques (optimised rotor design, screens and screen operation)</td><td rowspan="2">Applicable to new mills or major refurbishments</td></tr>
<tr><td>b</td><td>Best practice refining with heat recovery from the refiners</td></tr>
<tr><td>c</td><td>Optimised dewatering in the press section of paper machine/wide nip press</td><td>Not applicable to tissue paper and many speciality papers grades</td></tr>
<tr><td>d</td><td>Steam condensate recovery and use of efficient exhaust air heat recovery systems</td><td>Generally applicable</td></tr>
</table>
</td><td>All of the identified techniques will be used in the paper production processes.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details			Specific Measure
	e	Reduction of direct use of steam by careful process integration using e.g. pinch analysis		
	f	High efficient refiners	Applicable to new plants	
	g	Optimisation of the operating mode in existing refiners (e.g. reduction of ‘no load power requirements)	Generally applicable	
	h	Optimised pumping design, variable speed drive control for pumps, gearless drives		
	i	Cutting edge refining technologies		
	j	Steam box heating of the paper web to improve the drainage properties/dewatering capacity	Not applicable to tissue paper and many speciality papers grades	
	k	Optimised vacuum system (e.g. turbo fans instead of water ring pumps)		
	l	Generation optimisation and distribution network maintenance		
	m	Optimisation of heat recovery, air system, insulation		

BATc Requirement	BATc Details			Specific Measure
	n	Use of high efficient motors (EFF1)		
	o	Preheating of shower water with a heat exchanger		
	p	Use of waste heat for sludge drying or upgrading of dewatered biomass		
	q	Heat recovery from axial blowers (if used) for the supply air of the drying hood		
	r	Heat recovery of exhaust air from the Yankee hood with a trickling tower		
	s	Heat recovery from the infrared exhaust hot air		

Large Combustion Plant BATc

BATc Requirement	BATc Details	Specific Measure
BAT 1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features.	commitment of the management, including senior management;	Shotton Mill operates under an Environmental Management System (EMS) that is certified to ISO14001. The EMS incorporates all of the required features and will be updated to reflect the changes resulting from the re-development of the site. The existing EMS has been audited by NRW. **OUTCOME = COMPLIANT**
	definition, by the management, of an environmental policy that includes the continuous improvement of the environmental performance of the installation;	
	planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;	
	implementation of procedures paying particular attention to: structure and responsibility recruitment, training, awareness and competence communication employee involvement documentation effective process control planned regular maintenance programmes emergency preparedness and response safeguarding compliance with environmental legislation;	
	checking performance and taking corrective action, paying particular attention to: monitoring and measurement (see also the JRC Reference Report on Monitoring of emissions to air and water from IED-installations – ROM) corrective and preventive action maintenance of records independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;	

BATc Requirement	BATc Details	Specific Measure
	review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;	
	following the development of cleaner technologies;	
	consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; avoiding underground structures incorporating features that facilitate dismantling choosing surface finishes that are easily decontaminated using an equipment configuration that minimises trapped chemicals and facilitates drainage or cleaning designing flexible, self-contained equipment that enables phased closure using biodegradable and recyclable materials where possible;	
	application of sectoral benchmarking on a regular basis;	
	quality assurance/quality control programmes to ensure that the characteristics of all fuels are fully determined and controlled (see BAT 9);	
	management plan in order to reduce emissions to air and/or to water during other than normal operating conditions, including start-up and shutdown periods (see BAT 10 and BAT 11);	
	a waste management plan to ensure that waste is avoided, prepared for reuse, recycled or otherwise recovered, including the use of techniques given in BAT 16;	
	a systematic method to identify and deal with potential uncontrolled and/or unplanned emissions to the environment, in particular: emissions to soil and groundwater from the handling and storage of fuels, additives, by-products and waste	

BATc Requirement	BATc Details	Specific Measure
	emissions associated with self-heating and/or self-ignition of fuel in the storage and handling activities;	
	a dust management plan to prevent or, where that is not practicable, to reduce diffuse emissions from loading, unloading, storage and/or handling of fuels, residues and additives;	
	a noise management plan where a noise nuisance at sensitive receptors is expected or sustained, including; a protocol for conducting noise monitoring at the plant boundary a noise reduction programme a protocol for response to noise incidents containing appropriate actions and timelines a review of historic noise incidents, corrective actions and dissemination of noise incident knowledge to affected parties; and	
	for the combustion, gasification or co-incineration of malodourous substances, an odour management plan including: (a) a protocol for conducting odour monitoring; (b) where necessary, an odour elimination programme to identify and eliminate or reduce the odour emissions; (c) a protocol to record odour incidents and the appropriate actions and timelines; and (d) a review of historic odour incidents, corrective actions and the dissemination of odour incident knowledge to the affected parties.	

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td>BAT 2. BAT is to determine the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the gasification, IGCC and/or combustion units by carrying out a performance test at full load(1), according to EN standards, after the commissioning of the unit and after each modification that could significantly affect the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the unit. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>(1) In the case of CHP units, if for technical reasons the performance test cannot be carried out with the unit operated at full load for the heat supply, the test can be supplemented or substituted by a calculation using full load parameters.</td><td>A performance test in accordance with BS EN12952:2011-Part 15 will be undertaken.
If it is not possible to perform the test on the CHP at full load for heat supply, then a calculation will be used.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 3. BAT is to monitor key process parameters relevant for emissions to air and water including those given.</td><td><table>
<tr><th>Stream</th><th>Parameter(s)</th><th>Monitoring</th></tr>
<tr><td rowspan="3">Flue-gas</td><td>Flow</td><td>Periodic or continuous determination</td></tr>
<tr><td>Oxygen content, temperature, and pressure</td><td rowspan="2">Periodic or continuous measurement</td></tr>
<tr><td>Water vapour content (1)</td></tr>
<tr><td>Waste water from flue-</td><td>Flow, pH, and temperature</td><td>Continuous measurement</td></tr>
</table></td><td>Monitoring of emissions to air and water will be conditions in the varied Environmental Permit to be issued by NRW and will align with BAT.
Flue gas will be monitored continuously by Continuous Emissions Monitoring System.
There will be no generation of waste water from flue gas treatment.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td><table><tr><td>gas treatment</td><td></td><td></td></tr></table>([1]) The continuous measurement of the water vapour content of the flue-gas is not necessary if the sampled flue-gas is dried before analysis.</td><td></td></tr>
<tr><td>BAT 4. BAT is to monitor emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td><table><tr><th>Substance</th><th>Standard(s)</th><th>Minimum monitoring frequency</th></tr><tr><td>NO_x</td><td rowspan="2">Generic EN standards</td><td rowspan="2">Continuous</td></tr><tr><td>CO</td></tr></table></td><td>Monitoring of emissions will be a requirement of the varied Environmental Permit, the conditions of which are set to align with the relevant BAT by NRW.
A Continuous Emissions Monitoring System certified to MCERTS will be installed on the CHP plant.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 5. BAT is to monitor emissions to water from flue-gas treatment with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td></td><td>No applicable, no flue gas treatment takes place, as fuel is Natural Gas only.

OUTCOME = NOT APPLICABLE</td></tr>
<tr><td>BAT 6. In order to improve the general environmental performance of combustion plants and to reduce emissions to air of CO and unburnt substances, BAT is to ensure optimised combustion and to use an appropriate combination of the techniques given below.</td><td><table><tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>a</td><td>Fuel blending and mixing</td><td>Ensure stable combustion conditions and/or reduce the emission of pollutants by mixing different qualities of the same fuel type</td><td>Generally applicable</td></tr></table></td><td>The CHP plant will be maintained in accordance with the suppliers' recommendations and by supplier personnel.
The CHP plant will be controlled by an advanced control system.
The CHP plant will be fuelled by natural gas.
The gas turbines selected for the CHP plant are capable of burning up to a 20% blend of natural gas and Hydrogen.</td></tr>
</table>

BATc Requirement	BATc Details				Specific Measure
	b	Maintenance of the combustion system	Regular planned maintenance according to suppliers' recommendations		**OUTCOME = COMPLIANT**
	c	Advanced control system	See description in Section 8.1	The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system	
	d	Good design of the combustion equipment	Good design of furnace, combustion chambers, burners and associated devices	Generally applicable to new combustion plants	
	e	Fuel choice	Select or switch totally or partially to another fuel(s) with a better environmental profile (e.g. with low sulphur and/or mercury content) amongst the available fuels, including in start-up situations or when back-up fuels are used	Applicable within the constraints associated with the availability of suitable types of fuel with a better environmental profile as a whole, which may be impacted by the energy policy of the Member State, or by the integrated site's fuel balance in the case of combustion of industrial process fuels. For existing combustion plants,	

BATc Requirement	BATc Details	Specific Measure
	the type of fuel chosen may be limited by the configuration and the design of the plant	
BAT 7. In order to reduce emissions of ammonia to air from the use of selective catalytic reduction (SCR) and/or selective non-catalytic reduction (SNCR) for the abatement of NO_X emissions, BAT is to optimise the design and/or operation of SCR and/or SNCR (e.g. optimised reagent to NO_X ratio, homogeneous reagent distribution and optimum size of the reagent drops).		Not applicable, neither SCR nor SNCR are used. **OUTCOME = NOT APPLICABLE**
BAT 8. In order to prevent or reduce emissions to air during normal operating conditions, BAT is to ensure, by appropriate design, operation and maintenance, that the emission abatement systems are used at optimal capacity and availability.		The Solar Turbines will be fitted with 'SoLoNOx' patented burner technology and secondary air supply to minimise NOx emissions. **OUTCOME = COMPLIANT**
BAT 9. In order to improve the general environmental performance of combustion and/or gasification plants and to reduce emissions to air, BAT is to include the following elements in the quality assurance/quality	Initial characterisation and regular testing of the fuel can be performed by the operator and/or the fuel supplier. If performed by the supplier, the full results are provided to the operator in the form of a product (fuel) supplier specification and/or guarantee.	National Grid standards will be applicable. **OUTCOME = COMPLIANT**

BATc Requirement	BATc Details	Specific Measure
control programmes for all the fuels used, as part of the environmental management system (see BAT 1): Initial full characterisation of the fuel used including at least the parameters listed below and in accordance with EN standards. ISO, national or other international standards may be used provided they ensure the provision of data of an equivalent scientific quality; Regular testing of the fuel quality to check that it is consistent with the initial characterisation and according to the plant design specifications. The frequency of testing and the parameters chosen from the table below are based on the variability of the fuel and an assessment of the relevance of pollutant releases (e.g. concentration in fuel, flue-gas treatment employed); Subsequent adjustment of the plant settings as and when needed and practicable (e.g. integration of the fuel characterisation and control in the advanced control system (see description in Section 8.1)).		
BAT 10. In order to reduce emissions to air and/or to water during other than normal		An OTNOC management plan in accordance with relevant guidance will be produced and submitted to

BATc Requirement	BATc Details	Specific Measure
operating conditions (OTNOC), BAT is to set up and implement a management plan as part of the environmental management system (see BAT 1), commensurate with the relevance of potential pollutant releases, that includes the following elements: appropriate design of the systems considered relevant in causing OTNOC that may have an impact on emissions to air, water and/or soil (e.g. low-load design concepts for reducing the minimum start-up and shutdown loads for stable generation in gas turbines); set-up and implementation of a specific preventive maintenance plan for these relevant systems; review and recording of emissions caused by OTNOC and associated circumstances and implementation of corrective actions if necessary; periodic assessment of the overall emissions during OTNOC (e.g. frequency of events, duration, emissions quantification/estimation) and implementation of corrective actions if necessary.		NRW as part of the Environmental Permit variation application. **OUTCOME = COMPLIANT**

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td>BAT 11. BAT is to appropriately monitor emissions to air and/or to water during OTNOC.</td><td>The monitoring can be carried out by direct measurement of emissions or by monitoring of surrogate parameters if this proves to be of equal or better scientific quality than the direct measurement of emissions. Emissions during start-up and shutdown (SU/SD) may be assessed based on a detailed emission measurement carried out for a typical SU/SD procedure at least once every year and using the results of this measurement to estimate the emissions for each and every SU/SD throughout the year.</td><td>Continuous Emissions Monitoring will continue to record emissions data during OTNOC.

OUTCOME = COMPLIANT</td></tr>
<tr><td>BAT 12. In order to increase the energy efficiency of combustion, gasification and/or IGCC units operated ≥ 1 500 h/yr, BAT is to use an appropriate combination of the techniques given below.</td><td><table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a</td><td>Combustion optimisation</td><td>See description in Section 8.2. Optimising the combustion minimises the content of unburnt substances in the flue gases and in solid combustion residues</td><td>Generally applicable</td></tr>
<tr><td>b</td><td>Optimisation of the working medium conditions</td><td>Operate at the highest possible pressure and temperature of the working medium gas or steam, within the constraints associated with, for example, the control of NOX emissions or the</td><td>Generally applicable</td></tr>
</table></td><td>The equipment selected for the CHP plant has very high levels of efficiency and an advanced control system.
The plant will run in fully automatic mode with Siemens PCS7 SCADA system. All performance related parameters will be recorded and monitored.
Air and gas regulating devices will employ SERVO technology.
Heat recovery will be maximised by steam generators resulting in a low stack temperature of 60^{o}C.

OUTCOME = COMPLIANT</td></tr>
</table>

BATc Requirement	BATc Details				Specific Measure
			characteristics of energy demanded		
	c	Optimisation of the steam cycle	Operate with lower turbine exhaust pressure by utilisation of the lowest possible temperature of the condenser cooling water, within the design conditions	Generally applicable	
	d	Minimisation of energy consumption	Minimising the internal energy consumption (e.g. greater efficiency of the feed-water pump	Generally applicable	
	e	Preheating of combustion air	Reuse of part of the heat recovered from the combustion flue-gas to preheat the air used in combustion	Generally applicable within the constraints related to the need to control NO_X emissions	
	f	Fuel preheating	Preheating of fuel using recovered heat	Generally applicable within the constraints associated with the boiler design and the need to control NO_X emission	

BATc Requirement	BATc Details				Specific Measure
	g	Advanced control system	See description in Section 8.2. Computerised control of the main combustion parameters enables the combustion efficiency to be improved	Generally applicable to new units. The applicability to old units may be constrained by the need to retrofit the combustion system and/or control command system	
	h	Feed-water preheating using recovered heat	Preheat water coming out of the steam condenser with recovered heat, before reusing it in the boiler	Only applicable to steam circuits and not to hot boilers. Applicability to existing units may be limited due to constraints associated with the plant configuration and the amount of recoverable heat	
	i	Heat recovery by cogeneration (CHP)	Recovery of heat (mainly from the steam system) for producing hot water/steam to be used in industrial processes/activities or in a public network for district	Applicable within the constraints associated with the local heat and power demand. The applicability may be limited in the case of gas	

BATc Requirement	BATc Details				Specific Measure
			heating. Additional heat recovery is possible from: - flue-gas grate cooling circulating fluidised bed	compressors with an unpredictable operational heat profile	
	j	CHP readiness	See description in Section 8.2	Only applicable to new units where there is a realistic potential for the future use of heat in the vicinity of the unit	
	k	Flue-gas condenser	See description in Section 8.2	Generally applicable to CHP units provided there is enough demand for low temperature heat	
	l	Heat accumulation	Heat accumulation storage in CHP mode	Only applicable to CHP plants. The applicability may be limited in the case of low heat load demand	
	m	Wet stack	See description in Section 8.2	Generally applicable to new and existing units fitted with wet FGD	

BATc Requirement	BATc Details				Specific Measure
	n	Cooling tower discharge	The release of emissions to air through a cooling tower and not via a dedicated stack	Only applicable to units fitted with wet FGD where reheating of the flue-gas is necessary before release, and where the unit cooling system is a cooling tower	
	o	Fuel pre-drying	The reduction of fuel moisture content before combustion to improve combustion conditions	Applicable to the combustion of biomass and/or peat within the constraints associated with spontaneous combustion risks (e.g. the moisture content of peat is kept above 40 % throughout the delivery chain). The retrofit of existing plants may be restricted by the extra calorific value that can be obtained from the drying operation and by the limited retrofit possibilities offered by some boiler designs or	

BATc Requirement	BATc Details				Specific Measure
				plant configurations	
	p	Minimisation of heat losses	Minimising residual heat losses, e.g. those that occur via the slag or those that can be reduced by insulating radiating sources	Only applicable to solid-fuel-fired combustion units and to gasification/IGCC units	
	q	Advanced materials	Use of advanced materials proven to be capable of withstanding high operating temperatures and pressures and thus to achieve increased steam/combustion process efficiencies	Only applicable to new plants	
	r	Steam turbine upgrades	This includes techniques such as increasing the temperature and pressure of medium pressure steam, addition of a low-pressure turbine, and modifications to the	The applicability may be restricted by demand, steam conditions and/or limited plant lifetime	

BATc Requirement	BATc Details				Specific Measure
			geometry of the turbine rotor blades		
	s	Supercritical and ultra-supercritical steam conditions	Use of a steam circuit, including steam reheating systems, in which steam can reach pressures above 220,6 bar and temperatures above 374 °C in the case of supercritical conditions, and above 250 – 300 bar and temperatures above 580 – 600 °C in the case of ultra-supercritical conditions	Only applicable to new units of ≥ 600MWth operated > 4 000 h/yr. Not applicable when the purpose of the unit is to produce low steam temperatures and/or pressures in process industries. Not applicable to gas turbines and engines generating steam in CHP mode. For units combusting biomass, the applicability may be constrained by high temperature corrosion in the case of certain biomasses	

<table>
<tr><th>BATc Requirement</th><th colspan="4">BATc Details</th><th>Specific Measure</th></tr>
<tr><td rowspan="3">BAT 13. In order to reduce water usage and the volume of contaminated waste water discharged, BAT is to use one or both of the techniques given.</td><th></th><th>Technique</th><th>Description</th><th>Applicability</th><td rowspan="3">The CHP plant will have a closed loop water system.
Bottom ash will not be generated.

OUTCOME = COMPLIANT</td></tr>
<tr><td>a</td><td>Water recycling</td><td>Residual aqueous streams, including run-off water, from the plant are reused for other purposes. The degree of recycling is limited by the quality requirements of the recipient water stream and the water balance of the plant</td><td>Not applicable to waste water from cooling systems when water treatment chemicals and/or high concentrations of salts from seawater are present</td></tr>
<tr><td>b</td><td>Dry bottom ash handling</td><td>Dry, hot bottom ash falls from the furnace onto a mechanical conveyor system and is cooled down by ambient air. No water is used in the process.</td><td>Only applicable to plants combusting solid fuels. There may be technical restrictions that prevent retrofitting to existing combustion plants</td></tr>
<tr><td>BAT 14. In order to prevent the contamination of uncontaminated waste water and to reduce emissions to water, BAT is to segregate waste water streams and to treat them</td><td colspan="4">Waste water streams that are typically segregated and treated include surface run-off water, cooling water, and waste water from flue-gas treatment.</td><td>The redevelopment of the Shotton Mill site incorporates separate waste water drainage systems for uncontaminated surface water and process effluents. Process effluents are treated in the Effluent Treatment Plant.</td></tr>
</table>

BATc Requirement	BATc Details	Specific Measure
separately, depending on the pollutant content.		**OUTCOME = COMPLIANT**
BAT 15. In order to reduce emissions to water from flue-gas treatment, BAT is to use an appropriate combination of the techniques given below, and to use secondary techniques as close as possible to the source in order to avoid dilution.	(see nested table below)	The gas turbines selected for the CHP plant will utilise Solar Turbine's patented 'SoLoNOx' technology which optimises combustion. There is no requirement for additional flue gas treatment. **OUTCOME = COMPLIANT**

	Technique	Typical pollutants prevented/abated	Applicability
	Primary techniques		
a	Optimised combustion (see BAT 6) and flue-gas treatment systems (e.g. SCR/SNCR, see BAT 7)	Organic compounds, ammonia (NH_3)	Generally applicable
	Secondary techniques (1)		
b	Adsorption on activated carbon	Organic compounds, mercury (Hg)	Generally applicable
c	Aerobic biological treatment	Biodegradable organic compounds, ammonium (NH_4^+)	Generally applicable for the treatment of organic compounds. Aerobic biological treatment of ammonium (NH_4^+) may not be applicable in the case of high chloride

BATc Requirement	BATc Details				Specific Measure
				concentrations (i.e. around 10 g/l)	
	d	Anoxic/anaerobic biological treatment	Mercury (Hg), nitrate (NO_3^-), nitrite (NO_2^-)	Generally applicable	
	e	Coagulation and flocculation	Suspended solids	Generally applicable	
	f	Crystallisation	Metals and metalloids, sulphate (SO_4^{2-}), fluoride (F^-)	Generally applicable	
	g	Filtration (e.g. sand filtration, microfiltration, ultrafiltration)	Suspended solids, metals	Generally applicable	
	h	Flotation	Suspended solids, free oil	Generally applicable	
	i	Ion exchange	Metals	Generally applicable	
	j	Neutralisation	Acids, alkalis	Generally applicable	
	k	Oxidation	Sulphide (S^{2-}), sulphite (SO_3^{2-})	Generally applicable	
	l	Precipitation	Metals and metalloids, sulphate ($SO4^{2-}$), fluoride (F^-)	Generally applicable	

BATc Requirement	BATc Details				Specific Measure
	m	Sedimentation	Suspended solids	Generally applicable	
	n	Stripping	Ammonia (NH_3)	Generally applicable	
	([1]) The descriptions of the techniques are given in Section 8.6.				
BAT 16. In order to reduce the quantity of waste sent for disposal from the combustion and/or gasification process and abatement techniques, BAT is to organise operations so as to maximise, in order of priority and taking into account life-cycle thinking: waste prevention, e.g. maximise the proportion of residues which arise as by-products; waste preparation for reuse, e.g. according to the specific requested quality criteria; waste recycling; other waste recovery (e.g. energy recovery), by implementing an appropriate combination of techniques.		**Technique**	**Description**	**Applicability**	Not applicable, no solid wastes are generated by the CHP plant. **OUTCOME = NOT APPLICABLE**
	a	Generation of gypsum as a by-product	Quality optimisation of the calcium-based reaction residues generated by the wet FGD so that they can be used as a substitute for mined gypsum (e.g. as raw material in the plasterboard industry). The quality of limestone used in the wet FGD influences the purity of the gypsum produced	Generally applicable within the constraints associated with the required gypsum quality, the health requirements associated to each specific use, and by the market conditions	
	b	Recycling or recovery of residues in the construction sector	Recycling or recovery of residues (e.g. from semi-dry desulphurisation processes, fly ash, bottom ash) as a construction material (e.g. in road building, to replace sand in	Generally applicable within the constraints associated with the required material quality (e.g. physical properties, content of harmful substances)	

BATc Requirement	BATc Details				Specific Measure
			concrete production, or in the cement industry)	associated to each specific use, and by the market conditions	
	c	Energy recovery by using waste in the fuel mix	The residual energy content of carbon-rich ash and sludges generated by the combustion of coal, lignite, heavy fuel oil, peat or biomass can be recovered for example by mixing with the fuel	Generally applicable where plants can accept waste in the fuel mix and are technically able to feed the fuels into the combustion chamber	
	d	Preparation of spent catalyst for reuse	Preparation of catalyst for reuse (e.g. up to four times for SCR catalysts) restores some or all of the original performance, extending the service life of the catalyst to several decades. Preparation of spent catalyst for reuse is integrated in a catalyst management scheme	The applicability may be limited by the mechanical condition of the catalyst and the required performance with respect to controlling NO_X and NH_3 emissions	
BAT 17. In order to reduce noise emissions, BAT is to use one or a combination of the techniques given.		**Technique**	**Description**	**Applicability**	The gas turbines supplied by Solar Turbines have a noise level of 80dBA at 1m. Predicted noise levels from the CHP stack exits has been modelled at 80dBA. The CHP plant will be screened by other buildings on site.
	a	Operational measures	These include: — improved inspection and	Generally applicable	

<table>
<tr><th>BATc Requirement</th><th colspan="4">BATc Details</th><th>Specific Measure</th></tr>
<tr><td rowspan="4"></td><td></td><td></td><td>maintenance of equipment;
— closing of doors and windows of enclosed areas, if possible;
— equipment operated by experienced staff;
— avoidance of noisy activities at night, if possible; and
— provisions for noise control during maintenance activities.</td><td></td><td rowspan="4">OUTCOME = COMPLIANT</td></tr>
<tr><td>b</td><td>Low-noise equipment</td><td>This potentially includes compressors, pumps and disks</td><td>Generally applicable when the equipment is new or replaced</td></tr>
<tr><td>c</td><td>Noise attenuation</td><td>Noise propagation can be reduced by inserting obstacles between the emitter and the receiver. Appropriate obstacles include protection walls, embankments and buildings</td><td>Generally applicable to new plants. In the case of existing plants, the insertion of obstacles may be restricted by lack of space</td></tr>
<tr><td>d</td><td>Noise-control equipment</td><td>This includes:
— noise-reducers;
— equipment insulation;</td><td>The applicability may be restricted by lack of space</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th>BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td><table>
<tr><td></td><td></td><td>— enclosure of noisy equipment; and
— soundproofing of buildings.</td><td></td></tr>
<tr><td>e</td><td>Appropriate location of equipment and buildings</td><td>Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens</td><td>Generally applicable to new plants. In the case of existing plants, the relocation of equipment and production units may be restricted by lack of space or by excessive costs</td></tr>
</table></td><td></td></tr>
<tr><td>BAT 40. In order to increase the energy efficiency of natural gas combustion, BAT is to use an appropriate combination of the techniques given in BAT 12.</td><td><table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a</td><td>Combined cycle</td><td>See description in Section 8.2</td><td>Generally applicable to new gas turbines and engines except when operated < 1,500 h/yr. Applicable to existing gas turbines and engines within the constraints associated with the steam cycle design and the space availability. Not applicable to existing gas turbines and engines operated < 1,500 h/yr. Not applicable to mechanical drive gas turbines operated in</td></tr>
</table></td><td>Combined cycle gas turbines that meet the required BAT Associated Energy Efficiency levels have been specified for the CHP plant and have Heat Recovery Steam generators fitted.

OUTCOME = COMPLIANT</td></tr>
</table>

<table>
<tr><th>BATc Requirement</th><th colspan="4">BATc Details</th><th>Specific Measure</th></tr>
<tr><td></td><td></td><td></td><td></td><td>discontinuous mode with extended load variations and frequent start-ups and shutdowns. Not applicable to boilers</td><td></td></tr>
<tr><td rowspan="5">BAT 41. In order to prevent or reduce NO_x emissions to air from the combustion of natural gas in boilers, BAT is to use one or a combination of the techniques given below.</td><th></th><th>Technique</th><th>Description</th><th>Applicability</th><td rowspan="5">The back-up boilers associated with the CHP plant use low NO_x burners and advanced control systems.
The low NO_x burners will be supplied by OILON. The burner management control system will be PLC based and supplied by Lamtec.
The back up boilers will utilise flue gas recirculation.
The control system will consist of four programmable safety logic controllers (PLCs).

OUTCOME = COMPLIANT</td></tr>
<tr><td>a</td><td>Air and/or fuel staging</td><td>See description in Section 8.3. Air staging is often associated with low-NO_x burners</td><td rowspan="3">Generally applicable</td></tr>
<tr><td>b</td><td>Flue-gas recirculation</td><td rowspan="2">See description in Section 8.3</td></tr>
<tr><td>c</td><td>Low-NO_x burners (LNB)</td></tr>
<tr><td>d</td><td>Advanced control system</td><td>See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr</td><td>The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system</td></tr>
</table>

BATc Requirement	BATc Details				Specific Measure
	e	Reduction of the combustion air temperature	See description in Section 8.3	Generally applicable within the constraints associated with the process needs	
	f			Not applicable to combustion plants operated < 500 h/yr with highly variable boiler loads. The applicability may be limited in the case of combustion plants operated between 500 h/yr and 1,500 h/yr with highly variable boiler loads	
	g			Not applicable to combustion plants operated < 500 h/yr. Not generally applicable to combustion plants of < 100MWth. There may be technical and economic restrictions for retrofitting existing combustion plants operated between 500 h/yr and 1 500 h/yr	

BATc Requirement	BATc Details				Specific Measure
BAT 42. In order to prevent or reduce NO_x emissions to air from the combustion of natural gas in gas turbines, BAT is to use one or a combination of the techniques given below.		**Technique**	**Description**	**Applicability**	The gas turbines specified for the CHP plant utilise Solar Turbines patented 'SoLoNOx' technology, which is a form of dry low NOx burner technology. The CHP plant will have an advanced control system. **OUTCOME = COMPLIANT**
	a	Advanced control system	See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr	The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system	
	b	Water/steam addition	See description in Section 8.3	The applicability may be limited due to water availability	
	c	Dry low-NO_x burners (DLN)		The applicability may be limited in the case of turbines where a retrofit package is not available or when water/steam addition systems are installed	
	d	Low-load design concept	Adaptation of the process control and related equipment to maintain good combustion efficiency when the demand in energy varies, e.g. by improving	The applicability may be limited by the gas turbine design	

BATc Requirement	BATc Details				Specific Measure
			the inlet airflow control capability or by splitting the combustion process into decoupled combustion stages		
	e	Low-NO_X burners (LNB)	See description in Section 8.3	Generally applicable to supplementary firing for heat recovery steam generators (HRSGs) in the case of combined-cycle gas turbine (CCGT) combustion plants	
	f	Selective catalytic reduction (SCR)	See description in Section 8.3	Not applicable in the case of combustion plants operated < 500 h/yr. Not generally applicable to existing combustion plants of < 100MWth. Retrofitting existing combustion plants may be constrained by the availability of sufficient space. There may be technical and economic restrictions for retrofitting existing combustion plants operated between 500 h/yr and 1,500 h/yr	

BATc Requirement	BATc Details				Specific Measure
		Technique	**Description**	**Applicability**	
BAT 43. In order to prevent or reduce NOx emissions to air from the combustion of natural gas in engines, BAT is to use one or a combination of the techniques given below.	a	Advanced control system	See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr	The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system	Not applicable, engines are not used as part of the CHP plant. **OUTCOME = NOT APPLICABLE**
	b	Lean-burn concept	See description in Section 8.3. Generally used in combination with SCR	Only applicable to new gas-fired engines	
	c	Advanced lean-burn concept	See descriptions in Section 8.3	Only applicable to new spark plug ignited engines	
	d	Low-load design concept		Retrofitting existing combustion plants may be constrained by the availability of sufficient space. Not applicable to combustion plants operated < 500 h/yr. There may be technical and economic restrictions for retrofitting existing combustion plants	

BATc Requirement	BATc Details	Specific Measure
	operated between 500 h/yr and 1,500 h/yr	
BAT 44. In order to prevent or reduce CO emissions to air from the combustion of natural gas, BAT is to ensure optimised combustion and/or to use oxidation catalysts.	See descriptions in Section 10.8.3.	Solar Turbines are guaranteeing a CO emission limit value of 15mg/Nm^3 at 3% O_2 dry. **OUTCOME = COMPLIANT**
BAT 45. In order to reduce non-methane volatile organic compounds (NMVOC) and methane (CH_4) emissions to air from the combustion of natural gas in spark-ignited lean-burn gas engines, BAT is to ensure optimised combustion and/or to use oxidation catalysts.	See descriptions in Section 10.8.3. Oxidation catalysts are not effective at reducing the emissions of saturated hydrocarbons containing less than four carbon atoms.	Not applicable, spark ignition lean burn gas engines are not used as part of the CHP plant. **OUTCOME = NOT APPLICABLE**

9.0 Raw Materials

9.1 Inventory of Raw Materials

The raw materials that will be used on Site are detailed in Table 4.

A Control of Substances Hazardous to Health (COSHH) assessment will be undertaken prior to the use of chemicals, and if the chemical is found to present a hazard to health, it will be added to the COSHH inventory and appropriate safeguards implemented.

Material Safety Data Sheets (MSDS) for any potentially hazardous materials or chemicals will be kept on site together with the COSHH register. The MSDS will give information on how chemicals should be handled, stored and disposed of, and what to do in the event of an accident.

Table 4: Principal Raw Materials

Material	Consumption (tpa)	Site Storage
Virgin Pulp	75,000	Stored externally in bales
OCC	830,000	Stored externally in bales & within OCC warehouse

9.2 Raw Materials Selection

Wherever possible, raw materials will be selected that minimise environmental impact. Consideration will be given to such factors as degradability, bioaccumulation potential, product contamination and toxicity. Reviews will be frequently undertaken to ensure that all raw materials are appropriate for use, that consumption is optimised and that opportunities for reduction and improvements are implemented through an action plan.

Alternative raw materials will be evaluated for their environmental impact on an on-going basis and, where there is no overriding quality requirement substitution will be given appropriate consideration. The on-going programme of professional and technical development for all site personnel will ensure awareness of new developments in product availability and their implication.

9.2.1 Waste Minimisation Audit

The overall objective of the Site is to maximise the recovery of useful fibre to produce new paper based products, thereby minimising the volume sent to landfill or Energy from Waste facilities for disposal. Notwithstanding this, there will be waste produced by the processes undertaken at the Site.

Waste generation at the Site will be reviewed annually and where necessary an appropriate improvement programme will be implemented.

9.2.2 Water Use

Paper production processes utilise large volumes of water in preparing the pulp. Water will also be used for cooling purposes and steam generation. Water is supplied to site by a dedicated private pipeline.

The use of water will be regularly reviewed to ensure maximum efficiency and ensure that any further potential for reduction in consumption and recycling opportunities are identified. The predicted average total usage is expected to be:

- $8m^3/t$ of containerboard produced; and

- 7m³/t of tissue produced.

10.0 Waste Handling, Recovery or Disposal

Waste present at the Site falls into two categories:

- Waste delivered to Site for processing (feedstock); and
- Waste generated from on-site processes.

The Site's main objective is to produce paper products, the process is designed to maximise the product yield and minimise residual waste. In addition, the activities at the site are designed to prevent, or where that is not practicable, reduce any additional wastes generated.

All solid waste will be managed and disposed or recovered in accordance with the Duty of Care and the Environmental Permitting Regulations. All waste recovered or generated during the processes undertaken at the Site will be removed to a suitable licensed processing or disposal site.

The categories of waste, storage arrangement on site, and recovery/disposal options are detailed in Table 5 below.

Table 5: Waste Storage, Recovery and Disposal

Waste Material	Storage Arrangements	Disposal or Recovery
Waste Delivered to site for processing		
Waste paper	Internal & External	Recovery on site
Solid Waste Residues from processing		
Scrap metal	Individual containers	Recovery off site
ETP sludge	Hard surfaced area	Recovery on site
Domestic waste	Individual containers	Disposal or recovery off site
Plastics		
WEEE		
Pulping rejects (non-combustible)	Storage bunkers	Disposal off site
Pulping rejects (combustible)		
Pulping fibre rejects		Recovery on site

All waste is stored securely on site and will be protected from vandalism by site security fencing around the site and restricted site access.

10.1 Waste Minimisation

The key methods of ensuring that waste minimisation occurs on site will be;

- waste acceptance checks to ensure only compliant waste is accepted;
- working proactively with waste suppliers to manage any quality issues that may arise;
- the ongoing identification and implementation of waste prevention opportunities;
- the active participation and commitment of staff in all areas of the business; and
- monitoring of materials usage and reporting against key performance measures.

SML will take appropriate measures to ensure that;

- the waste hierarchy (referred to in Article 3 of the Waste Framework Directive) is applied in the generation of waste on site by the activities;
- any waste generated by the activities is treated in accordance with the waste hierarchy; and
- where disposal is necessary, as opposed to recovery, that it is undertaken in a manner which minimises its impact on the environment.

SML will review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by the review. Waste production will be avoided wherever possible. Any waste produced on site will be recovered, unless there are instances whereby it is not technically or economically practicable to do so.

On an annual basis, SML will complete a waste minimisation audit.

The audit will include;

- waste produced at the Site;
- destination of the waste;
- if it can it be recovered or recycled;
- if it is being stored correctly on site;
- if Duty of Care requirements are being met; and
- any further comments for future reference.

11.0 Energy

11.1 Energy Consumption

The total power requirement for the on-site processes is estimated to be 61MW. 46.6MW of this will be generated on-site by the CHP plant and 14.4MW by the biomass combustion plant. In the event of the CHP or biomass combustion plant being unavailable, 25MW of this will be generated by the Shotwick Solar Farm. If necessary, up to 61MW will be provided by the grid.

The anaerobic digestion stage of the ETP will generate 1,400Nm³/hr of biomethane. This will be combusted in gas engines and boilers to produce heat and power.

Up to 14,500Nm^3/hr natural gas will be required for the CHP plant operations. Annual consumption is anticipated to be 116,000,000Nm^3 per annum under normal operating conditions.

The site energy consumption is summarised in Table 6 below.

Table 6: Energy Consumption

Energy Source	Annual Consumption
Electricity from CHP	398,000Mwe
Electricity from biomass combustion	183,960Mwe
Electricity from Solar Farm	109,500Mwe
Electricity from National Grid	534,360Mwe
Steam from CHP	1,927,000MW

Energy Source	Annual Consumption
Steam from biomass combustion	930,000MW
Natural Gas	1,612,000MW
Biomethane	73,000MW

The site is part of a Climate Change Agreement.

11.2 Energy Management Measures

A number of features have been incorporated within the design of the Site in order to minimise energy use including:

- selection of plant and equipment with the lowest energy consumption;
- recovery of heat where possible;
- low energy light fittings will be used where practicable;
- category IE3 high efficiency electrical drive motors;
- use of variable speed drives for larger duties, where applicable; and
- use of adiabatic cooling towers.

To optimise energy efficiency, equipment will be maintained and serviced as required. Plant and equipment will be subject to regular maintenance to ensure it continues to operate at optimum energy efficiency and that energy consumption does not increase due to inefficient performance.

Energy use will be monitored and recorded and periodically reviewed to identify areas of improvement and to ensure that any inefficiency is investigated, and appropriate actions taken.

Energy use and energy minimisation will be included within the management system for the control of resources. Within the management system the review process will identify energy use by source for the different site operations. The results will be used to identify potential measures for improving energy efficiency. The site qualifies for the Energy Savings Opportunities Scheme (ESOS) and therefore conducts regular assessments.

Staff will undergo awareness training in energy efficient practices.

12.0 In-Process Controls

12.1 Material Handling and Storage

The storage procedures that will be implemented on site are considered to be best practice for the following reasons:

- storage areas will be clearly designated;
- procedures will be in place for the regular inspection and maintenance of storage areas with any repairs being undertaken as soon as is practicable;
- storage tanks will be designed to be fit for purpose, taking into account the nature of the material to be stored and the required design life;
- tanks will be fully quality assured and tested for leakage prior to commissioning;
- liquid levels within all storage tanks will be continuously monitored by instruments which will alert the operator to high levels and operate interlocks as relevant. High

level float switches will also be in place that acts to switch off pumps if a high level is reached;

- written records of all tanks will be kept, detailing:
  - capacity;
  - construction including materials;
  - maintenance schedules and inspection results; and
  - fittings.

12.2 Process Control Monitoring

The OCC, PM3, CHP, ETP and Tissue processes will all benefit from process control features which will ensure adequate control of the processes and prevent the development of abnormal operating conditions. Specific measures are detailed in Sections 4 to 7 of this document; however, additional information is provided below.

12.2.1 OCC and PM3 Process Control Systems

Both the OCC and PM3 plant and equipment are to be supplied by Valmet, a world leader in pulp and paper/board manufacturing technologies. Valmet will also provide the Distributed Control System (DCS) for these plants and equipment.

A DCS is a specifically designed automated control system that consists of geographically distributed control elements throughout the plant or control area. Data acquisition and control functions are carried out through a number of DCS controllers which are microprocessor based units distributed functionally and geographically over the plant and are situated near area where control or data gathering functions being performed as shown and are connected via a high speed communication network.

A DCS has three following main advantages:

- distribution of various control functions;
- automation of the manufacturing process; and
- a single automation system.

The plant/process/equipment will be controlled via Human Machine Interfaces (HMI) in the various control rooms.

12.2.2 ETP Process Control System

The ETP will also be controlled by a Valmet supplied DCS.

12.2.3 CHP Process Control System

The CHP will be controlled by a Siemens PCS 7 SCADA system.

12.2.4 Tissue Process Control System

The Tissue plant will also be controlled by a Valmet DCS.

12.3 Inspection, Maintenance and Monitoring

Infrastructure and equipment within the Site will be inspected on a regular basis and maintained and repaired as necessary. Records of all visual and scheduled inspections and details and certificates (where appropriate) of any maintenance work will be regularly updated and maintained. Maintenance schedules for equipment will be regularly reviewed and updated.

In the event of damage or deterioration being detected, all maintenance work will be carried out in conformance with SML's Health and Safety Policy.

Monitoring and recording of conditions within the plant will be carried out on a continuous basis by the comprehensive network of sensors and instrumentation as discussed above and displayed via the process control system. This will enable continuous mapping of the process in order to ensure efficiency of the process.

13.0 Control of Noise

SML recognises that the Site should be operated in a manner that minimises or prevents noise and / or vibration nuisance.

13.1 Noise Sources

Details of the locations, sources, frequency and estimated noise levels that will be associated with operations at the Site have been addressed as part of the Noise Impact Assessment, document reference 416.065169.00001_NIA which is provided in Section 08 of this EP variation application.

13.2 Noise Assessment

The noise assessment carried out to BS4142:2014 considered the potential for the operations to give rise to noise impacts at the closest noise-sensitive receptors (NSRs). Refer to Section 18.4 for more details.

The assessment has found that in the context of the existing background and ambient sound levels, the site would not lead to a significant impact at the closest NSRs, and that specific mitigation measures additional to those included within the design of the site would not be required.

13.3 Noise Mitigation and Management Measures

Mitigation to reduce the impact to receptors that may be affected by the noise emissions from the Site are detailed below.

13.3.1 Operating Hours

The facility will operate 24 hours a day, 365 days a year.

The Site will accept deliveries of feedstocks 24 hours a day, with peak deliveries during daytime working hours, 06:00 to 22:00 Monday to Friday. Dispatch will take place Monday to Friday 06:00 to 22:00 and 06:00 to 14:00 on Saturday and Sunday.

13.3.2 Building and Plant Design

Opening of doors will be kept to a minimum and roller shutter doors will be installed where appropriate.

Buildings have been designed to attenuate noise.

13.3.3 Plant Selection

Plant options with lower noise levels have been selected wherever possible to ensure noise is kept to a minimum.

Plant and equipment will be maintained regularly to minimise noise resulting from deterioration and inefficient operation. If any items of plant are found to give rise to unacceptable noise levels, consideration will be given to their replacement with quieter designs. If equipment continues to generate unacceptable noise levels, consideration will be given to modification to incorporate noise suppression equipment or replacement components.

13.3.4 Management Measures

The General Manager will be responsible for ensuring that nuisances arising from the Site noise are minimised. All site personnel will be trained in the need to minimise site noise and will be responsible for monitoring and reporting excessive noise when carrying out their everyday duties.

13.3.5 Noise Action Plan

In the event that noise is found to be causing a problem, action will be taken to determine the source and to take remedial actions as follows:

- shut down, replace, service or repair equipment to reduce noise levels; and
- modify plant to incorporate noise suppression equipment.

Records relating to the management and monitoring of noise will be maintained and include:

- inspections undertaken;
- noise problems (including date, time, duration, prevailing weather conditions and cause of the problem);
- complaints received; and
- corrective action taken and changes to operational procedures to prevent future occurrences.

14.0 Control of Odour

14.1 Potential Odour Sources

Potential odour sources relate to fugitive emissions associated with the emissions released by the stack following pyrolysis/combustion as well as the distillation, fuel storage and loading systems.

Waste paper feedstocks are not an inherently odorous waste and the site will have waste acceptance procedures in place including checks for any contamination by odorous material. In the event that non-conforming wastes are delivered to the Site, they will be returned to the delivery vehicle or quarantined. Waste paper feedstock will be stored within the OCC warehouse and within an open external area. The processing of the waste paper and the opening of bales and all subsequent handling will take place in the enclosed OCC building. The intensity of off-site odours relating to waste paper storage and pre-treatment is therefore likely to be low.

The other potential odour source is the ETP, however it is not anticipated to give rise to any odour emissions. The plant is a completely sealed process, meaning that the risk of odour outside the limits of the plant is considered low. Despite this, the plant will be fitted with odour control measures to ensure a completely odour free process.

The following measures will be also in place to ensure potential for odour emissions from the ETP is minimised:

- The ETP will be adequately sized to meet 100% of the Site's effluent requirements;
- The ETP will be maintained in accordance with the manufacturer's recommendations;
- The Site's wastewater drains are inspected and regularly cleaned in accordance with SML's existing management system procedures to ensure that the drains do not become blocked; and
- The anaerobic reactor associated with the ETP will be completely gastight and have no odour emissions to air.

There would be a potential risk from odour from the ETP in the event that the aeration system were to fail. If the aeration system were to fail and the issue was not resolved over a number of days, the treatment system could get overwhelmed and cause potential odour risk. This risk is minimised as the ETP will be maintained in accordance with the manufacturers recommendations to avoid any system failures.

Taking all of the above into account, it is considered that the potential for an odour source presence is small.

14.2 Potential Odour Exposure

The Site is located within an industrial setting. The nearest residential receptors are located approximately 1.3km to the west of the site and the nearest commercial receptor is 130m to the west.

Meteorological data illustrates that there is a predominant south-easterly and north-westerly wind direction (i.e. in alignment with the Dee Estuary, away from land receptors).

Taking into account the distance and wind direction, it is considered that there is an ineffective pathway between potential odour source and the identified receptors and therefore the risk of odour exposure is likely to be negligible.

In the event that odours are detected, investigations will be undertaken to determine the cause and appropriate remedial action.

The General Manager will be responsible for implementing risk management measures.

15.0 Emissions

15.1 Point Source Emissions to Air

The site has a number of emission points to air which are listed in Table 7. The locations of the emission points are shown on 416.065169.00001_Drawing 002 Site Layout and Environmental Permit Boundary.

Table 7: Point Source Emissions to Air

Reference	Emission point description
OCC & PM3	
A01	OCC Pulper 1 Exhaust
A02	OCC Pulper 2 Exhaust
A03	OCC Disc Filter Exhaust
A04	PM3 Wet End Machine Hall Exhaust
A05	PM3 Dryers Machine Hall Exhaust
A06	PM3 Reel Up Machine Hall Exhaust

Reference	Emission point description
A07	PM3 Former section exhaust 1
A08	PM3 Former section exhaust 2
A09	PM3 Vacushoe exhaust 1
A10	PM3 Suction roll exhaust
A11	PM3 Optidry Vac Roll exhaust
A12	PM3 Optidry twin exhaust
A13	PM3 Press Section exhaust
A14	PM3 Press pulper exhaust
A15	PM3 Optidry twin heat recovery turbo tower
A16	PM3 Optiair heat recovery tower 1
A17	PM3 Optiair heat recovery tower 2
A18	PM3 Optiair heat recovery tower 3
A19	PM3 Size pulper exhaust
A20	PM3 Reel pulper exhaust
A21	PM3 Optiair heat recovery tower 4
A22	PM3 Optiair heat recovery tower 5
A23	PM3 Slabbing pulper exhaust
A24	PM3 Winder pulper exhaust
ETP & Biogas	
A29	Anaerobic reactor pressure relief valve
A30	Biogas DSulph tank vent
A31	Scrubber vent
A32	Biogas buffer vent
A33	Biogas engine stack
A34	Emergency flare
Tissue Pulp	
A35	Bale Pulper Exhaust
A36	Roof exhaust
Tissue	
A37	Air system exhaust
A38	Exhaust turbo blower
A39	Mist removal
A40	Mist removal vis
A41	Dust removal
CHP	
A26	GT1 stack

Reference	Emission point description
A27	GT2 stack
A28	Back-up boiler stack
Biomass Boiler	
A25	Biomass Boiler 7 stack

The main emissions release points are associated with the CHP plant at locations A26 and A27 and the biomass boiler, location A25. An Air Emissions Risk Assessment (AERA) which includes detailed dispersion modelling has been carried out in accordance with NRW guidance and is provided in Section 05 of this application, document reference 416.065169.00001_AERA.

15.2 Global Warming Impact Assessment

NRW requires that EP variation applications must include a risk assessment to assess the potential environmental impacts of emissions from the proposed activities. The requirements are described in NRW guidance 'Risk assessments for your environmental permit' last updated 21 November 2023. For those sites which result in direct and / or indirect emissions to air that impact global warming, an assessment of impact of air emissions on global warming must be undertaken in accordance with NRW's 'Assess the impact of air emissions on global warming' guidance published 1 February 2016.

The redevelopment of the Shotton Mill site has the potential to contribute to global warming as a result of direct and indirect emissions to air. As such, an assessment of the Global Warming Impact associated with the direct and indirect emissions from the facility has been completed and presented in Appendix A of the ERA in Section 06 of this application.

15.3 Emergency Flare

The ETP will be equipped with an emergency flare for safety purposes, restricted to use only in extreme emergency situations. The flare is designed with all necessary safety features for the safe handling and combustion of biomethane. It is anticipated that the flare will be used for less than 100 hours per annum.

15.4 Point Source Emissions to Water

The site has a number of emission points to water which are listed in Table 8. The locations of the emission points are shown on 416.065169.00001_Drawing 002 Site Layout and Environmental Permit Boundary.

Table 8: Point Source Emissions to Water

Reference	Emission Point description
W1	Final discharge of treated effluent
W2	Site drainage from main car park
W3	Site drainage from northern half of production area
W4	Site drainage from HGV park and interior of northern section of finished paper warehouse
W5	Site drainage from roundwood storage area
W6	Site drainage from south end of OCC warehouse
E1	Biomass boiler effluent and treated scrubber water

15.4.1 Point Source and Fugitive Emissions to Groundwater

There are no point source emissions to groundwater. The Site benefits from impermeable surfacing and a sealed drainage system.

The containment measures in place at the Site are described in Section 5.16 of this BATOT. These will ensure there are no point source or fugitive emissions to groundwater.

Accordingly, there will be no direct or indirect discharges of contaminating materials into groundwater from the Site.

15.4.2 Point Source Emissions to Surface Water

The site benefits from impermeable surfacing and separate sealed drainage systems for clean and contaminated surface water. Uncontaminated rainfall run off from roofs and non-processing areas is collected in the 'clean' drainage system and will be discharged to local surface water features via oil separators as required. Emission points are shown on Drawing 002.

15.4.3 Fugitive Emissions to Surface Water

The containment measures in place at the Site are described in Section 5.16 of this BATOT. These are designed to contain accidental spillages and also firewater in the case of an incident. These measures will ensure there are no fugitive emissions to surface water.

15.4.4 Point Source Emissions to Sewer

There are no emissions to sewer. Foul drainage is managed via a waste water treatment plant designed and manufactured by 'rotoECOgroup'. This will discharge via the ETP.

15.5 Flood Risk

A Flood Consequences Assessment (FCA) was prepared as part of the Environmental Impact Assessment submitted to the Planning Authority to which NRW was a consultee. The conclusions of the FCA are summarised in this section.

15.5.1 Flood Risk Summary

A summary of the potential sources of flooding and the flood risk arising from them is presented in Table 9.

Table 9: Potential Sources of Flooding

Potential Sources of flooding	Potential Significant Flood Risk at the Site (Y/N)
Rivers or Fluvial	N – cumulative impact with tidal flooding considered under tidal flooding
Sea or Tidal	Y
Surface Water or Pluvial	N
Groundwater	N
Sewers	N
Reservoirs, Canals and other artificial sources	N
Infrastructure failure	N

15.5.2 Tidal Flood Risk

15.5.2.1 Defended Flood Risk

The modelling conducted indicates that provided the existing tidal flood defences are maintained to their current standard, then the risk of tidal flooding at the Site is negligible.

15.5.2.2 Undefended Flood Risk

The modelling conducted indicates that surrounding roads to the site may be impacted by tidal flooding if defences are removed or not maintained to current standard. The probability of flood defences being removed or not maintained are extremely low and the residual risk is therefore judged to be low.

15.5.2.3 Defence Breach Modelling

The breach analysis and modelling conducted indicated that the modelled breaches do not result in flooding of the Site or access roads.

15.5.2.4 Cumulative Fluvial Flooding Impact with Tidal Flooding

Modelling of the most extreme fluvial event indicates that the Site would remain dry as would the access road to the southeast. As the access road to the southwest is 3m above the highest flood level, this source does not require further assessment.

In the event of a fluvial event coinciding with a tidal event, the fluvial flows would be unable to enter the Dee Estuary due to tidal locking. Modelling of the topography of the surrounding area indicates that the risk of flooding from these mechanisms is very low.

15.5.3 Flood Risk Conclusions

a) The Site is located on an area of raised ground that is elevated above flood levels for all modelled tidal, fluvial and breach modelling for the area including undefended and climate change scenarios.

b) The access and egress to the Site via local roads is slightly at risk of flooding, although the defended scenario indicates that the roads would remain dry for all modelled events.

c) Other potential sources of flooding were scoped out as low or negligible risk, these include surface water, groundwater, sewer and water mains, canal, reservoir and artificial source flooding.

16.0 Monitoring

The Site will be subject to a comprehensive programme of monitoring to ensure it operates to the specified design standards and does not give rise to unacceptable environmental impact.

Monitoring comprises the following:

- general observations
- monitoring of infrastructure and equipment;
- monitoring of process variables; and
- emissions monitoring.

16.1 General Observations

Routine observations and monitoring will be undertaken daily by site personnel to ensure that the Site operates correctly and without giving rise to unacceptable levels of emissions.

Routine regular observations will include qualitative assessment of noise, dust, litter, mud on the road and odour at the installation, the results of which will be entered in the Site diary.

16.2 Monitoring of Infrastructure and Equipment

Infrastructure and equipment will be subject to regular visual inspection. In the event of deterioration or damage, appropriate remedial action will be taken to restore the infrastructure and equipment to a satisfactory condition.

16.3 Monitoring of Process Variables

Monitoring of process conditions and variables will be conducted through the various Process Control Systems, i.e. OCC, PM3, ETP and Tissue DCS' which will monitor and trend multiple process and plant variables to allow for early detection of issues.

16.4 Emissions Monitoring

16.4.1 Monitoring Emissions to Water

Emissions to surface water from uncontaminated run-off will not be routinely monitored. The discharge from the ETP will be subject to a routine monitoring programme, as described in Table 10. Emission limits will meet the limits set out in the Best Available Techniques Reference document (BRef) for Waste Treatment 2018.

Table 10: Emission Limits and Monitoring Programme for Emissions to Water

Emission Point	Parameter	Source	Limit
W1	Total Organic Carbon	Treated effluent from the ETP	100mg/l
	Chemical Oxygen Demand		300mg/l
	Total Suspended Solids		60mg/l
	pH		6 – 9
	Ammoniacal Nitrogen		4mg/l
	Temperature		25°C
	Instantaneous Flow		800l/s
	Daily Flow		22,000m³
	Tidal flow		11,000m³
	Total Phosphorus		3mg/l
	Total Nitrogen		60mg/l
	Arsenic		0.1mg/l
	Cadmium		0.1mg/l
	Chromium		0.3mg/l
	Copper		0.5mg/l
	Lead		0.3mg/l
	Nickel		1.0mg/l

Emission Point	Parameter	Source	Limit
	Mercury		10µg/l
	Zinc		2.0mg/l

16.4.2 Monitoring Emissions to Air

Emissions to air will be subject to a routine monitoring programme, as described in Table 11. Emissions limits will meet the limits set out in the relevant Best Available Techniques Reference Documents (BRefs).

Table 11: Emission Limits and Monitoring Programme for Emissions to Air

Emission Point	Parameter	Source	Limit (mg/Nm³)
A25	Particulate matter	Biomass boiler 7	5
	Cadmium & Thallium		0.02
	Other metals		0.3
	Hydrogen Chloride		8
	Hydrogen Fluoride		< 1
	Sulphur Dioxide		40
	Oxide of Nitrogen		150
	Carbon Monoxide		50
	Ammonia		10
	Total Volatile Organic Carbon		10
	Dioxins/furans		0.06ng/m³
	Dioxin like PCBs		0.08ng/m³
	Mercury		0.02
A26 & A27	Oxides of Nitrogen	CHP plant	40
	Carbon Monoxide		30
A33	Sulphur Dioxide	ETP Gas Engine	15
	Oxides of Nitrogen		190

16.5 Monitoring Standards and Techniques

Monitoring will be undertaken in compliance with recognised techniques or using 'standard methods'. Monitoring equipment will be calibrated, serviced and maintained in line with manufacturer recommendations.

16.5.1 Monitoring Stack Emissions

Emissions monitoring will be undertaken in accordance with the requirements of NRW's M1 and M5 guidance notes. This will include provision of suitable access routes and platforms as required and the siting of sample ports in accordance with the requirements of M1 and M5.

The sampling facilities for the CHP stacks will be designed in accordance with M1 Annexes 1 and 2 requirements.

16.5.2 Management, Reporting and Training

All monitoring results will be recorded and stored electronically. The General Manager or their nominated deputy will inspect the monitoring records at a suitable frequency to ensure monitoring is being undertaken in accordance with procedures. Results will be examined annually as part of the Site's management review.

Staff involved in sampling and monitoring will be trained sufficiently to carry out the set procedures and will be trained in the reporting requirements of the environmental permit.

17.0 Closure

17.1 Operations during the period of the Environmental Permit

The preparation and processing activities at the Site should not lead to a deterioration of the land by the introduction of any polluting substances due to the containment and control measures that will be implemented to ensure the processes are contained within the appropriate structure / containers.

In the unlikely event of a potentially polluting incident which impacts the Site, the General Manager will record the details of the incident together with any further investigation or remediation work carried out. This will ensure that there is a continuous record of the state of the Site throughout the period of the permit.

17.2 Design of Site

Records will be maintained of the location of facilities, services, and sub-surface structures. During any modifications or alterations on the Site, care will be taken to update these records to ensure easy closure of the Site.

The design ensures that:

- there are no underground tanks for the containment of potentially polluting substances;
- there is provision for the draining and clean out of vessels and pipe work prior to dismantling; and
- materials used are recyclable, if practicable (having regard for operational and other environmental protection objectives).

All supporting equipment manuals and documentation will be maintained in duplicate in hard copy and one electronic version of all documentation and manuals will be kept in the Site office.

17.3 Site Closure Plan

Definite closure will occur when the Site stops production of paper products. Actions that will be taken at this point to avoid pollution risk and return the Site to a satisfactory condition are set out below.

17.3.1 Communication

SML will inform NRW in writing of the date of the cessation of feedstock acceptance. This will enable NRW to inspect the Site, approve the closure and agree upon the actions that should occur post-closure.

Access & Security

Security provision will be audited to ensure that the Site is in a secure condition and that unauthorised access is avoided. Site security will be maintained through local perimeter fencing and lockable gates. Regular inspections of the fencing and gates will be carried out, and damage will be repaired as soon as practicable. If necessary temporary repairs will be implemented until permanent repairs can be carried out.

17.3.2 Restoration

Substances will be removed in such a way as to protect land and groundwater from potentially harmful contents. Containers and other structures will be dismantled in such a way as to prevent pollution risk to the surrounding environment.

Storage and treatment vessels and drainage systems will be drained and cleaned prior to dismantling, with all effluent and solid residues being contained and taken to an appropriate treatment or disposal facility.

18.0 Environmental Impact

18.1 Impact Assessments

A number of impact assessments have been undertaken in support of this variation application to demonstrate that the operation of the new plant and equipment proposed at the Site will not give rise to unacceptable impact on the environment.

The assessments carried out in line with current NRW guidance are as follows;

- Environmental Risk Assessment (Section 06);
- Air Emissions Risk Assessment (Section 05);
- Noise Impact Assessment (Section 08);
- Site Condition Report Addendum (Section 09); and
- Fire Prevention and Mitigation Plan (Section 07).

The conclusions of the assessments are summarised below.

18.2 Environmental Risk Assessment

The Environmental Risk Assessment considers numerous potential risks including, but not limited to odour, fugitive emissions, noise and vibration and potential for accidents and incidents. The assessment concludes that with the implementation of the risk management measures described, potential hazards from the proposed development are not likely to be significant.

The Environmental Risk Assessment is enclosed as Section 06 of this application.

18.3 Air Emissions Risk Assessment

An Air Emissions Risk Assessment which includes a detailed dispersion model has been carried out in accordance NRW guidance and is provided in Section 05 of the application. Please refer to the assessment for a detailed account of emission points, emission rates and abatement technologies provided. However, a short summary is given below:

- The Process Contributions do not lead to any exceedances of the standards (long-term or short-term) for the protection of human health at any relevant location outside of the Site;
- The Process Contributions will result in '*no adverse effect*' on the annual mean and 24-hour mean NOx Critical Levels at the Dee Estuary / Aber Dyfrdwy SAC and the Dee Estuary SPA;
- The Process Contributions will result in *no likely significant effect*' on the annual mean and 24-hour mean NOx Critical Levels at the River Dee and Bala Lake SAC, Dees and Buckley Newts SAC, Halkyn Mountain SAC, Alyn Valley Woods Coedwigoerr Dyffryn Alun SAC, and the Mersey Estuary SPA;
- The Process Contributions will cause '*no likely damage*' on the annual mean and 24-hour mean NOx Critical Levels at Inner Marsh Farm SSSI, and Shotton Lagoons and Reedbeds SSSI;

- The Process Contributions will cause '*no adverse effect*' on the annual mean SO_2 Critical Level at the Dee Estuary / Aber Dyfrdwy SAC, The Dee Estuary SPA, River Dee and Bala Lake SAC, Inner Marsh Farm SSSI and the Shotton Lagoons and Reedbeds SSSI;
- The Process Contributions will cause '*no likely significant effect*' on the annual mean SO_2 Critical Level at the Dees and Buckley Newts SAC, and the Halkyn Mountain SAC;
- The Process Contributions will cause '*no likely significant effect*' on the nutrient nitrogen Critical Load at Dee Estuary / Aber Dyfrdwy SAC, The Dee Estuary SPA, River Dee and Bala Lake SAC, Dees and Buckley Newts SAC, Halkyn Mountain SAC, Alyn Valley Woods Coedwigoerr Dyffryn Alun SAC, and Mersey Estuary SPA; and cause '*no likely damage*' at Inner Marsh Farm SSSI and Shotton Lagoons and Reedbeds SSSI; and
- The Process Contributions will cause '*no likely significant effect*' on the acid Critical Load at The Dee Estuary SPA, Dees and Buckley Newts SAC, Halkyn Mountain SAC, Alyn Valley Woods Coedwigoerr Dyffryn Alun SAC, and Mersey Estuary SPA; and cause '*no likely damage*' at Shotton Lagoons and Reedbeds SSSI.

The Air Emissions Risk Assessment is enclosed as Section 07 of this application.

18.4 Noise Assessment

A noise assessment has been undertaken in accordance with BS4142:2014, whereby the sound sources under investigation have been compared to the existing (background) sound levels as part of a Noise Management Plan.

The specific sound levels generated by the operation of the Site have been predicted at the closest receptors using the proprietary software-based model CadnaA®, which implements the full range of UK calculation methods. The calculation algorithms set out in ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation* have been used.

The model has been based on the following assumptions:

- A ground absorption factor of 0.8 (to represent mixed ground);
- Contour Data to include OS terrain data;
- A reflection factor of 2;
- A day-time receiver height at all locations of 1.5m; and
- A night-time receiver height at all locations of 4m, the approximate height of a first-floor bedroom room window.

The assessment concludes that the noise impact from the operations at the Site at all receptors, falls under the category of 'No noise, or barely audible or detectable noise' as defined by NRW. This level of noise indicates that no action is needed beyond the implementation of basic appropriate measures or Best Available Techniques (BAT).

The Noise Impact Assessment is enclosed as Section 08 of this application.

18.5 Site Condition Report Addendum

The Site Condition & Baseline Report details the condition of soil and groundwater at the Site. It contains the information necessary to determine the current state of soil and groundwater conditions at the Site, so that a comparison can be undertaken upon the eventual cessation of activities. It also considers the potential releases of hazardous substances which may arise and how these will be monitored.

A copy of the Site Condition Report is enclosed as Section 09 of this application.

18.6 Fire Prevention and Mitigation Plan

A Fire Prevention and Mitigation Plan (FPMP) has been prepared in accordance NRW guidance for FPPs[1]. The FPMP details the required mitigation and management methods to prevent a fire of combustible materials stored on site.

The information contained within this FPMP aims to meet the 3 main objectives of the NRW FPMP Guidance:

- minimise the likelihood of a fire happening;
- aim for a fire to be extinguished within 4 hours; and
- minimise the spread of fire within the Site.

The FPMP is enclosed as Section 07 of this application.

18.7 CIRIA Risk Assessment

A CIRIA Risk Assessment has been prepared to demonstrate how the Effluent Treatment Plant containment systems align with the requirements of the CIRIA C736 guidance.

The CIRIA RA is enclosed as Section 10 of this application.

18.8 Climate Change

Updated NRW guidance [2] on developing management systems for EPs requires that management systems for EPs issued before April 2023 consider climate impacts and that a climate change adaptation risk assessment in completed.

A suitable climate change risk assessment was completed as part of the due diligence for the redevelopment of the Shotton Mill site, see Appendix A, document reference *Shotton Mill Climate Change Risk Assessment, 402.064858.00001.*

Suitable adaptation plans for the identified risks will be incorporated into the EMS within 12 months of site becoming fully operational.

[1] Guidance No. 16 Fire prevention and mitigation plan - waste management (naturalresources.wales)

[2] Develop a management system: environmental permits - GOV.UK (www.gov.uk)

Appendix A Climate Change Risk Assessment

Shotton Mill Climate Change Risk Assessment

Shotton Mill Limited

SLR Project No.: 410.065169.00001402.064858.00001

5 June 20252024

Shotton Mill Climate Change Risk Assessment

Redevelopment and Expansion of Existing Paper Mill at Shotton Mill, Weighbridge Road, Deeside Industrial Park, Flintshire, CH52LL

Shotton Mill Limited

Weighbridge Road
Deeside
Flintshire
CH5 2LL

Prepared by:

SLR Consulting Limited

The Cursitor, 38 Chancery Lane, London, WC2A 1EN

SLR Project No.: 402.064858.00001

14 February 2024

Revision: 4

Basis of Report

This document has been prepared by SLR Consulting Limited (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Shotton Mill Limited (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations, and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations, and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

Table of Contents

1.0 Introduction

This Climate Change Risk Assessment (CCRA) has been prepared by SLR on behalf of Shotton Mill Limited for the Shotton Mill Paper Scheme located at Shotton Mill, Weighbridge Road, Shotton, at National Grid Reference SJ 30461 71563.

Shotton Paper Mill was founded in 1983 and thereafter produced newsprint paper, prior to its closure in 2021. Shotton Mill Limited is a wholly owned subsidiary of the Eren Group. The Eren Group is a family-owned resources management company based in Turkey, employing over 8,000 people with annual turnover in excess of EUR 1.8 billion, and total assets of over EUR 2.1 billion. The company intends to use the site to expand its paper and packaging division in the UK.

The redevelopment and expansion of the Shotton Paper Mill will comprise 820,000 sqm of new paper factory buildings, processing plant, associated landscaping, offices, access roads and parking. The development will be constructed sequentially over a period of three to four years.

This report presents the Climate Change Risk Assessment (CCRA) for the project, as required by the lender (Credit Suisse). It includes an assessment of the risks which relate to the physical impacts of climate change and, as the project's combined Scope 1 and Scope 2 emissions are expected to be more than 100,000 tonnes of CO_2 equivalent annually, an assessment of the risks which relate to the transition to a lower-carbon economy.

The purpose of this CCRA is to identify and describe the potential impacts of climate change to the project. As such, this CCRA is not an exploration of the impacts of the project on climate change (e.g., via project-related emissions).

This CCRA aligns to the Equator Principles, uses the EU Financing a Sustainable European Economy Taxonomy (EU Taxonomy) for physical climate hazard screening, and the Taskforce on Climate-Related Financial Disclosures (TCFD) categories for transition risk.

In December 2020, the United Kingdom of Great Britain, and Northern Ireland (the UK) communicated its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in line with Article 4 of the Paris Agreement. In its NDC, the UK commits to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels.[1] The UK government has also committed to reducing greenhouse gas emissions by at least 100% of 1990 levels (net zero) by 2050, as set out in the Climate Change Act. This includes reducing emissions from the devolved administrations (Scotland, Wales, and Northern Ireland), which currently account for about 20% of the UK's emissions.[2]

Shotton Mill is included in the UK Emissions Trading Scheme, which incentivises businesses to make cost-effective emissions reductions in line with the UK's Net Zero 2050 target.[3]

2.0 Background on the Project

This section provides some background information about the development to assist the reader with additional context if necessary. It is sourced from the Environmental Impact Assessment.

2.1 Existing Buildings and Plant

The existing buildings and plant that would be retained are primarily concerned with the reception, cleaning, and preparation for use as feedstock of raw recycled paper, and energy generation.

---

[1] https://unfccc.int/sites/default/files/NDC/2022-09/UK%20NDC%20ICTU%202022.pdf

[2] https://www.theccc.org.uk/what-is-climate-change/a-legal-duty-to-act/#:~:text=The%20Climate%20Change%20Act%20commits,20%25%20of%20the%20UK's%20emissions.

[3] https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets

The papermaking process starts with the delivery of the raw recycled material to the stock preparation area. Raw materials comprise products such as recycled paper and card, normally in bales. Following redevelopment, this part of the process would continue to use existing buildings comprising the White Paper Building and Recovered Fibre Warehouses: RCF1, RCF2, and RCF3, although there would be some internal alterations to the buildings. The Old Corrugated Cardboard (OCC) building would be relocated.

Pulp from the OCC production process is stored in short and long fibre storage towers (tanks). Approximately 70% of the produced pulp is short fibre and the remaining is long fibre. There is no fresh-water usage for the OCC line; the process uses only recycled water from the proposed Effluent Treatment Plant following biological treatment and water fed back from the papermaking process. There would be no direct freshwater input to the pulping plant.

Recycled paper is taken through a multi-stage cleaning process in which contaminants such as non-pulpable plastics, staples and sticky deposits are removed. The multi-stage reject handling system is designed to reduce the quantity of the reject material produced by each section of the process to minimise disposal. This is achieved by using a combination of sedimentation, floatation, screening, filtration, and compression. The recycling process is a significant outlet for recycled paper collected by local authorities and businesses across the UK.

There are two main types of rejects from the OCC process:

- Non-burnable rejects i.e., those not suitable to be used as a fuel; these can be utilised as building materials or would be disposed of via appropriate licensed companies; and
- Burnable rejects composed of sludge and light weight fibre rejects which can be used as a fuel in the Biomass Plant.

The Biomass Plant uses primarily waste wood to produce heat and power for the site. This would continue at a rated capacity of 18.5MWe for the redeveloped site. Wood preparation takes place in an existing on-site facility that prepares recycled wood grades for use in the Biomass Plant. The facility uses several different techniques to removes stones, metal and other unwanted contaminates from the fuel stream.

The Materials Recycling Facility (MRF) also contributes recycled fibre to the production process. The MRF takes co-mingled waste streams from household collections and processes them into a series of valuable materials for further processing at customer premises. The paper streams would be used in the OCC plant whilst the plastics, glass and metal streams would continue to be sold on for further processing. The MRF uses a series of mechanical process steps to sort the material along with a significant human resource who ensure the appropriate quality is achieved to allow maximum utilisation of these material streams.

2.2 Proposed Buildings and Plant

The overall scale of the proposed new buildings would be similar to the existing built form of the paper mill and ancillary plant, including buildings that would be retained such as the biomass plant and MRF. The development of the expansion site would extend the area of development to the north, closer to the A548 dual carriageway.

The CHP Facility would be located towards the southern part of the main site close to the existing Biomass Plant and Wood Preparation Facility. It would have a Gross Internal Floorspace (GIA) of 4,800 m2.

The total floorspace of the new build development on the main site (excluding the CHP) would be approximately 132,634 m^2 (GIA). The maximum height of the proposed paper manufacturing buildings, other than stacks and storage tanks, would be 32 m above ground level, although most buildings would be considerably lower. On the expansion site, the proposed new floor space associated with the tissue manufacturing production would comprise approximately 163,940 m^2 (GIA). The height of the proposed buildings on the expansion site would be less than on the main site with a maximum height of 24 m above ground level.

On the expansion site, the proposed new floor space associated with the tissue manufacturing production would comprise approximately 163,940 m^2 (GIA). The height of the proposed buildings on the expansion site would be less than on the main site with a maximum height of 24 m above ground level.

2.2.1 Cardboard Paper Machine

There would be two principal process units proposed on the main site, the Cardboard Paper Machine, and the Corrugating Machine. Output from the Cardboard Paper Machine would either be exported from the site to supply other paper (corrugator) manufacturers or sent to a second stage of processing on site where it would be converted into card through a 'corrugation' process. Other proposed buildings on the main site are ancillary to these processes, including warehouses, loading bays and stores.

The proposed Cardboard Paper Machine would produce cardboard from recycled paper and card. The machine would have an annual output of 750,000 tpa (the largest single machine in the UK).

The Cardboard Paper Machine passes paper pulp from recycled paper through a series of processes designed to dry and press the pulp into sheets. Once processed the card emerges as jumbo rolls that are cut to size and transferred to the New Warehouse Building from where it is either dispatched offsite to customers or transferred to the Corrugating Paper Machine. All operations in the warehouse would be automated using state of art technology.

2.2.2 Corrugating Machine Building

The corrugating machine would have a capacity of 110,000 tpa. Paper rolls would be transferred to the Corrugating Machine Building by an overhead conveyor that would link the Paper Machine Building with the Corrugating Machine Building.

Corrugating of 'fluting grade' paper is done with the corrugating rolls which are covered with flutes; these are horizontal, parallel ridges like the teeth of widely spaced gears. When the hot paper passes between the corrugating rolls, the flutes trap and bend it, forming the middle part of a sheet of corrugated cardboard. Installing a different flute size in the corrugator changes the width of the corrugated medium and hence the thickness of the finished cardboard.

After the corrugating process, boards would either be sold directly from the site or converted into containers (i.e., cardboard boxes). Transfer to the box production area would be via internal conveyors. The box production lines, operated by skilled workers, would prepare boxes of different sizes and designs.

2.2.3 Effluent Treatment Facility

Paper mills use large quantities of water. The objective of the wastewater treatment system is to recycle as much water as possible for re-use in the system and to ensure that any water that is discharged from site meets the regulatory standards. The process would be regulated by Natural Resources Wales (NRW) under an Environmental Permit.

Wastewater from the production process would be treated in a new Effluent Treatment Facility (EFT). The new ETF would make use of the existing lagoon system that would remain in operation and continue to fulfil the role it currently plays in ensuring that effluent produced in the process reaches the required standard for discharge to a watercourse. Lagoon 2A would continue as an aeration lagoon and Lagoon 3 would be the final balancing lagoon before discharge takes place on high tide. Lagoon 2B provides emergency by-pass capability.

The proposed EFT would replace the existing EFT with new, state-of-the-art technology comprising anaerobic digestion in combination with further processing to remove organic pollutants. The new EFT would service the whole site, including both the main site and the expansion site. It would also manage foul water arising from staff welfare facilities throughout the site, including the CHP plant.

The EFT process would remove organic pollutants by means of complete oxidation of organic matter to methane, carbon dioxide and water.

The water treatment process would remove biomethane from the effluent. Biomethane is a valuable by-product that would then be upgraded in the biogas treatment line and used as a natural gas substitute, either for use in on-site boilers or for direct injection into the national grid. A biogas flare would be installed as a safety device to ensure a continuous and safe management of the biogas generated in the anaerobic reactor.

2.2.4 Starch Processing and Storage Building

This building would prepare starch from vegetable sources for use in card processing (for stiffening and waterproofing). The building would also house ancillary essential chemicals located in a self - contained bunded area.

2.2.5 Services Area

Site electrical and other support services are grouped together into a 'energy services island' comprising the following:

- Electrical Annex Motor Control Centre - this allows the incoming 132 KV power to site to be stepped down to the correct operational voltage and then distributed to the designated operational areas.
- Low Pressure Combined Turbine Area (LPCT) - the existing LPCT must be relocated to allow construction of the new paper mill facilities. The LPCT uses low pressure steam to generate electrical power that is currently exported via a grip connection. In the future, once paper production has restarted, the LPCT unit would allow utilisation of any excess steam that is available to ensure this steam is not wasted and so maximise energy efficiency.
- Cooling Tower Area - cooling towers are used cool the condensed steam from the LPCT. These are existing equipment and are being relocated to make way for construction of the new paper mill facilities.
- Boiler 6 – this is an existing gas fired tube boiler that is used to supply steam for the papermaking operation when the Biomass Plant is not operating. The boiler is being relocated from elsewhere within the site as part of the redevelopment. Boiler 6 only has intermittent use and is not part of the continual energy balance.

2.2.6 Raw Material Area

Due to the production level of the new paper machine, it would be necessary to store additional volumes of baled feedstock on site to allow continuous production during weekends and bank holidays. Suitable hard standing surfaces and screening would provide control of the materials in the area.

The Old Corrugated Cardboard Building will utilise the footprint of an existing building, which will be redeveloped. The building recycles OCC, otherwise known as cardboard boxes, and includes a pulping line for preparation of feedstock for the paper making process.

The Tissue Machine Buildings would be housed on the Expansion Land. Tissue production would comprise three separate production units of 70,000 tpa production capacity each, producing jumbo rolls. A converter unit would convert the jumbo rolls to finished products.

The Tissue Machine Buildings comprise three parallel, identical buildings producing jumbo rolls of tissue. Pulp for tissue manufacturing would be either virgin, recycled or a mix of these. Virgin pulp would be sourced from responsible, certified pulp producers and delivered in bales. Recycled pulp would be transferred to this process from the existing paper recycling process plant on the main site using the overhead pipe bridge.

Jumbo rolls would be stretch film wrapped and then transferred to the Reel Storage Building.

2.2.7 Pulp Storage Building

The Pulp Storage Building would accept recycled pulp using the overhead pipe from the existing paper recycling process plant on the main site.

2.2.8 Reel Storage Building

This building would store jumbo rolls. Jumbo rolls to be sold directly to the market would be loaded onto trucks in this building or would be sent to converter building to produce finished goods.

2.2.9 Converter Building

This building would house several different 'converting' lines to produce various tissue product lines including bathroom tissues and kitchen towels, napkins, handkerchiefs, facials, and interfolded towels. All products would be wrapped, bundled, and palletised before being sent to the finished goods warehouse.

This building would accept palletised finished goods and store them in racking. The number of pallets in stock would be around 50,000 units (or 6,000 tonnes) which corresponds to 15 days stock.

2.2.10 Combined Heat and Power (CHP)

The CHP Facility will have a capacity of 60MW. CHP is the generation of electrical power and usable heat in a single process. This is also known as co-generation. CHP is a well proven technique for reducing primary energy consumption, thereby reducing the total carbon emissions that would result from the generation of electrical power and heat separately. Paper mills require a reliable and continuous source of energy, and a CHP Facility is proposed to provide additional power to Shotton Mill to enable the works to be self-sufficient in energy.

The proposed new CHP Facility would be located on the main site, close to the existing biomass CHP facility. The proposed CHP plant and equipment would occupy a site area of 4800 m^2. The main building would be 60 m wide by 80 m in length and would be 20 m in height. The tallest elements of the CHP plant would be four stacks that are proposed to be at a maximum of 106 m above ground level and are required as part of the emissions management system. A cooling tower would be located to the east of the CHP on land known as the 'power island' that would also be used for electrical equipment associated with the Paper Mill. The cooling tower would be 15 m in height and its purpose is to cool the condensed steam from the CHP.

The proposed CHP Facility would burn natural gas or biogas in a gas turbine. Air passing through an air filtration system would be compressed at the front end of the gas turbine and directed to the combustion section, where it would be mixed with gas and combustion would take place. The high temperature exhaust gases would expand in the turbine section, which makes the turbine shaft rotate and generate electrical energy.

To provide flexibility and allow for the normal steam /electricity fluctuations in demand of the paper manufacturing processes, a steam turbine would be added to the gas turbine and waste heat recovery generator to reduce steam output and generate more electricity. This would help to optimise and stabilise the system. For instance, if one of the paper mills needed to suspend operations, the steam normally required for that paper mill could be directed immediately to the steam turbine to produce electricity instead. Any excess electricity would be exported to the grid, introducing low carbon energy supply to the network.

Low pressure steam would also be transferred to the paper mill for use within the production process. If excess steam is created, or the mill production process is interrupted then the low-pressure steam is instead transferred to the cooling tower where it is condensed into water, to be reused within the CHP process.

The key inputs for the CHP process are therefore natural gas and compressed air, together with pre-treated water and condensate from the paper machines where possible, together with cooling air.

The CHP plant creates electricity and low-pressure steam which are transferred to the paper mill (or exported to the grid in the case of any excess electricity), along with other outputs comprising exhaust gases which are discharged to the atmosphere. There would also be a small amount of process effluent arising from welfare facilities.

3.0 Methodology and Sources

This section identifies the resources accessed and approaches used to deliver the Climate Change Risk Assessment to support the Environmental Permit variation application for the proposed Shotton Paper Mill redevelopment and A4 plot expansion site at Shotton Paper Mill. The vulnerability of the project to climate change has been assessed by:

i. Describing baseline climate and hazard conditions at the regional and national levels.
ii. Assessing current and anticipated climate risks to the project.
iii. Analysing climate projections at regional and national levels to inform risk assessment.
iv. Proposing high-level adaptation and mitigation measures.

3.1 Historical Climate Data

Baseline climate conditions at national level (Wales) were informed by the Climate Change Knowledge Portal of the World Bank Group[4]. The data that is presented includes a climate classification of the region using the Koppen-Geiger Climate Classification system (method for dividing climates by precipitation and temperature). Regional (Flintshire County) temperature, precipitation and drought trends have been informed by the Met Office and Natural Resource Wales. Relevant mine location and risk information has been taken from The National Coal Authority. Subsidence maps have been extracted from Geobear. Wind speed and direction data have been obtained from the Meteoblue Weather Database and Met Office data.

3.2 Climate Hazards

Following review of historical climate conditions and climate projections, current and anticipated climate-related physical hazards were screened to support identification of potential risks. These hazards were categorised according to the EU Taxonomy Appendix A II Classification of climate-related hazards.[5]

3.3 Climate Projections

Climate projections for the country of Wales in the United Kingdom (UK) were compiled by accessing data from the Intergovernmental Panel on Climate Change (IPCC), the UK Climate Projections (UKCP18) and the Climate Change Knowledge Portal of the World Bank Group. Flooding projections data was compiled based on the Flood Map for Planning from Natural Resources Wales. Drought projections were compiled based on data produced by Forest Research, which used data from the UK Climate Impacts Programme (UKCIP). Temperature, precipitation, and sea level rise projections were compiled based on data from the World Bank, wind projections used data from the IPCC and UKCP, and wildfire projections used data from the Met Office.

3.4 Climate Risk Identification and Scoring

Risks were identified through a blend of desk-based research, peer- and sector-reviews, and internal resources (e.g., SLR's proprietary industry-based risk and opportunity database). Project components that related to different risks were identified and risks were described via impact pathways relating to the project components.

---

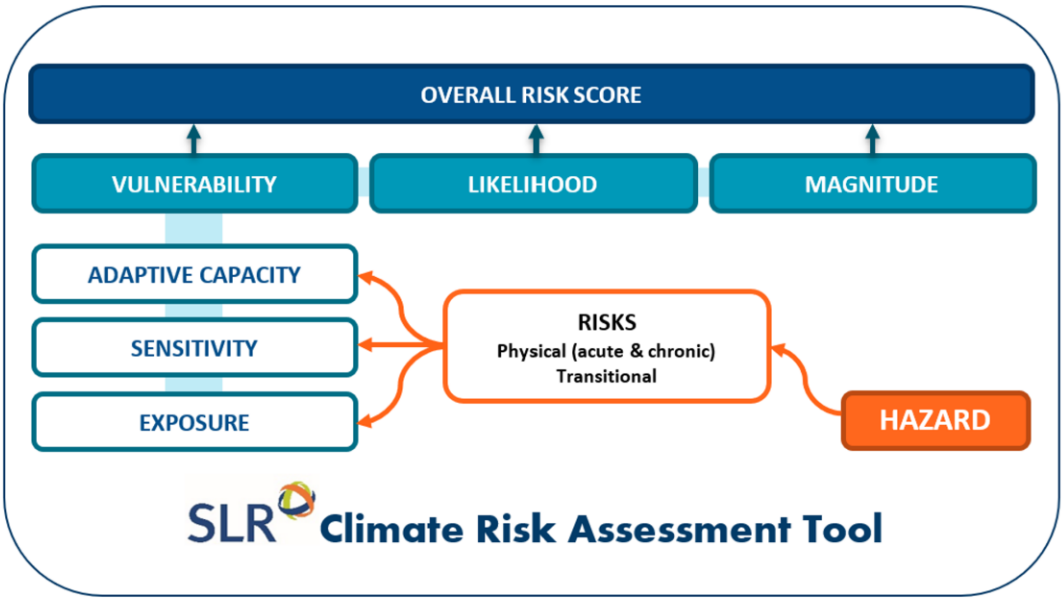
[4] World Bank Group. Climate Change Knowledge Portal: climateknowledgeportal.worldbank.org

[5] EU Taxonomy (2020) Financing a sustainable European economy. Taxonomy Report: Technical Annex. EU Technical Expert Group on Sustainable Finance, March 2020.

The risk scoring hierarchy followed the IPCC approach to risk determination[6, 7] (Figure 1). Risk signifies the possibility of adverse effects driven by the occurrence of a hazard. Risk is defined by the three terms: vulnerability, magnitude of impact, and likelihood of occurrence. The vulnerability term is a function of exposure, sensitivity, and adaptive capacity. Sensitivity reflects the predisposition of organisations, assets, societies, processes, or systems to be adversely affected by risk. Adaptive capacity refers to characteristics or actions that may reduce the level of risk posed by a hazard and thereby alleviate vulnerability. Exposure is binary and determines whether or not the organisations, assets, societies, processes, or systems are exposed to the transition or physical risk being considered.

Each term (sensitivity, adaptive capacity, vulnerability, magnitude of impact, and likelihood of occurrence) is scored using professional judgement in accordance with the characteristics associated with the corresponding level from 1 to 5 on a five-point scale. For example, for magnitude of impact a score of 5 (very high impact) is associated with the potential need to completely cease operations or potential loss of life were the risk to occur. Please see Appendix I for the full list of characteristics associated with each score from 1 to 5 for each of the terms: sensitivity, adaptive capacity, vulnerability, magnitude of impact, and likelihood of occurrence. Exposure is scored as either 1 or 0 (exposed or not exposed). Given that this report only discusses risks relevant to the project, in all cases the exposure score is 1 (i.e., the project is considered exposed to the risk in question).

Figure 1. Risk scoring hierarchy.



The formula for calculating an overall risk score is as follows:

First, vulnerability is calculated as the average of the sensitivity score (1-5) and adaptive capacity score (1-5), multiplied by the exposure score of 1 or 0. Please note that the adaptive capacity score is inverted for the purposes of this calculation to make it comparable to the sensitivity (i.e., so that higher adaptive capacity corresponds to a lower score). The vulnerability score remains constant regardless of the timeframe considered.

[6] IPCC (2012) Determinants of Risk: Exposure and Vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change.

[7] IPCC (2021) The concept of risk in the IPCC Sixth Assessment Report: a summary of cross-Working Group discussions. Intergovernmental Panel on Climate Change, September 2020.

Second, for each timeframe (short, medium, long term) a magnitude of impact (1-5) and likelihood of occurrence (1-5) score is attributed to each risk.

Third, for each timeframe, vulnerability, magnitude of impact and likelihood of occurrence are multiplied together. This gives a maximum score of 125 (5 x 5 x 5). This is then re-scaled to provide an overall risk score from 1-100 for each timeframe.

The final overall risk scores from 1-100 are split into five categories. Risk categories are arranged as follows:

• Score 1 to 20: low risk

• Score 20 to 40: medium risk

• Score 40 to 60: high risk

• Score 60 to 80: very high risk

• Score 80 to 100: extreme risk

For **physical risks**, magnitude and likelihood vary across the three selected time horizons which are:

- Short Term (2020 – 2039)
- Medium Term (2040 – 2059)
- Long Term (2080 – 2099)

These time horizons encompass the design life of key machinery at the site (which ranges from 15 to 30 years according to information from Eren Group) and also allows long-term changes in the severity of physical climate change risks to be captured.

For **transition risks**, magnitude and likelihood vary across the three selected time horizons which are:

- Short Term: 0-5 years (2023-2028)
- Medium Term: 5-10 years (2028-2033)
- Long Term: 10-30 years (2033-2053)

These time horizons have been selected to follow a business perspective and be compatible with the Project's capital planning and investment horizons and the asset life. Discussions with the Eren Group indicated that payback of equipment is based on 15 years and payback on buildings is 30 years.

3.5 Mitigation and Adaptation

A range of high-level mitigation and adaptation response measures are proposed in section 7 relevant to specific physical and transition risks.

Measures related to mitigation and adaption of physical risks were categorised according to response type: green, soft, and grey:

- 'Green' approaches target opportunities to employ natural capital and integrate environmental systems into response measures.
- 'Soft' approaches target managerial and strategic responses through, e.g., processes and protocols.
- 'Grey' approaches target technical responses that focus on, e.g., infrastructure refurbishment and development.

Measures related to mitigation and adaption of physical risks were also prioritised according to their relevance to:

- Human wellbeing (very high priority).
- Project and infrastructure integrity and lifespan (high priority).
- Potential project and infrastructure improvements (medium priority).

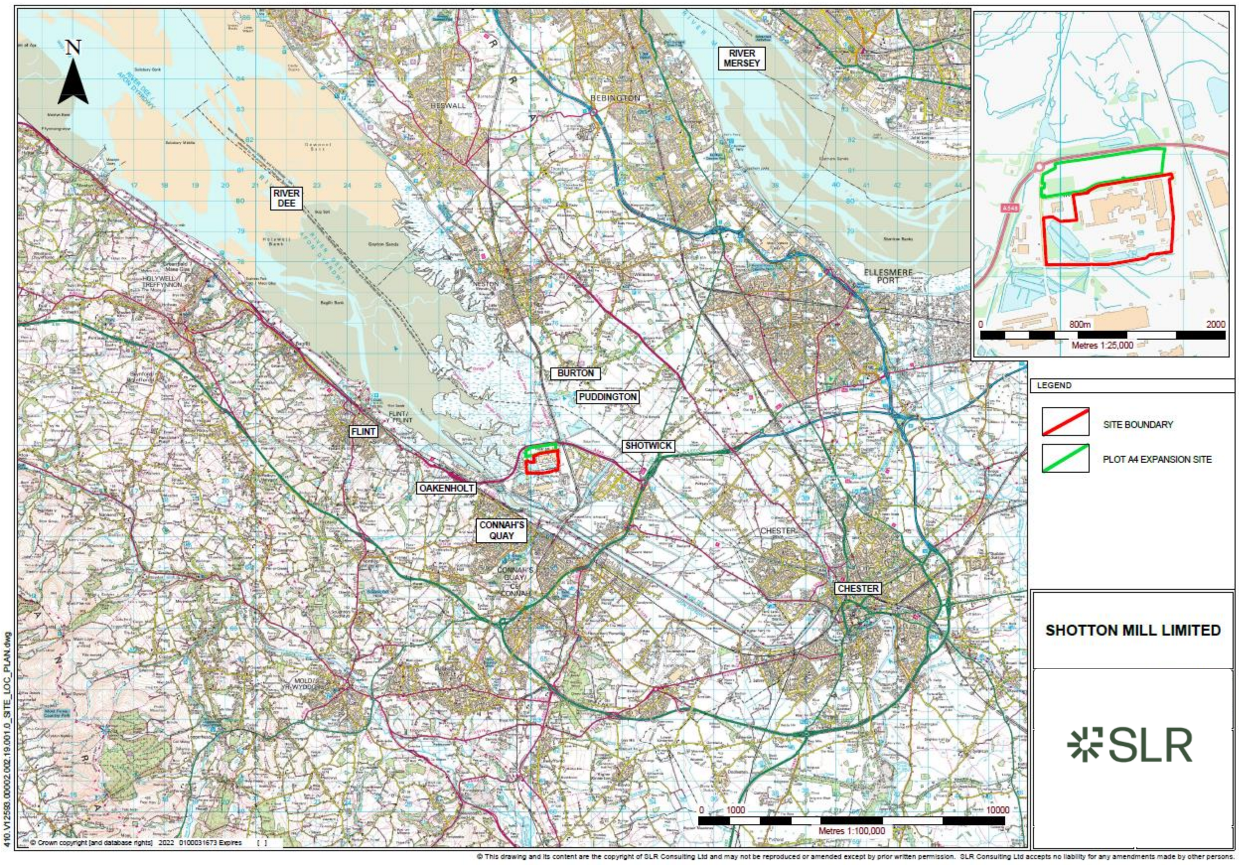
4.0 Study Region

Shotton is a town within Flintshire, North Wales. The town developed around coal mining and farming of reclaimed marshland. Shotton is located 5 miles (8 km) west of Chester and can be reached by road from the A548. The site is within the Deeside Industrial Estate, to the north side of the Dee Estuary on a moderately flat river plain. Artificial land raising of the industrial estate, transport infrastructure and flood defences are the predominant features across the plain.

The River Dee flows in a SE to NW direction approximately 1 kilometre to the SW of the site. The River Dee rises in Snowdonia and flows east via Chester, England, and discharges into Liverpool Bay. The River Dee is a designated site of special scientific interest (SSSI) with a total length of 113km.

The complete site boundary covers an area of approximately 600,000 sqm. The site can be separated into two areas: the current site and the A4 plot expansion site (Figure 2).

Figure 2. Shotton Paper Mill site boundary and relation to the surrounding area.



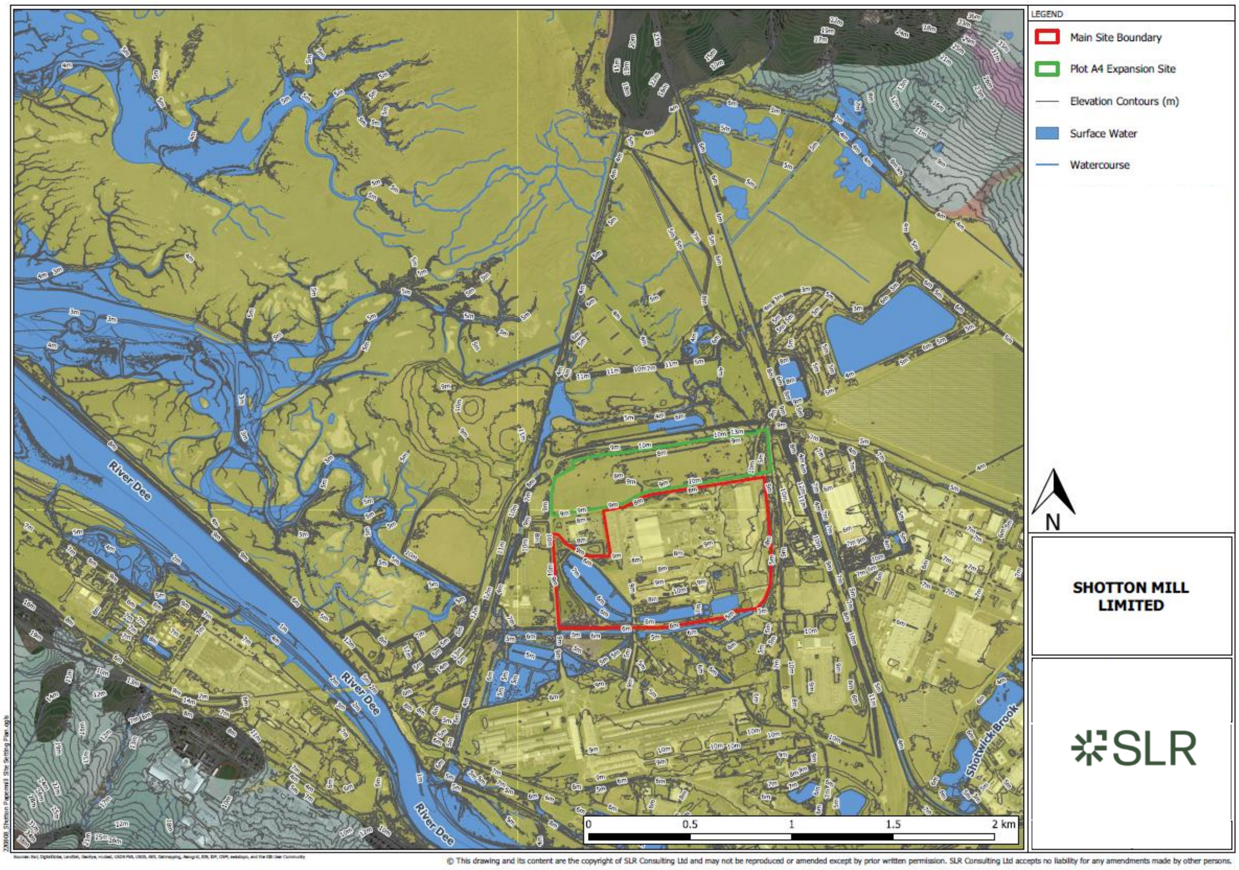
The existing site is industrial, consisting of large buildings and areas of hardstanding. The ground surface is therefore largely covered by material that is highly resistant to water infiltration. The main site includes a number of warehouses; workshops; manufacturing and office buildings with above ground storage tanks; water treatment tanks; legacy railway lines; car park; landscaping and effluent treatment lagoons. An area of woodland is present in the southwest corner and an overhead powerline passes through the south of the site, from east to west.

The plot A4 expansion site previously formed part of Shotton steelworks which was demolished in the 1980s and has remained vacant since. It covers approximately 220,000sqm and is primarily covered in rough grassland/scrub vegetation. A former gravel access track runs along the length of the site, inside the northern boundary. A combined gravel soakaway and gas vent ditch (approximately 3m deep) runs parallel to and just south of the access track, from near the eastern boundary across approximately three quarters of the site. A curved mound is present in the centre south of the site that forms the above ground portion of a bentonite cut-off wall, installed during remediation work in the 1990s.

Topography

The entire site is located on an area of land that has a been raised above the surrounding natural ground level (Figure 3).

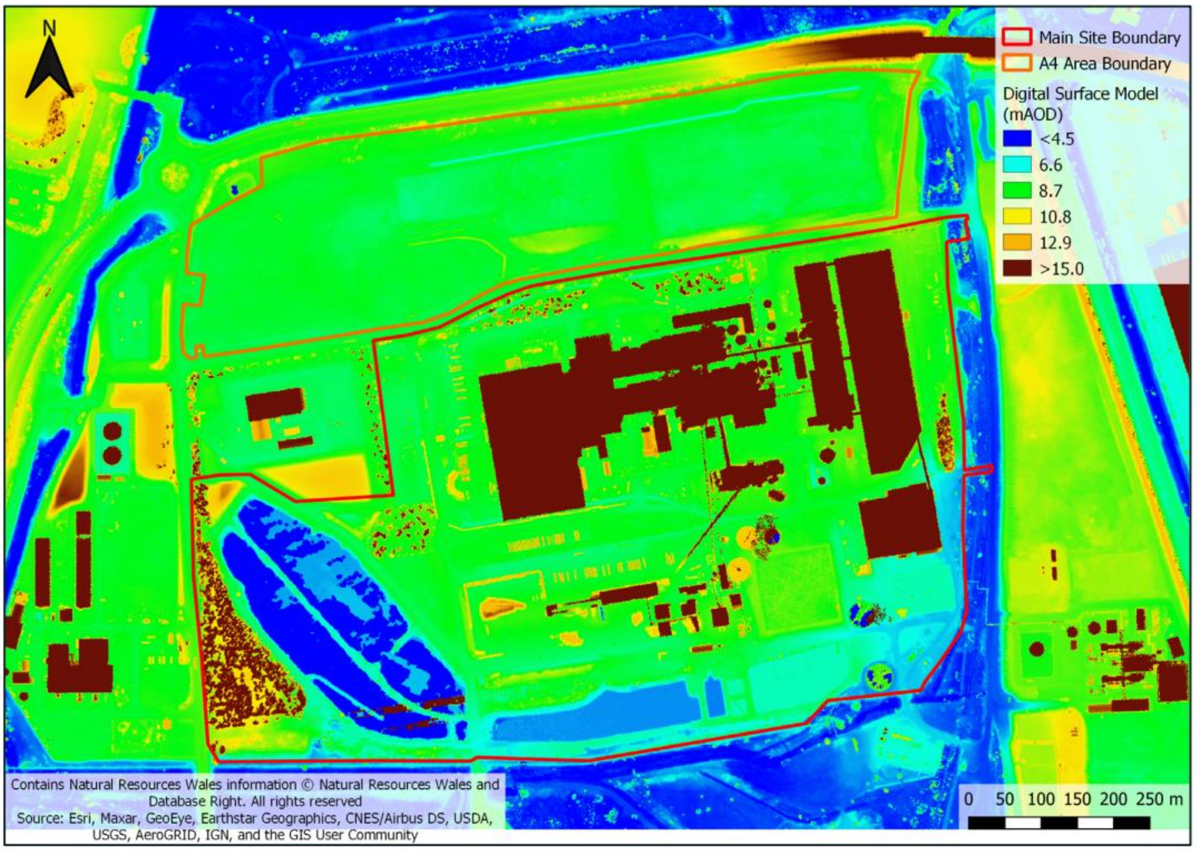
Figure 3. Elevation contour, surface water and watercourse network surrounding the study region.



LiDAR satellite topographic data for the site and immediate locality have been downloaded from the National Resources Wales (NRW) open data website and contained in Figure 4[8]. This Digital Surface Model (DSM) provides bare earth elevation data which includes all reflective surfaces, including buildings and trees. The height of the tide and groundwater has been measured in metres relative to average sea level, referred to as 'ordnance datum', where "mAOD" means "Above Ordnance Datum". These have been presented here to show the topographical details across the site.

[8] Natural Resources Wales, Lle geoportal, http://lle.gov.wales/Catalogue/Item/LidarCompositeDataset/?lang=en

Figure 4. Digital Surface Model of the site.



The site itself can be described as broadly flat with a platform level between 8.3mAOD and 8.7mAOD. In the south of the site is a water treatment area with a series of large lagoons. Along the northern boundary of the A4 land there is a drainage ditch which is approximately 1m deep. Rail tracks through the centre of the main site are up to 1m below the surrounding land. Although not clearly visible in the LiDAR, there is a ditch in the north of the main site. The Digital Surface Model (DSM) also shows that the lagoons across the south of the site are lower than main site. Additionally, the land in the southeast corner of the site is set below the main site with an elevation of approximately 6.2mAOD.

Hydrology

The site is located within the plain of the Dee Estuary with the main course of the river located circa 1km southwest of the site. This is the dominant hydrological feature of the area. The low-lying land (named White Sands) to the northwest of the site is crossed by several tidal and surface water channels where the water progresses into the estuary.

Within the site there are currently 4 surface water lagoons along the southern boundary and across the southwest corner of the site. These lagoons provide water treatment for the existing mill and discharge into White Sands Gutter, approximately 400m west of the site. This discharge then flows across the low-lying marginal marshland to the west, entering the Dee Estuary.

There is a ditch immediately to the south of the southern boundary of the site, which does not appear to connect to nearly gutter flow or directly to the reedbeds during normal hydrological conditions. However, it is likely this is in continuity with groundwater and therefore hydro-geologically connected to Shotton lagoons and reedbeds. During high flows these would likely form a surface water connection to the lagoon and reedbed network.

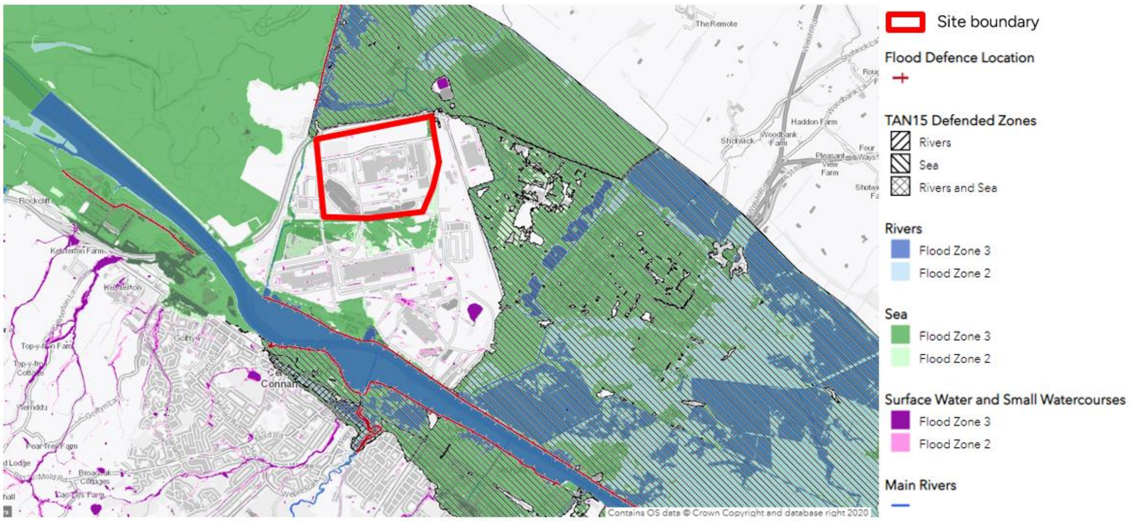
Based on this hydrological context it can inferred be a that the site has sufficient drainage networks and a healthy groundwater system, which are discussed in more detail in subsequent sections.

Watercourses

The River Dee nearby to the site has a floodplain that is flat and wide. Downstream of Chester Weir the river was canalised over 200 years ago and flood defences were constructed to protect land from tidal inundation. These flood defences are still maintained today by Natural Resources Wales. The River Dee is typically tidal up to Chester Weir. This boundary is exceeded during spring high tides and extreme tides when tidal influence can affect river levels as far as 15km upstream of Chester Weir.

Historically, the River Dee has posed a flood risk across several locations, including Deeside where the Shotton Paper Mill is located (Figure 5). Consequently, the River Dee is covered under the Catchment Flood Management Plan (CFMP). Over time, the CFMP has involved modification of the surrounding rivers as a primary solution to managing flood risk. The River Dee's natural river system has been modified in the upper catchment through flow control, located at the confluence of the River Dee and the River Tryweryn. The CFMP is monitored regularly and well managed by Natural Resource Wales.

Figure 5. Location of the site in relation to local flood defences, flood zones, watercourses, and River Dee[9].



Tidal river flooding can also be a significant source of flooding in the Dee Estuary[10]. Downstream of Farndon, the River Dee is influenced by high tides which regularly exceed the Chester weir level, resulting in flow reversals on the river. These tides can restrict the discharge of tributary rivers into the River Dee. The most severe flooding can occur when extreme tidal events coincide with high river flows.

Surface water flooding has historically occurred in multiple locations across the Dee River Basin District (RBD)[11]. The flooding typically occurs rapidly following intense rain and most commonly affects small, localised areas. Groundwater and sewer flooding has also occurred in some areas of the Dee RBD and caused road flooding and some property flooding. Groundwater is naturally stored in the ground below the water table level. Where the water table reaches ground level, water emerges onto the surface and results in flooding. According to the RBD, groundwater flooding is closely linked to ground conditions and is not as widespread of an issue in the Dee RBD as it is in other parts of England.

---

[9] Flood Map for Planning (2023) Natural Resources Wales: https://naturalresources.wales/flooding/flood-map-for-planning development-advice-map/?lang=en

[10] Dee River Basin District Flood Risk Management Plan (English Catchments) 2021 to 2027 (2022) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1118196/Dee-FRMP-2021-2027.pdf

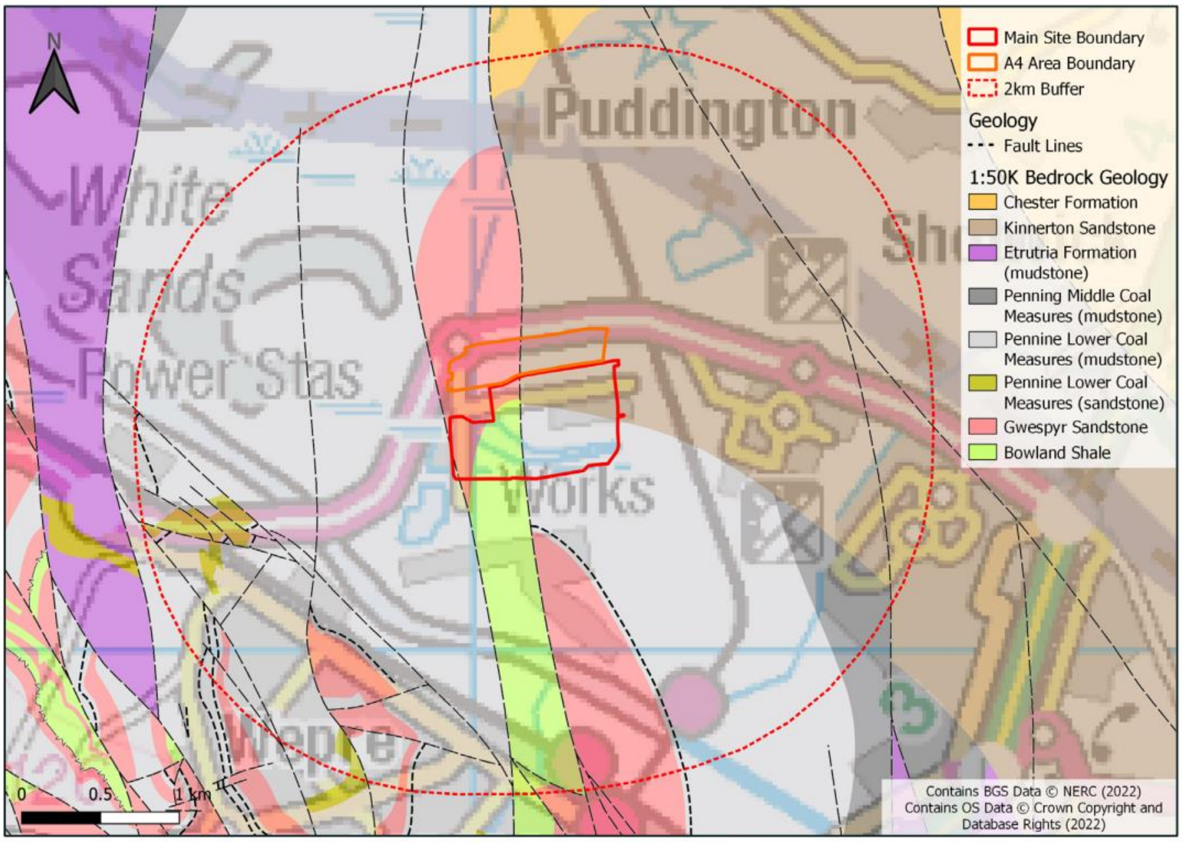
[11] Ibid. ref 10.

Reservoirs within the RBD (Llyn Tegid, Llyn Celyn, Llyn Brenig and Alwen) regulate downstream releases into the River Dee. The releases are controlled by Natural Resources Wales to manage the flow of water in the River Dee. Downstream areas, such as the Wales-England border section of the RBD, are noted to be at risk from flooding should a reservoir fail in the upper catchment. The risk to the downstream regions arises from the consequent increased water flow into the River Dee[12]. As Flintshire falls within the downstream catchment region, this could result in flooding depending on the size of the failing reservoir.

Geology

A map of the bedrock at 1:50,000 scale (each millimetre represents 50,000 millimetres or 50 meters) has been downloaded for the site and surrounding area (Figure 6)[13]. This shows that the bedrock beneath the site is complex. To the east of the fault lines is Pennine Lower Coal Measures Formation consisting of mudstone, siltstone, and sandstone. In the northeast of the site and beneath the A4 site area this is overtopped by the Kinnerton Sandstone. To the west of the central fault line, the site is underlain by the Bowland Shale which is overlain by the Gwespyr Sandstone further north in the site. The entire site is overlain with tidal flat superficial deposits, which consists of clay, silt, and sand. These are all shown below.

Figure 6. Extract of 1:50,000 Geological Mapping: Bedrock.



An additional geological layer sits on top of the bedrock, referred to as superficial deposits. Superficial deposits are the youngest geological deposits formed during the most recent period of geological time (Quaternary), which extend back 2.6 million years from present. These largely consist of unconsolidated sediments. These top-layer materials play a key role in redistributing surface

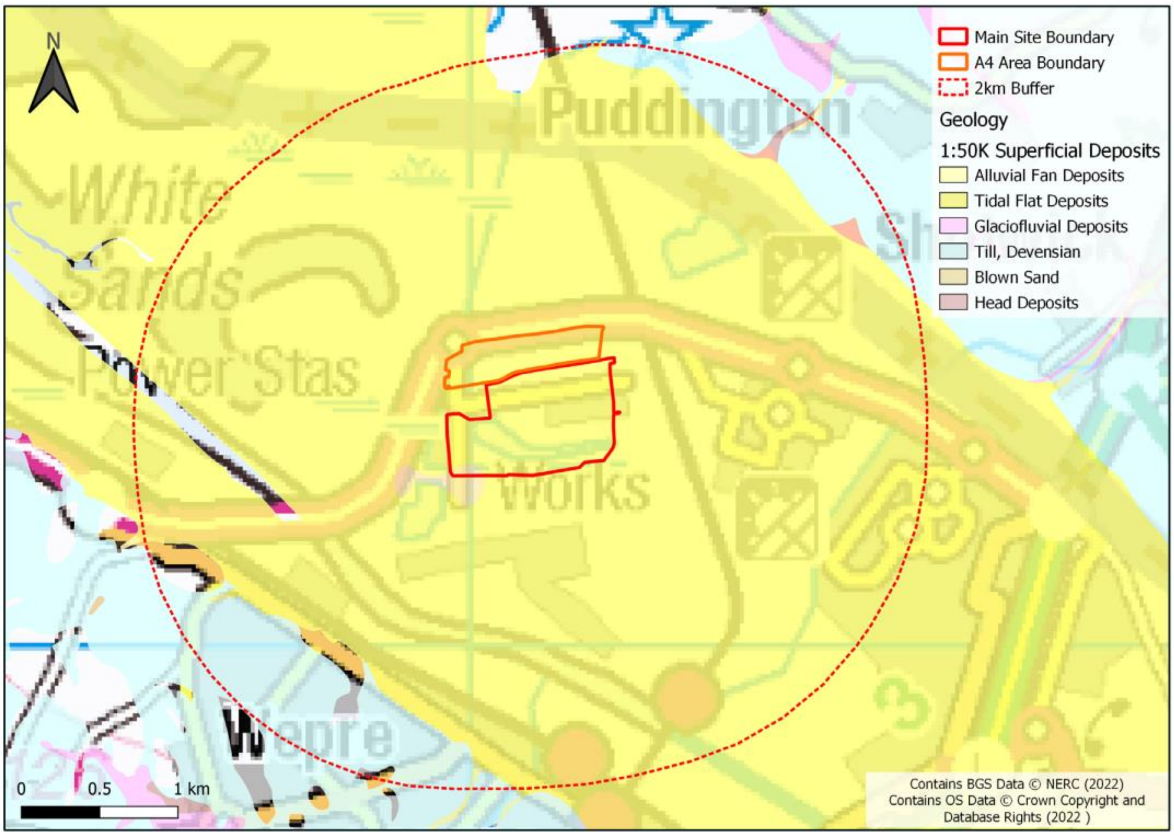
[12] Ibid. ref 10.

[13] British Geological Survey, Geology of Britain Viewer, https://mapapps.bgs.ac.uk/geologyofbritain/home.html?&_ga=2.69149649.1302426254.1632923777-1431768481.1632923777, Accessed November 2021

water to the bedrock aquifer via permeable pathways. The permeability of the superficial deposit layer varies across sediment type.

The site is located on an area of land that has a been raised above the surrounding natural ground level using superficial deposits. The superficial deposits at Shotton Mill are understood to consist of sandstone material extracted during the formation of Shotwick Lake[14]. This indicates that the transferred material would be from the tidal flat deposits and the Kinnerton Sandstone Formation (Figure 7). Tidal flat deposits are typically mud flat and sand flat deposits. Sandy materials are both porous and permeable, making them good aquifer materials with high vulnerability. High aquifer vulnerability allows for water to permeate the rock and consequently increased groundwater and groundwater storage potential. This decreases the risk of the ground drying out and consequent subsidence events.

Figure 7. Extract of 1:50,000 Geological Mapping: Superficial Deposits.



Hydrogeology

The hydrogeological potential of a site is determined by multiple factors relating to water permeability of the land, across both surface and groundwater. Aquifers are water-bearing rock that can readily transfer water. The aquifer designations across are classified by Natural Resource Wales:

1. Principal - "layers of rock that have high intergranular and/or fracture permeability – usually providing a high level of water storage. They may support water supply and/or river base flow on a strategic scale".
2. Secondary A – "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers."

[14] Gordon Smith, History of Shotton Steel, https://shottonsteel.co.uk/appendix/#sailing-club

3. Secondary B - "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering."
4. Secondary (undifferentiated) – "where it is not possible to classify as either Secondary A or B due to the heterogenous nature of the geology" [15].

The bedrock aquifer designations across the site have been identified and presented within Table 1 in relation to aquifer vulnerability, as per Natural Resource Wales aquifer classifications.

Table 1. Overview of Bedrock Aquifer Designations and Vulnerability.

Bedrock Geology	Part of Site	Aquifer Designation	Aquifer Vulnerability
Kinnerton Sandstone	NE	Principal	High vulnerability, Secondary Aquifer
Pennine Lower Coal Measure	SE	Secondary A	High vulnerability, Secondary Aquifer
Gwespyr Sandstone	NW	Secondary A	High vulnerability, Secondary Aquifer
Bowland Shale	SW	Secondary (undifferentiated)	High vulnerability, Secondary Aquifer

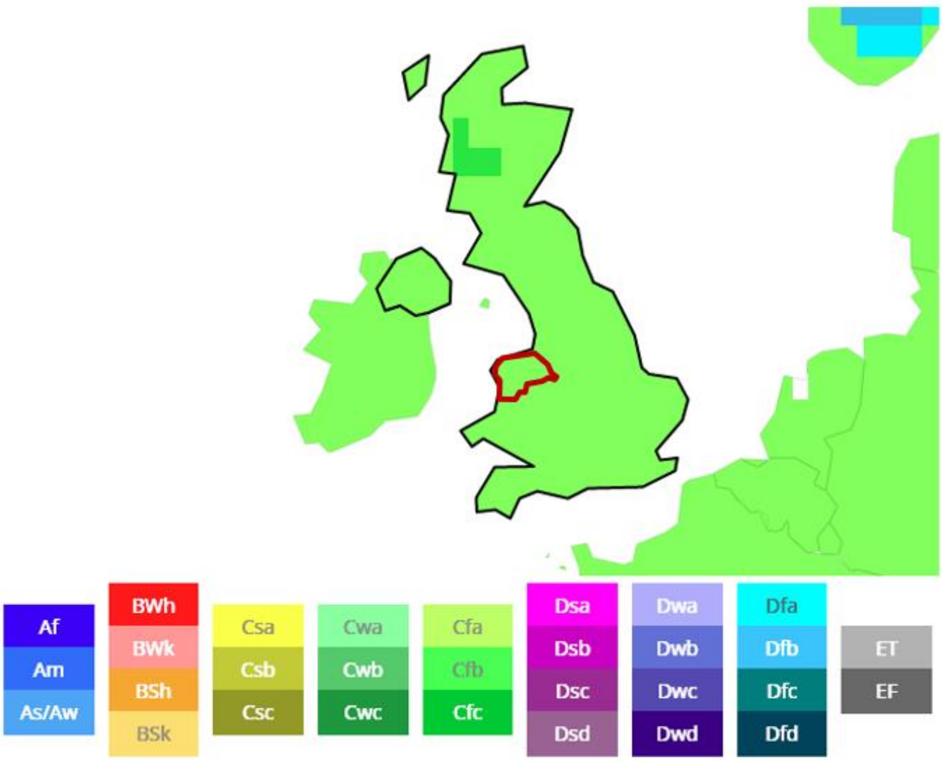
The superficial tidal flat deposits beneath the site are mostly classified as secondary (undifferentiated) and are also a high vulnerability secondary aquifer. These designations indicate that the geology beneath the site has moderate permeability. Moderate permeability will allow for groundwater to be present beneath the site and moderate water flow.

4.1 Climate context

Wales is a constituent part of the UK. The UK is located within Northwest Europe. According to the Köppen-Geiger climate classification system, the UK is classed as 'temperate oceanic' (Cfb), including the country of North Wales (Figure 8).

[15] Natural Resources Wales via GeoIndex,
http://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.103662016.1144138339.1636645458-1431768481.1632923777,
Accessed November 2021

Figure 8. Climate classification of United Kingdom, showing the North Wales boundary (red).



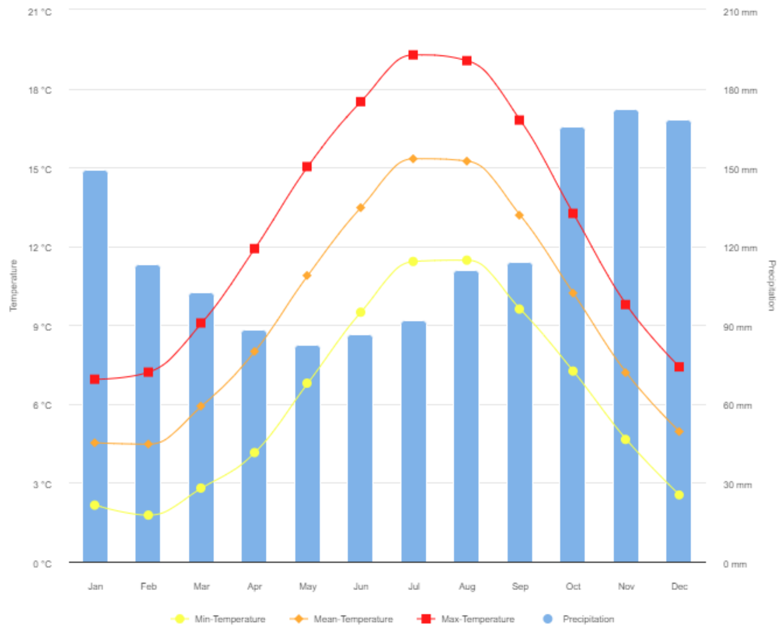
The UK climate is heavily influenced by its proximity to the Atlantic Ocean and the Gulf Stream/North Atlantic Drift which brings warm water into high northern latitudes. The study region falls within the North Wales boundary (shown in red, Figure 8). Here the climate is characterised as maritime by weather that is often cloudy, wet, and windy[16].

Weather context

North Wales rainfall trends are likened to eastern England, especially for locations nearer to the England border, such as Shotton. In Wales, the mean annual minimum temperature has typically varied from an average daily temperature of 4.5 °C in the winter months to 15 °C during summer between 1991-2020 (Figure 9). Seasonal lows (minimum) average around 1.7 °C and highs (maximum) average around 19 °C.

[16] Wales Climate (2016)
https://www.google.com/search?q=wales+climate+mnet+offioce&oq=wales+climate+mnet+offioce&aqs=edge..69i57j0i546l3j69i64.2772j0j1&sourceid=chrome&ie=UTF-8

Figure 9. Monthly climatology of minimum, mean and maximum temperature and precipitation between 1991-2020 for Wales.



4.2 Climate trends

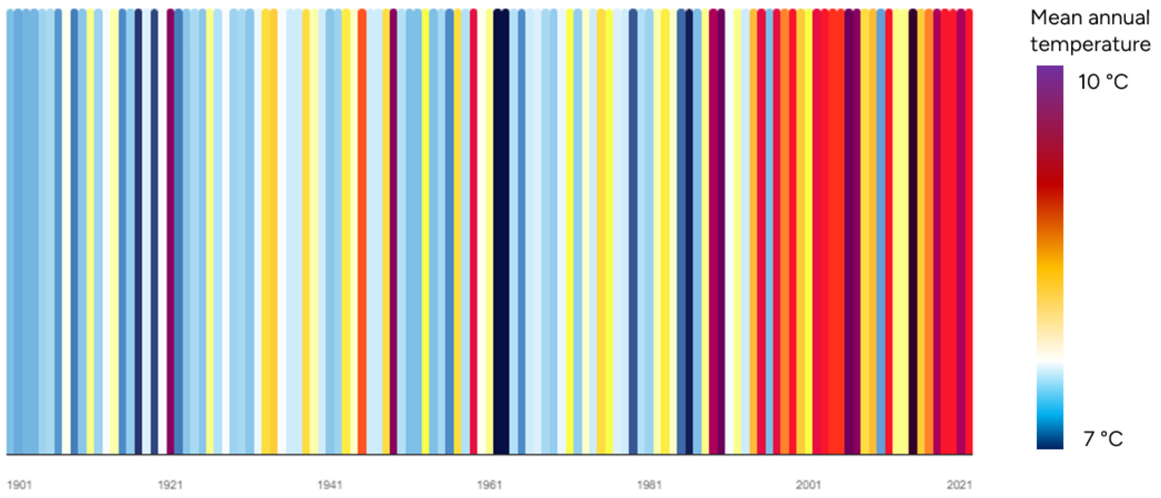
Climate change is a long-term change in the average weather patterns. According to the IPCC, the climate has been experiencing a long-term global warming trend since pre-industrial times. As an example, observed global mean surface temperatures over the last two decades were higher than the average over the 1850–1900 period[17]. Weather conditions are predicted to become more extreme due to climate change and weather events are to become more frequent and intense[18].

Temperature

Figure 10 shows the increase in annual mean temperatures across Wales between 1901 and 2021. This chart uses a colour gradient (hot to cold) to highlight where annual mean temperatures have become more frequent and more intense (hotter).

[17] IPCC (2023) AR6 Synthesis Report https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf
[18] StatSoft, Inc. (2023) STATISTICA (Data Analysis Software System) UK: hottest years 1884-2022 | Statista

Figure 10. Observed annual mean temperature in Wales between 1901-2021.



Data from the UK Met Office shows that since the start of temperature recording in 1884, the 10 warmest years recorded in Wales have all occurred since 2002[19]. Using 2022 as the most recent example year to this report, all four seasons during 2022 were the warmest on record since 1844 across the UK and Wales[20]. The provisional mean temperature in 2022 was also the highest on record, reaching 10°C in Wales. This is 0.9°C above the recorded average and previous hottest year on record (2014, 9.9°C).

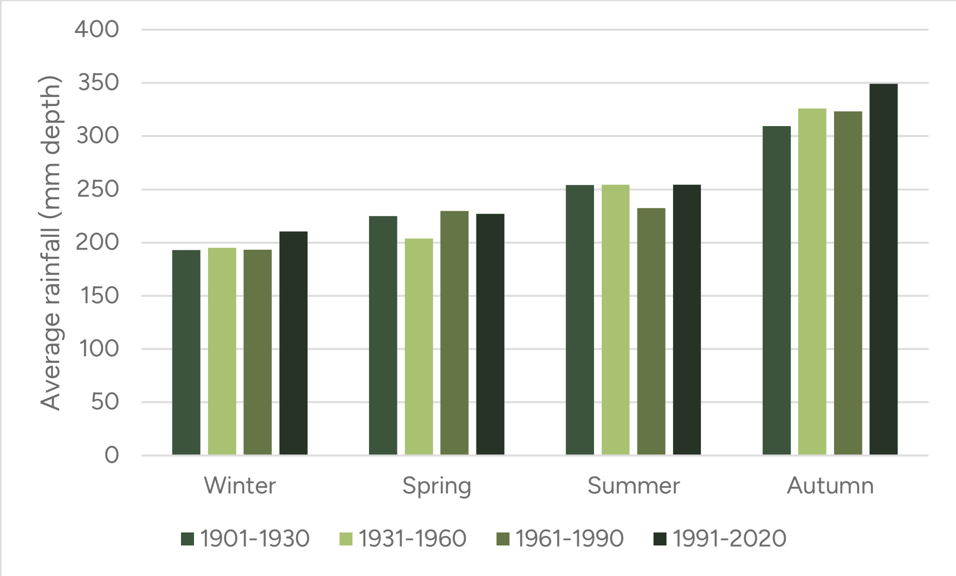
Precipitation

Between 1901-2020, average annual precipitation in the has typically ranged between 800-1,400 mm. The World Bank Group data (Table 2) presenting the highest and lowest precipitation sums for each season, shows that since the 1900s rainfall has become more intense across most seasons, especially Winter (December, January, February) and Autumn (September, October, November) months.

[19] Met Office UK Annual Weather Trends (2022) uk_monthly_climate_summary_annual_2022.pdf (metoffice.gov.uk)

[20] Met office (2023) Climate change drives UK's first year over 10°C https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/climate-change-drives-uks-first-year-over-10c#:~:text=Influence%20of%20climate%20change&text=The%20full%20annual%20UK%20mean,%C2%B0C%20set%20in%202014.

Table 2. Seasonal precipitation sums across the last four decades (1901-2020).



Historically from 1901-2020, rainfall in Wales is the heaviest between October to January, with 30-year monthly rainfall depths averaging a maximum of 126 mm. In contrast, February to September tend to be drier. This seasonal pattern reflects the high frequency of winter Atlantic depressions and the relatively low frequency of summer thunderstorms.

Soil erosion and subsidence

Soil erosion is the degradation of topsoil. Floods and droughts are currently the major drivers of this phenomenon due to their increasing frequency, erosive runoff, and the changing nature of sediments[21]. Heavy rainfall and flooding increase surface runoff and resulting removal of topsoil. Drought conditions lead to soil moisture depletion, making the soil more vulnerable to erosion when rainfall eventually occurs. Unsaturated soils are also less cohesive and more prone to detachment and transport by wind or water. This form of land degradation also leads to an increase in carbon emissions in the atmosphere through displacement of the soil and the organic carbon within it.

Subsidence is the sinking of the ground due to underground material movement. This occurs where there is a loss of volume and depth of organic soils due to oxidation caused by above normal microbial activity resulting from excessive water drainage, soil disturbance, or extended drought. Subsidence is most often caused by the removal of water, oil, natural gas, or mineral resources from the ground by pumping, fracking, or mining activities[22]. Natural events such as earthquakes, soil compaction, glacial isostatic adjustment, erosion, sinkhole formation, and adding water to fine soils deposited by wind (a natural process known as loess deposits) can also cause subsidence to occur.

Of the bedrock formations, those containing weathered shale (such as Halkyn Formation) have been the most susceptible to subsidence. Of the superficial deposits, head is particularly risk prone. Groundwater abstraction for agricultural, industrial, and domestic purposes during periods of drought can also lead to subsidence, however no evidence was found of these activities being undertaken to date at the site.

Many soils contain clay minerals with high water absorbency and consequent swell potential. The reverse effect of this occurs when soils lose water as they dry, resulting in shrinkage of the ground.

---

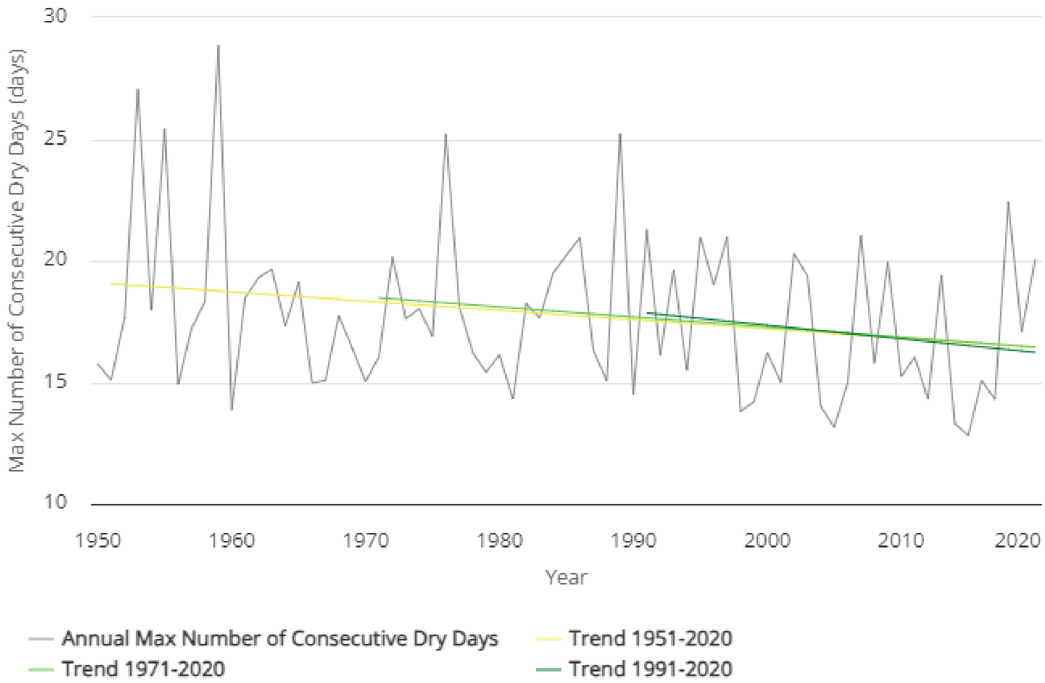
[21] Special Issue of 'Land', "The Impact of Extreme Weather on Land Degradation and Conservation" (2022) https://www.mdpi.com/journal/land

[22] Understanding Subsidence, Geobear [Accessed 2023] Understanding Subsidence | Geobear UK

Dry weather and high temperatures have been found to be a major factor in the emergence of subsidence in clay soils. This can pose a risk to infrastructure where a reduction in groundwater levels occur close to foundations of structures.

Historically, there has not been a risk of drought at the site, as the number of consecutive dry days has gradually decreased from 1950 to 2020 (Figure 11).

Figure 11. Maximum number of consecutive dry days between 1950-2020 and significance of trend per decade, indicated in shades of green.



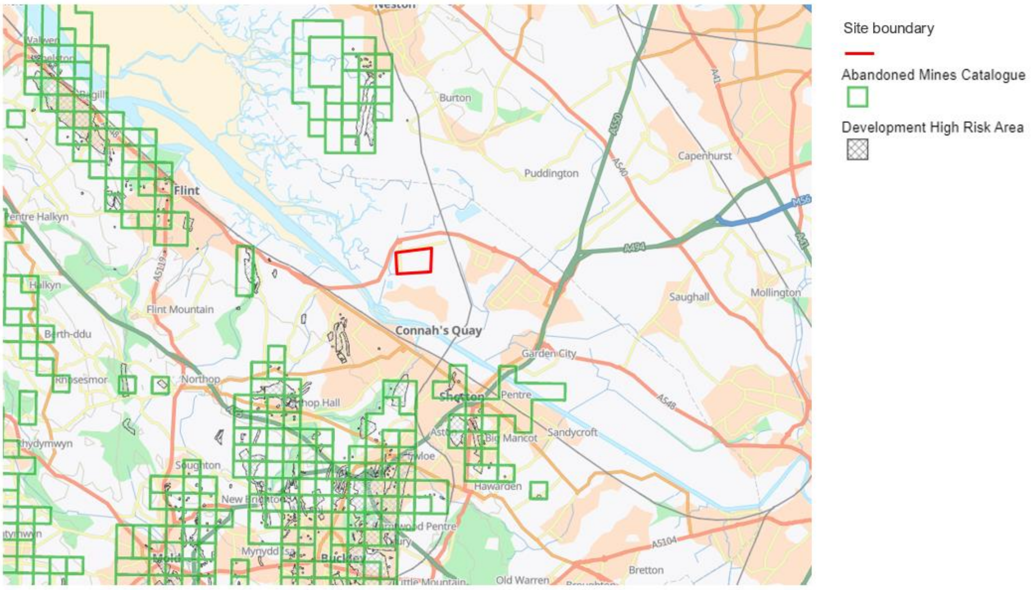
According to the Geobear subsidence data, historical trends in weather events, such as drought and high temperatures have not posed a subsidence threat to the site to date. However, the Deeside area has experienced subsidence events relating to specific bedrock composition (Figure 12). Former underground mining activities have also posed a risk of subsidence within Deeside, due to the area's industrial history.

Figure 12. Subsidence map, 2013-2019[23]. Site location indicated in red.

Mining Subsidence

A review of the Coal Authority data for the site indicates that while the south-eastern aspect of the site is mapped as a surface coal resource area, the proposed development area lies outside the coal mining reporting area as shown by Figure 13. However, a permit may be required for any site investigation works that intercept Coal Authority interests.

Figure 13. Map of abandoned coal mines and associated risk areas in relation to the Site[24].



[23] Subsidence Map of England and North Wales, Geobear [Accessed 2023] subsidence-map-uk-england-north-wales.pdf (geobear.co.uk)

[24] Map of UK Coal Mines, The Coal Authority [Accessed 2023] Interactive Map Viewer | Coal Authority (bgs.ac.uk)

Following review of the hydrogeological and historical industrial context of the site, it considered that an increase in potential of subsidence hazards occurring due to climate change and a result of historical coal mining at the site is minimal. However, it should be noted that coal mining data only refers to the known extent of coal mining and the potential exists for ground investigations to encounter new evidence of unrecorded mine workings, which should be assessed at the point of identification by a suitably qualified person.

Shrink-Swell Subsidence

The BGS GeoSure shrink-swell dataset considers the physical properties of the geology to provide a susceptibility rating for potential ground movement. It does not, however, account for changes in climate, and parameters that will affect soil water content.

The BGS GeoClimate shrink–swell national datasets however show potential change in subsidence due to climate change. They combine long-term UK Climate Projection (UKCP) scenarios for rainfall and temperature changes with the geotechnical properties of the ground, to identify areas projected to experience the largest increases in susceptibility to subsidence over the next century.

The present assessment is based on GeoClimate UKCP18 Open which is provided for two time periods, 2030s (2025-2035) and 2070s (2065-2075), with one projection provided for each time period based on the average (median) outcome for the UKCP18 higher emissions scenario (RCP8.5) and the most susceptible GeoSure value (worst case) within the grid cell.

The UKCP18 Open data provides a broad/outline national overview with higher resolution data available from a premium dataset for regional and local assessments. However, the data is derived from the GeoClimate Premium dataset by taking the 'worst-case' susceptibility classification for each grid cell. The score does not necessarily apply to the whole of a 2 km cell although the cell does include some proportion of the worst-case rating.

Based on the data resolution available for the site at the time of writing, considering average conditions, it is 'improbable' that climate change will affect clay shrink-swell susceptibility and change the likelihood of ground movement resulting in subsidence.

It should be noted that a higher resolution assessment this classification may result in a change in classification within the range of Highly Unlikely to Extremely Likely.

Effect of Climate Change on Soil Erosion

An outline assessment of the effect of climate change on soil erosion has been conducted using the Revised Universal Soil Loss Equation (RUSLE) (Renard et al., 1991)[25]. The data available was typically in mixed format at European and national level resolution and were therefore offered as a range of values as extracted from the European commission Joint Research Centre Data Catalogue and shown in Table 3 below[26].

[25] Renard, K.G., Foster, G.R., Weesies, G.A. and Porter, J.P., 1991. RUSLE: Revised universal soil loss equation. *Journal of soil and Water Conservation*, *46*(1), pp.30-33.

[26] Joint Research Centre Data Catalogue [Accessed 2023] https://esdac.jrc.ec.europa.eu/

Table 3. Revised Universal Soil Loss Equation for soil erosion potential at the Site.

RUSLE FACTORS	DATA RANGE
Rainfall and runoff (R)	610-730
Soil erodibility (K)	0.028-0.033
Slope length and steepness (LS)	0.1-0.5
Crop management (C)	0.099
Support practices (P)	0.95-0.97

Predictions of soil erosion based on climate change projections based on the above factors were between 0.16 and 1.16 tons/ha/yr. A review of similar assessments in which annual soil loss and land management priority were used to classify the severity of erosion indicates the results are consistent with a 'Very Low' soil erosion class (Buraka et al., 2022)[27]. However, it is recommended that local scale analyses are undertaken with higher resolution datasets for all the RUSLE input parameters for a more accurate estimation of soil erosion based on the climate projection data.

Wind and Storms

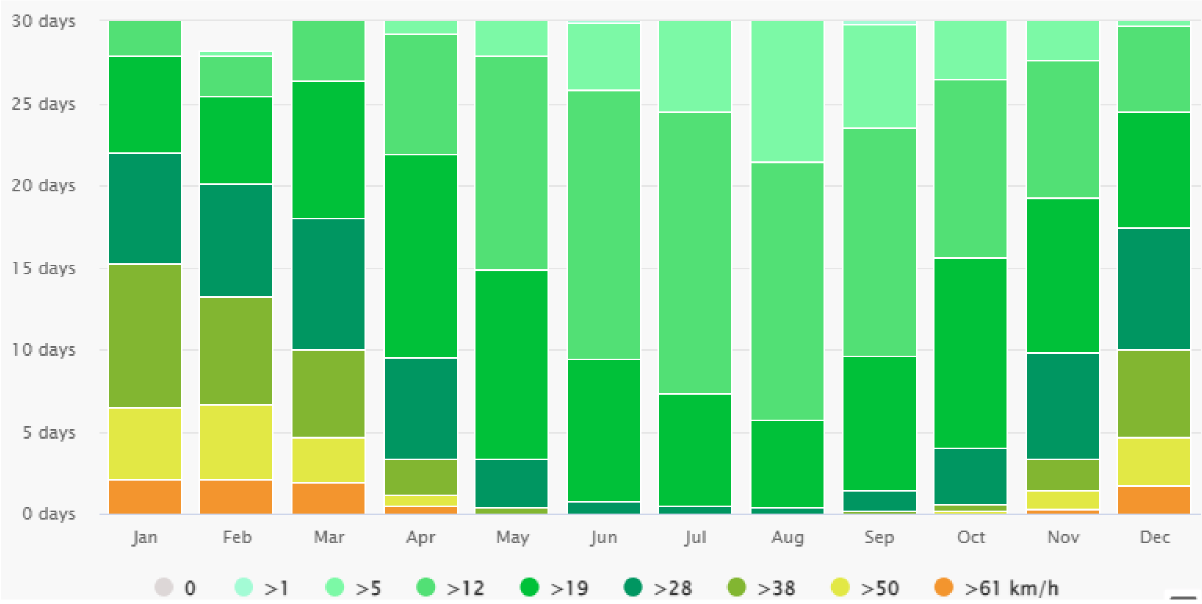
Prevailing winds in the UK are westerly, meaning that UK regional climates vary with distance from the Atlantic. Wales has historically been more susceptible to higher average wind speeds, due to its Westerly location.

Figure 14 shows the number of days per month during which winds reach a certain speed threshold (km/h) across North Wales. Autumn and winter months in North Wales have historically experienced higher wind speeds. February has typically experienced the highest wind speeds for the longest period in comparison to other months over the last 30-years. Historically during February, an average of 4.6 days a month have exceeded 50 km/h wind speeds and 2.1 days a month exceeding 61 km/h[28].

[27] Tadele Buraka, Eyasu Elias, Karuturi Venkata Suryabhagavan & Alemu Lelago (2022) Assessment of soil erosion risks in response to land-use and land-cover changes in Coka watershed, Southern Ethiopia, Geology, Ecology, and Landscapes, DOI: 10.1080/24749508.2022.2109825

[28] Meteoblue Simulated historical climate & weather data for North Wales - meteoblue

Figure 14. Average number of days per month during which wind speeds reach a certain threshold in North Wales, across the last 30 years.

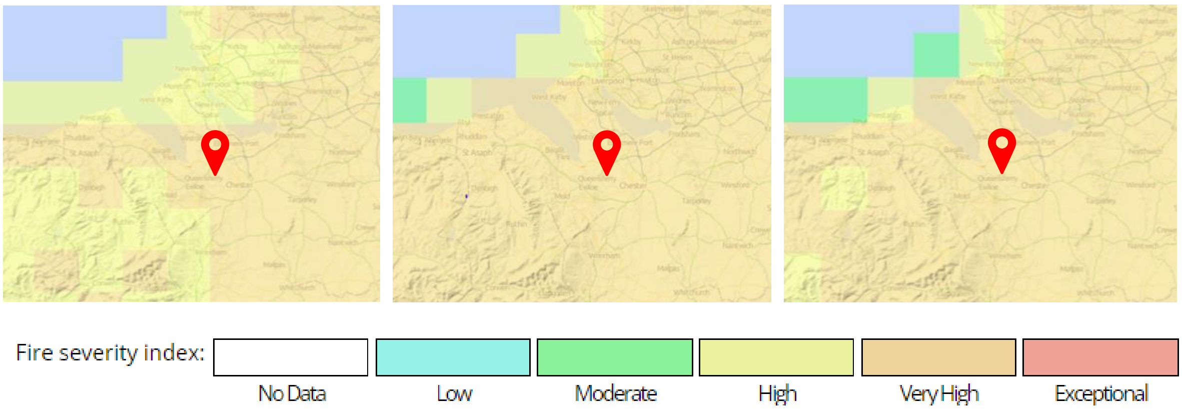


Wildfires

The Met Office's Fire Severity Index (FSI) has detailed an assessment of the severity of a fire if it were to start on any given day. The assessment uses wind speed, temperature, time of year and rainfall to produce a fire severity index.

In general, fire severity is higher in the warmer months out of the year. We see this trend in Wales with there being a low fire severity risk from January to May and late September to December in 2022. Figure 15 pictures the warmer months out of the year where there is a very high fire severity risk from June to August[29]. Wales tends to have high wind speeds and high temperatures during the summer months which can increase the fire severity.

Figure 15. Fire Severity risk in Wales is pictured for June (left), July (middle), and August (right) in 2022. Shotton Mill is indicated with the red marker and shows a very high fire risk in the three months below.

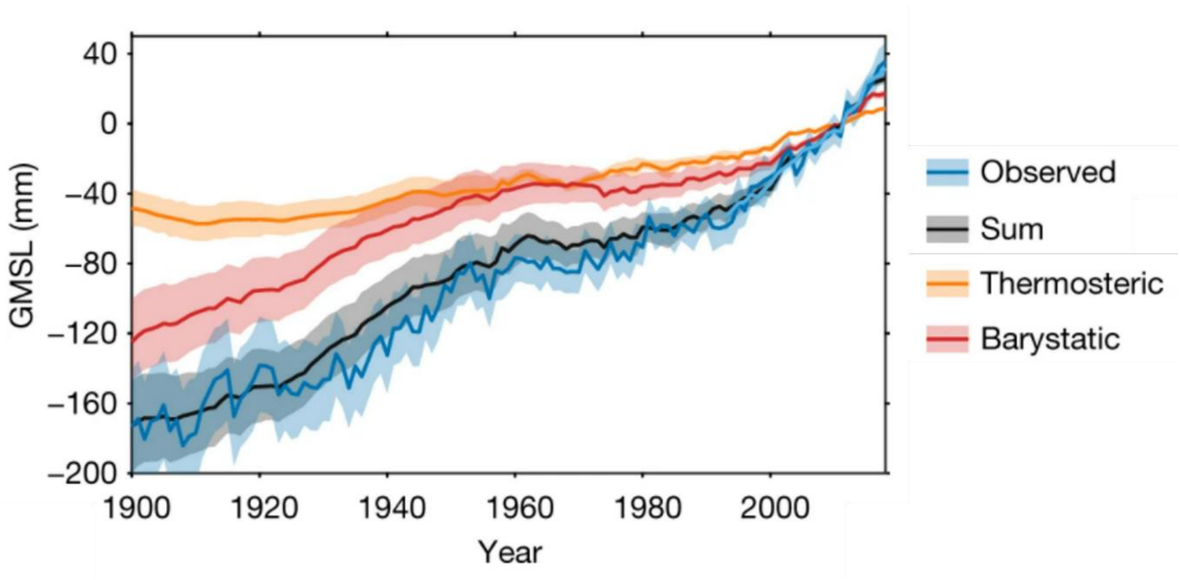


[29] The Met Office, Fire Severity Index https://www.metoffice.gov.uk/public/weather/fire-severity-index/#?tab=map&fcTime=1630666800&zoom=5&lon=-4.00&lat=55.74

Sea level rise

Sea level is rising across the globe due to climate change (Figure 16). The primary contributors to global sea-level rise are thermal expansion of the oceans and ice melt from land-based sources such as Greenland, Antarctica, regional ice caps and glaciers. Global mean sea level has risen at a rate of 1.5 mm/year for the period 1902-2010, but the rate of global sea-level rise is accelerating (Dangendorf et al., 2019)[30]. More recently, the rate of global mean sea level rise has increased. Between 1993-2015 the rate of global mean sea level rise was 3.2 mm/year (IPCC 2019)[31]. Now (i.e., the most recent period of 2006-2018) global mean sea level is rising at a rate of 3.7 mm/year (IPCC 2021)[32]. However, sea-level changes are not spatially uniform across the globe.

Figure 16. Global mean sea-level changes observed since 1900 and the thermosteric (e.g., expansion from ocean warming) and barysteric (e.g., ice melt from land-based sources) components that make up total sea-level rise (adapted from Frederikse et al., 2020[33]).



4.3 Climate-related physical hazards

The EU Taxonomy provides a classification for climate-related physical hazards. The classification comprises four major hazard groups related to water, temperature, wind, and mass-movements (Table 4). Climate-related hazards are further grouped by those relating to acute physical risks, and those related to chronic physical risks. Acute physical risks relate to risks that are event driven (e.g., flooding, heat waves). Chronic physical risks relate to longer-term shifts in climate patterns (e.g., sea-level rise, changing temperatures). The EU Taxonomy aligns with the TCFD risk classification.

[30] Dangendorf et al. (2019) Persistent acceleration in global sea-level rise since the 1960s. Nature Climate Change, 9, 705-710.

[31] IPCC (2019) IPCC Special Report on the Ocean and Cryosphere in a Changing Climate.

[32] IPCC (2021) Ocean, cryosphere, and sea level change. Chapter 9 of AR6 Climate Change 2021: The Physical Science Basis. WGI AR6 IPCC.

[33] Frederikse et al. (2020) The causes of sea-level rise since 1900. Nature, 584, 393-397

The EU Taxonomy classification for climate-related hazards shown in Table 4 was used and adapted alongside desk-based research to identify climate-related hazards potentially material to the site location and operational activity. Identified climate-related hazards are considered hazards that may affect the performance of the economic activity during its expected lifetime.

Physical climate hazards not relevant due to location, operational activities or the climate have been muted in grey.

Table 4. EU taxonomy classification for climate-related physical hazards, with hazards relevant to the project shown in bold.

	Temperature	Wind	Water	Solid Mass
Chronic	**Changing temperature**	**Changing wind patterns**	**Changing precipitation patterns**	Coastal erosion
	Heat stress	**Strong winds**	**Precipitation or hydrological variability**	Soil degradation
	Temperature variability		Ocean acidification	**Soil erosion**
	Permafrost thawing		Saline intrusion	Solifluction
			Sea-level rise	
			Water stress	
Acute	**Heat wave**	Cyclone, hurricane, typhoon	**Drought**	Avalanche
	Cold wave/frost	**Storm (including blizzards, dust- and sandstorms)**	**Heavy precipitation**	Landslide
	Wildfire	Tornado	**Flood (coastal, fluvial, pluvial, and ground water)**	**Subsidence**
			Glacial lake outburst	

Where the site activity is assessed to be at risk from one or more of the physical climate risks listed in the initial screening, a risk score is set out in Section 6.

5.0 Climate Projections

Projections of relevant climate variables were compiled provide insight into the climate-related changes that can be expected under different climate scenarios. Three climate scenarios (SSP-RCPs[34]) were considered and derive from the most recent IPCC report (AR6 Climate Change 2021: The Physical Science Basis[35]). The three scenarios represent climate futures which follow: i) a ‘sustainable development scenario’ where global CO_2 emissions are drastically reduced and net-zero is reached around 2050 (SSP1-2.6); ii) ‘middle of the road’ pathway where social, economic, and technological trends do not shift significantly from historical patterns, some reduction in fossil fuel

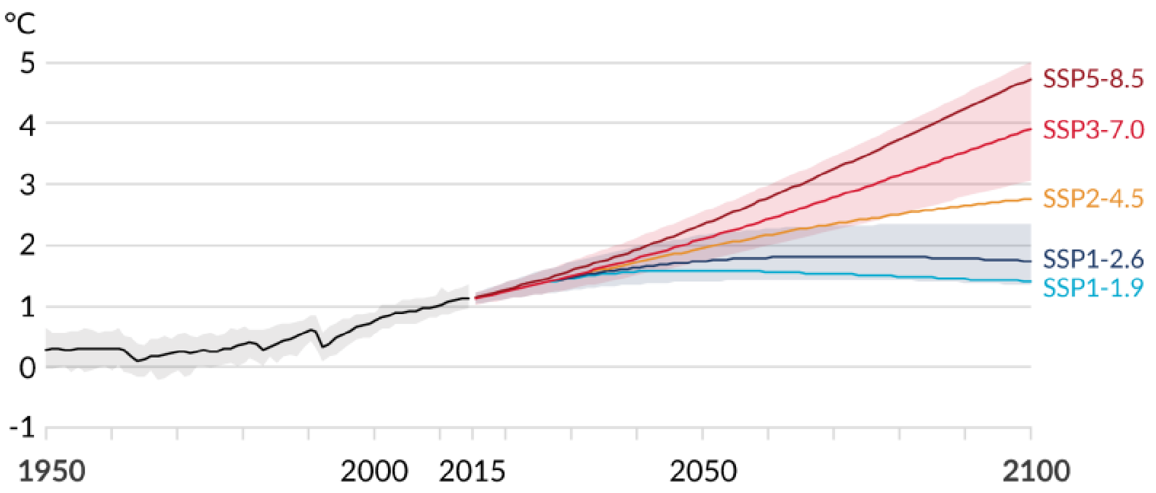
[34] Riahi et al. (2017) The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. Global Environmental Change, 42, 153-168.

[35] IPCC (2021) Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

use is achieved, and global warming reaches 2.1°C to 3.5°C by the end of the century (SSP2-4.5); iii) a 'high-warming scenario' which sees an increase in global development, including exploitation of fossil fuel resources, adoption of energy intensive lifestyles worldwide, leading to global warming of 3.3°C to 5.7°C by the end of the century (SSP5-8.5). Using a higher warming scenario for a physical risk assessment is recommended across different guidelines including the Environment Agency and the Institute of Environmental Management and Assessment (IEMA).

Projections are provided for three time periods, equivalent to the 'near-term' (2020-2039), the 'medium-term' (2040-2059), and the 'long-term' (2080-2099). The World Bank includes two medium-term time periods, the focus here is on the medium-term period that includes 2050 and not the period of 2060-2079. The uncertainties associated with each projection are also presented in the form of percentiles (10th, 50th, and 90th percentiles). The 10th percentile indicates that there is a 10% chance the actual outcome will be below this value, this percentile is seen as a lower level of risk. The 50th percentile indicates that there is a 50% chance the actual outcome will be below or above this value, this percentile is usually considered the best estimate. The 90th percentile indicates that there is a 90% chance the actual outcome will be below this value, this percentile is seen as a higher level of risk.

Figure 17. Temperature projections associated with different IPCC AR6 climate scenarios compared to a baseline equivalent to 1850-1990.



5.1 Temperature Projections

Temperature projections derive from the sixth phase of the Coupled Model Intercomparison Project, which is a global collaborative project that uses computer models to simulate and compare Earth's climate system (CMIP6[36]). The CMIP6 data has been accessed from the World Bank Climate Change Knowledge Portal. Projections of different temperature-related climate variables were considered across three IPCC climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5; Figure 17) to consider the full range of plausible climates futures. Projections were also considered across three time horizons: 2020-2039, 2040-2059, and 2080-2099. Projections have been reported as modelled median (50th percentile) values, alongside 10th and 90th percentiles, for each time horizon and climate scenario considered. The temperature-related climate variables considered were:

i. **Mean temperature:** the change in mean temperature relative to the baseline of 1995-2014.
ii. **Maximum temperature:** the change in the mean value of maximum daily temperatures relative to the baseline of 1995-2014.

[36] Eyearing et al. (2016) Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization. Geoscientific Model Development, 9, 1937-1958.

iii. **Minimum temperature:** the change in the mean value of minimum daily temperatures relative to the baseline of 1995-2014.
iv. **Very hot days (35°C):** the absolute number of days that maximum daily temperatures exceed 35°C.
v. **Extreme hot days (40°C):** the absolute number of days that maximum daily temperatures exceed 40°C.

Temperature is expected to increase through time across Wales under all climate scenarios (Table 5 in Appendix 2). The mean, maximum and minimum temperatures are all expected to be warmer compared to the baseline period of 1995-2014. The number of days exceeding 35°C or 40°C is not expected to change significantly through time and under different climate scenarios.

Mean temperature change will increase by up to 2.9°C by 2100 (50th percentile, SSP5-8.5), although this increase in the mean could be as large as 4.8°C (90th percentile, SSP5-8.5). In the years 2020-2039, mean temperature (50th percentile) is expected to increase by 0.5°C (SSP1-2.6) to 0.6°C (SSP2-4.5), demonstrating that warming will occur regardless of climate scenario. Uncertainty in the change of mean temperature grows over time. In the years 2020-2039, the difference between the 10th and 90th percentiles under SSP5-8.5 is 1.1°C, compared to 3.0°C in the long-term.

Maximum temperatures are expected to increase by up to 3.4°C by 2100 (50th percentile, SSP5-8.5), although this increase could be as large as 5.1°C (90th percentile, SSP5-8.5). In the years 2020-2039, maximum temperatures (50th percentile) are expected to increase by 0.5°C (SSP1-2.6) to 0.6°C (SSP2-4.5). Uncertainty in the change in maximum temperatures grows over time (e.g., 0.0°C-1.2°C in SSP2-4.5 in the years 2020-2039, compared to 0.7°C-2.8°C in SSP2-4.5 in the years 2080-2099).

Changes in mean minimum temperatures follow broadly similar patterns of changes in mean and changes in mean maximum temperatures. The median values (50th percentile) increase over time under all climate scenarios. However, the lower range of the modelled projections (10th percentile values) in the years 2020-2039 demonstrate that under the SSP1-2.6 climate scenario there is a small chance that minimum temperatures will decrease. Generally, however, the expectation is that mean minimum temperatures will rise and uncertainty in the projections increases over time.

The absolute number of very hot days with maximum temperatures over 35°C remains close to 0 across all time horizons and climate scenarios. Only the high end of model ranges (i.e., 90th percentile values) suggest that there could be one or more very hot days with temperatures over 35°C. There are no projections of extremely hot days with temperatures of over 40°C expected in Wales, regardless of time horizon or climate scenario.

5.2 Precipitation Projections

Precipitation projections derive from the sixth phase of the Coupled Model Intercomparison Project (CMIP6). The CMIP6 data has been accessed from the World Bank Climate Change Knowledge Portal. Projections of different precipitation-related climate variables were considered across three IPCC climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) to consider the full range of plausible climates futures. Projections were also considered across three time horizons: 2020-2039, 2040-2059, and 2080-2099. Projections have been reported as modelled median (50th percentile) values, alongside 10th and 90th percentiles, for each time horizon and climate scenario considered. The precipitation-related climate variables considered were:

i. **Total precipitation:** the change in total precipitation relative to the baseline of 1995-2014.
ii. **Maximum precipitation (1 day):** the change in the maximum amount of precipitation to fall in one day relative to the baseline of 1995-2014.
iii. **Maximum precipitation (5 days):** the change in the maximum amount of precipitation to fall in five days relative to the baseline of 1995-2014.
iv. **Dry days:** the absolute maximum number of consecutive days without precipitation.
v. **Wet days:** the absolute maximum number of consecutive days with precipitation.

Precipitation is broadly expected to increase in Wales over time and under different climate scenarios. However, the change in precipitation is not uniform and there is low model agreement in the CMIP6 outputs, as demonstrated by wide differences between the 10th and 90th percentiles across the precipitation-related climate variables (Table 6 in Appendix 2).

Mean precipitation is broadly expected to increase over time and under different climate scenarios (50th percentiles). The direction of change is not consistent through time, for example, in the SSP2-4.5 scenario precipitation may increase by 25.2 mm in the years 2020-2039, by 10.3 mm in the years 2040-2059, and by 27.6 mm in the years 2080-2099 (50th percentiles). Across all scenarios and time horizons, the low end of model outputs (10th percentiles) all suggest that there is a chance that mean total precipitation in Wales decreases as global temperatures increase. These patterns of model ranges are consistent under maximum (1 day and 5 day) precipitation projections. Median values tend to indicate increased precipitation over time and under different climate scenarios, yet it is possible (10th percentiles) that maximum precipitation decreases as global temperatures increase.

There are no clear trends in the maximum number of consecutive wet days, nor in the maximum number of consecutive dry days. Under the SSP1-2.6 and SSP2-4.5 climate scenarios the projections are broadly consistent through time. There is a small potential increase in the maximum number of consecutive wet days, and a small potential decrease in the maximum number of consecutive dry days under the SSP5-8.5 climate scenario. This pattern is indicative of potentially more intense precipitation events in Wales when they occur.

In general, precipitation patterns in Wales appear to lack clear trend direction and have wide ranges of model variability across all time horizons and climate scenarios, even in the years 2020-2039.

5.3 Wind Projections

There is low agreement within CMIP6 climate models with regards to wind speed projections for Northwest Europe (IPCC 2021) and for Great Britain (UCKP 2018). In the near-, medium-, and long-terms, the CMIP6 mean model outputs from IPCC (2021) indicate a decreasing trend in wind speed under all climate scenarios. However, there are no consistent trends across models (i.e., there is 'low model agreement'), and different modelling communities report different trends in wind speed under the same model assumption conditions. In some cases, in Northwest Europe, the CMIP6 model outputs indicate opposing trend signals, which further demonstrates the uncertainty associated with developing wind speed projections. Climate projections developed by the Met Office for the UK in 2018 (UKCP 2018) report close to zero annual mean changes to surface wind speed under future global climates of +2°C and +4°C.

At a global scale, IPCC (2021) shows that some (not all) climate models indicate that the frequency of tropical storms may decrease. However, at the same time, many tropical storm model simulations also project increases in the proportion of tropical storm intensities. In addition, the maximum surface wind speeds associated with tropical storms may increase by about 5% with a +2°C increase in global warming. Likewise, rainfall associated with tropical storms is also expected to increase by 12% with a +2°C increase in global warming.

It is plausible that extreme wind related events will decrease in frequency but increase in intensity and maximum wind speed. The location of non-uniform changes in wind speed will also be important (e.g., some projections indicate a decrease in the number of extratropical cyclones in the Northern Hemisphere, but an increase in the Southern Hemisphere). The current consensus is that there is low model agreement and high uncertainty in wind speed projections, but Northwest Europe may experience increased maximum wind speeds and increasing precipitation associated with extratropical cyclones.

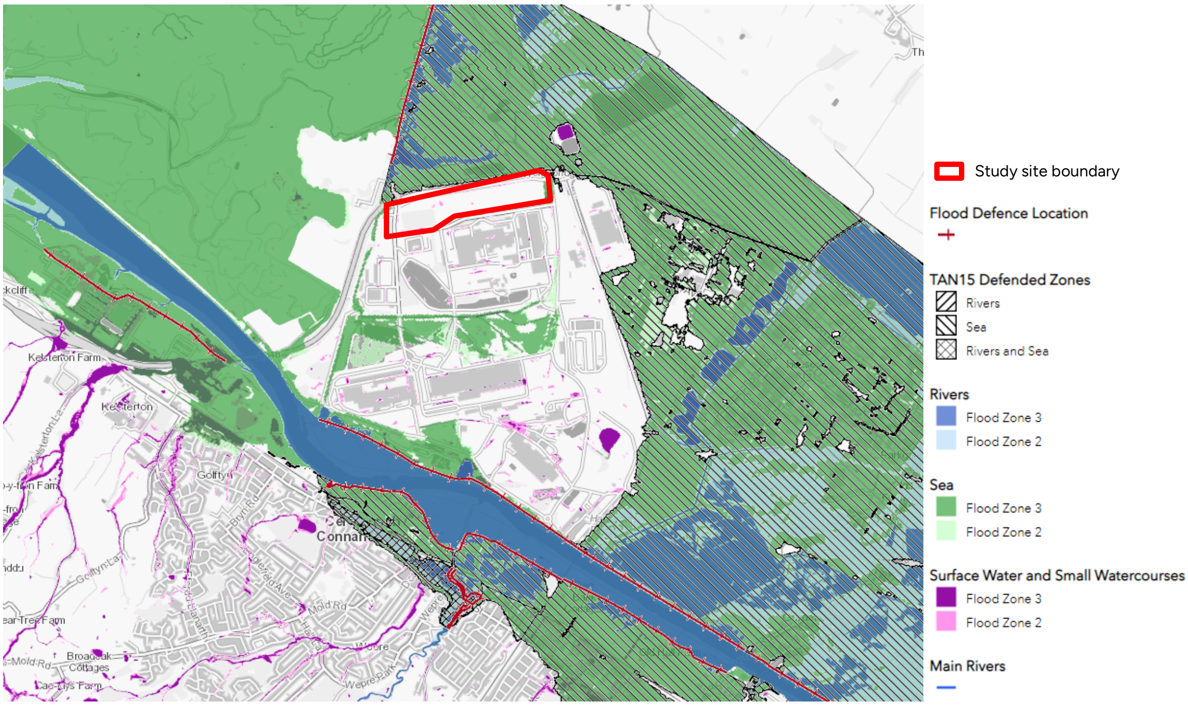
5.4 Flooding Projections

Flooding projections for Wales were assessed by Natural Resources Wales based on a national assessment of risk flooding from rivers, the sea, and surface water and small watercourses. The Flood Map for Planning from Natural Resources Wales shows how climate change will affect flood risk over the next century. The map (Figure 18) shows the potential extent of flooding, assuming there are no flood defences in place. The map shows where flood defences are located, so in a future flooding scenario it can be assumed that the flooding risk will be lessened with these in place.

The project and the surrounding area are projected to be most affected by coastal flooding in the next century. There is also risk of flooding from surface water and small watercourses scattered across the site.

The potential extent of flooding is divided into flood zones 2 and 3. For rivers, surface water and small watercourses, flood zone 2 means areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding in a given year, considering the effects of climate change. Rivers, surface water and small watercourses in flood zone 3 mean areas with more than 1% (1 in 100) chance of flooding in a given year, considering the effects of climate change. For the sea, flood zone 2 means areas with 0.1% to 0.5% (1 in 1000 to 1 in 200) chance of flooding in a given year, considering the effects of climate change. For the sea, flood zone 3 means areas with more than 0.5% (1 in 200) chance of flooding in a given year, considering the effects of climate change. The risk of coastal flooding in zone 3 is most prominent for the project.

Figure 18. Shotton Mill is shown with the surrounding flooding risk from surface water and small watercourses, rivers, and the sea.



5.5 Drought Projections

The probability of drought occurrence is expected to increase in Wales in the future. Forest Research for Wales used data from the UKCIP to assess moisture deficit in the baseline climate, 2050 and 2080 for two separate emissions scenarios.[37] Here, moisture deficit is defined as the maximum accumulated excess of evapotranspiration over rainfall in the summer months. It can be a good indication of how much water is available for plant growth.[16] In Figure 19, the maps for 2050 show that moisture deficit is increasing in the south and eastern border with the baseline showing a high value of 180 mm, the low emissions scenario showing a high value of 180-200 mm and the high emissions scenario reaching 200-220 mm. For 2080, the baseline shows a high of 180 mm, the low

[37] Forest Research. (2020) Projected warmth and droughtiness changes in the climate of Wales: https://www.forestresearch.gov.uk/research/climate-change-adaptation/adapting-forests-and-woodlands-in-wales-to-a-future-climate/projected-warmth-and-droughtiness-changes-in-the-climate-of-wales/

emissions scenario shows a high of 200-220 mm, and the high emissions scenario reaches 240-260 mm. Forest soils can hold only 150-180 mm of water to be accessible to plants so the northern parts of Wales, where Shotton Mill is located, is likely to see more frequent summer drought. The World Bank Standardised Precipitation-Evapotranspiration Index (SPEI) for drought is shown in Figure 20. Here, we can see that in the high emissions scenario (SSP5-8.5) and by the end of the century Wales experiences a moderate level of drought. The mill relies on water availability for manufacturing; therefore, a drought can inhibit the ability to secure an adequate water supply which could lead to disruptions in production or increased costs for alternative water sources. There is a moderate increase in the risk of drought in a higher emissions scenario and later in the century.

Figure 19. Map of Wales showing moisture deficit in the baseline climate, low and high emissions scenarios for 2050 (top row) and 2080 (bottom row).

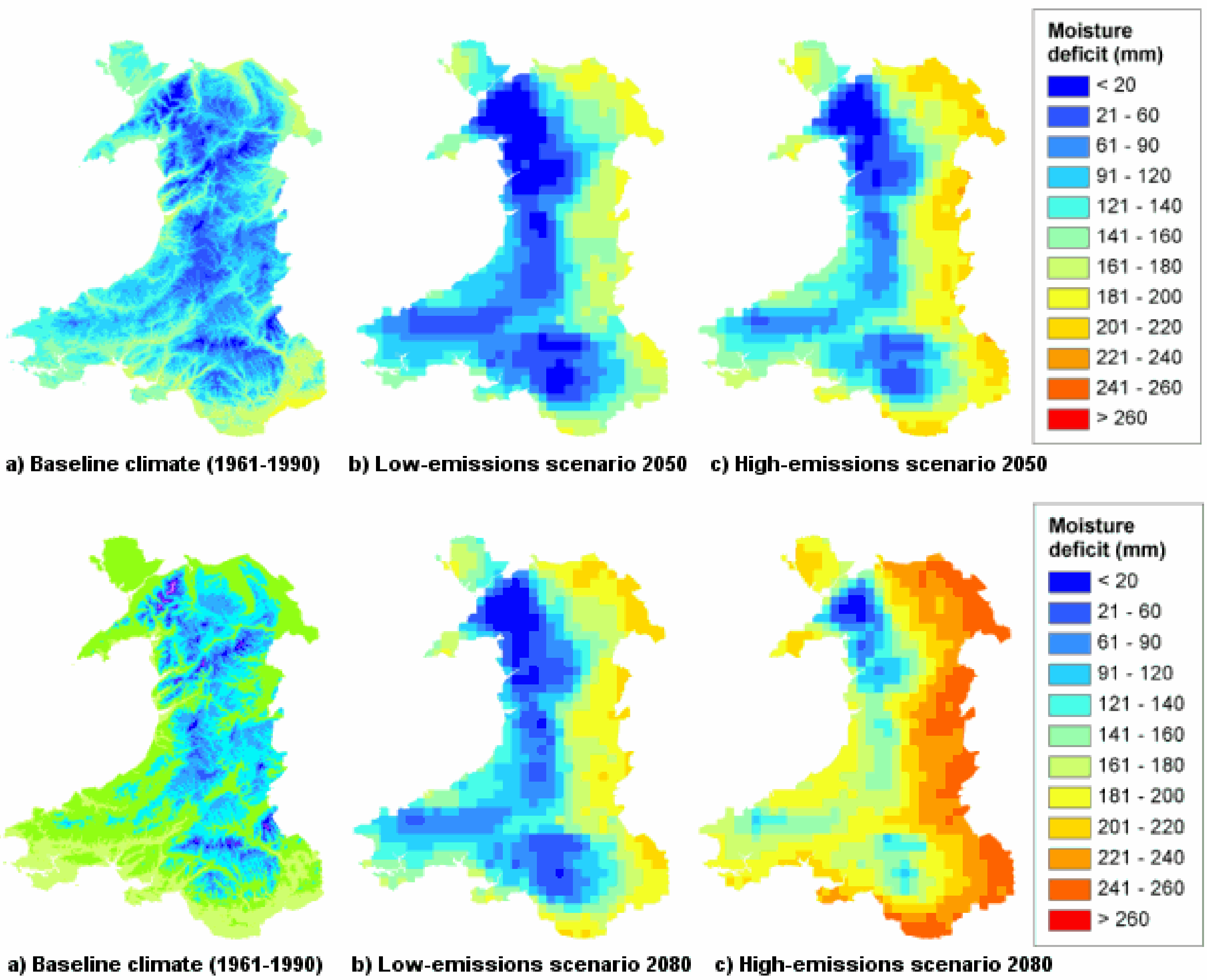


Figure 20. Projected Annual SPEI Drought Index for 2080-2099 for the United Kingdom under climate scenario SSP5-8.5.

5.6 Sea level rise Projections

To explore local sea-level changes specific to Wales and the UK, sea level projections have been accessed from the World Bank Group Climate Change Knowledge Portal. Projections were developed for time horizons and climate scenarios equivalent to those used for temperature and precipitation projections. Sea level is expected to rise across the UK (Table 7). In the near-term, sea level is expected to rise by 0.1 m in all three scenarios. In the long-term, sea level is expected to rise between 0.3 and 0.5 m across all climate scenarios. This is also shown in Figure 21 where all three climate scenarios can be seen, and the projected sea level rise is increasing for all three from 2008 to 2099. This increase in sea level will have a significant impact on the return period frequencies of extreme water level events (e.g., from storm surges), which increase the risk of coast flooding at the site.

Figure 21. Sea level rise projections in the UK from 2008 to 2099, highlighting in white the years 2080-2099. Sea-level projections are shown for climate scenarios RCP2.6 (blue), RCP4.5 (green), and RCP8.5 (red).

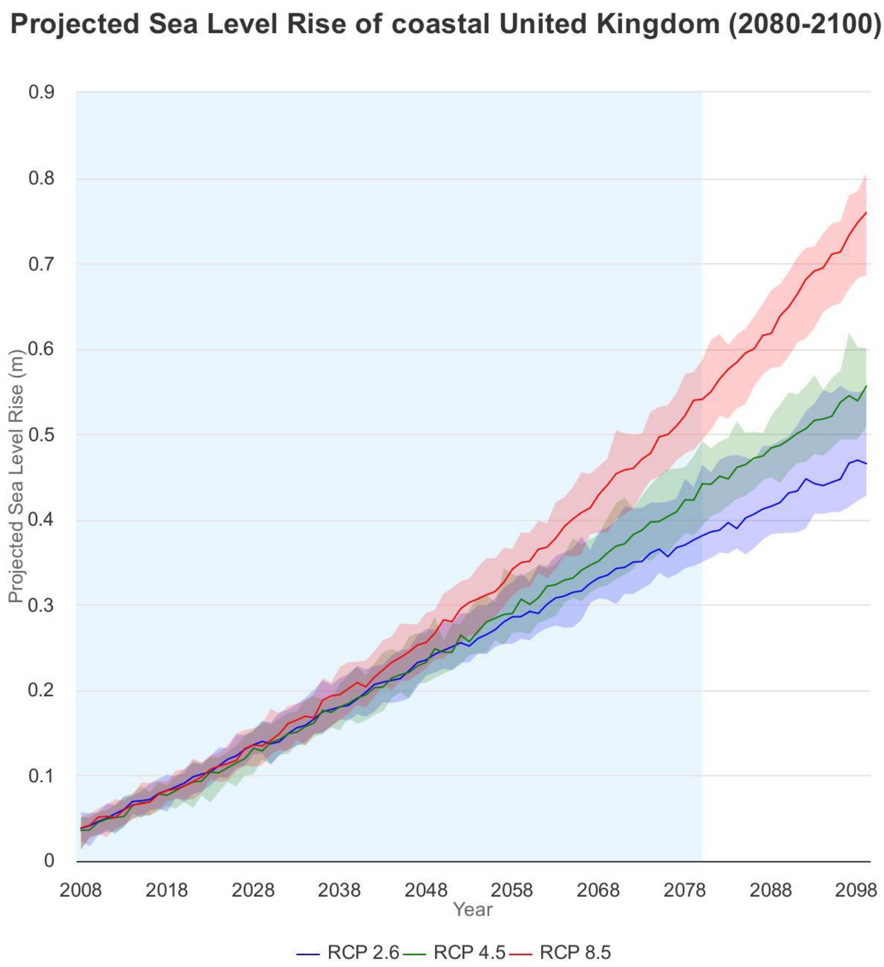
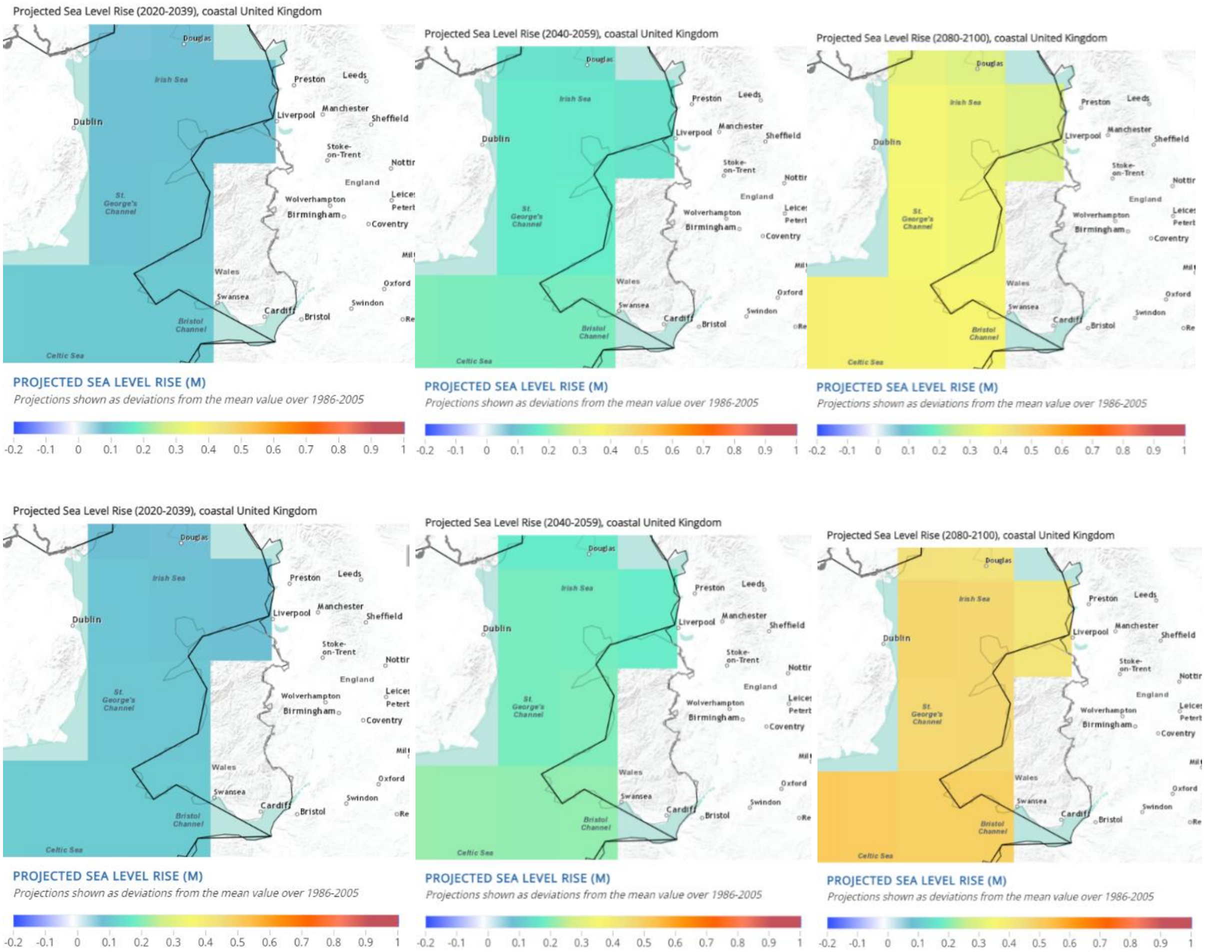


Table 7. Average sea level projections for the United Kingdom under three different climate scenarios (RCP2.6, RCP4.5, RCP8.5) and the across three-time horizons.

	2020-2039			2040-2059			2080-2099		
	RCP 2.6	RCP 4.5	RCP 8.5	RCP 2.6	RCP 4.5	RCP 8.5	RCP 2.6	RCP 4.5	RCP 8.5
Average Sea Level Rise (m)	0.14	0.14	0.14	0.24	0.24	0.27	0.42	0.49	0.65

The sea level projections for Wales are shown in Figure 22 across three time periods for two climate scenarios (RCP4.5 and RCP8.5). The sea level rise will affect the area surrounding the project in all time frames and scenarios. The mill is located close to the coast; therefore, the potential of sea level rise can pose threats including damage to infrastructure, should existing flood defences prove to be insufficient. However, the site is elevated to a level of 4.6m above sea level, which significantly mitigates the risk of coastal flooding. Saltwater intrusion into local freshwater sources is not expected to be an issue because all freshwater is delivered via pipe from the River Dee above the Chester Weir and this fresh water is stored in tanks on site. In both scenarios the time periods of 2020-2039 and 2040-2059 are similar and sea level is projected to rise from 0.1 to 0.2 m. In the time period of 2080-2099, in climate scenario RCP4.5 sea level is projected to rise to 0.3 m and in climate scenario RCP8.5 sea level is projected to rise up to 0.5 m. The IPCC and World Bank have high confidence that these increases in sea-level rise will occur and will contribute to an increase in coastal flooding and coastal erosion.

Figure 22. Projected sea level rise for the three time periods in Wales for climate scenario RCP4.5 (top row) and for climate scenario RCP8.5 (bottom row).



5.7 Wildfire Projections

Wildfire projections were derived from research done by Met Office Scientist Matthew Perry, who indicates that in higher warming scenarios there will be an increase in hazardous fire weather during the summer. Perry mentions there is also possibility for extension of the wildfire season into late summer and early autumn (Perry et al., 2022)[38].

Figure 23 shows the levels of fire danger in the summer for Wales at different warming periods into the future. Each plot is based on the daily 95th percentile which means that 5% of Wales is going to be affected by higher fire danger levels (Perry et al., 2022). There are noticeable increases between the period of 1981-2010 and the 2°C warming scenario and large increases between the period of 1981-2010 and the 4°C warming scenario. The percentage of days that will be affected by high fire danger levels is expected to double from the period of 1981-2010 to the 2°C warming scenario and increase by 5 times the period of 1981-2010 for the 4°C warming scenario.

[38] Perry et al. (2022) Past and future trends in fire weather for the UK. Natural Hazards Earth System Science, 22, 559-575.

Table 8 displays results for each month during the period of 1981-2010, the 2°C warming scenario and the 4°C warming scenario. The median values of 10-90th percentile uncertainty are displayed in the parenthesis for each month. Large increases in fire danger from the historical period can be seen in the months of May-September which further demonstrates the danger extending into early autumn. There is a significant difference between the 2°C and 4°C warming scenario.

Figure 23. Levels of fire danger in the period of 1981-2010, 2°C of warming and 4°C of warming in the summer of Wales[39].

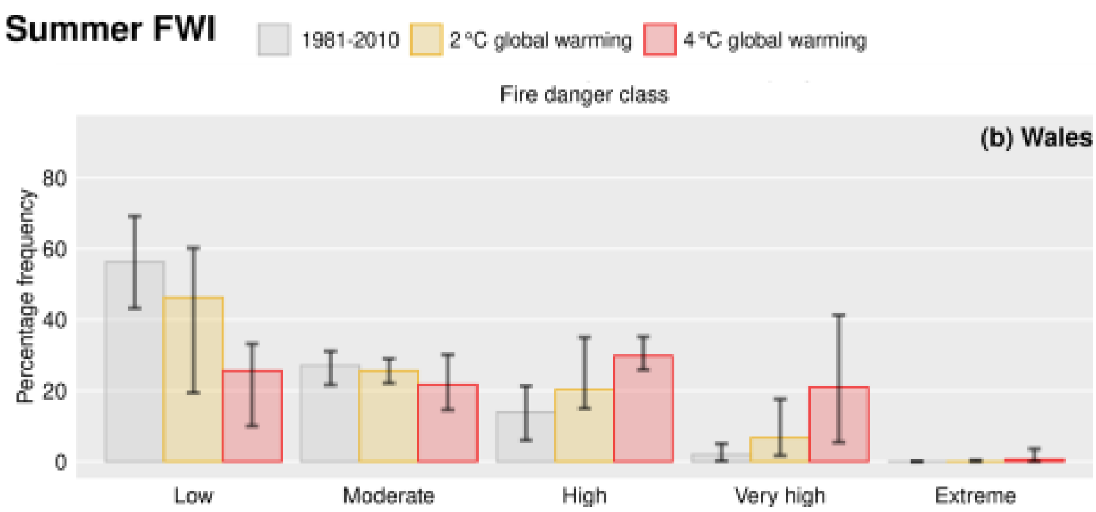


Table 8. Monthly percentage of days with dangerous fire weather for the UK in three different warming scenarios[40].

Month	1981–2010	2 °C global warming	4 °C global warming
February	1.8 (0.2–2.9)	1.5 (0.0–4.4)	1.5 (0.0–3.0)
March	2.8 (0.5–4.2)	3.0 (0.9–6.5)	3.0 (0.9–7.5)
April	5.8 (3.0–8.4)	6.4 (2.5–11)	8.2 (1.6–13)
May	8.4 (3.4–15)	14 (4.4–20)	18 (9.8–30)
June	3.3 (0.3–6.0)	8.0 (1.2–24)	23 (7.0–34)
July	9.2 (2.4–17)	27 (6.3–44)	44 (21–76)
August	9.1 (1.8–19)	25 (7.4–52)	55 (36–86)
September	3.2 (0.3–10)	18 (5.5–42)	44 (19–69)
October	0.2 (0.0–2.0)	1.1 (0.3–2.7)	6.4 (1.9–18)

[39] Ibid. ref 38.

[40] Ibid. ref 38.

6.0 Transition Risk

Transition risks are the challenges that arise because of the global shift towards a net-zero carbon economy, driven by efforts to mitigate climate change. The adoption of policies such as carbon pricing, renewable energy subsidies, and stricter emissions regulations, and the development of new technologies, can cause disruption or financially impact businesses.

In this climate change risk assessment, a range of transition risks which have the potential to impact Shotton Mill have been identified and scored, assuming the transition to a low-emissions economy occurs in line with the Network for Greening the Financial System's (NGFS) Divergent Net Zero scenario. In this scenario, different countries may implement varying policies and regulations, leading to an uneven playing field for businesses. Companies operating in jurisdictions with stringent regulations may face higher compliance costs or stranded assets if they are unable to adapt quickly. Other features of this scenario include the rapid development of new technology, high carbon prices, but with varying approaches to carbon pricing across different jurisdictions, and a reduction in Gross Domestic Product. This scenario has been selected because the assumption that different countries' policy responses to mitigate climate change will be uneven is currently reflected in the real world. It also represents a 'reasonable worst-case scenario,' because an uneven response to climate change is likely to be more challenging for businesses to navigate.

Figure 24. Key Assumptions of the 'Divergent Net Zero' Scenario[41].

		Physical risk	Transition risk			
Category	**Scenario**	**Policy ambition**	**Policy reaction**	**Technology change**	**Carbon dioxide removal**	**Regional policy variation**
Orderly	Net Zero 2050	1.4°C	Immediate and smooth	Fast change	Medium-high use	Medium variation
	Below 2°C	1.6°C	Immediate and smooth	Moderate change	Medium-high use	Low variation
Disorderly	Divergent Net Zero	1.4°C	Immediate but divergent across sectors	Fast change	Low-medium use	Medium variation
	Delayed Transition	1.6 °C	Delayed	Slow / Fast change	Low-medium use	High variation
Hot house world	Nationally Determined Contributions (NDCs)	2.6°C	NDCs	Slow change	Low-medium use	Medium variation
	Current Policies	3°C +	Non-currente policies	Slow change	Low use	Low variation

6.1 Further Context about Shotton Mill used in the Transition Risk Assessment

Once redeveloped and expanded, Shotton Mill will have a 750ktpa (kilotons per annum) containerboard manufacturing capacity and 70ktpa tissue paper manufacturing capacity. Eren Group intends to shift production at the site from newsprint, which has been in decline, to containerboard and tissue products, currently the UK is a net importer of containerboard and tissue and a new exporter of wastepaper, Eren Group perceives this as an opportunity to close both gaps by increasing production at the Shotton Mill site. By decreasing the need for import and export Eren Group argues that the investment will have a positive effect on climate change via avoided

[41] NGFS (2022) NGFS scenarios for central banks and supervisors

emissions ("saving over 120ktpa CO2eq" according to the climate change risk aspects of the SERV report).

6.1.1 Products Created

Product	Explanation	Projected revenue Proportion 2025 - 2040 by product type
Unbleached Testliner	Unbleached Testliner is a type of paperboard manufactured from recycled fibres. Unbleached Testliner is widely used in the production of corrugated cardboard boxes due to its strength and cost-effectiveness. These boxes are prevalent in many industries, including e-commerce, food and beverages, and consumer goods, offering robust packaging solutions.	**42%**
Recycled Fluting	Recycled fluting is primarily used in the creation of the corrugated layer found within corrugated cardboard; a material commonly used in packaging. Its inherent strength and elasticity make it the perfect candidate for this middle layer, providing rigidity and durability to the final product. Corrugated cardboard produced using recycled fluting is utilized extensively across numerous sectors, including e-commerce, shipping, and manufacturing industries.	**42%**
Virgin Tissue	Virgin tissue paper is a type of paper product manufactured directly from raw materials, usually wood pulp sourced from trees, instead of using recycled materials. Virgin tissue paper is extensively used in the production of a variety of consumer products such as toilet paper, paper towels, napkins, and facial tissues. The qualities of virgin tissue paper, such as high absorbency and softness, make it particularly suitable for personal hygiene applications where consumer preference leans towards these attributes.	**12%**
Recycled tissue	Recycled tissue paper is a type of paper product that is made primarily from recycled paper pulp. The pulp is derived from a variety of paper waste sources, including office paper, newspapers, and packaging materials. Recycled tissue paper is used extensively in a wide range of consumer products, including toilet paper, napkins, paper towels, and facial tissues. While recycled tissue may not offer the same level of softness or strength as its virgin counterpart, reduces the demand for virgin pulp.	**4%**

6.1.2 Target Market

Shotton Mill primarily intends to sell to the UK, potentially also exporting to mainland Europe.

Expected clients are UK based or international packaging and paper companies such as DS Smith, CEPAC, Pro Group, Logson and VPK. Customers which are not vertically integrated (i.e., do not have a paper mill) will be more dependent on Shotton Mill's Products, such as the UK based business CEPAC and Logson.

6.1.3 Costs and Supplies

A key supply for the paper mill is fibres, which are primarily mixed paper and "Old Corrugated Cardboard". Veolia, Suez, Bifa, Vipa is expected to be among fibre suppliers, the site also owns its own materials recovery and recycling facility to assist with sourcing these supplies.

Chemicals are another key supply, these include starch and a wide variety of pulping chemicals, bleaching agents, sizing agents, biocides, and pH adjusters among others.

Other significant costs include energy and personnel. Existing operations employ approximately 190 people. The proposed development would require this to rise to approximately 853 according to the Environmental Impact Assessment.

Cost Category	Projected Cost Proportion 2025	Projected Cost Proportion 2040
Fibres	42%	48%
Chemicals	13%	14%
Energy	31%	24%
Personnel	13%	4%
Other costs	10%	10%

6.1.4 Emissions

According to the associated Greenhouse Gas Estimation Report it is projected that the climate impact of the operation of Shotton Mill will be 686,338 tCO_2e per annum. The most significant proportion of GHG emissions (around 40%) comes from the onsite CHP plant which consumes natural gas to produce electricity and heat for onsite usage. Shotton Mill is included in the UK Emissions Trading Scheme, which incentivises businesses to make cost-effective emissions reductions in line with the UK's Net Zero 2050 target.[42]

6.1.5 Current Policies and Targets

As of the present time Shotton Mill does not have processes or policies in place relating to notifying, managing, or responding to transition related risks as they are in effect a new business, they will be creating these processes. The business has not yet set climate targets or defined a transition plan.

7.0 UK NCC Compatibility

7.1 Climate Change Act 2008

The foundational legislative framework for the UK's climate action was established by the Climate Change Act 2008. In 2019, the UK government, heeding the advice of the Climate Change Committee (CCC), enacted the Climate Change Act 2008 (2050 Target Amendment) Order 2019, committing the UK to a legally binding target of a 100% reduction in greenhouse gas emissions by 2050 compared to the 1990 baseline, known as the 'net zero target'. The Act specifies that achieving net zero will involve not only reducing emissions but also implementing measures to offset greenhouse gases, such as afforestation and carbon capture and storage technologies, thus balancing out the total emissions produced with the equivalent amount of greenhouse gases removed from the atmosphere.

This target mandates that all parts of the UK achieve net zero by 2050, albeit with distinct emissions profiles and strategies for reaching this goal. While England, Wales, and Northern Ireland are on a path to net zero by 2050, Scotland aims to become a net zero economy by 2045[43].

7.2 UK Carbon Budgets

Pursuant to Section 4 of the Climate Change Act 2008, the UK government is mandated to establish carbon budgets every five years, projecting twelve years ahead, spanning from 2008 to

[42] https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets

[43] https://commonslibrary.parliament.uk/research-briefings/cbp-9888/

2050, with a legal obligation to adhere to these budgets. Carbon budgets serve as a legally binding limit on the total quantity of greenhouse gases the UK is allowed to emit over a five-year timeframe. The set carbon budgets are as follows:

- The initial carbon budget, spanning 2008 to 2012, imposed an emissions cap of 3,018 $MtCO_2e$ of carbon dioxide equivalent ($MtCO_2e$), marking a 26% decrease from 1990 levels.
- The second carbon budget, from 2013 to 2017, set an emissions limit of 2,782 $MtCO_2e$, a 32% reduction from 1990 levels.
- The third carbon budget, covering 2018 to 2022, established an emissions cap of 2,544 $MtCO_2e$, achieving a 38% reduction from 1990 levels.
- For the fourth carbon budget, the period from 2023 to 2027 has an emissions limit of 1,950 $MtCO_2e$, indicating a 52% decrease from 1990 levels.
- The fifth carbon budget, from 2028 to 2032, places a cap at 1,725 $MtCO_2e$, a 58% reduction from 1990 levels.
- The sixth carbon budget, covering 2033 to 2037, sets an emissions limit of 965 $MtCO_2e$, reflecting a 78% reduction from 1990 levels.
- A seventh carbon budget is scheduled to be established in 2025 for the period extending from 2038 to 2042.

The UK has already met, and overachieved, its first (2008-2012) and second (2013-2017) carbon budgets and is on track to meet the third (2018-2022)[44]. However, as noted in the 2023 Progress Report from the Climate Change Committee to Parliament, there are concerns about the UK meeting its fourth and fifth budgets, as well as its 2030 NDC target[45].

While these carbon budgets are applicable across the UK, Wales has adopted distinct carbon budget periods compared to England and Northern Ireland. In Scotland, the legislation does not necessitate the setting of carbon budgets; however, it does require adherence to annual carbon reduction targets. The emissions from all four UK regions contribute towards the national carbon budgets, despite variations in their individual legislative and policy approaches.

7.3 Wales Carbon Budgets

The emission reduction targets for Wales are established by the Environment (Wales) Act (2016). In March 2021, the Senedd escalated its climate ambitions by committing Wales to achieving net zero emissions by the year 2050. This commitment was accompanied by updates to the Act to include modified interim targets and the introduction of the second and third carbon budgets. These revisions outline a trajectory towards net zero, specifying a 37% reduction in emissions for the UK's Carbon Budget 2 (2021-25), a 58% reduction for Carbon Budget 3 (2026-30), leading up to a 63% reduction by 2030, an 89% reduction by 2040, and ultimately aiming for at least a 100% reduction (net zero) by 2050, all without relying on international offsets.

7.4 UK NDC

In December 2020, the United Kingdom solidified its climate action commitment by submitting an updated Nationally Determined Contribution (NDC) to the UNFCCC, in accordance with Article 4 of the Paris Agreement. This commitment involves a pledge by the UK to cut its greenhouse gas emissions by at least 68% by 2030, relative to the levels in 1990.

As the host country of the COP26 summit held in Glasgow, the UK embarked on a thorough reassessment of its NDC. This reassessment aimed to align the UK's climate efforts to keep global warming within 1.5C, in line with the Paris Agreement and to explore opportunities for enhancing

[44] https://assets.publishing.service.gov.uk/media/6424b2d760a35e000c0cb135/carbon-budget-delivery-plan.pdf

[45] https://www.theccc.org.uk/wp-content/uploads/2023/06/Progress-in-reducing-UK-emissions-2023-Report-to-Parliament-1.pdf

these efforts in line with the highest standards of environmental stewardship. The review process incorporated an array of considerations, including the latest scientific insights, objectives outlined in the Paris Agreement and the Glasgow Climate Pact, the UK's goal to reach net zero emissions by 2050, issues of energy security, and recommendations from the Climate Change Committee and other advisory bodies.

Moreover, the UK has enacted several enhancements to its NDC which are documented in the Information to Facilitate Clarity, Transparency, and Understanding (ICTU) that accompanies the NDC. Key updates include[46]:

- A detailed clarification of how the UK's ambitious target to reduce its greenhouse gas emissions by at least 68% by 2030, based on 1990 levels, is in line with the 1.5C target of the Paris Agreement.
- An explanation of the strategies and policies the UK intends to implement to achieve its NDC by 2030, considering the initiatives and plans unveiled since the initial submission of the NDC in December 2020.

The most relevant policies from the UK are:

- UK Industrial Decarbonisation Strategy
- Third National Adaptation Plan (NAP3)
- UK Emissions Trading Scheme (ETS)

These are discussed in the subsequent sections below.

7.5 UK Industrial Decarbonisation Strategy

The UK's Industrial Decarbonisation Strategy sets targets to significantly reduce emissions by approximately two-thirds by 2035 and by at least 90% by 2050 compared to current levels. To achieve these goals, the strategy emphasizes the importance of adopting "low-regret" technologies and retrofitting existing infrastructure to minimize carbon output without committing to high carbon production methods in the long term. This approach aligns with the UK's carbon budgets and the Paris Agreement commitments. The strategy sets out plans to establish four low carbon industrial clusters by 2030 and at least one fully net zero cluster by 2040.

A key component of this strategy is fuel switching, specifically the increased use of low carbon fuels such as electricity, hydrogen, and bioenergy to replace fossil fuels. Action 4.2 of the strategy underscores the critical role of hydrogen in this transition, projecting a minimum replacement of 20 TWh per year of fossil fuel use with low carbon alternatives by 2030. The strategy outlines the potential for hydrogen consumption in industrial applications, ranging from 10 TWh per year in limited uptake scenarios to as much as 86 TWh by 2050 in more widespread adoption scenarios. It highlights the necessity of demonstrating fuel switching to hydrogen in industrial sites alongside scaling up low carbon hydrogen production[47].

The Solar Turbines technology used in the project is "hydrogen ready," capable of incorporating up to 20% hydrogen, which would result in a 7% carbon reduction once hydrogen becomes commercially available. This readiness for hydrogen conversion demonstrates Shotton Mill as an adopter of low carbon fuel technologies, in line with the UK government's decarbonisation objectives. Since there are no specific requirements at present for plants to move towards 100% hydrogen, we can judge that based on the current UK policy, the Shotton Mill project is aligned with Action 4.2 through its readiness for hydrogen conversion.

---

[46] https://commonslibrary.parliament.uk/research-briefings/cbp-9888/

[47] https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

Furthermore, Action 4.1 focuses on supporting the deployment of Carbon Capture, Usage, and Storage (CCUS) technology on industrial sites, aiming to capture and store around 3 $MtCO_2$ per year by 2030. The strategy states CCUS is essential for reducing emissions from industrial processes to levels consistent with achieving net zero, with projections indicating emission reductions from CCUS could reach between 8 and 14 $MtCO_2$ per year by 2050.

While carbon capture technology is not currently available or viable to the Shotton Mill project, its SERV report outlines the potential for implementing carbon capture technology within the next decade, highlighting the mill's engagement in local consortia investigating this technology. Carbon Capture technology can be applied to Solar Turbomachinery. As part of the CATERPILLAR group, turbine manufacturers Solar have in-house carbon capture technology which can be supplied as a retrofit in the future. Depending on the technical and commercial viability there is the possibility of future investment in this technology. The possibility of retrofitting Solar Turbomachinery with carbon capture technology demonstrates Shotton Mill's proactive approach to exploring future investment in CCUS, aligning with the UK government's plans to deploy CCUS technologies on industrial sites.

7.6 Third National Adaptation Programme (NAP3)

The UK's third National Adaptation Programme (NAP3) is an initiative developed by the government in collaboration with stakeholders across various sectors and governmental levels. NAP3 aims to tackle the risks and harness the opportunities presented by climate change. This program is in line with section 58 of the Climate Change Act 2008 (CCA 2008) and focuses on responsibilities related to England and non-devolved functions for the rest of the UK.

Under the legislative framework established by the CCA 2008, the UK government is required to conduct a Climate Change Risk Assessment (CCRA) every five years, followed by a National Adaptation Programme that outlines strategies to address identified risks. Currently, the UK is in its third cycle of risk assessment and adaptation planning under this act.

The government is setting standards and regulations to align private sector incentives with climate goals, enabling private investment in adaptation efforts. In the energy sector, as systems decarbonize and others electrify to meet net zero targets, managing the energy system's exposure to climate hazards becomes crucial.

To intensify efforts in climate adaptation within the energy sector, the UK's Department for Energy Security and Net Zero (DESNZ) and Ofgem, the energy regulator, have outlined specific actions aimed at bolstering the resilience of the energy infrastructure against climate and weather-related hazards. These actions include:

1. Assigning clear responsibilities to designated parties for the ongoing maintenance of energy sector codes and standards, emphasizing the imperative to enhance climate and weather resilience.
2. Guaranteeing that licensed network businesses within England adhere to the regulatory framework established by Ofgem. This compliance extends to meeting other statutory requirements, such as those outlined in the Electricity Act and the Electricity Safety, Quality, and Continuity Regulations, under the oversight of both DESNZ and the Health and Safety Executive (HSE).
3. Promoting investment in the resilience of infrastructure through Ofgem's price control framework. This approach is designed to strike a balance between network investments, the returns companies can expect, and the operational charges levied by these networks, ensuring they have the financial resources needed to invest in enhancing the resilience of their sites and assets.
4. Implementing clear standards for infrastructure resilience within the price control mechanism, thereby providing network companies with the necessary revenue streams to support investments in the resilience of their infrastructure.

In addition to these actions, DESNZ has committed to conducting an internal review of the governance arrangements pertaining to resilience against climate hazards within the energy system by 2024. This review is critical for adapting governance structures to the evolving and increasingly diversified low-carbon energy system.

Furthermore, DESNZ and Ofgem will undertake periodic assessments of climate resilience for both existing and new energy plants. This includes evaluating plants that are classified as Nationally Significant Infrastructure Projects during the planning application process. Starting from 2024, the environmental permitting regime will increasingly integrate climate risk management into the management systems of relevant sites. Additionally, a rigorous risk assessment will be conducted for the most critical energy sites, systems, and assets, leveraging the UK government's 'Criticalities' process for identifying Critical National Infrastructure (CNI) [48].

Natural Resources Wales also has a role in encouraging businesses to adapt to climate change. It produces guidance and tools to help businesses understand the risks they face and develop adaptation plans. Additionally**,** Natural Resources Wales can take enforcement action against businesses that cause significant pollution or environmental damage, which could include damage caused by a lack of adaptation to climate change. The NAPs published every 5 years are not currently directly mandatory for businesses but they provide a clear signal of the government's expectations and direction of travel for adaptation policy. Natural resources Wales requires nuclear sites and COMAH sites to produce climate change risk assessments and adaptation plans. However this requirement does not current extend to other types of site. As such, Shotton Mill is currently aligned with the guidance set out in NAP3 and Natural Resources Wales policy framework for adaptation.

7.7 UK Emissions Trading Scheme (ETS)

The UK Emissions Trading Scheme (UK ETS) replaced the UK's participation in the European Union Emissions Trading Scheme (EU ETS) on 1 January 2021. The UK, Scottish and Welsh Governments and Northern Ireland Department of Agriculture, Environment and Rural Affairs – collectively making up the UK ETS Authority – established the scheme to increase the climate ambition of the UK's carbon pricing policy, while protecting the competitiveness of UK businesses. The UK ETS is established through The Greenhouse Gas Emissions Trading Scheme Order 2020.

The UK ETS applies to energy intensive industries, the power generation sector and aviation. Shotton Mill's CHP plant falls under the scope of the UK ETS under Schedule 2 of the Greenhouse Gas Emissions Trading Scheme Order 2020. Shotton Mill has successfully applied for and has obtained a GHG permit from Natural Resources Wales, which is required by the UK ETS. This permit will be varied for the new installation in line with the start up schedule and the permit variation window.

7.8 Forward-looking assessments of UK Policy Landscape

The UK has one of the most aggressive greenhouse gas emissions reduction commitments globally, and this commitment is enshrined in law through the Climate Change Act. The initial target set in 2008 to reduce emissions by 80% by 2050 compared to 1990 level was further increased in 2019 by committing to reach net zero greenhouse gas emissions by 2050. In addition, the 2019 amendment committed the government to reduce emissions by 78% by 2035 compared to 1990 levels, significantly increasing the pace of decarbonization.

Therefore, while there may not be significant additional legislation or political commitments from the current government, it is reasonable to expect that future governments will face increasing pressure to increase the speed of decarbonization to meet these targets. Future governments are likely to be compelled by the courts to act if they fail to do so.

---

[48] https://www.gov.uk/government/publications/third-national-adaptation-programme-nap3

This is particularly likely given the independent Climate Change Committee publishes a progress report to Parliament every June highlighting areas that are falling short.

Indeed, we have already seen this happen in the UK with the English High Court ordering the UK government to refine and reissue its 2021 Net Zero Strategy. In July 2022, following a claim brought against the government by Friends of the Earth, ClientEarth and the Good Law Project, the English High Court determined the 2021 Net Zero Strategy to be "unlawful" and "inadequate" in meeting the 2050 net zero target[49]. The government updated its commitments and plans in March 2023 in response. In October 2023, these NGOs requested a judicial review of the revised UK Net Zero Strategy, arguing that it relies on "unproven and high-risk technological fixes"[50].

Should future governments be compelled to increase the range and extent on policy levers available to them to reduce emissions, by the courts or otherwise, they may consider some of the following:

- Increase the scope of the UK Emissions Trading Scheme;
- Set a higher floor price for the UK Emissions Trading Scheme (or similar mechanism to increase the cost to pollute);
- Require specific energy efficiency performance standards in buildings and/or industrial processes (it is likely that some form of subsidized funding would be made available to offset costs for businesses if this were to happen).
- Increase the scope of reporting requirements.

7.9 Conclusion

The Shotton Mill project has met all of the UK regulatory gateways as part of the local authority planning process for which it has full permission. The CHP application has been screened by Planning and Environment Decisions Wales (PEDW) who will authorise the development in Wales and they have confirmed that the development meets the requirements for an application to be made. Based on our review of the project nothing has come to our attention to suggest that Shotton Mill is not currently aligned with the different UK climate policy instruments detailed in this report and the NDC.

8.0 Risk Assessment

Climate-related risks relevant to the project were initially identified by screening the physical climate hazards presented in the EU Taxonomy. Risks were then identified through a blend of desk-based research, peer- and sector-reviews, and internal resources (e.g., SLR's proprietary industry-based risk and opportunity database). Project components that related to different risks were identified and the risks were then described via impact pathway statements. Project components considered were predefined and are presented in Table 9.

Please note, the CCRA only considers potential Project risks occurring during operations (e.g., damage to infrastructure). Whilst the Project Descriptions included in the ESIA Reports do not include maintenance activities, this CCRA has assumed that some maintenance activities will be required in the future. Whilst the details of such activities are unknown, SLR has evaluated likely workforce-related maintenance risks as park of this CCRA and included them in the table below. Potential Project risks occurring because of construction activities have been scoped out as the construction phase occurs for less than 24 months and it has been determined that climate change effects are not predicted to materially change from the baseline conditions assessed in the ESIA by this time.

[49] https://www.whitecase.com/news/media/landmark-high-court-decision-uks-net-zero-strategy-unlawful

[50] https://www.clientearth.org/latest/news/we-re-taking-the-uk-government-over-its-net-zero-strategy/

Table 9. Project components considered in climate risk assessment.

Primary Component	Secondary Components
Infrastructure	• Existing Biomass plant Combined Heat and Power (CHP) facility (69m stack). • New CHP Facility with (three 75m stacks and one 30m stack). • Cooling tower (15m height). • Containerboard paper machine and building. • Corrugating machine and building. • Effluent treatment facility and lagoons. • Tissue machine buildings. • Other Buildings (corrugated cardboard building, pulp storage building, reel storage building, converter building, finished goods warehouse, truck loading building). • Road access. • Sustainable Urban Drainage System (SuDS)
Workforce	• 190 workers, including production staff, engineering support, and administration and management. • Additional workforce due to the redevelopment.
Operations	• Manufacture of tissue. • Manufacture of containerboard. • Water Treatment. • Generation of Electricity.

The below tables set out the identified risks, explain how they could impact the project and the related climate impact. For each risk, scores of 1-5 are shown for sensitivity, adaptive capacity, vulnerability, magnitude of impact and likelihood of occurrence. **For more details on the scoring** methodology **please see** Section 3.4.

Vulnerability scores are combined with magnitude of impact and likelihood of occurrence for each time frame to give a normalised risk score from 1-100.

Risk categories are arranged as follows:

- Score 1 to 20: low risk
- Score 20 to 40: medium risk
- Score 40 to 60: high risk
- Score 60 to 80: very high risk
- Score 80 to 100: extreme risk

For physical risks, the magnitude of impact and likelihood were scored over three time periods: ‘short-term’ (2020-2039), ‘medium-term’ (2040-2059), and ‘long-term’ (2080-2099). Please note, the ‘2040-2059’ period was chosen to represent the ‘medium term’ to cover the expected life of the asset. The decision was taken to use the ‘2080-2099’ time period for the ‘long-term’ to provide the longest possible view on potential physical impacts for which data is readily available through the sources used such as UKCP18 and the World Bank Climate Knowledge Portal.

For **transition risks**, the magnitude of impact and likelihood were scored over three time periods: short term: 0-5 years (2023-2028), medium term: 5-10 years (2028-2033) and long term: 10-30 years (2033-2053). These time horizons have been selected to follow a business perspective and be compatible with the Project’s capital planning and investment horizons and the asset life. Discussions with the Eren Group indicated that payback of equipment is based on 15 years and payback on buildings is 30 years.

For each time period ('short-term', 'medium-term' and 'long-term'), a risk score from 1-100 is provided. In addition, the risk scores across all time periods were summed to provide an indication of the significance of the risk regardless of timeframe. Please note, the summed risk score view is merely used to prioritise risks across all timeframes for the purposes of proposing mitigation measures and should not be viewed as an indication as to the significance of the risk. For a view of the significance of each risk, risk scores for each timeframe should be used.

A Hot House World (RCP8.5 high-emissions scenario) was considered for physical risks; while a Divergent Net Zero scenario was considered for transition risks. Both of these scenarios were chosen to provide a 'reasonable worst-case scenario' for these two risk categories.

STORM SURGE			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Operations Reduced operational capability and production output. **Infrastructure** Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. **Workforce** Deleterious working conditions, including risk to life.	• Structural damage to mill buildings, warehouses, storage facilities, etc., caused by strong winds and storms. • High rise structures such as the stacks and cooling towers may be especially vulnerable to damage. • Compromise of roofing, walls, windows, potentially leading to safety hazards and operational disruptions. • Power outages and electrical disturbances resulting from storms, possibly damaging sensitive machinery. • Impacts on critical components like motors, generators, and control systems, causing operational downtime and repair costs. • Employee safety risks from strong winds, falling debris, and structural damage. • Potential need for temporary shutdowns or evacuations to ensure employee safety, leading to further operational disruptions.	**Sensitivity**: The site has an elevation of 4.6m (AoD) and has installed flood defences which can both help to mitigate the effects of storm surges. Therefore, the site is considered to have a low sensitivity to storm surges. **Adaptive capacity:** The site already has flood defences in place. However, increasing the flood defences is expected to be very expensive to and therefore the adaptive capacity is considered very low. **Magnitude:** As sea level rises into the future, even small increases can lead to increased magnitude of storm surge events. With sea level rise projected to increase by 0.27m in the medium term and 0.65m in the long term under a hot house world scenario, the magnitude of this risk is projected to be more significant in the medium to long term. **Likelihood:** Under a hot house world scenario, storm surges are expected to occur and worsen as time goes on as the sea level continues to rise.	Sensitivity 2 Adapt. Capacity 2 Vulnerability 3 **Short Term (2020-2039)** Magnitude 2 Likelihood 2 **RISK SCORE 10** **Medium Term (2040-2059)** Magnitude 3 Likelihood 3 **RISK SCORE 22** **Long Term (2080-2099)** Magnitude 4 Likelihood 4 **RISK SCORE 38** **All Time Periods** **Sum Risk Score** **70**

HEAVY PRECIPITATION			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Operations Reduced operational capability and production output. **Infrastructure** Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. **Workforce** Deleterious working conditions, including risk to life.	• Excessive rainfall and flooding may cause structural damage to mill's buildings, warehouses, and other infrastructure due to potential weakening of foundations, collapsing walls, and leaking or collapsing roofs. • Flooding can cause damage to critical machinery and equipment, leading to electrical failures, corrosion, and mechanical malfunctions. • Heavy precipitation and flooding may lead to power outages, disrupting operations and causing production delays and financial losses. • Potential contamination of raw materials and finished products due to flooding. • Disruption of transportation networks by heavy precipitation and flooding, causing delivery delays, inventory shortages, and potential customer dissatisfaction. • Safety and health risks to employees from flooded areas, including physical injuries and exposure to contaminated water. • Possible need for temporary shutdowns or evacuations to ensure employee safety, further impacting operations.	**Sensitivity:** The site is considered to have a moderate sensitivity to the risk because heavy precipitation is expected to affect some critical operations, such as transport in and out of the site. However, the business is expected to be able to tolerate such disruption and not be affected for more than 1 day. **Adaptive capacity:** The development proposes to include a new Sustainable Urban Drainage System which is expected to mitigate this risk considerably. There is also risk of transportation networks being affected which could lower productivity as workers cannot get into and out of the site, and this risk is mostly out of the site's control. However, soft adaptation measures such as pausing certain operations can be implemented at relatively low cost. **Magnitude:** Heavy precipitation is going to occur into the future and jumps from 200 mm per annum in the short and medium term to almost 300 mm in the long term. This means the potential size of the impact on the site will be higher in the long term. **Likelihood:** Precipitation patterns change yearly by 200+mm in every timeframe. This is a significant change in annual rainfall which is	Sensitivity 3 Adapt. Capacity 4 Vulnerability 2.5 **Short Term (2020-2039)** Magnitude 2 Likelihood 4 **RISK SCORE 16** **Medium Term (2040-2059)** Magnitude 2 Likelihood 4 **RISK SCORE 16** **Long Term (2080-2099)** Magnitude 3 Likelihood 4 **RISK SCORE 24** **All Time Periods** **Sum Risk Score 56**

		highly likely to affect the site and therefore this risk is considered likely to occur.	

PLUVIAL FLOODING			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Operations Reduced operational capability and production output. **Infrastructure** Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. **Workforce** Deleterious working conditions, including risk to life.	• Excessive rainfall and flooding may cause structural damage to mill's buildings, warehouses, and other infrastructure due to potential weakening of foundations, collapsing walls, and leaking or collapsing roofs. • Flooding can cause damage to critical machinery and equipment, leading to electrical failures, corrosion, and mechanical malfunctions. • Heavy precipitation and flooding may lead to power outages, disrupting operations and causing production delays and financial losses. • Potential contamination of raw materials and finished products due to flooding. • Disruption of transportation networks by heavy precipitation and flooding, • causing delivery delays, inventory shortages, and potential customer dissatisfaction. • Safety and health risks to employees from flooded areas, including physical injuries and exposure to contaminated water. • Possible need for temporary shutdowns or evacuations to ensure employee safety, further impacting operations.	**Sensitivity:** Since the site is prone to intense periods of rain there is some sensitivity to this risk. However, the trends in precipitation patterns do not show any extreme rainfall events into the future that are likely to cause an extreme amount of flooding. **Adaptive capacity:** The development proposes to include a new Sustainable Urban Drainage System which is expected to mitigate this risk considerably. **Magnitude:** If pluvial flooding were to occur it could cause structural damage to the mill's buildings, warehouses, and other infrastructure due to potential weakening of foundations, collapsing walls, and leaking or collapsing roofs. The intensity of rainfall is projected to worsen in a longer-term scenario; hence the magnitude of impact is expected to increase over time and in higher warming scenarios. **Likelihood:** Natural Resources Wales considers the likelihood of flooding from pluvial sources to be low. However, precipitation levels are projected to increase in the long-term, hence a higher likelihood score has been assigned in the long term.	Sensitivity 3 Adapt. Capacity 4 Vulnerability 2.5 **Short Term (2020-2039)** Magnitude 3 Likelihood 2 **RISK SCORE 12** **Medium Term (2040-2059)** Magnitude 3 Likelihood 2 **RISK SCORE 12** **Long Term (2080-2099)** Magnitude 4 Likelihood 3 **RISK SCORE 24** **All Time Periods** **Sum Risk Score 48**

COASTAL FLOODING/SEA LEVEL RISE			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Infrastructure Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. Additional costs to build flood defences may be required. **Workforce** Deleterious working conditions, including risk to life.	• Coastal flooding of the local areas could damage buildings, machinery, and electrical systems, disrupting operations and leading to financial losses. • Rising sea levels increases the probability of coastal flooding due to storm surges and extreme high tides and could lead to flooding of the local Dee Estuary. • The site location, elevation and existing flood defences make it relatively safe from the effects of sea level rise, coastal flooding, and storm surge, provided this risk continues to be managed.	**Sensitivity:** The site is judged to have a low sensitivity to this risk as disruption would be minimal given the site is elevated to 4.6m AOD and is equipped with flood defences to protect against this risk. **Adaptive capacity:** The site has flood defences in place, however further adaptation measures would be required to defend against coastal flooding such as building new sea walls. Such adaptation measures are very expensive. **Magnitude:** While the site itself is located far away from the coast, flooding of the local Dee estuary could disrupt supply chains and roads. An increasing magnitude score across time horizons is assigned as the risk of coastal flooding increases over time and with increased warming. **Likelihood:** A low likelihood score is assigned as climate projection data from Natural Resource Wales considers the site's elevation and flood defences and hence defines coastal flood risk as low in the short term. However, as the sea level rises over time and in higher warming scenarios, the likelihood of extreme water levels from storm surges increases and are projected to worsen into the future. Hence, an increasing likelihood score is assigned across the defined time horizons.	Sensitivity 2 Adapt. Capacity 2 Vulnerability 3 **Short Term (2020-2039)** Magnitude 1 Likelihood 2 **RISK SCORE 5** **Medium Term (2040-2059)** Magnitude 2 Likelihood 3 **RISK SCORE 14** **Long Term (2080-2099)** Magnitude 3 Likelihood 4 **RISK SCORE 29** **All time periods** **Sum Risk Score 48**

<table>
<tr><th colspan="3">DROUGHT</th><th colspan="2">Risk Scoring</th></tr>
<tr><td>Risks to Project Components</td><td>Impact Pathways</td><td>Risk Scoring Justification</td><td colspan="2"></td></tr>
<tr><td rowspan="16">Infrastructure
Increased maintenance requirements and operating costs.

Operations
Reduced operational capability and production output.

Reduced water treatment capability.</td><td rowspan="16">• Insufficient water supply can disrupt the operations of the project, affecting processes like pulping, cleaning, and paper formation.
• Water shortages can lead to decreased output or temporary shutdowns.
• Inadequate cooling may impact the quality of paper, machinery performance, and overall energy efficiency.
• Limitation on water availability for cooling purposes due to water stress.
• Drought may lead to inefficiencies or need for alternative cooling solutions.
• Water scarcity may lead to increased costs of water.
• Severe droughts could lead to ground instability, causing potential damage to roadways.
• The effectiveness of the effluent treatment facility and lagoons may be impaired by reduced water flow.</td><td rowspan="16">Sensitivity: The mill relies on water availability for manufacturing; therefore, a drought can inhibit the ability to secure an adequate water supply which could lead to disruptions in production or increased costs for alternative water sources. Therefore, the site is considered to have high sensitivity to the risk.

Adaptive capacity: A neutral adaptive capacity score is assigned as the site can implement measures, such as water storage, at relatively low cost.

Magnitude: Droughts could cause deleterious working conditions and present risk to human life. The magnitude of impact is expected to increase from minimal to moderate over the three timeframes and with greater warming.

Likelihood: UKCIP data indicates that the probability of drought occurrence is expected to increase in Wales in the future, therefore the likelihood scores are projected to increase from ‘very unlikely’ to ‘possible’ over the three timeframes and with greater warming.</td><td>Sensitivity</td><td>4</td></tr>
<tr><td>Adapt. Capacity</td><td>3</td></tr>
<tr><td>Vulnerability</td><td>3.5</td></tr>
<tr><td colspan="2">Short Term (2020-2039)</td></tr>
<tr><td>Magnitude
Likelihood</td><td>1
1</td></tr>
<tr><td>RISK SCORE</td><td>3</td></tr>
<tr><td colspan="2">Medium Term (2040-2059)</td></tr>
<tr><td>Magnitude</td><td>2</td></tr>
<tr><td>Likelihood</td><td>2</td></tr>
<tr><td>RISK SCORE</td><td>11</td></tr>
<tr><td colspan="2">Long Term (2080-2099)</td></tr>
<tr><td>Magnitude</td><td>3</td></tr>
<tr><td>Likelihood</td><td>3</td></tr>
<tr><td>RISK SCORE</td><td>25</td></tr>
<tr><td colspan="2">All Time Periods</td></tr>
<tr><td>Sum Risk Score</td><td>39</td></tr>
</table>

FLUVIAL FLOODING			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Operations Reduced operational capability and production output. **Infrastructure** Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. **Workforce** Deleterious working conditions, including risk to life.	• Excessive rainfall and flooding may cause structural damage to mill's buildings, warehouses, and other infrastructure due to potential weakening of foundations, collapsing walls, and leaking or collapsing roofs. • Flooding can cause damage to critical machinery and equipment, leading to electrical failures, corrosion, and mechanical malfunctions. • Heavy precipitation and flooding may lead to power outages, disrupting operations and causing production delays and financial losses. • Disruption of transportation networks by heavy precipitation and flooding, causing delivery delays, inventory shortages, and potential customer dissatisfaction. • Safety and health risks to employees from flooded areas, including physical injuries and exposure to contaminated water. • Possible need for temporary shutdowns or evacuations to ensure employee safety, further impacting operations.	**Sensitivity:** The site is considered to have moderate sensitivity to this risk as flooding would be expected to disrupt operations. **Adaptive capacity:** The site has flood defences in place, however further adaptation measures would be required to defend against pluvial flooding such as building new storm drains. Such adaptation measures are considered to be very expensive. **Magnitude:** Flooding can cause damage to critical machinery and equipment, leading to electrical failures, corrosion, and mechanical malfunctions. There may be possible need for temporary shutdowns or evacuations to ensure employee safety, further impacting operations. The flooding would worsen in a longer-term scenario which is the magnitude is higher. **Likelihood:** Natural Resources Wales considers the likelihood of flooding from rivers to be low. These scores are lower than pluvial flooding since climate projection data suggests a low likelihood of fluvial flooding.	Sensitivity 3 Adapt. Capacity 2 Vulnerability 3.5 **Short Term (2020-2039)** Magnitude 3 Likelihood 1 **RISK SCORE 8** **Medium Term (2040-2059)** Magnitude 3 Likelihood 1 **RISK SCORE 8** **Long Term (2080-2099)** Magnitude 4 Likelihood 2 **RISK SCORE 22** **All Time Periods** **Sum Risk Score 38**

WATER STRESS			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Infrastructure Increased maintenance requirements and operating costs. **Operations** Reduced operational capability and production output. Reduced water treatment capability.	• Insufficient water supply can disrupt the operations of the project, affecting processes like pulping, cleaning, and paper formation. • Water shortages can lead to decreased output or temporary shutdowns. • Inadequate cooling may impact the quality of paper, machinery performance, and overall energy efficiency. • Limitation on water availability for cooling purposes due to water stress. • Drought may lead to inefficiencies or need for alternative cooling solutions. • Water scarcity may lead to increased costs of water. • Severe droughts could lead to ground instability, causing potential damage to roadways. • The effectiveness of the effluent treatment facility and lagoons may be impaired by reduced water flow.	**Sensitivity:** The mill relies on water availability for manufacturing; therefore, a water stress can inhibit the ability to secure an adequate water supply which could lead to disruptions in production or increased costs for alternative water sources. Therefore, the site is considered to have high sensitivity to this risk. **Adaptive capacity:** A neutral adaptive capacity score has been assigned as alternative water supply options can be sourced in the event of chronic water stress and storage systems can be put in place at relatively low cost. **Magnitude:** Water stress might affect key production operations and the site might have to shut down if there is insufficient water supply. Furthermore, the magnitude score increases into the long term due to the projected increase in number of annual dry days as per UKCIP data. **Likelihood:** UKCIP data indicates that the probability of drought occurrence and number of dry days is expected to increase in Wales in the future therefore the likelihood increases from 'very unlikely' to 'possible' over the three timeframes and with greater warming.	Sensitivity 4 Adapt. Capacity 3 Vulnerability 3.5 **Short Term (2020-2039)** Magnitude 1 Likelihood 1 **RISK SCORE 3** **Medium Term (2040-2059)** Magnitude 1 Likelihood 2 **RISK SCORE 6** **Long Term (2080-2099)** Magnitude 3 Likelihood 3 **RISK SCORE 25** **All Time Periods** **Sum Risk Score 34**

WILDFIRES			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Infrastructure Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. **Workforce** Deleterious working conditions, including risk to life.	• Increased heat could reduce efficiency, strain cooling systems, and increase risk of overheating or fires. • Machinery critical to the production processes may be damaged. • Increased evaporation rates due to high temperatures could lead to reduced capacity and efficiency of waste treatment. • Heat stress may create negative health impacts and reduce the productivity of employees. • Possible need for temporary shutdowns or evacuations to ensure employee safety, further impacting operations.	**Sensitivity:** The site is considered to have a high sensitivity to this risk since disruption to operations could significantly impact the business. **Adaptive capacity:** Having evacuation plans, good communication, early warning systems, and backup data can be implemented at relatively low cost. **Magnitude:** The magnitude of wildfires is expected to stay the same in the defined short and medium timeframes. There is potential for more wildfires to occur in the longer-term warming scenario which is why a high magnitude of impact score has been assigned for this time frame. **Likelihood:** Temperatures are rising during the summer in the short term and significantly into the long term as the number of dry days in Wales is set to increase. However, the likelihood of wildfires occurring is considered 'very unlikely' in the near and medium term, rising to 'unlikely' in the longer term.	Sensitivity 4 Adapt. Capacity 4 Vulnerability 3 **Short Term (2020-2039)** Magnitude 3 Likelihood 1 **RISK SCORE 7** **Medium Term (2040-2059)** Magnitude 3 Likelihood 1 **RISK SCORE 7** **Long Term (2080-2099)** Magnitude 4 Likelihood 2 **RISK SCORE 19** **All Time Periods** **Sum Risk Score 33**

STRONG WINDS			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Operations Reduced operational capability and production output. **Infrastructure** Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. Increased maintenance requirements and operating costs. **Workforce** Deleterious working conditions, including risk to life.	• Structural damage to mill buildings, warehouses, storage facilities, etc., caused by strong winds and storms. • High rise structures such as the stacks and cooling towers may be especially vulnerable to damage. • Compromise of roofing, walls, windows, potentially leading to safety hazards and operational disruptions. • Power outages and electrical disturbances resulting from storms, possibly damaging sensitive machinery. • Impacts on critical components like motors, generators, and control systems, causing operational downtime and repair costs. • Employee safety risks from strong winds, falling debris, and structural damage. • Potential need for temporary shutdowns or evacuations to ensure employee safety, leading to further operational disruptions.	**Sensitivity:** The site is considered to have a low sensitivity to this risk due to the nature of its operations generally being indoors, except for transport in and out of the site. **Adaptive capacity:** The site can be monitored and maintained appropriately. The site is also well constructed to be resistant to current storm magnitudes. **Magnitude:** A low magnitude score is assigned as the site is well constructed to defend against damage from strong winds. It is also unlikely that wind speeds would be high enough to cause significant structural damage to the site's structures. **Likelihood:** A neutral likelihood score is assigned as there is uncertainty about whether storms will become more severe, however there is a possibility of increased maximum wind speeds and precipitation associated with extratropical cyclones in Northwest Europe, including Wales. Furthermore, there is model uncertainty about the projected frequency of strong winds, there is some evidence to suggest that the intensity and maximum speeds might increase over time.	Sensitivity 2 Adapt. Capacity 4 Vulnerability 2 **Short Term (2020-2039)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **Medium Term (2040-2059)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **Long Term (2080-2099)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **All Time Periods** **Sum Risk Score 30**

<table>
<tr><th colspan="3">CHANGING WIND PATTERNS</th><th>Risk Scoring</th></tr>
<tr><th>Risks to Project Components</th><th>Impact Pathways</th><th>Risk Scoring Justification</th><th></th></tr>
<tr><td>Operations
Reduced operational capability and production output.

Infrastructure
Damage to the structure, integrity, and durability of the mill's infrastructure.

Reduction of infrastructure lifespans.

Increased maintenance requirements and operating costs.

Workforce
Deleterious working conditions, including risk to life.</td><td>Structural damage to mill buildings, warehouses, storage facilities, etc., caused by strong winds and storms.
High rise structures such as the stacks and cooling towers may be especially vulnerable to damage.
Compromise of roofing, walls, windows, potentially leading to safety hazards and operational disruptions.
Power outages and electrical disturbances resulting from storms, possibly damaging sensitive machinery.
Impacts on critical components like motors, generators, and control systems, causing operational downtime and repair costs.
Employee safety risks from strong winds, falling debris, and structural damage.
Potential need for temporary shutdowns or evacuations to ensure employee safety, leading to further operational disruptions.</td><td>Sensitivity: A low sensitivity score is assigned as the site is not expected to be significantly affected by this risk.

Adaptive capacity: The site can be monitored and maintained appropriately, and further changes are not expected to be costly.

Magnitude: A low magnitude of impact score is assigned across all timeframes as the site is well constructed to defend against damage from strong winds.

Likelihood: A low likelihood score is assigned as there is significant uncertainty about whether storms will become more severe, however there is a possibility of increased maximum wind speeds and precipitation associated with extratropical cyclones in Northwest Europe, including Wales. Furthermore, there is model uncertainty about the projected frequency of strong winds, there is some evidence to suggest that the intensity and maximum speeds might increase over time. Hence the likelihood of strong winds is occurring in isolation is higher than storm damage.</td><td>Sensitivity 2
Adapt. Capacity 4
Vulnerability 2

Short Term (2020-2039)
Magnitude 2
Likelihood 3
RISK SCORE 10

Medium Term (2040-2059)
Magnitude 2
Likelihood 3
RISK SCORE 10

Long Term (2080-2099)
Magnitude 2
Likelihood 3
RISK SCORE 10

All Time Periods
Sum Risk Score 30</td></tr>
</table>

HEAT WAVES/ HEAT STRESS			Risk Scoring
Risks to Project Components	Impact Pathways	Risk Scoring Justification	
Infrastructure Damage to the structure, integrity, and durability of the mill's infrastructure. Reduction of infrastructure lifespans. **Workforce** Deleterious working conditions, including risk to life.	• Increased heat could reduce efficiency, strain cooling systems, and increase risk of overheating or fires. • Heatwaves could put additional demand on the cooling tower, potentially leading to overheating and reduced performance. • Machinery critical to the production processes may be disrupted and suffer increased wear and require additional maintenance. • Increased evaporation rates due to high temperatures could lead to reduced capacity and efficiency of waste treatment. • Heat stress may create negative health impacts and reduce the productivity of employees. • Operations may need to be halted if the heat index is too high.	**Sensitivity:** The site is judged to have moderate sensitivity to this risk as there is the potential for heat waves/heat stress to disrupt operations. **Adaptive capacity:** The site is considered to have a low adaptive capacity as it would not be feasible to install temperature control capabilities across the entire site. **Magnitude:** Heatwaves could potentially cause heat injury or reduced productivity to workers and cause outages and closures at the mill, and this is expected to increase in severity in the long term with higher global warming. **Likelihood:** A 'very unlikely' score is assigned in the short and medium term as the absolute number of very hot days with maximum temperatures over 35°C remains close to 0 across all time horizons and climate scenarios. Only the 90th percentile values suggest that there could be one or more very hot days with temperatures over 35°C in the long-term scenario, which is why the likelihood increases to 'unlikely' over this period horizon. There are no projections of extremely hot days with temperatures of over 40°C expected in Wales, regardless of time horizon or climate scenario.	Sensitivity 3 Adapt. Capacity 2 Vulnerability 3.5 **Short Term (2020-2039)** Magnitude 2 Likelihood 1 **RISK SCORE** 6 **Medium Term (2040-2059)** Magnitude 2 Likelihood 1 **RISK SCORE** 6 **Long Term (2080-2099)** Magnitude 3 Likelihood 2 **RISK SCORE** 17 **All Time Periods** **Sum Risk Score** 29

<table>
<tr><th colspan="3">TEMPERATURE VARIABILITY</th><th>Risk Scoring</th></tr>
<tr><th>Risks to Project Components</th><th>Impact Pathways</th><th>Risk Scoring Justification</th><th></th></tr>
<tr>
<td>Infrastructure
Damage to the structure, integrity, and durability of the mill’s infrastructure.

Reduction of infrastructure lifespans.

Workforce
Deleterious working conditions, including risk to life.</td>
<td>• Increased heat could reduce efficiency, strain cooling systems, and increase risk of overheating or fires.
• Heatwaves could put additional demand on the cooling tower, potentially leading to overheating and reduced performance.
• Machinery critical to the production processes may be disrupted and suffer increased wear and require additional maintenance.
• Increased evaporation rates due to high temperatures could lead to reduced capacity and efficiency of waste treatment.
• Heat stress may create negative health impacts and reduce the productivity of employees.
• Operations may need to be halted if the heat index is too high.</td>
<td>Sensitivity: A neutral sensitivity score is assigned as temperature variability is unlikely to significantly affect the operations or structure of the site.

Adaptive capacity: The site is considered to have a low adaptive capacity as it would not be feasible to install temperature control capabilities across the entire site. However, the site can monitor projected changes in temperature to amend working schedules to accommodate and maintain a safe work environment for workers in response to these projected changes.

Magnitude: A low magnitude score is assigned as temperature variability does not mean extreme temperatures and effects can be mitigated with planning. The magnitude of impact is expected to increase in the long term with higher global warming.

Likelihood: Even though mean temperature in Wales is expected to increase over the long term, there is model uncertainty about how temperatures will vary in the short to medium term. The absolute number of very hot days with maximum temperatures over 35°C remains close to 0 across all time horizons and climate scenarios. The 90th percentile values suggest that there could be one or more very hot days with temperatures over 35°C in the long term,</td>
<td>Sensitivity 3
Adapt. Capacity 2
Vulnerability 3.5

Short Term (2020-2039)
Magnitude 2
Likelihood 1
RISK SCORE 6

Medium Term (2040-2059)
Magnitude 2
Likelihood 1
RISK SCORE 6

Long Term (2080-2099)
Magnitude 3
Likelihood 2
RISK SCORE 17

All Time Periods
Sum Risk Score 29</td>
</tr>
</table>

TEMPERATURE VARIABILITY			Risk Scoring
		which is why likelihood increases under this timeframe. There are no projections of extremely hot days with temperatures of over 40°C expected in Wales, regardless of time horizon or climate scenario.	

<table>
<tr><th colspan="3">CHANGING PRECIPITATION PATTERNS</th><th>Risk Scoring</th></tr>
<tr><th>Risks to Project Components</th><th>Impact Pathways</th><th>Risk Scoring Justification</th><th></th></tr>
<tr>
<td>Operations
Reduced operational capability and production output.

Infrastructure
Damage to the structure, integrity, and durability of the mill's infrastructure.

Reduction of infrastructure lifespans.

Increased maintenance requirements and operating costs.

Workforce
Deleterious working conditions, including risk to life.</td>
<td>• Excessive rainfall and flooding may cause structural damage to mill's buildings, warehouses, and other infrastructure due to potential weakening of foundations, collapsing walls, and leaking or collapsing roofs.
• Flooding can cause damage to critical machinery and equipment, leading to electrical failures, corrosion, and mechanical malfunctions.
• Heavy precipitation and flooding may lead to power outages, disrupting operations and causing production delays and financial losses.
• Disruption of transportation networks by heavy precipitation and flooding, causing delivery delays, inventory shortages, and potential customer dissatisfaction.
• Safety and health risks to employees from flooded areas, including physical injuries and exposure to contaminated water.</td>
<td>Sensitivity: The site is considered to have a 'low' sensitivity to this risk because few critical assets are expected to be affected by changing precipitation patterns.

Adaptive capacity: The development proposes to include a new Sustainable Urban Drainage System which is expected to mitigate this risk considerably. There is also risk of transportation networks being affected which could lower productivity as workers cannot get into and out of the site, and this risk is mostly out of the site's control. However, soft adaptation measures such as pausing certain operations can be implemented at relatively low cost.

Magnitude: A 'minimal impact' score is assigned in the short and medium term rising to 'low impact' in the long term as changing precipitation patterns will not cause structural damage, although it may present the risk of deleterious working conditions for workers and worsen in the longer-term horizon.

Likelihood: There is a small potential increase in the maximum number of consecutive wet days, and a small potential decrease in the maximum number of consecutive dry days in the long term. This pattern is indicative of potentially more intense precipitation events in Wales when they occur.</td>
<td>Sensitivity 2
Adapt. Capacity 4
Vulnerability 2

Short Term (2020-2039)
Magnitude 1
Likelihood 3
RISK SCORE 5

Medium Term (2040-2059)
Magnitude 1
Likelihood 3
RISK SCORE 5

Long Term (2080-2099)
Magnitude 2
Likelihood 4
RISK SCORE 13

All Time Periods
Sum Risk Score 23</td>
</tr>
</table>

EXPOSURE TO LITIGATION			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Policy and legal	• The mill will be a significant greenhouse gas emitter, as such it faces risk from climate-related litigation. This risk comes from two main types: liability litigation, which links the mill's emissions to climate change impacts and seeks compensation, and regulatory litigation, centred on compliance with climate policies and laws. • In a Divergent Net Zero transition it is expected that the physical impacts of climate change will be significant, and as a response there is likely to be a rise in global climate litigation cases. • As a significant emitter, the mill will be subject to increased scrutiny in relation to its climate targets and actions it takes to meet them. If the mill fails to set targets, fails to meet targets, or meets target but only by purchasing offsets which are not fit for purpose – this could lead to litigation. • Additionally, the mill is subject to conditions in its environmental permit which could expose it to legal action if it does not comply. It generates pollutants, which must be treated and discharged appropriately.	**Sensitivity:** The site is assigned a 'moderate' sensitivity to this risk due to potential exposure to litigation which could result in fines, however, fines would not be expected to significantly impact the business. **Adaptive capacity:** A 'neutral' adaptive capacity score has been given because although Shotton Mill is currently not optimally equipped to respond, the site could improve its position by setting up systems and enhancing its capacity to ensure compliance with relevant legislation and regulations. **Magnitude:** The magnitude of this risk is 'high' in the short term, reducing to 'moderate' in the medium and long term. This is because a Divergent Net Zero transition implies a swift escalation of climate action which, if Shotton Mill is not well prepared, may amplify the impact of this risk in the short term. **Likelihood:** The likelihood of occurrence is scored as 'possible'. Shotton Mill has been fined previously, and regulatory uncertainty could result from a rapid ramping up of climate action. Avoiding litigation is within the control of Shotton Mill making which is why a neutral likelihood score has been given.	Sensitivity 3 Adapt. Capacity 3 Vulnerability 3 **Short Term (2023-2028)** Magnitude 4 Likelihood 3 **RISK SCORE 29** **Medium Term (2028-2033)** Magnitude 3 Likelihood 3 **RISK SCORE 22** **Long Term (2033-2053)** Magnitude 3 Likelihood 3 **RISK SCORE 22** **All Time Periods** **Sum Risk Score 73**

SHIFTS IN CONSUMER PREFERENCE			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Market	• Shotton Mill relies on demand for their products to make a profit and continue operating. It is expected that Divergent Net Zero transition may result in shifts in consumer preferences, for example, towards products with a higher recycled content, or towards digitised alternatives to products which utilise paper and cardboard. • Other sustainability linked trends which could impact the mill include the minimisation of packaging or the use of handkerchiefs instead of tissues. • It is also noted that these trends present an opportunity to the mill given the high proportion of recycled materials it produced and that its products are biodegradable alternatives to plastics – although an analysis of opportunities is outside the scope of this report.	**Sensitivity:** The business has a 'high' sensitivity to this risk as its profitability is driven by demand for its products. **Adaptive capacity:** A 'moderate' adaptive capacity score is assigned based on the potential for Shotton Mill to mitigate this risk through strategic planning, such as diversifying into other high-demand products. **Magnitude:** The magnitude of this risk is scored as 'high' across all timeframes, given the importance of demand for Shotton Mill's products to its profitability. **Likelihood:** This risk carries a 'low' likelihood, given the expectation that demand for products like cartonboard and tissue would persist despite potential consumption fluctuations.	Sensitivity 5 Adapt. Capacity 3 Vulnerability 4 **Short Term (2023-2028)** Magnitude 4 Likelihood 2 **RISK SCORE 26** **Medium Term (2028-2033)** Magnitude 4 Likelihood 2 **RISK SCORE 26** **Long Term (2033-2053)** Magnitude 4 Likelihood 2 **RISK SCORE 26** **All Time Periods** **Sum Risk Score 78**

INCREASED REPORTING OBLIGATIONS			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Policy and legal	• Shotton Mill may be subject to further reporting obligations regarding GHG emissions, climate change risk and other sustainability requirements which relate to climate change. Examples of emerging regulatory frameworks include the TCFD, ISSB and Transition Plan Taskforce. • In order to comply with these regulations Shotton Mill may incur expenses related to hiring employees or third parties such as consultants.	**Sensitivity:** Shotton Mill is assigned a 'moderate' sensitivity to this risk, as it has already begun to align with existing environmental regulations and the cost to adhere to further reporting obligations is not expected to be material to the business. **Adaptive capacity:** The cost of establishing these processes is expected to be low in relation to revenue, which is why adaptive capacity is scored as 'high'. **Magnitude:** The impact of this risk is scored as 'moderate' in the short term to accommodate for the potential need to redirect resources to ensure compliance, and the anticipated surge in climate action within a Divergent Net Zero transition. The impact is expected to lessen to 'low' in the medium and long term as the increase in regulation becomes more gradual over time. **Likelihood:** The likelihood of occurrence is scored as 'high'. This is based on the existing trend of increasing reporting obligations, which is expected to continue in this scenario.	Sensitivity 3 Adapt. Capacity 4 Vulnerability 2.5 **Short Term (2023-2028)** Magnitude 3 Likelihood 4 **RISK SCORE 24** **Medium Term (2028-2033)** Magnitude 2 Likelihood 4 **RISK SCORE 16** **Long Term (2033-2053)** Magnitude 2 Likelihood 4 **RISK SCORE 16** **All Time Periods** **Sum Risk Score 56**

INCREASED PRICING OF GHG EMISSIONS			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Policy and legal	• Shotton Mill's ETS surrender obligations may increase over time depending on the direction of government policy. As the surrender obligation increases the mill may have to purchase additional carbon credits which may increase costs. • Additionally, over time the ETS prices may rise, i.e., due to a deliberate reduction in the number of allowances available, which would increase the cost of each credit purchased. • Shotton Mill may export products the European Union (although the UK is the main market). If the carbon pricing of the EU and UK ETS diverge in such a way that Shotton mill is subject to lower carbon taxes than EU counterparts, this could lead to additional charges under the EU Carbon Border Adjustment mechanism, thus reducing the price competitiveness of the mill's products.	**Sensitivity:** Shotton Mill is already part of the UK ETS (although it receives free allocation to prevent carbon leakage). Therefore, the project is assigned a 'moderate' sensitivity to this risk. **Adaptive capacity:** Shotton Mill has already taken steps to reduce emissions and therefore lower the ETS costs and is positioned to take further steps in future, such as utilising hydrogen when it becomes feasible. However, further steps to fully decarbonise may be expensive to implement which is why its adaptive capacity is scored as 'low'. **Magnitude:** The magnitude of impact is expected to increase from 'low' in the short term to 'moderate' in the medium term and 'high' in the long term. This is because the Divergent Net Zero scenario assumes a steady increase in carbon price over time. **Likelihood:** The likelihood of an increase in GHG emissions pricing occurrence is scored as 'likely'. This includes a sharp uptick in the short term under a Divergent Net Zero transition, which then steadies in medium- and longer-term timeframes. Over all time horizons, carbon pricing is a feature of the Divergent Net Zero scenario.	Sensitivity 3 Adapt. Capacity 2 Vulnerability 3.5 **Short Term (2023-2028)** Magnitude 2 Likelihood 4 **RISK SCORE 22** **Medium Term (2028-2033)** Magnitude 3 Likelihood 4 **RISK SCORE 34** **Long Term (2033-2053)** Magnitude 4 Likelihood 4 **RISK SCORE 45** **All Time Periods** **Sum Risk Score 101**

UNSUCCESSFUL INVESTMENT IN NEW TECHNOLOGIES			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Technology	• Shotton Mill is investing in new machinery and infrastructure as part of the redevelopment. With the rapid development in new technology associated with a Divergent Net Zero transition, Shotton Mill may be exposed to the risk of this plant being superseded, for example through developments in the use of hydrogen and Carbon Capture and Storage. • If these technologies develop faster than expected, competitors may be able to utilise them, and gain advantages related to reputation, brand and lower carbon costs.	**Sensitivity:** Shotton Mill has a 'moderate' sensitivity to this risk, given the potential for developments in hydrogen use and carbon capture and storage technology to render its operations less carbon efficient than competitors. **Adaptive capacity:** Adaptive capacity is 'neutral' as Shotton Mill is aware of the potential need to upgrade machinery or infrastructure in response to developments in technology, however, costs may be significant to retrofit and update to lower carbon technology in the medium to long term. **Magnitude:** The magnitude of impact is scored as 'high' in the near term, decreasing over time, to 'moderate' in the medium term and 'low' in the long term. This is because if Shotton Mill does have to replace equipment, then the costs to replace technology are expected to fall over time. **Likelihood:** The likelihood of occurrence is scored as 'unlikely' in the near term, 'possible' in the medium term and 'likely' long term. This is because with the rapid advancements in technology associated with a Divergent Net Zero transition, the risk of Shotton Mill's plant becoming outdated increases over time, specifically with developments in hydrogen use and Carbon Capture and Storage. Furthermore,	Sensitivity 3 Adapt. Capacity 3 Vulnerability 3 **Short Term (2023-2028)** Magnitude 4 Likelihood 2 **RISK SCORE 19** **Medium Term (2028-2033)** Magnitude 3 Likelihood 3 **RISK SCORE 22** **Long Term (2033-2053)** Magnitude 2 Likelihood 4 **RISK SCORE 19** **All Time Periods** **Sum Risk Score 60**

UNSUCCESSFUL INVESTMENT IN NEW TECHNOLOGIES			Risk Scoring
		if these technologies progress faster than anticipated, competitors may adopt them, gaining advantages related to reputation, brand, and reduced carbon costs.	

COST AND AVAILABILITY OF RAW MATERIALS			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Market	• In a Divergent Net Zero transition, the anticipated intensification of climate change is expected to stimulate stronger regulations and societal demands for sustainability. This may cause an increase in the demand for wastepaper and cardboard. Although this presents a significant opportunity for Shotton Mill due to the high recycled content of its products, it may also mean that the raw materials Shotton Mill relies on, such as wastepaper and feedstock for the CHP, may increase in cost or may be in short supply. • Additionally, the cost of raw materials the mill requires such as old, corrugated cardboard, wastepaper, and especially chemicals, may increase due to GHG emissions pricing which suppliers pass onto the mill.	**Sensitivity:** Shotton Mill has a 'high' sensitivity to this risk since a shortage or price increase for resources could impact the Mill's operations in a material way by significantly increasing costs which may not always be able to be passed onto the end consumer. **Adaptive capacity:** The Mill's adaptive capacity is scored as 'low' since Shotton Mill is poorly positioned to withstand supply shocks to its key input materials. Some degree of strategic planning, e.g., supplier management plans may help to mitigate this risk by ensuring a diversified supplier base. **Magnitude:** The magnitude of impact is 'high' in all timeframes since supply shocks or significant price increase to key input materials are expected to have a significant impact on Shotton Mill. **Likelihood:** Under a Divergent Net Zero transition, the likelihood of occurrence is expected to increase from 'low' in the near term, to 'possible' in the medium term and 'likely' in the long term. This is because GHG emissions pricing is forecast to rise steadily in this scenario increasing the likelihood that suppliers pass on additional costs to the mill over time.	Sensitivity 4 Adapt. Capacity 2 Vulnerability 4 **Short Term (2023-2028)** Magnitude 4 Likelihood 2 **RISK SCORE 26** **Medium Term (2028-2033)** Magnitude 4 Likelihood 3 **RISK SCORE 38** **Long Term (2033-2053)** Magnitude 4 Likelihood 4 **RISK SCORE 51** **All Time Periods** **Sum Risk Score 115**

MANDATES ON RECYCLED CONTENT FOR PRODUCTS			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Policy and legal	• Introduction or intensification of mandates on the amount of recycled content in products could disrupt Shotton Mill's supply of wastepaper and other fibres. This may manifest in Divergent Net Zero transition, where a ramping up of climate action is expected, as well as potential supply chain disruptions. • It is also noted that these trends present a large opportunity to the mill given the high proportion of recycled materials it produces and that its products are biodegradable alternatives to plastics – although an analysis of opportunities is outside the scope of this report.	**Sensitivity:** Shotton Mill's sensitivity to this risk is 'moderate' since this risk is mitigated as it already plans to utilise a large quantity of recycled material, accounting for 100% in cartonboard production. **Adaptive capacity:** With strategic planning and careful monitoring of regulatory developments, this risk can be managed effectively through increased partnerships with waste management firms to maintain supply, for example, thus it is scored as 'neutral'. **Magnitude:** The magnitude of impact is scored as 'moderate' since, if this risk were to materialise, it has the potential to materially impact Shotton Mill's operations. **Likelihood:** The likelihood of occurrence is scored as 'very unlikely' in the short-term increasing to 'unlikely' in the medium to long term as regulations increase over time. However, given the substantial amount of recycled material already being utilised in the operations this is not considered to be a likely risk.	Sensitivity 3 Adapt. Capacity 3 Vulnerability 3 **Short Term (2023-2028)** Magnitude 3 Likelihood 1 **RISK SCORE 7** **Medium Term (2028-2033)** Magnitude 3 Likelihood 2 **RISK SCORE 14** **Long Term (2033-2053)** Magnitude 3 Likelihood 2 **RISK SCORE 14** **All Time Periods** **Sum Risk Score 35**

COST TO TRANSITION TO LOWER EMISSIONS TECHNOLOGY			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Technology	• In a Divergent Net Zero transition, there are rapid developments in technology coupled with a rapid (but uneven) increase in climate action. Shotton Mill may need to invest in lower emissions technology as more efficient options are developed and requirements (e.g. energy efficiency mandates) and/or consumer expectations increase, or as competitors invest in more efficient technology. • As the Mill relies on several pieces of large, expensive machinery, this may pose a risk. It is also possible that technology development could replace the tissue and cartonboard products being manufactured at the Mill.	**Sensitivity:** Shotton Mill's sensitivity to this risk is 'high' as the estimated emissions of the redeveloped Mill operations are over 600,000 tonnes CO2e per annum (according to the Greenhouse Gas report provided by SLR Consulting on 8 June 2023). In the event that Shotton Mill comes under energy efficiency mandates or competition from alternative mills with more efficient and near-zero emission technology, there may be a significant cost to replace its technology with zero carbon alternatives in the future. **Adaptive capacity:** Shotton Mill has a 'low' adaptive capacity to this risk, as upgrading a significant portion of its equipment would have a very high cost associated with it. **Magnitude:** The magnitude of impact is scored as 'high' in the near term, decreasing over time, to 'moderate' in the medium term and 'low' in the long term. This is because if Shotton Mill does have to replace equipment, then the costs to replace technology are expected to fall over time. **Likelihood:** The likelihood of occurrence is scored as 'unlikely' in the near term, 'possible' in the medium term and 'likely' long term. This is because with the rapid advancements in technology associated with a Divergent Net Zero transition, the risk of Shotton Mill's plant	Sensitivity 4 Adapt. Capacity 2 Vulnerability 4 **Short Term (2023-2028)** Magnitude 4 Likelihood 2 **RISK SCORE 26** **Medium Term (2028-2033)** Magnitude 3 Likelihood 3 **RISK SCORE 29** **Long Term (2033-2053)** Magnitude 2 Likelihood 4 **RISK SCORE 26** **All Time Periods** **Sum Risk Score 81**

COST TO TRANSITION TO LOWER EMISSIONS TECHNOLOGY			Risk Scoring
		becoming outdated increases over time, specifically with developments in industrial heat pumps, innovation on technologies that reduce heat needs, for example. Furthermore, if these technologies progress faster than anticipated, competitors may adopt them, gaining advantages related to reputation and reduced carbon costs.	

REPUTATIONAL DAMAGE			Risk Scoring
Transition Risk Category	Impact Pathways	Risk Scoring Justification	
Reputation	• In a Divergent Net Zero transition it is expected that businesses will be under increased scrutiny. This, coupled with the physical impacts of climate change, may increase the likelihood of Shotton Mill causing damage to the environment. For example, a period of drought could exacerbate the effect of an effluent spill. • In a Divergent Net Zero transition it is expected that climate action will increase rapidly, and as a result Shotton Mill may also come under scrutiny for its fuel use.	**Sensitivity:** Shotton Mill's sensitivity to this risk is 'low', as impacts on reputation are unlikely to significantly affect product demand, primarily because products are not sold directly to the end consumer by Shotton Mill. However, pressure imposed by customers across their whole value chains due to their own reputational risks mean there is still a reputational risk to Shotton Mill from failing to adhere to high environmental standards. **Adaptive capacity:** Shotton Mill's adaptive capacity is 'high', as it can maintain its social license to operate by implementing the mitigation measures detailed in the project's Environmental Statement, and it could augment these measures if needed. **Magnitude:** The magnitude of impact is scored as 'low' across all timeframes, given that Shotton Mill's environmental impact is relatively low compared to other sectors. **Likelihood:** Avoiding reputational damage is within the control of Shotton Mill making which is why a neutral likelihood score has been given.	Sensitivity 2 Adapt. Capacity 4 Vulnerability 2 **Short Term (2023-2028)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **Medium Term (2028-2033)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **Long Term (2033-2053)** Magnitude 2 Likelihood 3 **RISK SCORE 10** **All Time Periods** **Sum Risk Score 30**

8.1 Hazards and Risks Summary

A summary of **the summed risk scores** across all timeframes for each physical climate hazard and transition risks is provided in Table 10 below for prioritisation of mitigation measures, regardless of timeframe. Codes are assigned to each hazard based on the hazards rank and are linked to specific risks relating to the project components listed in Table 11. More details on the risks scoring methodology can be found in section 3.4.

Table 10. Summary of climate-related hazards and ranking.

Code	Hazard/Risk	Sum Risk Score (all timeframes)
TR1	Cost and Availability of Raw Materials	115
TR2	Increased Pricing of GHG Emissions	101
TR3	Cost to Transition to Lower Emissions Technology	81
TR4	Shifts in Consumer Preference	78
TR5	Exposure to Litigation	73
PH1	Storm Surge	70
TR7	Unsuccessful Investment in New Technologies	60
TR6	Increased Reporting Obligations	56
PH2	Heavy Precipitation	56
PH3	Pluvial Flooding	48
PH4	Coastal Flooding/ Sea Level Rise	48
PH5	Drought	39
PH6	Fluvial Flooding	38
TR8	Mandates on Recycled Content for Products	35
PH7	Water Stress	34
PH8	Wildfires	33
TR9	Reputational Damage	30
PH9	Strong Winds	30
PH10	Changing Wind Patterns	30
PH11	Heat Waves/ Heat Stress	29
PH12	Temperature Variability	29
PH13	Changing Precipitation Patterns	23

Table 11. Summary of physical risks to project components and associated hazards.

		Storm Surge	Heavy Precipitation	Pluvial Flooding	Coastal Flooding/ Sea Level Rise	Drought	Fluvial Flooding	Water Stress	Wildfires	Strong Winds	Changing Wind Patterns	Heat Waves/ Heat Stress	Temperature Variability	Changing Precipitation Patterns
INFRASTRUCTURE	Damage to the structure, integrity, and durability of the mill's infrastructure.	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
	Reduction of infrastructure lifespans.	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
	Increased maintenance requirements and operating costs.	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓
WORKFORCE	Deleterious working conditions, including risk to life.	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
OPERATIONS	Reduced operational capability and production output.	✓	✓	✓		✓	✓	✓		✓	✓			✓
	Reduced water treatment capability.					✓		✓						

9.0 Mitigation and Adaptation

This CCRA presents a high-level overview of potential mitigation and adaptation options as response measures to the risks identified. Response measures were designed to address physical risks to infrastructure (Section 7.1), risks to workforces (Section 7.2), risks to operations (Section 7.3) and transition risks to the project (Section 7.4).

The measures were categorised according to response type: green, soft, and grey. Green approaches target opportunities to employ natural capital and integrate environmental systems into response measures. Soft approaches target managerial and strategic responses through, e.g., processes and protocols. Grey approaches target technical responses that focus on, e.g., infrastructure refurbishment and development.

The identified response measures were prioritised according to relevance to i) human wellbeing (very high priority); ii) project and infrastructure integrity and lifespan (high priority); and iii) potential project and infrastructure improvements (medium priority).

9.1 Response Measures: Risks to Infrastructure

Table 12. Response measures to infrastructure risks.

- Damage to the structure, integrity, and durability of the mill's infrastructure.
- Reduction of infrastructure lifespans.
- Increased maintenance requirements and operating costs.

Human wellbeing   Project integrity   Project improvements

Priority	Response Measure	Approach	Hazards Addressed
(Human wellbeing)	I1: **Secure flat-bottom tanks**: Identify potential flooding risks to flat-bottomed tanks containing liquid (perhaps the above ground storage tanks or water treatment tanks), they may be exposed to significant buoyant forces during a flood event which can lead to them becoming dislodged. If necessary, install protection measures e.g., bracing or anchoring the tanks.	Grey	PH1, PH3, PH2, PH6, PH4, PH4, PH13
(Human wellbeing)	I2: **Review wind loading calculations**: Review wind loading calculations, especially for high-rise structures like stacks and cooling towers. Provide reinforcement if necessary. Maintain building integrity.	Grey	PH1, PH9, PH10
(Human wellbeing)	I3: **Establish fire safety measures**: Conduct regular fire safety assessments of any storage areas containing large amounts of flammable materials (e.g., tissue, cardboard raw materials or finished product storage). Ensure that fire safety plans incorporate climate considerations, for example by increasing the frequency and comprehensiveness of checks and training during times when fire risk is heightened such as during heat waves and droughts. Also ensure this plan considers that fire risk is likely to increase in summer months in the future due to increased average temperature and reduced average rainfall. Other mitigations may include ensuring that flammable materials	Soft	PH8, PH5, PH11

Priority	Response Measure	Approach	Hazards Addressed
	are stored under cover and not exposed to direct sunlight wherever possible.		
	I4: **Conduct preventive maintenance and inspection**: Establish a proactive maintenance programme to regularly inspect and maintain critical components, such as motors, generators, and control systems. This programme will identify and address potential issues before they escalate, reducing downtime and repair costs. Conduct additional maintenance assessments after significant weather events (e.g., extreme heat waves, storms, floods). Prioritize structures exposed to the event and crucial for site operation. Perform necessary maintenance promptly. Implementing these measures will enhance the mill's resilience to climate change impacts, minimise disruptions, and ensure efficient operation.	Grey	PH1, PH3, PH2, PH8, PH6, PH5, PH9, PH4, PH11
	I5: **Protect critical machinery and equipment**: Safeguard sensitive machinery and critical components from electrical disturbances by implementing surge protection measures. Elevate critical machinery and equipment above potential flood levels or relocate them to higher floors whenever feasible. Ensure proper waterproofing and sealing of electrical systems and machinery to prevent water damage and electrical failures. Implement regular maintenance and inspection programmes to identify and address potential issues related to corrosion and mechanical malfunctions caused by flooding.	Grey	PH1, PH3, PH2, PH6, PH4, PH4, PH11
	I6: **Drainage and diversion of surface water**: Ensure sufficient drainage and diversion of surface water from the site. Install additional measures to divert rainwater and runoff if necessary. The site proposal includes a new Sustainable Urban Drainage System ("SuDS") which should provide water quality and biodiversity benefits and connect into the existing southwest lagoon. Ensure that this system corresponds to what is agreed with the SuDS Approval Board and ensure that drainage at the site is prepared for rain and flooding events with an annual exceedance probability of at least 1%, or if possible 0.1%. Ensure sufficient measures are in place to frequently monitor and maintain drainage systems.	Soft, Grey and Green	PH1, PH3, PH2, PH6, PH4, PH4, PH13
	I7: **Protect roofs and windows**: Install storm-resistant roofing materials and reinforce windows to minimize the risk of damage and water infiltration during storms. Additionally, it is advisable to implement shutters or protective coverings to safeguard windows against high winds and flying debris. By incorporating these measures, the mill will enhance its resilience to climate change-related risks, reducing the potential for damage and disruption caused by severe storms.	Grey	PH1, PH9, PH10

9.2 Response Measures: Risks to Workforce

Table 13. Response measures to workforce risks.

- Deleterious working conditions, including risk to life.

Human wellbeing | Project integrity | Project improvements

Priority	Response Measure	Approach	Hazards Addressed
	W1: **Flood Safety Processes:** Implement robust safety protocols to protect employees from the risks associated with flooded areas such as physical injuries, exposure to contaminated water, and waterborne diseases. Provide appropriate personal protective equipment (PPE) and conduct training on safety measures.	Soft	PH1, PH3, PH2, PH6, PH4
	W2: **Storm Safety Processes:** Define storm conditions at which operations should be suspended (could be defined by Beaufort scale or warning severity from the National Severe Weather Warning Service). Ensure that wind speed and storm surge (forecasts and present) are monitored closely at the site. Create plans to adapt operations at times of extreme wind speed and storm surge e.g., communicate with employees, provide additional personal protective equipment, secure any materials stored outdoors, prepare pumps to remove floodwater and back-up generator(s) in case of power outages.	Soft	PH1, PH9, PH10
	W3: **Heat Safety Processes**: Establish which employees will be most exposed to heat stress (PPE, proximity to the CHP and hot machinery, exposure to the sun, are all examples of aggravating factors). Define the heat index thresholds at which operations should be suspended. Ensure that temperature and humidity (forecasts and present) are monitored closely at key locations across the site. Create plans to adapt operations at times of extreme heat, e.g., alter working hours, establish more frequent breaks where employees can cool off, provide cold water/refreshments and a temperature controlled room where employees can rest.	Soft	PH5, PH11, PH12
	W4: **Climate Monitoring and Early Warning Processes:** Implement storm monitoring systems to receive timely and accurate information about approaching storms, heavy rainfall, or heat waves. Maintain close communication with local meteorological services to stay informed about severe weather conditions. Early warning systems can provide valuable time to enact protective measures and make informed decisions regarding operations and employee safety.	Soft	PH1, PH3, PH2, PH8, PH6, PH5, PH9, PH4, PH11

9.3 Response Measures: Risks to Operations

Table 14. Response measures to operational risks.

- Reduced operational capability and production output.
- Reduced water treatment capability.

Human wellbeing | Project integrity | Project improvements

Priority	Response Measure	Approach	Hazards Addressed
	O1: **Establish a flood plan:** Establish a flood plan which includes frequent monitoring and maintain drains, discharge points, interceptors, silt traps and lagoons to minimise flood risk. Ensure emergency pumps are located at the site to remove floodwater. Identify the lowest risk location to discharge floodwater.	Soft	PH1, PH3, PH2, PH6, PH4, PH4
	O2: **Ensure sufficient buffer storage of wastewater:** Ensure that sufficient buffer storage is in place to hold excess wastewater during high flow periods. Install additional buffer storage space if deemed necessary, this will help to prevent overflow.	Grey	PH1, PH3, PH2, PH6, PH4, PH13
	O3: **Maintain backup generators:** Install backup power generators or uninterruptible power supply (UPS) systems to ensure continuity of essential operations during power outages caused by climate hazards. Conduct regular checks on backups to ensure they are operational.	Soft and Grey	PH1, PH3, PH8, PH6, PH4, PH9, PH4, PH11
	O4: **Monitor and control of effluent:** Establish a plan to regularly monitor and control temperature variations, oxygenation levels and floc formation and ensure that the treatment process operates within the optimal temperature range. This can involve temperature sensors, automated controls, and alarms to prompt corrective actions when necessary. Ensure that the effluent treatment plans consider that increased water temperatures can hinder floc formation and thus solid impurity removal from wastewater. Ensure that the effluent treatment plans consider that increased water temperatures can slow down and inhibit the nitrification process which can increase the quantity of harmful compounds in effluent. Ensure that the plan incorporates considerations about adjust the dosage and type of chemicals used in the treatment process accordingly. Ensure that the plan consider increasing the frequency of testing during periods of extreme temperature. Ensure that adequate aeration and oxygenation measures are in place to maintain optimal conditions for nitrifying bacteria, consider possible reductions in dissolved oxygen levels linked to changing climate conditions, i.e., increased temperature and evaporation. Ensure that adequate temperature control measures are in	Soft and Grey	PH5, PH7, PH11, PH12, PH13

Priority	Response Measure	Approach	Hazards Addressed
	place at the effluent treatment plant, e.g., heat exchanges or cooling towers.		
	O5**: Collaborate with local authorities:** Establish communication channels and collaborate with local emergency management agencies to exchange information, coordinate response efforts, and stay informed about storm-related risks and precautions.	Soft	PH1, PH3, PH2, PH8, PH6, PH4, PH5, PH9, PH4, PH7, PH11
	O6: **Enhance resilience of transportation and supply chain:** Maintain alternative transportation routes and develop contingency plans for disruptions in transportation networks caused by storms, flooding, or wildfires. Establish relationships with multiple suppliers and have backup inventory arrangements in place to mitigate the impact of delivery delays or inventory shortages. Maintain regular communication with transportation providers to stay informed about potential disruptions and proactively address any issues.	Soft	PH1, PH3, PH2, PH8, PH6, PH4
	O7: **Protect stored raw materials and products:** Store raw materials, finished products, and important documents in elevated or flood-resistant areas to minimise the risk of contamination or damage. Develop procedures for rapid relocation or protective measures for sensitive materials in case of imminent flooding. Implement strict inventory management practices to track and safeguard inventory during flood events.	Soft	PH1, PH3, PH2, PH6, PH4
	O8: **Develop contingency plans:** Create comprehensive contingency plans to address potential disruptions caused by water shortages or droughts. These plans should outline alternative strategies, such as temporary shutdowns, reduced production, or utilizing backup water sources, to mitigate the impacts of water scarcity.	Soft	PH1, PH3, PH8, PH6, PH5, PH9, PH4, PH11
	O9: **Keep air intake filters free of dust:** Ensure that air intake filters of Combined Heat and Power facility are more frequently maintained during periods of drought and heat when there is likely to be increased dust. Increase dust intake can reduce the efficiency of the CHP.	Soft	PH8, PH5, PH11, PH12
	O10: **Recycle and re-use water:** Implement advanced water recycling systems to treat and reuse water within the mill. This can reduce reliance on freshwater sources and mitigate the impact of water shortages on paper mill operations	Soft & Grey	PH5, PH7, PH13
	O11: **Manage increased effluent odour and pests:** Increased water evaporation and temperature may increase odour from effluent treatment plant and lagoons. Ensure an odour management plan and pest control plan is in place that accounts for the potential for increased odour caused by increased heat and evaporation in summer months and in future years as the climate changes. Mitigations may include covering tanks and storage facilities, creating, or reviewing the pest management plan, and cooling of influent.	Grey	PH5, PH7, PH11, PH12, PH13

Priority	Response Measure	Approach	Hazards Addressed
	O12: **Diversify water sources & water storage:** Explore alternative water sources, such as rainwater harvesting, groundwater extraction, or collaboration with local water utilities, to supplement the mill's water supply during periods of water stress. Diversifying water sources can help ensure a reliable water supply for essential processes. Consider storing contingency supplies of water on site for use during periods of drought. Consider installing rainwater collection systems to supplement contingency supplies of water.	Green	PH5, PH7, PH13
	O13: **Monitor and manage water resources:** Implement water monitoring systems to track water availability and consumption within the mill. This data can help identify trends, optimise water use, and enable informed decision-making regarding water management strategies.	Soft	PH5, PH7
	O14: **Collaborate and engage with stakeholders on water stress:** Engage with local water management authorities, community stakeholders, and other industrial users in the region to collaborate on sustainable water management practices. Sharing best practices, resources, and knowledge can help collectively address water stress challenges.	Soft	PH5, PH7
	O15**: Improve cooling systems:** Enhance cooling systems by implementing efficient technologies and practices that reduce water consumption for cooling purposes. Consider alternative cooling methods, such as air cooling or closed-loop systems, to minimise water usage while maintaining effective cooling capacity.	Grey	PH11, PH12
	O16: **Supplier risk management programme:** Develop a supplier risk management plan to mitigate the risk of operational disruptions due to supply chain issues. Identify the key suppliers used and their key sites which Shotton Mill is dependent on. Ensure suppliers are diversified (including by geographic location), to reduce vulnerability. If particular key suppliers or sites are identified track climate and economic events which may disrupt these suppliers (e.g., floods, wildfires, in their vicinity or increased demand for OCC or starch, important changes to forestry regulations). Identify contingencies such as alternative suppliers or material inputs in the event of disruptions. Consider working with suppliers to enhance their own resilience, including their resilience to transition risks which can be achieved through emissions reductions. Regularly review and update the plan, document supply chain problems or near-misses and their causes.	Soft	PH1, PH3, PH2, PH6, PH4, PH4

9.4 Response Measures: Transition Risks

Table 15. Response measures to Transition risks.

Response Measure	Risk Category
T1: **Minimise Natural gas in CHP fuel mix to minimise emissions:** The Combined Heat and Power (CHP) system can use either natural gas or biogas as a fuel source. The mill should use biogas rather than natural gas as much as possible. Biogas is a renewable source of energy, often produced from organic waste materials which are already part of the short-term carbon cycle, whereas natural gas is extracted from the earth where it has been sequestered for thousands of years. Therefore, biogas is preferable due to its lower carbon footprint. Using biogas, the mill can become more resilient to transition risks associated with stricter carbon regulation and carbon pricing and may also enhance its reputation as a relatively low emissions facility.	TR2, TR9
T2: **Resource efficiency monitoring**: Ensure that the mill's consumption of water, energy and raw materials are systematically tracked, utilise smart meters to benefit from real-time tracking. If consumption of a resource is unusually high, quickly take steps to assess the causes and address them. Conduct energy audits and water assessments periodically to identify wasteful practices and implement efficiency improvements. Regularly evaluate waste management processes, look for opportunities to minimize waste, reuse or recycle materials.	TR2, TR4, TR6, TR9
T3: **Monitor CCS options**: Conduct proactive research and planning to ensure that the mill is prepared to leverage Carbon Capture and Storage ("CCS") technologies once they become commercially viable and accessible. Given the significant emissions associated with paper production, CCS technologies could be instrumental in helping the mill achieve its decarbonization goals. The mill should monitor advances in CCS technologies, assess their applicability to the mill's specific operational context, and build relationships with providers and industry experts. Eventually, it would be prudent for the mill to conduct feasibility studies, examining the technical, economic, and regulatory aspects of implementing such systems at their facilities. Additionally, it may be worth exploring partnerships with other stakeholders, such as research institutions or industry consortia, to share knowledge and potentially costs. Preparing for the introduction of CCS technologies in this way will ensure that the mill is well-positioned to further reduce its carbon emissions substantially as soon as such solutions become available. When the time comes to replace or refurbish the CHP, Shotton Mill can review whether CCS could be included, according to one estimate provide the lifecycle of the CHP may be around 15 years.	TR2, TR3, TR4, TR7, TR9
T4: **Provide input on consultations**: Regulators often request input on proposed changes to regulations. By contributing to these consultations, the mill can articulate its views and concerns, potentially influencing the development of such policies and minimising their financial impact on its operations. It can highlight if proposed regulatory changes threaten jobs or business viability. Additionally, the mill can emphasise the need for supportive measures, such as transitional assistance, to ease the burden of adjustment. Engaging with regulators may also enhance the mill's understanding of upcoming regulatory changes and facilitate timely and effective adaptation. Regular and proactive communication with regulators, policy makers, and industry bodies is essential for ensuring that the mill's interests are taken into consideration as climate change policies are developed.	TR2, TR5, TR6, TR8
T5: **Incorporate emissions in decision making**: The mill should integrate climate change and emissions considerations into its own strategic decision-making	TR2, TR3, TR4, TR6, TR7, TR9

Response Measure	Risk Category
processes, particularly those related to plant, machinery repair, replacement, or expansion. This entails assessing the carbon footprint of various options and considering the direct or indirect costs from those emissions when deciding which actions to take. To facilitate this, the mill could establish an internal carbon price, effectively setting a monetary value on each tonne of carbon emitted from its operations. This internal pricing mechanism will allow the mill to quantify the environmental cost of its emissions, making it an integral part of cost-benefit analyses. Alternatively, the mill could also consider the shadow cost of carbon, which is the estimated cost of the damage caused by each additional tonne of greenhouse gas emitted. By incorporating these financial representations of environmental impact into decision-making processes, the mill will be better equipped to align its operational decisions with its long-term sustainability goals and reduce its vulnerability to future regulatory changes related to carbon emissions.	
T6: **Minimise energy consumption**: By taking measures to minimise the mill's energy usage the mill will be more resilient to potential future increases in energy prices which could be caused by climate change. By implementing energy efficiency measures and adopting energy-saving technologies, the mill could significantly decrease its energy demand. This could involve, optimising operational processes to conserve energy, improving insulation within the facilities to decrease heating, and cooling requirements, conducting regular energy audits, and implementing employee training programs to cultivate a culture of energy conservation. Through minimising overall energy consumption, the mill not only reduces operational costs and dependence on external energy supplies, but it also lessens its environmental impact, thereby contributing to wider climate change mitigation efforts.	TR2, TR9
T7: **Plan for cost of raw material increases**: Shotton Mill should prepare for potential increases in the costs of its key inputs - fibres, chemicals, energy, and water - due to climate change impacts. There is high uncertainty related to climate change impacts, but it may lead to increased costs in various ways. For example, increased demand for recycled goods or reduced supply due to more efficient practices may reduce the supply of fibres like old, corrugated cardboard and paper, driving up prices. Changes in environmental regulations related to chemical use or climate-related disruptions to chemical production could increase chemical costs. Energy costs may rise due to carbon pricing mechanisms or reduced availability of fossil fuel sources, and water costs could increase due to shortages from changing precipitation patterns or increased competition for resources. To mitigate these risks, the mill should engage in forward-planning exercises such as scenario analysis, considering how these cost increases could impact operations and finances. They could also explore opportunities for greater efficiency in resource use, diversification of suppliers, and investment in renewable or recycled alternatives where possible. The mill could ensure it has sufficient liquid assets or cash reserves to absorb temporary increases in costs of inputs.	TR1
T8: **Highlight measures adopted:** Highlight ways that the environmental footprint is being minimised (e.g., the relative efficiency of the plant), to enhance reputation and brand.	TR9
T9: **Monitor water levels at Dee Estuary:** Monitor water levels in the Dee estuary and consider the potential environmental impacts of discharging, especially when levels are low. Ensure effluent is properly treated on site and that discharges only take place in line with the site's permit. Ensure that the water which is discharged complies with all requirements such as those relating to its temperature and level of	TR5, TR9

Response Measure	Risk Category
pollutants. Failure to do so could lead to legal costs, reputational damage and harm to the environment or human beings.	
T10: **Contribute to local nature-based solutions:** The mill could contribute to nature-based solutions for climate risks in the local area. For instance, it could contribute to wetland conservation efforts around the Dee estuary. Wetlands serve as natural sponges, absorbing and storing excess rainfall and reducing the risk of flooding. They also sequester carbon, contribute to water purification, and provide a habitat for diverse wildlife. Additionally, the mill could contribute to the installation of additional riprap, or rock armouring, along local waterways if this is deemed necessary by local authorities. This not only disrupts wave energy, reducing the risk of erosion and protecting infrastructure, but also creates a habitat for local wildlife. Investing in such nature-based solutions will not only reduce the mill's vulnerability to climate change risks like flooding and extreme weather but also support local biodiversity, improve community resilience, and enhance its reputation as a responsible local business committed to sustainability.	TR9
T11: **Investments in beneficial offsets:** In addition to taking all reasonable steps to reduce its own emissions the mill could offset its remaining emissions via certified carbon offset projects. These projects may include initiatives that either absorb CO2, such as reforestation or afforestation activities, or prevent CO2 emissions, like renewable energy or energy efficiency projects. Given the mill's operations in the paper industry, offsetting through forestry-based projects would align well to its business, promoting sustainable forestry while sequestering carbon. It's imperative to ensure that the projects invested in are verifiable, adhere to recognised standards, and result in additional carbon savings that would not occur without the project. Additionally, the mill should consider projects that offer co-benefits, such as conservation of biodiversity, water protection, or community development. Such strategic investments can help the mill reduce its net emissions, contribute positively to environmental and community wellbeing, and enhance its reputation as a responsible business committed to combating climate change.	TR4, TR9
T12: **Strengthening compliance and climate risk management capacity:** The mill should ensure it has sufficient capabilities to adhere to existing and future climate regulations and to effectively manage climate-related risks. This could involve drawing on the expertise of employees with compliance experience, hiring additional specialists, or engaging third-party consultants. Key areas of focus should include compliance with the UK Emissions Trading Scheme, relevant climate disclosure regulations, and the formulation of a comprehensive transition plan. The mill may need assistance with setting measurable, achievable climate-related targets in line with recognised standards. Ensuring adequate capacity for these tasks will not only help the mill avoid regulatory penalties and potential reputational damage, but also equip it to anticipate and respond to emerging risks and opportunities in a changing climate. This in turn can contribute to the mill's overall resilience and long-term sustainability. As another example, the mill may want to ensure resources are allocated to monitoring the development of the EU's Carbon Border Adjustment Mechanism and the EU and UK Emissions Trading Schemes. If the carbon pricing in these two jurisdictions diverges the mill's goods may be less competitive due to the carbon border adjustment mechanism.	TR1, TR2, TR3, TR4, TR5, TR6, TR7, TR8, TR9

10.0 Conclusion

An evaluation of the project information, historical climate data and climate model projections show that the project is exposed to a range of climate-related physical risks and climate-related transition risks.

For each timeframe, vulnerability, magnitude of impact and likelihood of occurrence are multiplied together giving a maximum score of 125 (5 x 5 x 5). This is then re-scaled to provide an overall risk score from 1-100 for each timeframe.

The overall risk scores from 1-100 are split into five categories. Risk categories are arranged as follows:

- Score 1 to 20: low risk
- Score 20 to 40: medium risk
- Score 40 to 60: high risk
- Score 60 to 80: very high risk
- Score 80 to 100: extreme risk

For further details on the risk scoring methodology please see Section 3.4.

For **physical risks**, which were evaluated using a Hot House World (RCP8.5 high-emissions scenario):

- When considering the short term (2020-2039), no physical risks scored above 16/100 (low risk) suggesting that there are no significant physical risks to the project expected during this period.
- When considering the medium term (2040-2059), no physical risks scored above 22/100 (medium risk) suggesting that there are no significant physical risks to the project expected during this period.
- When considering the long term (2080-2099), no physical risks scored above 38/100 (medium risk) suggesting that there are no significant physical risks to the project expected during this period.

In general, physical risks are expected to increase in likelihood of occurrence and magnitude of impact over time and with greater level of global warming. In the long term, the highest scoring risks were:

- Storm surge leading to flooding 38/100 (medium risk);
- Sea level rise leading to coastal flood 29/100 (medium risk); and,
- Drought impacting operations 25/100 (medium risk).

Project components deemed to be at risk are the site's infrastructure, the workforce, and ongoing operations.

Based on the available data, risks of the occurrence of subsidence (due coal mining and soil erosion) because of climate change have been assessed to be minimal, improbable, and very low and therefore the project was not deemed to be exposed to this hazard.

For **transition risks**, which were evaluated using a Divergent Net Zero (Disorderly transition) scenario:

- When considering the short term (2023-2028), no transition risks scored above 29/100 (medium risk) suggesting that there are no significant transition risks to the project expected during this period.
- When considering the medium term (2028-2033), no transition risks scored above 38/100 (medium risk) suggesting that there are no significant transition risks to the project expected during this period.

- When considering the long term (2033-2053), the highest scoring transition risks scored above 51/100 (high risk) suggesting that there are some significant transition risks to the project expected during this period.

The highest scoring transition risks were:

- Market risk: Cost and availability of raw materials. This risk scored 51/100 (high risk) in the long term (2033-2053), 38/100 (medium risk) in the medium term (2028-2033) and 26/100 (medium risk) in the short term (2023-2028).
- Policy and Legal risk: Increased pricing of GHG emissions. This risk scored 45/100 (high risk) in the long term (2033-2053), 34/100 (medium risk) in the medium term (2028-2033) and 22/100 (medium risk) in the short term (2023-2028).

We recommend mitigating and adapting to physical risks using a range of measures. These are grouped by responses to risks to infrastructure, risks to workforce, and operational risks. Response measures include green, soft, and grey approaches, and are prioritised by their relevance to human wellbeing, project integrity and project improvements.

In response to risks to infrastructure, we propose ensuring structural resilience including protecting roofs and windows, protecting critical machinery and equipment, conducting preventative maintenance and inspection, reviewing wind loading calculations, diverting surface water, ensuring proper drainage, securing flat-bottom tanks, and establishing fire safety measures.

In response to workforce risks, we propose developing emergency response and evacuation plans and implementing monitoring and early warning systems for extreme weather, while also ensuring robust health and safety measures are in place which encompass risks from floods, storms, and extreme heat.

In response to operational risks, we propose a wide range of measures such as maintaining backup generators and pumps to remove floodwater, monitoring, and managing water resources and effluent, protecting raw materials and stored products, ensuring that the CHP's air intake filters are protected from increases in dust and ensuring sufficient buffer storage of wastewater.

A range of mitigation and adaptation measures are also recommended in order to manage the risks associated with the transition to a low-emissions economy. Transition risks across all categories will be reduced by using as much biogas and waste product as possible – rather than natural gas - in the energy mix of the CHP facilities and by ensuring that the mill is run as efficiently as possible. In the long term, we recommend investigating options to use carbon capture and storage at the site if or when this becomes available. Other measures proposed include contributing to local nature-based solution projects incorporating emissions into decision making and strengthening compliance and risk management capacity.

Engagement with government consultations on climate change policy which may impact Shotton Mill is recommended to manage policy and legal risks. In response to the potential for rapid technological developments associated with a Divergent Net Zero scenario, we propose incorporating climate change considerations into decisions relating to plant and machinery.

Lastly, in response to climate-related market risks, we propose minimising energy consumption where possible, and planning for potential increases in the cost of construction materials during the redevelopment project. Highlighting the ways in which the environmental footprint of Shotton Mill is being reduced may mitigate both market risk and risks to reputation. Further proposals to mitigate risk to reputation include proper management of effluent discharges, contributions to enhancing the local environment, and investment in credible and high-quality emissions offsets.

Appendix 1 Risk Scoring Categories

Sensitivity	Description / Characteristics	Score
Very high sensitivity to risk	The company has a large number of critical assets or operations that will be significantly affected by physical or transition risks, or such risks will significantly affect the company's supply chain. Characteristics may include: • Affected assets or operations account for (e.g.) >20% of revenue. • Disruption to supply chain can have very significant impacts on business operations, including limited availability of key input materials. • Affected assets perform unique function which cannot be easily relocated without incurring very high costs. • Affected assets have multiple dependencies across the business. • Interruption of 1 day or more of these critical assets would likely result in significant financial losses (e.g., customers cancelling future contracts, major loss in revenue, brand damage etc.).	**5**
High sensitivity to risk	The company has critical assets or operations that will be significantly affected by physical risks or transition risks, or the company will be significantly affected by climate impacts affecting its supply chain. Characteristics may include: • Affected assets or operations account for (e.g.) >10% of revenue. • Disruption to supply chain can have significant impacts on business operations, including limited availability of key input materials. • Affected assets perform unique function which cannot be easily relocated without incurring high costs. • Affected assets have multiple dependencies across the business. • Interruption of 1 day or more of these critical assets would likely result in significant financial losses (e.g., customers cancelling future contracts, major loss in revenue, brand damage etc.).	**4**
Moderate sensitivity to risk	The company has some critical assets or operations that will be affected by physical risks or transition risks, or the company will be affected by climate impacts affecting its supply chain. Characteristics may include: • Affected assets or operations account for (e.g.) <10% of revenue. • Disruption to supply chain can have moderate impacts on business operations, including limited availability of key input materials. • Business can tolerate interruption if critical asset is offline for up to 1 day.	**3**
Low sensitivity to risk	The company has few critical assets or operations that will be affected by physical risks or transition risks, or the company will only be moderately affected by climate impacts affecting its supply chain. Characteristics may include: • Critical assets account for (e.g.) <5% revenue. • Business can tolerate interruption if critical asset is offline. • Disruption to supply chain can have limited impacts on business operations, including limited availability of key input materials.	**2**
Very low sensitivity to risk	The company does not have any critical assets that will be affected by physical or transition climate change risks or is not reliant on fixed physical assets. Characteristics may include: • Highly versatile operations. • Typically, no or few fixed-asset locations. • No or very few supply chain dependencies.	**1**

Adaptive Capacity	Description / Characteristics	Score
Very high adaptive capacity	The company is already well positioned to manage transition or physical climate risks. Characteristics may include: • No or very low level of physical assets critical to business. • Able to easily implement steps to reduce sensitivity to risk at low cost. • Low carbon footprint or easily able to reduce carbon footprint. • Company activities likely to benefit from transition to low carbon economy.	**5**
High adaptive capacity	The company is well positioned manage transition or physical climate risks, although some further investment may be required. Characteristics may include: • Low level of physical assets critical to business. • Able to implement steps to reduce sensitivity to risk at relatively low cost. • Able to reduce emissions or mitigate transition risks at relatively low cost. • Some company activities may benefit from transition to low carbon economy.	**4**
Neutral adaptive capacity	The company requires strategic planning and investments to improve its sensitivity to risk exposure. Characteristics may include: • Some physical assets or processes (e.g., supply chain) critical to business which may be exposed to transition or physical risks. • Able to implement steps to reduce sensitivity to risk at moderate cost. • The company is in a sector associated with moderate emissions. • Some company activities are not exposed to the risk or may benefit from the transition to a low carbon economy.	**3**
Low adaptive capacity	The company is poorly positioned to manage transition or physical climate risks. Characteristics may include: • Very high costs associated with addressing risks. • Risks may be tolerable or can be externalised (e.g., insured or assets sold). • High carbon footprint associated with the company and /or sector. • Mitigation measures require adjustments to the business model. • Significant portion of revenue from activities that are likely to be adversely affected by the transition to low carbon economy.	**2**
Very low adaptive capacity	The company is very poorly positioned to manage transition or physical climate risks. Characteristics may include: • Extremely high costs associated with addressing risks. • Risks cannot be externalised (e.g., insured or assets sold). • Significant alteration to business model required to address risks. • Very high carbon footprint associated with the company and sector. • Majority of revenue from activities that will be adversely affected by the transition to low carbon economy.	**1**

Magnitude	Description / Characteristics	Score
Very High Impact	The impact has the potential to be catastrophic. Characteristics may include: • Complete need to cease operations. • Loss of life. • Financial losses that could result in bankruptcy, i.e., liabilities that exceed ability to pay them. • Litigation against company directors that could result in prison sentences. • Irreversible environmental damage.	**5**
High Impact	The impact has the potential to significantly impact profitability, operations, reputation etc. Characteristics may include: • Financial losses or liabilities that could have a significant impact on the business, e.g., resulting in needing to downscale, liabilities that require the company to significantly change its plans. • Litigation against company or directors that could result in significant fines. • Major environmental damage. • Negative publicity and damage to reputation which may result in the loss of very significant portion of the customer base.	**4**
Moderate Impact	The impact has the potential to materially impact profitability, operations, reputation etc. Characteristics may include: • Financial losses or liabilities that could result in a material impact on the business, e.g., significant impact on profitability. • Minor environmental damage. • Negative publicity and damage to reputation which result in the loss of some of the customer base.	**3**
Low Impact	The impact has the potential to have a small effect on profitability, operations, reputation etc. Characteristics may include: • Small losses or liabilities that do not have a material impact on the business. • No environmental damage. • Short lived or minor reputational damage and no customers lost as a result.	**2**
Minimal Impact	The impact does not have the potential to materially impact profitability, operations, reputation etc. Characteristics may include: • Negligible financial loses or liabilities. • No environmental damage. • No negative publicly.	**1**

Likelihood	Description / Characteristics	Score
Very High Potential	Equivalent to a **90-100% probability** of occurring within a specified timeframe. This can otherwise be thought of as **'very likely'** to occur**.**	**5**
High Potential	Equivalent to a **66%-100% probability** of occurring within a specified timeframe. This can otherwise be thought of as '**likely'** to occur.	**4**
Medium Potential	Equivalent to a **33-66% probability** of occurring within a specified timeframe. This can otherwise be thought of as '**possible'** to occur, or about as likely as not to occur.	**3**
Low Potential	Equivalent to a **0-33% probability** of occurring within a specified timeframe. This can otherwise be thought of as '**unlikely'** to occur.	**2**
Minimal Potential	Equivalent to a **0-10% probability** of occurring within a specified timeframe. This can otherwise be thought of as '**very unlikely'** to occur.	**1**

Appendix 2 Climate Projection Data

Table 5. Temperature-related climate projections for Wales.

Temperature Variables		2020-2039									2040-2059									2080-2099								
		SSP1-2.6			SSP2-4.5			SSP5-8.5			SSP1-2.6			SSP2-4.5			SSP5-8.5			SSP1-2.6			SSP2-4.5			SSP5-8.5		
		10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th
Mean Temp.	Change in near-surface air temperature (°C) relative to 1995-2014	-0.1	0.5	1.0	0.0	0.6	1.1	0.1	0.5	1.2	-0.1	0.7	1.5	0.3	0.9	1.7	0.5	1.1	2.1	0.0	0.9	1.9	0.4	1.7	2.8	1.8	2.9	4.8
Max. Temp.	Change in the mean of maximum daily temperatures (°C) relative to 1995-2014	0.0	0.5	1.0	0.0	0.6	1.2	-0.1	0.5	1.2	0.0	0.7	1.5	0.3	1.0	1.8	0.6	1.2	2.2	0.1	0.9	1.9	0.7	1.8	2.8	1.8	3.4	5.1
Very Hot Days (>35)	Number of days of maximum temperatures above 35°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6
Extreme Hot Days (>40)	Number of days of maximum temperatures above 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Min. Temp.	Change in the mean of minimum daily temperatures (°C) relative to 1995-2014	-0.1	0.4	0.9	-0.1	0.5	1.1	0.0	0.7	1.2	-0.3	0.6	1.4	0.2	0.9	1.6	0.5	1.3	2.0	-0.3	0.9	1.9	0.3	1.5	2.7	1.8	3.2	4.7

Table 6. Precipitation-related climate projections for Wales.

Precipitation Variables		2020-2039									2040-2059									2080-2099								
		SSP1-2.6			SSP2-4.5			SSP5-8.5			SSP1-2.6			SSP2-4.5			SSP5-8.5			SSP1-2.6			SSP2-4.5			SSP5-8.5		
		10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th
Precip.	Change (mm) in annual precipitation relative to 1995-2014	-129.9	18.9	202.5	-113.0	25.2	191.2	-120.2	23.8	213.9	-114.3	25.3	199.2	-101.7	10.3	183.9	-118.1	7.9	215.4	-84.2	35.9	207.4	-98.0	27.6	39.9	-72.5	41.2	263.7
Max. Precip. (1 day)	Change (mm) in maximum precipitation in 1 day relative to 1995-2014	-11.8	0.1	12.5	-8.8	2.2	23.5	-10.2	-0.7	17.8	-8.0	2.2	20.2	-10.9	1.9	18.5	-8.0	4.6	21.1	-9.3	1.3	24.9	-7.4	4.5	21.3	-4.9	7.6	33.9
Max. Precip. (5 day)	Change (mm) in maximum precipitation in 5 days relative to 1995-2014	-15.3	2.7	30.9	-12.9	3.6	40.2	-15.9	3.0	33.0	-17.9	6.1	35.5	-19.1	3.7	32.2	-14.5	8.1	28.6	-14.8	3.4	47.9	-14.1	9.5	32.5	-7.1	19.4	58.5
Consec. Dry Days	Maximum number of consecutive dry days	84.1	107.9	122.5	84.9	107.4	120.5	89.5	106.2	119.5	87.7	107.5	126.5	87.3	108.1	124.3	88.5	110.7	129.7	85.2	106.5	124.8	89.3	112.0	126.2	91.2	122.5	141.8
Consec. Wet Days	Maximum number of consecutive wet days	66.3	83.9	106.9	66.8	85.1	108.6	66.6	83.5	104.4	67.3	83.8	106.5	66.9	83.5	107.7	64.3	82.5	105.3	68.6	86.1	105.7	65.9	82.7	105.2	62.0	80.3	100.6

Making Sustainability Happen

Making Sustainability Happen