

Cleanaway Operations Pty Ltd

Bromelton Energy and Resource Centre

Technical Process Description

Reference: BERC-ARU-BNE-SYWP-RPT-0003

D | 27 July 2026

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Arup Australia Pty Ltd | ABN 76 625 912 665

Arup Australia Pty Ltd

Level 26
123 Albert Street
Australia
[arup.com](https://www.arup.com)

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			Prepared by	Checked by	Approved by
		Name	Trinity Schabe, Elena Manzo (Ramboll)	Matt Glavina, Anthony Douglas (Ramboll)	Henry Moore
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			Prepared by	Checked by	Approved by
		Name	Trinity Schabe, Anthony Douglas (Ramboll)	Matt Glavina	Anna Stewart
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		Name	Trinity Schabe	Matt Glavina	Henry Moore
		Signature			

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Acknowledgement of Country

Arup acknowledges the Traditional Owners across all lands, waters and skies our firm may reach; we acknowledge their wisdom, resilience, and rich cultural heritage. We pay our respects to the Elders, past and present, and to all Aboriginal and Torres Strait Islander peoples.

‘Continuing to Shift to shape an even better world’ original artwork by Tarni O’Shea of Gilimbaa and updated by David Williams of Gilimbaa.



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Abbreviations and glossary

Abbreviations	Definition
µg	micrograms
°C	Degrees Celsius
ACC	Air Cooled Condenser
ACCS	Automated Combustion Control System
APC	Air Pollution Control
APCr	Air Pollution Control Residue
As	Arsenic
BA	Boiler Ash
bara	bar absolute (pressure)
BAT	Best Available Techniques
BAT-AEL	Best Available Techniques – Associated Emission Level
BATC	Best Available Techniques Conclusions
BERC	Bromelton Energy and Resource Centre (the Project)
BREF	Best Available Techniques Reference Document
BREF-WI	Best Available Techniques Reference Document on Waste Incineration
BREF-WT	Best Available Techniques Reference Document on Waste Treatment
BoP	Balance of Plant
C&I	Commercial and Industrial
CCTV	Closed-Circuit Television
Cd	Cadmium
CEMS	Continuous Emission Monitoring System
CFD	Computational Fluid Dynamics
CHP	Combined Heat and Power
CMS	Control and Monitoring System
CMMS	Computerised Maintenance Management System
Co	Cobalt
COPC	Chemicals Of Potential Concern
Cr	Chromium
Cu	Copper
CV	Calorific Value
DCS	Distributed Control System
DETSI	Department of Environment, Tourism, Science and Innovation
EA	Environmental Authority
EDG	Emergency Diesel Generator
EfW	Energy from Waste

Abbreviations	Definition
EIPPCB	European Integrated Pollution Prevention and Control Bureau
ELV	Emission Limit Value
EMS	Environmental Management System
EN	European Standard
EOW	End of Waste
EP Act	Environmental Protection Act 1994 (Qld)
EPA	Environmental Protection Authority
ERA	Environmentally Relevant Activity
EU	European Union
FGC	Flue Gas Cleaning (a.k.a. Flue Gas Treatment)
FGT	Flue Gas Treatment
h	Hours
ha	Hectares
HCl	Hydrochloric Acid
HF	Hydrofluoric Acid
Hg	Mercury
hpa	Hours per annum
IBA	Incinerator Bottom Ash
IBAA	Incinerator Bottom Ash Aggregate
ID	Induced Draft
IED	Industrial Emissions Directive
ISO	International Organisation for Standardisation
JRC	Joint Research Centre
kg	Kilogram
km	Kilometre
kPa	Kilopascals
L	Liter
LHV	Lower Heating Value
LOI	Loss on Ignition
LP	Load Point
m	Metres
m³	Cubic metres
mg	Milligrams
MJ	Mega Joules
Mn	Manganese
MSW	Municipal Solid Waste
MW	Megawatt

Abbreviations	Definition
MWe	Megawatts electrical
MWh	Megawatt hours
MWth	Megawatts thermal
N₂O	Nitrous Oxide
ng	Nanogram
NH₃	Ammonia
Ni	Nickel
Nm³	Normal Metres cubed (i.e. volume at 0 degrees Celsius and 101.325 kPa)
NO₂	Nitrogen Dioxide
NOC	Normal Operation Conditions
NO_x	Nitrogen Oxides
O₂	Oxygen
OTNOC	Other Than Normal Operating Conditions, defined as start-up and shut-down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations in Article 14 (1)(f) of the IED
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PCBs	Polychlorinated Biphenyl
PCDD/F	Polychlorinated Dibenzodioxins/ Dibenzofurans
PoC	Point of Connection
POPs	Persistent Organic Pollutants
QA/QC	Quality Control/ Quality Assurance
R1	Energy efficiency
Sb	Antimony
SDA	State Development Area
SEQ	South East Queensland
SNCR	Selective Non-Catalytic Reductor
SO₂	Sulphur Dioxide
t	Tonnes
TEEP	Technically, environmentally, and economically practicable
Ti	Titanium
TOC	Total Organic Carbon
tpa	Tonnes per annum
tph	Tonnes per hour
UPS	Uninterruptible Power System
V	Vanadium
WAP	Waste Acceptance Protocol
WSA	Waste Supply Agreement

Executive Summary

Cleanaway Operations Pty Ltd (Cleanaway) is an Australian waste management, recycling, and industrial services company. Cleanaway is developing an Energy from Waste (EfW) facility in Queensland known as the Bromelton Energy and Resource Centre (BERC / the Project). The Project will be located within the Special Industry Precinct of the Bromelton State Development Area (SDA), west of Beaudesert.

This report provides a technical process description of the Project and the underlying technologies selected. This report discusses the state of knowledge for EfW facilities locally and internationally, and responds to three key policy outcomes which require proponents to:

- Draw on operational experience in the development of their facility, by analysing reference facility data
- Design in line with international best practice requirements.

Whilst the EfW sector in Australia is emerging, the sector and these facilities have been used internationally, particularly in Europe, for decades and best practice is well established.

The BERC has selected the following three reference facilities to inform the design and demonstrate the performance of the proposed energy recovery technology, which are at similar scale (i.e. capacity per line) to the BERC, process similar feedstocks using similar technology, and have been in successful commercial operation for many years.

- FCC Gloucestershire (Javelin Park Energy Recovery Facility) Energy from Waste (United Kingdom)
- FCC Greatmoor Energy from Waste (United Kingdom)
- Covanta Dublin Waste to Energy Facility (Ireland).

Operational data from these reference facilities has been investigated and has helped to inform the design development of the BERC. This data is provided within and appended to this report.

Each of the key technologies selected for the Project are recognised as best available techniques in accordance with international best practice. International best practice for thermal EfW facilities is widely recognised (including by the Queensland EfW Policy and EfW Guideline) as the European Union Best Available Techniques (BAT) Reference Document for Waste Incineration (BREF-WI), last published in December 2019. The BREF-WI (2019) provides 37 BAT Conclusions (BATC) based on actual operating information collected from a large number of operating EfW facilities regulated under the Industrial Emissions Directive (IED) (2010), that is shared between European Union member states.

The current level of design of the BERC allows for assessment against each of the BAT conclusions listed in the BREF-WI. The BERC will, via design and operational controls, be compliant with all applicable (32 out of 37) BATC.

1. Introduction

1.1 Purpose of this Assessment

In Australia, the Energy from Waste (EfW) sector is an emerging industry where the state of knowledge is developing. Existing EfW policies and guidelines in Queensland are largely focused on the eligibility of waste feedstocks and environmental protection. Commonwealth policy deals primarily with upholding the waste hierarchy, and whilst it recognises resource recovery (including energy recovery) as a key target, guidance on the development or operation of EfW facilities is not provided.

Internationally, particularly in Europe, the state of knowledge for EfW is well established and is published in the Best Available Techniques Reference Document for waste incineration (BREF-WI). The BREF-WI is regularly updated based on the latest information, technology and approaches to ensure a continually evolving state of knowledge. The EfW process has been used successfully for decades across hundreds of facilities and there have been several iterations of legislation and best practice guidelines issued regulating its use and environmental performance. International experience is also used to gain an understanding of the risks EfW activities pose and how best to address those risks.

The Queensland EfW Policy includes three key outcomes which require proponents to draw on international expertise:

- Policy outcome 2 requires proponents to demonstrate the operational performance of their selected technology by reference to example facilities currently in operation internationally
- Policy outcome 6 requires proponents to design the EfW facility to meet energy recovery requirements and are encouraged to adopt energy efficiencies in accordance with the BREF Documents (BREFs)
- Policy outcome 7 requires potential environmental impacts to be managed in accordance with the relevant Best Available Techniques (BAT) conclusions as set out in the BREFs.

This report provides evidence to support the compliance of the Bromelton Energy and Resource Centre (BERC) proposal with these policy outcomes. It includes:

- A project overview to provide a high-level process description, summarise the key process and environmental risk mitigation and risk management design features, and a summary of the key process design parameters relevant to the Project (Section 4)
- A description of the selection of reference facilities, comparison of key metrics between the BERC and reference facilities and operational data for the reference facilities, as required by the Queensland EfW Policy Outcome 2 (Section 5)
- An overview of the energy efficiency of the conceptual design of the BERC, as required by the Queensland EfW Policy Outcome 6 (Section 6)
- The BERC's approach to BAT through development of the design as well as operation, as required by the Queensland EfW Policy Outcome 7 (Section 7). This section describes the design decisions and features which contribute to the facility demonstrating the use of best practice techniques, including:
 - How the design has considered and incorporated BAT where reasonably practicable
 - How the facility's design and operational intention responds to the BAT conclusions and meets the definition of BAT as set out in the BREF-WI (and related Queensland requirements)
- A detailed technical process description of the EfW process to be used at the BERC, including the thermal treatment, Air Pollution Control (APC) and solid residue handling processes selected, which are the key processing components of the EfW facility (Appendix A).

1.2 Project Description

1.2.1 Project Overview

Cleanaway Operations Pty Ltd (Cleanaway) is developing an Energy from Waste (EfW) facility in Queensland known as the Bromelton Energy and Resource Centre (BERC / the Project). The Project will be located within the Special Industry Precinct of the Bromelton State Development Area (SDA), west of Beaudesert within the Scenic Rim Regional Council local government area.

The Project has been designed to thermally treat approximately 760,000 tonnes per annum (tpa) of waste feedstock, consisting of residual Municipal Solid Waste (MSW) and residual Commercial and Industrial (C&I) waste. Residual waste is waste that is not technically, environmentally, and economically practical (TEEP) to reuse or recycle, which would otherwise be sent to landfill for disposal. The facility's actual annual throughput will vary depending on the calorific value of the feedstock and plant availability. To account for variability in feedstock energy content, the facility will be designed for a maximum processing capacity of up to 10% above the nominal figure (836,000 tpa). The EfW process is summarised in Figure 1.

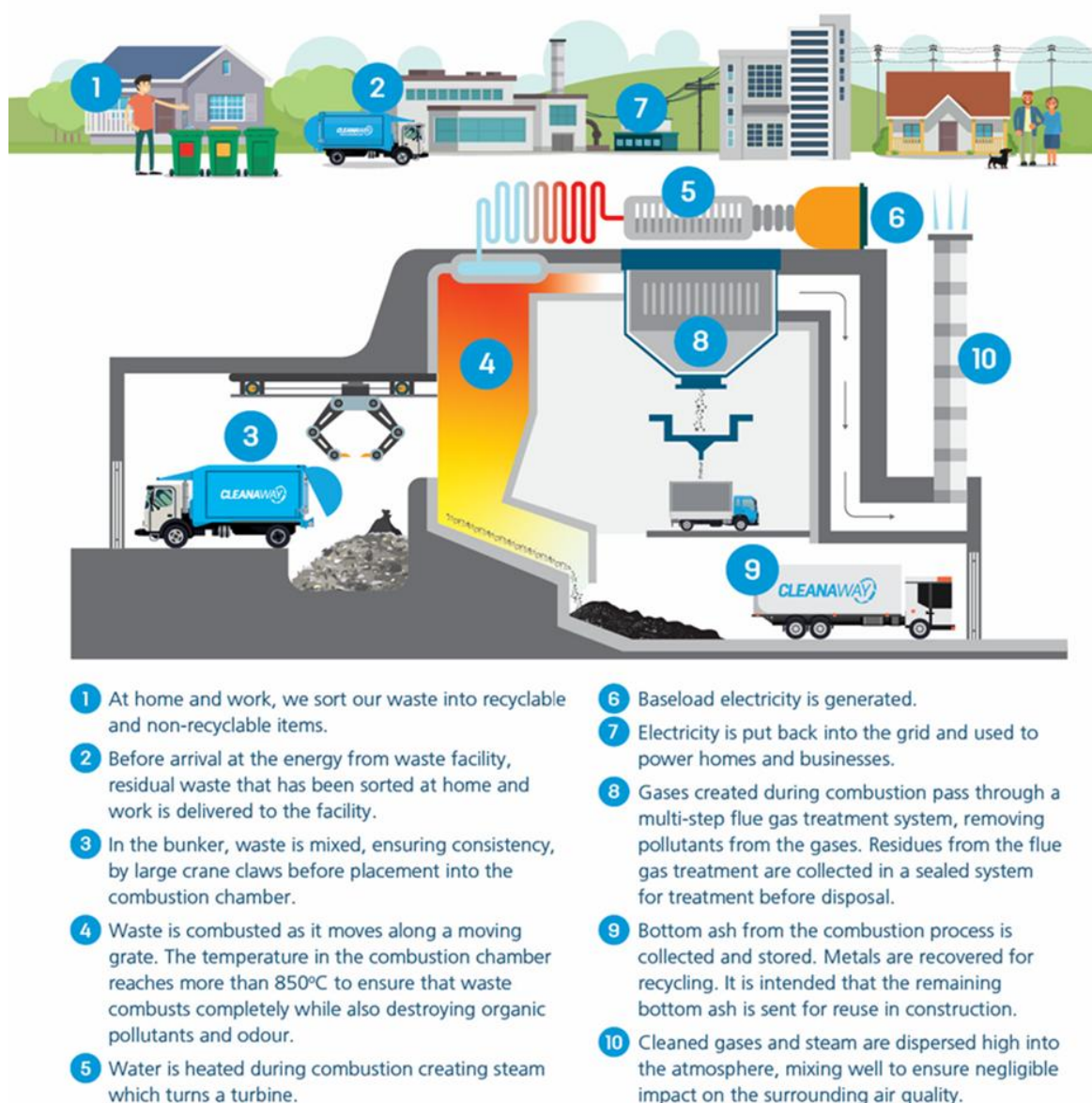


Figure 1: Energy from Waste Process

1.2.2 Proponent

Cleanaway, an Australian owned company, has operated for more than 50 years, supporting industry, government, communities and households across Australia. Its mission is to make a sustainable future possible, achieved through action across all levels of the waste hierarchy. Waste generation is minimised

through extensive education programs, with Cleanaway's 50 education officers reaching over 120 businesses, 30 councils, and almost 33,000 school participants in the last financial year.

Cleanaway invests heavily in recycling, operating several Material Recovery Facilities nationwide and has partnered with Pact Group, Asahi Beverages and Coca-Cola to deliver two large-scale PET (polyethylene terephthalate) recycling facilities and a HDPE (high density polyethylene) recycling facility with Pact Group. In addition, in collaboration with Viva Energy, Cleanaway is developing a soft plastics recycling plant. EfW is recognised by Cleanaway as an important part of the future waste management framework, enabling recovery of energy and other resources from residual waste that cannot otherwise be recycled.

1.2.3 Policy Alignment

The BERC aligns with the Queensland EfW Policy and the Queensland EfW Guideline (2021) by diverting residual waste from landfill and delivering economic and social benefits through employment and local business opportunities in South East Queensland.

In accordance with Policy outcome 7 of the Queensland EfW Policy, the BERC will be designed to meet the best practice emission standards and requirements of the European Industrial Emissions Directive (IED) (2010) and the associated Best Available Techniques Reference (BREF) Document for Waste Incineration (2019), which sets the European Union environmental standards for waste incineration.

The Project also supports the Queensland Waste Strategy contributing to its 2050 targets to reduce household waste by 25%, recycle 75% of all waste, and divert 90% from landfill. In doing so, the BERC will play a key role in advancing Queensland's transition to a circular economy and reducing long-term reliance on landfill.

1.2.4 Key Components

The key components of the Project are summarised in Table 1.

Table 1: Key Project Components

Project Component	Detail
Address	Lot 1 Beaudesert Boonah Road, Bromelton, Queensland, 4285 (Lot 1 on RP45234). Refer Figure 2.
Site Area	63 hectares
Summary of proposed works	The Project includes the construction of a main EfW facility for waste processing, incinerator bottom ash (IBA) maturation and processing facility and an air pollution control residue (APCr) facility. It also includes all onsite infrastructure needed for the EfW facility, such as site utilities, internal roads, weighbridges, parking and hardstand areas, stormwater infrastructure, fencing and landscaping. The Project will include a visitor centre to help educate and inform the community on circular economy principles, the waste hierarchy, including waste avoidance, recycling, resource recovery, the benefits of landfill diversion and the EfW process. The intent behind this education is to drive a shift in community awareness and attitudes toward waste management and resource recovery.
Technology Used	The proposed technology is moving grate combustion technology. This has been used globally for over 100 years and is common in many of the 500 similar operational examples across Europe.
Facility Outputs	Approximately 73.2 MW (577,600 MWh/year, corrected for ambient temperature) exported to the grid as baseload electricity. Potential to supply energy in the form of heat and/or process steam to local industrial users. Residual materials include IBA and APCr. - It is intended that the IBA will be mechanically processed on site to create incinerator bottom ash aggregate (IBAA). During this process, both ferrous and non-ferrous metals are recovered for recycling and sale. It is intended that the remaining material is repurposed for use as an aggregate in construction. - The Project includes a facility to stabilise APCr before removal and disposal at a licensed landfill.
Key infrastructure	EfW facility including administration and visitor's centre IBA maturation and processing facility (2 x pads and 2 x sheds)

Project Component	Detail
	APCr facility (1 x pad, 1 x shed) Transformer yard and switchyard De-coupling area for trucks Weighbridges Internal road network and carparking 2 x combined storm water treatment and detention basin 1 x lined retention basin Access from Beaudesert Boonah Road via a signalised intersection with Recycling Street
Hours of Operation	24 hours per day, seven days per week (365 days per year)
Operational Staff	Approximately 60 staff

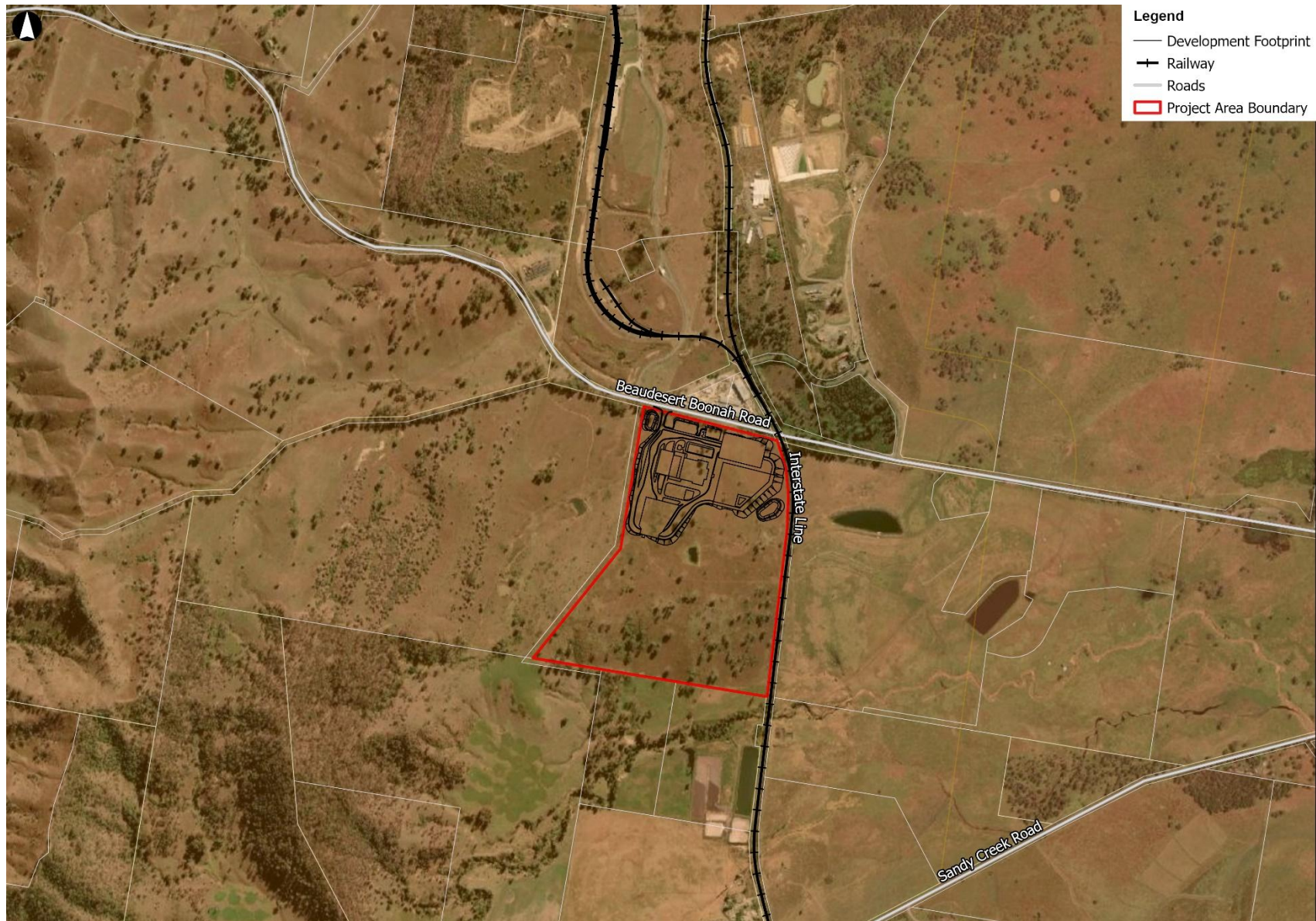


Figure 2: Site Location

2. Regulatory context

The regulatory context for this facility is set out in the Planning Report and the Energy from Waste Policy Report. Key legislation and policy context relevant to this report includes:

- *Queensland Environmental Protection Act 1994 (EP Act)*
- Queensland Environmental Protection Regulations 2019 (EP Regulations)
- Queensland EfW Policy (2021) and supporting Guideline (EfW Guideline) (2021)
- European Union Best Available Techniques Reference Documents, in particular the BREF-WI (2019)
- European Union Directive 2010/75/EU on industrial emissions (IED).

The BERC site is located within the Bromelton SDA. The purpose of the SDA is to promote and facilitate economic development in Queensland, and more specifically to support the growing demand for medium to large scale industries and difficult to locate industries. The proposed BERC constitutes a Material Change of Use for Special Industry and is assessable development under the Development Scheme.

2.1.1 Reference Facilities

The Queensland EfW Policy dictates that proponents proposing to establish a commercial technology are expected to meet the following requirements:

- *Provide data from a reference facility to demonstrate that the proposed facility can function in an environmentally-sound manner in compliance with the requirements of this policy*
- *Provide at least two (2) years of operational data from the reference facility to enable the department to assess and validate the potential environmental and human health risks of the proposed facility. Data from the design, modelling or commissioning phases alone is not acceptable to demonstrate operational performance of the proposed facility.*

Further requests for data are included in the supplementary EfW Guideline. This report describes the selection of reference facilities and provides a summary of key insights from the operational data. Raw data sets are provided in appendices.

2.1.2 Best Available Techniques

The concept of BAT was introduced in the European Union (EU) by the IPPC-Directive (Integrated Pollution Prevention and Control Directive of 1996; 2000/76/EC) and subsequently has been moved into the IED (2010/75/EU), which requires the EU commission to adopt the BREF-WI.

The drafting of the BREF is led by the European Commission's Joint Research Centre (JRC) through its European Integrated Pollution Prevention and Control Bureau (EIPPCB). Thirty different BREF documents are issued (one for EfW and 29 for other industries), all having the same standard table of contents, of which Chapter 5 outlines BAT.

International best practice for thermal EfW facilities is widely recognised (including by the Queensland EfW Policy and EfW Guideline) as the BREF-WI, last published in December 2019. The BREF-WI is an update to previous BAT advice (issued in the 2006 BREF-WI) and is expected to be continually updated every (approximately) 8 years. EfW facilities are required to continue to comply with any updates to BAT advice.

The BREF-WI provides 37 BAT conclusions based on the IED and information on a large number of actual operating EfW facilities shared between EU member states. The EU has issued an Implementing Decision (Commission Implementing Decision 2019/2010) of 12 November 2019 establishing the BAT conclusions,

under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration, referred to as the BATC, 2019. The BATC, 2019 contains a summary of the key BAT conclusions¹.

The BERC is required to demonstrate the use of best practice techniques for environmental protection by the Queensland EfW Policy and the EfW Guideline, and the Queensland SDA assessment criteria. EfW Policy outcome 7 states:

“The potential impacts of EfW facilities are expected to be managed in accordance with the Waste Incineration BREF and the Waste Treatment BREF².”

A variety of approaches, systems and controls constitute BAT, as recognised in the BREF-WI. Not all techniques are appropriate in all situations and not all techniques can be used together. Techniques are chosen that best suit the technology being utilised.

Section 6 of this report demonstrates (where applicable) how the design of the BERC meets the requirements of the 37 BAT conclusions. Where BAT conclusions are not relevant to the BERC, a justification of why they are deemed not relevant to this Project has been provided.

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D2010&from=EN>

² Note: The BREF-Waste Treatment (BREF-WT) broadly relates to treatment of a wide range of wastes, including non-thermal, biological waste treatment and generally excludes thermal treatment of waste. The BREF-WT does discuss best practice in relation to the treatment of APCr, referred to in the BREF-WT as Flue Gas Treatment residue), to stabilise this material prior to disposal. However, best practice in relation to the management and treatment of IBA is covered by the BREF-WI and is specifically excluded from the scope of the BREF-WT. As the BAT conclusions in the BREF-WI are directly applicable to thermal treatment of waste, the BREF-WT is therefore not discussed further in this document, except in relation to APCr stabilisation.

3. Proposed Site Layout

The Project is situated within the locality of Bromelton, Queensland, approximately 47 km inland of the Gold Coast and around 56 km south south-west of Brisbane.

The entire site measures approximately 63 hectares in area and is generally regular in shape. Site dimensions are approximately 510 m northern boundary (road frontage), 965 m eastern boundary (adjacent rail corridor), 880 m southern boundary (adjacent private land) and 1,060 m western boundary (in two parts) being 535 m and 525 m (adjacent private land).

A conceptual masterplan layout is depicted in Figure 3, while a preliminary elevation drawing (subject to detailed design and technology provider selection) is presented in Figure 4.

The Project site will incorporate the following key process elements:

- Two-line EfW facility, with each line comprising: a moving grate combustor, heat recovery steam boiler, flue gas treatment system, induced draft (ID) fan, Continuous Emissions Monitoring System (CEMS) and a dedicated flue. The design is based on 2 x 140 MWth Lines (at 100% MCR) with a capacity of 380,000 tpa per line, assuming 8,000 hours per year of boiler availability. This establishes a design waste calorific value (CV) of 10.6 MJ/kg (Lower Heating Value (LHV)). The design shall also consider operation at maximum thermal overload (110% MCR i.e. 154 MWth), assuming 10% mechanical overload (i.e. 418,000 tpa per line) at the design CV of 10.6 MJ/kg (LHV). The two lines will supply steam to a single steam turbine while flue gas will be discharged through a single stack containing two internal flues
- IBA treatment area incorporating:
 - an enclosed conveyor for delivery of IBA from EfW facility to the IBA temporary storage area
 - a maturation building to store raw IBA in maturation piles prior to sorting (45 days at 100% MCR)
 - a fully enclosed sorting facility
 - temporary open-air stockpiles for sorted and matured IBA aggregate (IBAA) product (36 days at 100% MCR), with dust control for open air stockpiles using water spraying
 - a segregated stormwater retention system servicing the IBA storage area to facilitate both rainwater and run-off water capture for reuse within the IBA maturation and storages areas
 - a truck loading area for IBAA collection.
- An undercover APCr stabilisation area where treated APCr (a slurry of APCr, cement and water) is allowed to cure into solid concrete-like blocks prior to transport offsite for landfill disposal.

Site infrastructure including roads, weighbridges, a waste vehicle quarantine and pre-inspection area, consumables storage, firewater and process water storage tanks, a non-process wastewater treatment system, electrical switchyard, transformer yard, truck movement areas, administration offices, a visitor and education centre and car parking spaces.

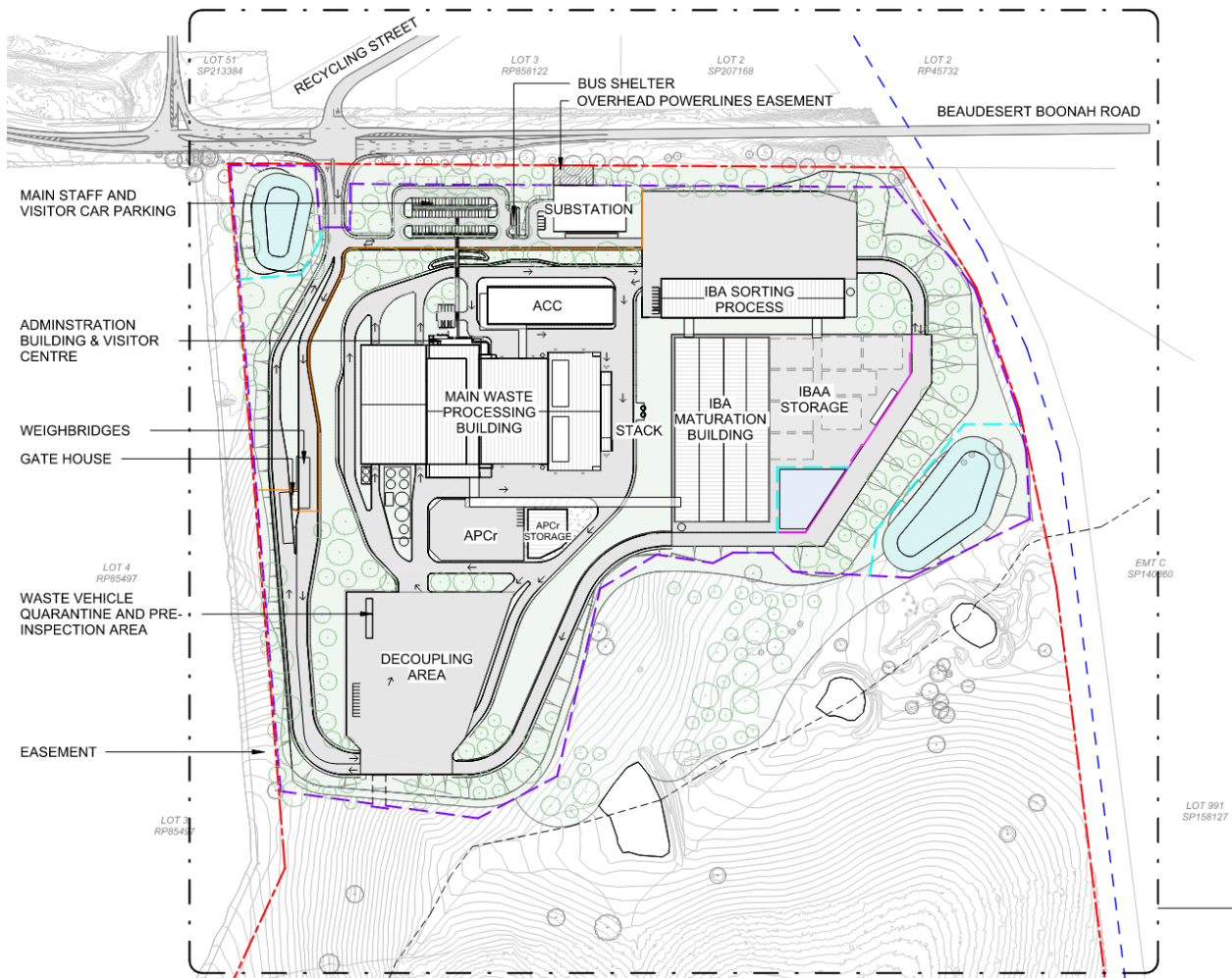


Figure 3: Conceptual Masterplan layout for the BERC Project

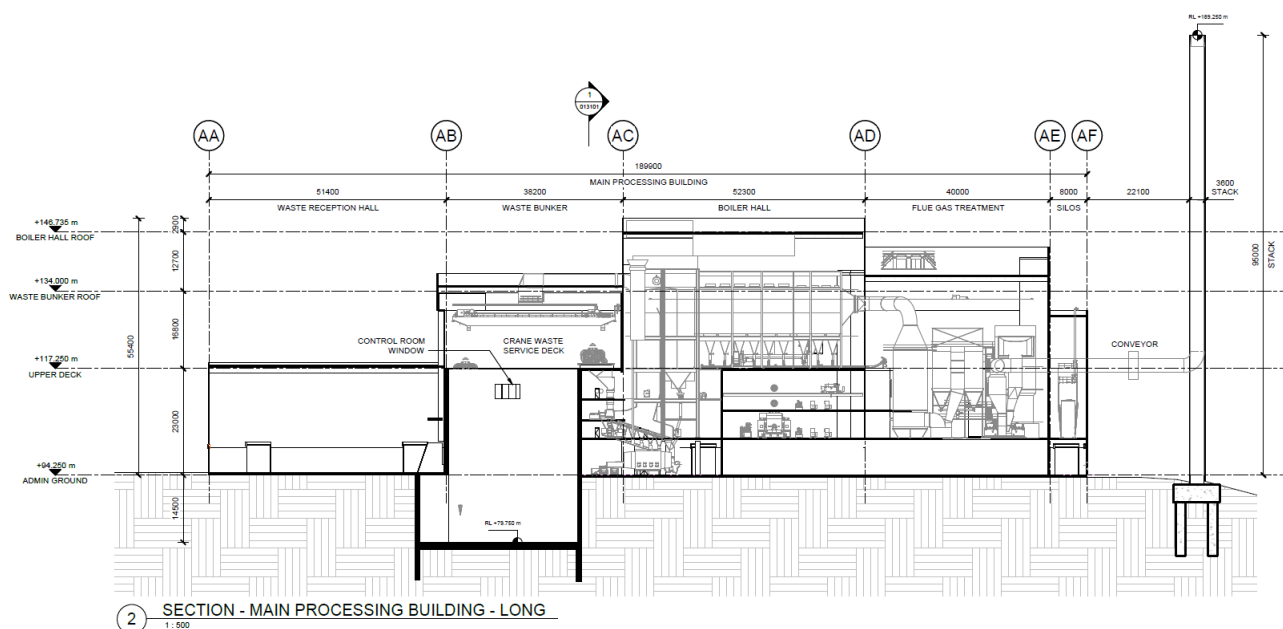


Figure 4: Preliminary elevation drawing for the BERC EfW Facility

4. Project Overview

The BERC will extract energy (as heat, to be used for electricity generation) and other useful resources from the residual waste feedstock using proven technologies and processes, and handle process residues in line with international best practice. Whilst technology providers have not yet been selected, the conceptual design undertaken to date includes preliminary process assessments which give confidence to key project parameters.

The proposed EfW technology is moving grate combustion. The BERC will have a design throughput of 760,000 tpa of waste at the design CV of 10.6MJ/kg (LHV). Two equally sized boiler lines are included in the design which will utilise a common steam turbine to generate electricity. The EfW process will generate approximately 84.6 MW (gross) of electricity, with approximately 11.3 MW used to power the facility itself, including the associated on-site by-product and residue handling processes. Approximately 73.2 MW or 577,600 MWh/year³ will be exported to the grid as baseload electricity, a significant portion of which is categorized as renewable, due to the biogenic carbon content of the waste feedstock.

This section presents a high-level overview of the EfW process. A comprehensive and detailed description is provided in Appendix A.

4.1 High-Level Process Description

Pre-registered waste delivery vehicles will arrive on-site and proceed to a weighbridge where each waste load is subjected to a radiation detection check, weighed, and delivery details recorded. Once the vehicle is identified including confirmation of acceptable residual waste type and origin, and cleared by the radiation check (in accordance with the site contractual Waste Acceptance Protocol), the driver will be allowed to proceed to a decoupling area (for twin trailer A-Double type waste transfer station trucks), or directly to the waste receiving hall (tipping hall) identified as (1) in the process schematic presented in Figure 5.

The waste receiving hall is a fully enclosed building with fast acting entry and exit roller doors and adjustable ventilation louvres. The waste delivery vehicle will approach the tipping bay (2) and tip its load into the waste bunker (3) which has a storage capacity equivalent to up to five days of operation, and up to seven days of operation with closed bays. Combustion air intakes for the furnace combustion system are located above the waste bunker area, thus creating a negative air pressure within the waste receiving hall and waste bunker. This is a primary odour control design feature for the facility along with requiring waste delivery vehicles to be fully enclosed upon arrival and ensuring that no dumping of waste occurs outside the receiving hall.

³ Based on 8,000 hours of operation at design capacity per year and a 98.7% climate correction factor to account for a slight reduction in electricity generation when ambient temperatures are higher than the Air Cooled Condenser design temperature.

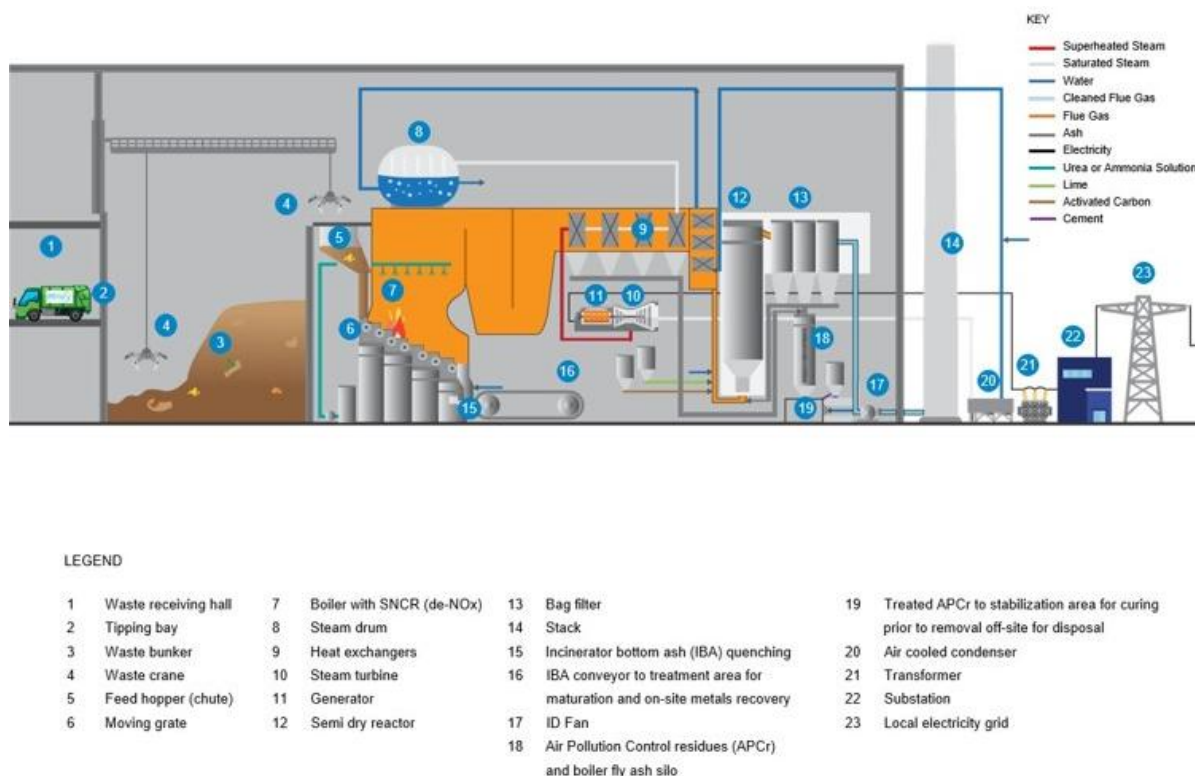


Figure 5: Process schematic with key features

A waste grab crane (4) continuously mixes the waste in the waste bunker, to homogenise the waste prior to loading some of the waste into the boiler feed hopper (5). An automated ram-feeder pushes the waste from the feed hopper onto the inclined moving grate combustor (6), where it dries, gasifies and then combusts to produce flue gas, ash and heat. An Automatic Combustion Control System (ACCS) that is part of the plant Control and Monitoring System (CMS) controls the waste feed rate, the grate speed and carefully controls the injection of both primary combustion air (introduced below the grate) and secondary combustion air (blown into the furnace above the grate). A reducing reagent (urea solution or ammonia solution) is sprayed into the furnace (7) where the flue gas is still at high temperature, to remove oxides of nitrogen (NOx) that is produced during the combustion process.

The furnace is designed to ensure that the flue gases are held at a temperature not less than 850°C for at least two seconds after the final injection of combustion air. This helps to ensure a high level of carbon burnout and helps to destroy products of incomplete combustion or undesirable by-products of combustion. Diesel fuel fired auxiliary burners are also provided to facilitate safe start-up (warm-up) and shutdown of each grate-boiler line. The auxiliary burners can also be called upon by the ACCS, if the flue gas temperature approaches the minimum allowable temperature (850°C), while waste is still being combusted on the grate. If the system is unable to achieve the minimum high temperature residence time or a component failure means that continued operation would likely breach daily average emission limits, then the impacted line will be shutdown in accordance with the provisions in the IED. The IED also includes various provisions for Other Than Normal Operating Conditions (OTNOC), to allow EfW facility operators to rectify malfunctions and issues within a finite period of time, after which the line or facility would need to be shutdown. These provisions seek to reduce the frequency of plant start-ups and shutdowns, which are also classified as OTNOC by the IED.

Heat is recovered from the hot flue gases in the integrated heat recovery steam boiler system by boiling water to produce steam in a steam drum (8). The flue gases are cooled further by superheating the steam in tube banks in a horizontal convective section of the boiler (9), and then by preheating boiler feedwater in the final boiler economiser section. The high pressure superheated steam expands through a steam turbine (10) to generate mechanical energy by turning a shaft to which an electrical generator (11) is connected. The low pressure exhaust steam at the outlet of the steam turbine is condensed in an Air Cooled Condenser (ACC) (20), to allow the condensate to be pumped back to the boiler, thus creating a closed-loop water-steam power cycle.

A steam turbine bypass system facilitates start-up of the steam turbine and allows the EfW plant to continue to operate even if the steam turbine generator is shut down for maintenance. In the event of a failure of the external electricity grid, the bypass system also facilitates Power Island Mode. In this mode the steam turbine generator operates at minimum load to supply the parasitic (own consumption) needs of the BERC in the event that the external electricity grid is unavailable or unable to accept generation capacity from the BERC. An emergency diesel generator (EDG) and a dedicated uninterruptible power system (UPS) will be provided to ensure that the BERC can shutdown safely in the event of a major power system failure.

Cooled flue gases leaving the boiler economiser are further cooled and conditioned with water sprays. Lime and powdered activated carbon and recirculating residue from the downstream baghouse filter (13) are injected into the cooled flue gas upstream of a semi dry reactor (12), which provides residence time for acid gas neutralisation reactions to occur and adsorption of heavy metal and residual organic compounds. These solid residues (reagents and reaction products) and fly ash from the furnace are separated from the flue gas in a baghouse filter (13). The cleaned (scrubbed and filtered) flue gas is drawn through the boiler and flue gas treatment system by an ID fan (17) and then discharged high into the air via the 95 m flue gas stack (14). Each boiler line will have its own dedicated CEMS located in a straight section of flue gas ducting or on the flue gas stack, to facilitate continuous monitoring of a range of potential pollutants and other process parameters (flow rate, temperature, moisture, oxygen content) associated with the cleaned flue gas.

Non-combustible waste materials such as metals, soil, bricks, glass and ceramics, and bound ash released from combustion of waste materials remains on the grate after the combustible components are combusted for energy recovery. This solid ash residue, termed IBA, is quench cooled in a wet ash extraction system (15), which also acts as a water bath to prevent uncontrolled air ingress into the furnace, since the furnace operates under slight negative air pressure. The IBA is conveyed (16) to an on-site maturation and treatment area, where the IBA is allowed to age in a three-sided building. During the aging or maturation process, certain mineral compounds in the IBA react with carbon dioxide in the air which stabilises the material. The IBA is then sorted and processed to recover recyclable ferrous and non-ferrous metals and to produce an aggregate potentially suitable for use in civil construction projects. Dust suppression and management measures are included within Appendix A.

A small portion (purge) of the solid residue separated from the flue gas in the baghouse filter is combined with boiler ash collected in hoppers under the horizontal section of the boiler and the boiler economiser and temporarily stored in APCr silos (18). The APCr is then mixed with cement and water (19) to produce a concrete-like slurry and allowed to cure into solid concrete blocks. This process stabilises the APCr so that it can be sent to an appropriate landfill for disposal. Prior to stabilisation treatment the APCr is typically less than 5% of the original weight of the waste feedstock.

Electricity is generated at 22 kV (to be confirmed during Basic Engineering) by the steam turbine generator and distributed to internal users. Electricity generated in excess of internal electricity consumption requirements (i.e. almost 90% of gross electricity generated) is stepped up in voltage to 110 kV by a transformer (21) for export to the Beaudesert Bulk Supply Substation (22) and then into the electricity grid (23).

4.2 Key Process Design Parameters

The key process design parameters are summarised in Table 2. Where noted, these parameters will be subject to change once technology providers are selected and subject to further development of the engineering design, once final equipment selections have been made.

Table 2: Key Process Design Parameters

Parameter Description	Value 100% MCR (110% MCR)	Comment
Plant and Equipment Design Life	30 years	
Structural Design Life	50 years	
Operational Regime	24 hours, 7 days per week. With a provision of 760 hrs per year for planned and unplanned outages, the	Waste feedstock deliveries typically received between 6 AM and 6 PM Monday to Sunday, but may be delivered 24 hours a day, 7 days a week.

Parameter Description	Value 100% MCR (110% MCR)	Comment
	Facility has an expected boiler availability of 8,000 hrs per year.	8,000 hrs is a typical process guarantee for boiler availability. However, actual boiler availability may be higher. Refer to Appendix A for high-level start-up and shutdown procedures.
Number of grate-boiler lines	2	
Fuel/Feedstock Type	Residual mixed solid wastes	Examples include residual MSW and residual C&I wastes.
Design Fuel CV	10.6 MJ/kg (LHV)	Corresponding to Load Point 1 (LP1) on the BERC Capacity Diagram
Fuel CV Allowable Range	7.4 MJ/kg – 14.6 MJ/kg (LHV)	Range to accommodate expected variability in waste composition both day to day and over the life of the Facility e.g. resulting from improvements in recycling of organics, plastics and other recyclable materials, and changes in consumer behaviour.
Nominal fuel ash content (as received)	25%	Allowance from experience, inclusive of potentially recyclable metals, non-combustible materials and ash bound to combustible materials.
Plant capacity		Also see Figure 6.
LP1 (10.6 MJ/kg (LHV)) i.e. Nominal design load point	2 x 47.5 tph per line 760,000 tpa @ 8,000 hours	See ‘Operational Regime’ above.
110% MCR (at 10.6 MJ/kg (LHV) i.e. 10% mechanical overload)	2 x 52.25 tph per line 836,000 tpa @ 8,000 hours	See ‘Operational Regime’ above.
LP2 (8.8 MJ/kg (LHV)) i.e. maximum mechanical load point	2 x 57 tph per line	The grate-boiler lines are not expected to operate at this capacity for an extended period of time.
LP9, LP10 (7.4 MJ/kg (LHV)) i.e. minimum allowable waste CV load points	2 x 57tph per line	The grate-boiler lines are not expected to operate at this capacity for an extended period of time.
LP7 (10.6 MJ/kg (LHV)) i.e. maximum turndown load point at nominal design CV	2 x 33.3 tph per line	70% thermal input turndown
LP8 (7.4 MJ/kg (LHV)) i.e. maximum turndown load point at minimum fuel CV	2 x 47.5 tph per line	70% thermal input turndown
100% Thermal Input	2 x 140 MW _{thermal}	Thermal input corresponding to LP1, LP2 and LP5.
110% Thermal Input	2 x 154 MW _{thermal}	10% Thermal Overload to accommodate expected variability in fuel CV. Operation above 100% thermal input is not recommended for extended periods.

Parameter Description	Value 100% MCR (110% MCR)	Comment
Target steam parameters	425 °C, 60 bara	At the steam turbine emergency stop valve
Target Oxygen in flue gas (wet)	~6.5%	Subject to technology provider selection and detailed design
Target boiler economiser exit temperature	160 °C	Subject to technology provider selection and detailed design
NOx abatement	Selective Non-Catalytic Reduction (SNCR)	With either urea solution or aqueous ammonia solution as the reducing agent.
Flue Gas Treatment	Semi-dry scrubbing in combination with baghouse filter, with hydrated lime and powdered activated carbon injection and residue recirculation	
Stack exit temperature	147 °C (Note: 130 °C used for Air Quality modelling)	Subject to technology provider selection and detailed design
Air Cooled Condenser design	100 mbar(a) @ turbine exit up to 20 °C ambient air temperature	Subject to technology provider selection and detailed design
Stack height	95 m per flue	Height of stack to ensure that emissions comply with applicable ground level air quality criteria under the Environment Protection (Air) Policy 2019.
Gross Generation Capacity	~84.6 MWe (92.6 MWe)	Subject to technology provider selection and detailed design
Estimated Parasitic Load	~11.3 MWe (12.1 MWe)	Subject to technology provider selection and detailed design. Includes a provision for on-site IBA processing, APCr stabilisation and Point of Connection (PoC) losses.
Net Generation Capacity for export	~73.2 MWe (80.6 MWe)	Subject to technology provider selection and detailed design
Estimated Net Electrical Generation Efficiency (LHV)	~26%	Subject to technology provider selection and detailed design
Estimated R1 (European Waste Framework Directive)	>0.65 (theoretical estimate ~0.8)	Subject to technology provider selection and detailed design. Also see Section 6.
Connection Voltage	110 kV	Proposed connection point is at Beaudesert Bulk Supply Substation. It is proposed to connect via a new ~7 km dual circuit 110 kV line.
Process potable water consumption (preliminary estimate, excluding Firewater Tank make-up)	LP1: 501 m ³ /day (20.9 m ³ /h) 100% MCR: 550 m ³ /day (23 m ³ /h) Peak: 31.8 m ³ /h	Rainwater to be harvested for reuse and potentially greywater reuse, to offset import of potable water.
Potable water source	Queensland Urban Utilities potable water main	Will require extension to the existing 375 mm DI water main along Beaudesert Boonah Road.
Process wastewater discharge	N/A	No process wastewater discharge. During normal operation, all process wastewater is to be reused within the process.

Parameter Description	Value 100% MCR (110% MCR)	Comment
Sewage wastewater	Up to ~4,000 L/day, likely ~2000 L/day with separate greywater management and reuse	It is proposed to reuse greywater from showers and handwashing basins as make-up to the Recycled Water Tank, to facilitate reuse within the process plant. Use for on-site landscape irrigation is subject to further investigation.
Sewage discharge point	Wastewater to be periodically trucked to the Beaudesert Wastewater Treatment Plant	It is proposed to retain sewage wastewater from staff amenities (toilets and kitchens) in on-site septic tanks. On-site secondary sewage treatment may also be considered during detailed design, subject to further site suitability assessment and local approvals.
Auxiliary fuel type and source	Diesel fuel, delivered via road tanker	Stored on-site in double walled or bunded tank compliant with AS 1940:2017.

4.3 Capacity Diagram

A preliminary Capacity Diagram, explaining the relationship between fuel feed rate and thermal input as a function of waste CV is illustrated in Figure 6. The Capacity Diagram shows the valid operating envelope for 1 of 2 grate-boiler lines.

Key features of the Capacity Diagram are as follows:

- Diagonal pale green lines: indicate the range of CVs for the waste fuel from 7.4 MJ/kg (load points (LPs) 8, 9, and 10) to 14.6 MJ/kg (LP4, 5, and 6). This allows for a variation in fuel CV of 70% to 138% of the design CV (10.6 MJ/kg of waste)
- Vertical dashed lines: indicate the waste throughput mechanical load ranging from 33.3 t/hr to 57 t/hr per line. This allows for variation of $\pm 30\%$ of the design point of 47.5 t/hr
- Horizontal dashed lines: indicate the thermal input ranging from 98 MW to 154 MW. This represents a range between 70% - 110% of the design thermal input of 140 MW
- Load Points: These indicate valid operational points at the extremities of the valid operating envelope for each grate-boiler system. The Project can continuously operate at all LPs for periods over two hours, except for the region bounded by LP2, 3, 4 and 5. The area constituted by the points LP2, 3, 4 and 5 represents the thermal overload region, which is designed to manage inevitable fluctuations from the preferred continuous operational line LP2 – LP5, corresponding to 100% thermal input. Continuous operation within the thermal overload region is not recommended.

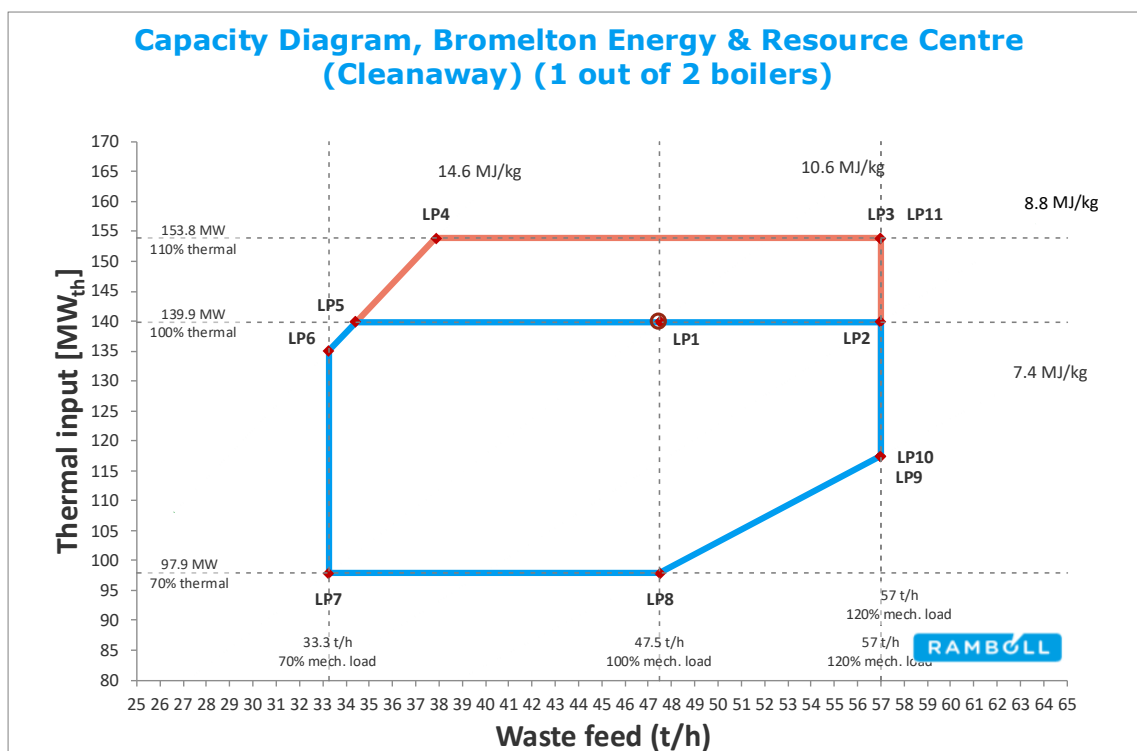


Figure 6: Capacity (Firing) Diagram for 1 of 2 grate-boiler lines

4.4 Key Process, Environmental Risk Mitigation and Risk Management Design Features

The Project will largely be automated, incorporating continuous emissions monitoring technology, continuous monitoring of operational performance and automatic shut off mechanisms triggered where preprogramed limits are reached for key parameters. The operating system will incorporate several layers of contingency to detect system changes and respond to potential incidents. Regular monitoring, alarms and standard operating procedures will be in place to ensure that emissions are monitored continuously, and the necessary actions taken should the risk of related emissions exceedances or actual exceedance be detected.

Key process and environmental risk mitigation and risk management measures to be employed at the Project are described in this report. These aim to reduce process and environmental risks as far as reasonably practicable.

The main EfW building will incorporate design features to manage emissions and mitigate the potential for fugitive emissions from the building:

- The tipping hall and waste bunker areas will be maintained under negative pressure to manage fugitive odour emissions. Odours will be destroyed in the combustion chamber(s) during normal operation and a back-up air filtration system will be in place should the entire EfW facility be shutdown for an extended period, to maintain safe working conditions within the waste reception hall and waste bunker areas
- The waste bunker will be fully sealed to prevent leakage of waste into groundwater or groundwater ingress into the bunker
- Chemical consumables that are used for pollution control will be delivered and stored within the EfW building. Storage and handling of consumables will be in accordance with appropriate Australian Standards, WorkSafe Queensland and Department of Environment, Tourism, Science and Innovation (DETSI) Guidelines, including bunding, separation distances (for incompatible materials) and placarding.

The BERC site will incorporate further design features to manage risks and mitigate emissions:

- All process wastewater is either discharged as water vapour through the stack or will be re-used within the ash quench, residue stabilisation and flue gas treatment systems, such that during normal operation there will be no rejection of process wastewater from the facility
- The facility will be designed such that noise emissions at the nearest noise sensitive receptors around the proposed site remain within applicable regulatory limits
- IBA will be treated and managed on-site in designated hardstand areas, and where appropriate, within undercover areas. Stormwater from the IBA maturation and storage area will be segregated, retained and managed separately
- Diesel will be stored in either double skinned or bunded fuel tanks compliant with AS1940:2017.

5. Reference Facilities

5.1 Selection

The Queensland EfW Policy defines a reference facility as:

“A reference facility is a facility that has been in commercial operation:

- *At a scale (size and throughput) similar to the facility being proposed*
- *With a feedstock similar in composition to that proposed*
- *For at least two continuous years*
- *In Queensland or in a jurisdiction with comparable regulatory governance to Queensland”*

The BERC Project has selected the following three reference facilities to inform the design and demonstrate the environmental performance of the proposed energy recovery technology.

- FCC Gloucestershire (Javelin Park Energy Recovery Facility) Energy from Waste (United Kingdom)
- FCC Greatmoor Energy from Waste (United Kingdom)
- Covanta Dublin Waste to Energy Facility (Ireland).

As there are no locally established plants currently operational in Australia at the time of writing (noting several currently under construction), all selected reference facilities are international facilities.

In summary, the facilities have been chosen as they meet the reference facility definition and provide an accurate insight into the Project, for the following reasons:

- They are at a similar scale to the BERC (i.e., several hundred thousand tonnes per annum of waste per boiler-line)
- They process residual MSW and C&I wastes that would otherwise have been sent to landfill (refer to Section 5.3 for comparison of the feedstock)
- They have been in successful commercial operation for more than two continuous years (refer to section 5.5 for operational data)
- The EfW guideline defines the EU and UK as comparable regulatory jurisdictions.

The facilities have been used as follows:

- The two facilities in the United Kingdom utilise the same thermal treatment technology and similar APC (flue gas treatment and NO_x reduction methods) as proposed for the BERC. They are therefore used as reference facilities to demonstrate the appropriateness of the technology proposed for the BERC. However, there is no residue composition data available for these facilities.
- The Dublin facility has therefore been used to compare the expected composition of the thermal treatment residues (IBA and APCr) in the Resource and Waste Management Technical Report and provide a preliminary waste classification for these residues (to inform management pathways). Whilst utilising a different flue gas treatment process to the BERC, the feedstock type and processing capacity is comparable, and the process technology up to the baghouse filter is generally the same. Hence, the raw IBA and APCr characteristics are considered suitably representative of what the BERC will produce.

Table 3 gives an overview of key parameters for the reference facilities to allow high-level comparison.

5.2 Comparison / Overview of Key Parameters

Table 3: Reference facilities – comparison / overview

Parameter	FCC Gloucestershire EFW (Note 1)	FCC Greatmoor EFW (Note 2)	Dublin EFW Facility (Note 3)	Bromelton Energy and Resource Centre
Relevance to the BERC Project as a reference facility	Same waste processing technology (moving grate combustion) and APC (semi-dry system, SNCR) Processes a similar feedstock at a somewhat smaller scale (i.e. capacity per boiler line) to the BERC facility.	Same waste processing technology (moving grate combustion) and APC (semi-dry system, SNCR) Processes a similar feedstock at a similar scale (i.e. capacity per boiler-line) to the BERC facility.	Same waste processing technology (moving grate combustion) Thermal treatment residue analysis (Refer Resource and Waste Management Technical Report for further details)	Not applicable
Facility details				
Year commissioned	2019	2016	2017	n/a
Location	Gloucester – United Kingdom Javelin Park, Haresfield, Gloucestershire, GL2 7NQ	Buckinghamshire – United Kingdom Greatmoor Energy from Waste Facility, Edgcott, Aylesbury, Buckinghamshire HP180QN	Dublin - Ireland Pigeon House Road, Poolbeg, Dublin D04 N2P2	Queensland – Australia Lot 1, Boonah-Beaudesert Road, Bromelton Queensland 4285
Number of incineration lines	One line	One line	Two lines	Two lines
Operational waste throughput (tph based on 8,000 hours)	190,000 tpa @9.65 MJ/kg (23.75 tph)	345,000 tpa @ 9.3 MJ/kg (43 tph)	599,000 tpa in 2018 (~35 tph per line)	Design capacity 100% MCR: 760,000 tpa @ 10.6 MJ/kg (47.5 tph per line or 380,000 tpa) Design capacity 110% MCR: 836,000 tpa @ 10.6 MJ/kg (47.5 tph per line or 418,000 tpa)
Design net calorific value	9.65 MJ/kg	9.3 MJ/kg	10.5 MJ/kg	10.6 MJ/kg
Combustion technology	Moving grate fired furnace and horizontal pass boiler	Moving grate fired furnace and horizontal pass boiler	Moving grate fired furnace	Moving grate fired furnace and horizontal pass boiler
Technology provider	B&W Vølund	Hitachi Zosen Inova (HZI)	HZI	Not yet selected, to be determined through competitive tender at later design stage

Parameter	FCC Gloucestershire EfW (Note 1)	FCC Greatmoor EfW (Note 2)	Dublin EfW Facility (Note 3)	Bromelton Energy and Resource Centre
Air Pollution Control (emission control and flue gas treatment) technology	• SNCR using ammonia solution for NO_x abatement • Semi-dry flue gas treatment with Hydrated lime injection and Powdered activated carbon injection in combination with a Bag house filter	• SNCR using ammonia solution for NO_x abatement • Semi-dry flue gas treatment with Hydrated lime injection and Powdered activated carbon injection in combination with a Bag house filter	• SNCR using ammonia solution for NO_x abatement • Semi-dry flue gas treatment with Hydrated lime injection and Powdered activated carbon injection in combination with a Bag house filter • Wet scrubber with sodium hydroxide make-up (caustic soda)	• SNCR using ammonia or urea solution injection for NO_x abatement • Semi-dry flue gas treatment with Hydrated lime injection and Powdered activated carbon injection in combination with a Bag house filter
APCr management	Off-site disposal	Off-site disposal	Off-site disposal	Off-site disposal (Refer Resource and Waste Management Technical Report for further details)
IBA management	On-site IBA treatment and recovery	Offsite IBA treatment and recovery	Offsite IBA treatment and recovery	On-site IBA treatment and pursuing opportunities for IBAA re-use. (Refer Resource and Waste Management Technical Report for further details)
Metal recovery from IBA	On-site metal recovery 1,507t (2021 data)	Off-site metal recovery	Off-site metal recovery In 2018: • 7,740 t ferrous metal • 5,020 t non-ferrous metal	On-site metal recovery: Ferrous and non-ferrous metals will be recovered at the BERC project (in the on-site IBA processing area) ~12,000 tpa (100% MCR), 13,200 tpa (110% MCR) ferrous metals recovery expected (1.5% of waste received estimated) ~4,700 tpa (100% MCR), 5,200 tpa (110% MCR) non-ferrous metals recovery expected (0.7% of waste received estimated)
Stack height	70m	95m	105m	95m
Licensing				
Licensing framework (Note 4)	EU IED of 2010	EU IED of 2010	EU IED and Waste Framework Directive translated into local legislation and administered by the EPA Ireland. Facility waste licence no. W0232-01	ERA 61 (as well as ERA 14 and ERA 54) under the <i>Queensland EP Act</i> and EP Regulations, having regard for the Queensland EfW Policy and EfW Guideline and European best practice guidance. Emission limit values selected based on the BREF-WI BAT-AEL (Upper) daily average concentrations and IED

Parameter	FCC Gloucestershire EfW (Note 1)	FCC Greatmoor EfW (Note 2)	Dublin EfW Facility (Note 3)	Bromelton Energy and Resource Centre
Licenced waste throughput	190,000tpa in total	345,000tpa in total	602,500tpa	n/a
Waste feedstock	MSW and C&I Waste (Note 5)	MSW and C&I Waste (Note 5)	Primarily MSW, some C&I Waste (Note 5)	MSW and C&I Waste
Outputs/Performance				
Electricity generation	18.3MWe gross (2021 data) 16.4 MWe export (2021 data)	28.3MWe gross (2021 data) 25.8 MWe export (2021 data)	68MWe gross 60MWe export	Design values (100% MCR): 84.6 MWe gross 73.2 MWe export (net). Design values (110% MCR): 92.6 MWe gross 80.6 MWe export (net).
Heat recovery	Combined Heat and Power (CHP) ready for 10MWth	CHP ready	No offsite heat export. Design allows for future connection to district heating.	No offsite heat export in the short term. Turbine steam extraction for future heat offtake will be installed to allow flexibility for heat export to future on-site consumers and future neighbouring industrial facilities.
Facility availability (hours per annum)	>8000 hpa (2021 data)	>8,000 hpa (2021 data)	Not reported	Designed to achieve 8000 hpa (91%)
Energy recovery performance (based on design data)	~29% gross efficiency (based on design gross MWe/MWth input)	~29.3% gross efficiency (based on design gross MWe/MWth input)	Design net efficiency: 29% Operational net energy efficiency (including start-up and electricity grid curtailment): 27% R1 value: 0.71	Gross energy efficiency: ~30.2% Net energy efficiency: ~26.2%. Expected R1 value: ~0.8 subject to final technology selection and boiler design.
APCr generation	25.1 kg/t of waste (2.5% of throughput) (2021 data i.e. not yet required to meet the BREF-WI BAT-AEL daily average emission concentrations)	37.6 kg/t of waste (3.8% of throughput) (2021 data i.e. not yet required to meet the BREF-WI BAT-AEL daily average emission concentrations)	26,178 t (4.4% of throughput) (2018 data i.e. not yet required to meet the BREF-WI BAT-AEL daily average emission concentrations)	If the annual average waste CV is 10.62 MJ/kg, 100% MCR: ~34,200 tpa (dry) ~4.5% of throughput If the annual average waste CV is 10.6 MJ/kg, 110% MCR: ~37,620 tpa (dry) ~4.5% of throughput Note: Meeting the BREF-WI BAT-AEL (Upper) daily average emission concentration

Parameter	FCC Gloucestershire EfW (Note 1)	FCC Greatmoor EfW (Note 2)	Dublin EfW Facility (Note 3)	Bromelton Energy and Resource Centre
IBA generation	200 kg/t of waste (20% of throughput) after quenching and recovery of metals	194 kg/t of waste (19% of throughput) after quenching and prior to recovery of metals	104,061 t in 2018 ~17% of throughput	Assuming 25% ash content in waste feedstock: IBA (dry): 180,400tpa (100% MCR), 198,500tpa (110% MCR) IBAA (dry) ~163,800tpa (100% MCR), 180,100 (110% MCR) after recovery of recyclable metals)
Notes: Note 1: Data sourced from the Gloucestershire Energy from Waste Facility website and associated links (e.g. EA application and permit) and annual reports from the Environmental Agency (UK) - Contains Environment Agency information © Environment Agency and/or database rights. Note 2: Data sourced from the Greatmoor Energy from Waste website and associated links (e.g. EA permit), HZI website and annual reports from the Environmental Agency (UK) - Contains Environment Agency information © Environment Agency and/or database rights. Note 3: Data sourced from various sources including Dublin Waste to Energy, EPA Ireland, wrc, HZI, Ramboll and environmental reports and originally produced in the WSERRC EIS. More recent data is publicly accessible online, however cannot be republished without consent. Inspection of the most recent data shows no material difference and therefore confirms the 2018/19 data presented is still relevant. Note 4: Reference facility emission limits are currently set based on the IED (none of the reference facilities are currently required to meet BAT-AEL air emission limits, however will be required to meet the limits as identified in the BREF-WI when this legislation comes into effect (by the end of December 2023)) Note 5: European Waste Catalogue (EWC) waste codes for the facilities' licensed feedstocks can be viewed in their respective environmental permits.				

5.3 Data sources

Data has been sourced from several locations as identified below. Primary data sources have been included as appendices.

Table 4: Data Sources

Data source	Reference
Javelin Park Energy Recovery Facility, Gloucestershire, Annual Performance Report, 2021	Appendix C.1
Javelin Park Energy Recovery Facility, Gloucestershire, Annual Performance Report, 2022	Appendix C.2
Javelin Park Energy Recovery Facility, Gloucestershire, Annual Performance Report, 2023	Appendix C.3
Greatmoor Energy from Waste Facility, Annual Performance Report, 2021	Appendix C.3
Greatmoor Energy from Waste Facility, Annual Performance Report, 2022	Appendix C.4
Greatmoor Energy from Waste Facility, Annual Performance Report, 2023/24	Appendix C.5
Javelin Park Energy Recovery Facility, Gloucestershire, Environmental permit	Appendix D.1
Greatmoor Energy from Waste Facility, Environmental permit	Appendix D.2
FCC Gloucestershire Website	Available online ⁴
FCC Greatmoor Website	Available online ⁵
Dublin facility data, as previously published in the WSERRC EIS	Available online ⁶
WRAP National Household Waste Composition 2017	Available online ⁷
WRAP National Municipal Commercial Waste Composition 2017	Available online ⁸
Gloucestershire County Council Four Season Waste Composition Analysis Study	Available online ⁹

5.4 Comparison of feedstock

The Queensland EfW Policy requires that reference facilities process feedstocks which are similar in composition to that proposed by the BERC. The intent of selecting reference facilities with similar feedstocks is to demonstrate that acceptable operational and environmental performance is achievable using the selected processing technologies for the intended feedstock.

Assessment of reference facility waste streams considers the overall waste stream (for example, sourced from MSW or commercial waste sources). All reference facilities accept a mixture of MSW and C&I waste (refer Table 28). Similarly, the BERC facility proposes to source primarily MSW and C&I feedstock in accordance with a defined feedstock strategy (refer to the Waste Feedstock Report).

The relative proportions of MSW and C&I waste will differ over long- and short-term timescales; however, because the material components of MSW and C&I waste streams are broadly similar (and therefore their physical and chemical composition is similar) the impact on the operation of the facility is not significant.

⁴ <https://www.gloucestershire.co.uk/>

⁵ <https://www.greatmoor.co.uk/>

⁶ <https://www.planningportal.nsw.gov.au/major-projects/projects/cleanaways-western-sydney-energy-resource-recovery-centre>

⁷ <https://wrap.org.uk/resources/report/quantifying-composition-municipal-waste>

⁸ <https://wrap.org.uk/resources/report/quantifying-composition-municipal-waste>

⁹ <https://www.gloucestershire.gov.uk/media/2095018/200130-four-season-waste-composition-analysis-study.pdf>

The BERC is designed to be able to accept between 0-100% throughput of MSW and 0-100% throughput of C&I waste at any time.

Detailed waste audit composition data for the feedstock accepted at the reference facilities has not been made available, though permitted waste types are identified in their respective permits. Recent waste audit data is available for the UK which is considered representative of the feedstock that the reference facilities are processing. This demonstrates that they process comparable waste streams.

5.4.1 MSW

A report by the Waste and Resources Action Programme (WRAP) published in 2019, details the compositional analysis of household waste across the UK, including residual and recyclable streams. The intent of this report was to reliably estimate the quantity of different materials in residual waste and recycling for policy development and progress tracking. Table 5 presents the results of the study. The data has been organised into the categories as identified in waste audits undertaken for the BERC throughout 2023 (refer to the Waste Feedstock Report for more details). The UK data is considered representative of the waste that both UK reference facilities receive as MSW feedstock. Kerbside recycling data showing a high proportion of garden waste, paper, card and glass being recycled, as is the case for the MERC with 3-bin kerbside collection systems in place.

This table also presents the results of waste audits undertaken for Gloucestershire County Council in 2019, which is representative of the feedstock received by the Gloucestershire (Javelin Park) facility.

Table 5: Comparison of MSW composition for the BERC and the UK

MSW Composition, shoulder season waste audit for the BERC (Note 1)	%	Kerbside residual (MSW) waste composition, UK (Note 2)	%	Kerbside household waste audits, Gloucestershire (average) (Note 3)	%
Paper, cardboard	17.6	Paper, card	13	Paper, card	14.8
Wood	2.7	Wood	1.4	n/a (wood forms part of 'combustibles' category)	n/a
Plastic	14.0	Dense plastic, plastic film	13.7	Dense plastic, plastic film	17.6
Metals (ferrous and non-ferrous)	2.6	Ferrous metals, non-ferrous metals	3	Ferrous, nonferrous	3.1
Organic (excluding wood, including nappies and textiles)	52.1	Food waste, garden waste, other organic, textiles	46.8	Food waste, garden and other organic, textiles, sanitary	45.4
Hazardous (includes items such as e-waste, chemicals, batteries etc)	4.8	WEEE, Hazardous	1.5	WEEE, Hazardous	2.5
Other (includes mostly inert materials such as glass, earth, building materials)	6.2	Glass, miscellaneous combustible, miscellaneous non-combustible, fines, other	20.5	Glass, combustibles, non combustibles, fines	16.5

Notes:

Note 1: Audits undertaken for the BERC of MSW representative of the BERC feedstock.

Note 2: WRAP, 2019, Bristol, National Household Waste Composition 2017, prepared by Eunomia Research & Consulting Ltd. (Table 8)

Note 3: Gloucestershire County Council, 2019, Gloucestershire County Council Four Season Waste Composition Analysis Study, prepared by Resource Futures (Table 16)

MSW is comparable in composition between Queensland and the UK, containing comparable materials in similar proportions. The most notable difference is in the 'miscellaneous' category which is substantially higher for the UK. It is noted that this category will contain elements of the combustible streams above. As such, it is not expected that this variance will affect the operation of the BERC.

5.4.2 C&I

WRAP have also produced a report that presents composition estimates for materials in 'municipal' C&I waste that is similar in nature to household waste. 'Municipal' C&I waste is C&I waste with components removed such solvents, biological wastes, discarded vehicles, combustion wastes and soils. The resulting

composition is considered representative of the C&I feedstock that would be processed at the UK reference facilities and the BERC, since these removed components are typically excluded by the facilities' waste acceptance protocols. Table 6 presents the results of the WRAP study, compared with the results of the audits of C&I waste undertaken for the BERC.

Table 6: Comparison of C&I waste composition for the BERC and the UK

C&I Composition, shoulder season waste audit for the BERC (Note 1)	%	Residual municipal C&I waste composition, England (Note 2)	%
Paper, cardboard	28.4	Paper & card	30.4
Wood	15.6	Wood	3.2
Plastic	18	Plastic	19.4
Metals (ferrous and non-ferrous)	2.4	Metals	4.1
Organic (excluding wood, including nappies & textiles)	32.8	Food waste, other organic & garden waste, textiles	29.3
Hazardous (includes items such as e-waste, chemicals, batteries etc)	0.7	WEEE, hazardous	1.3
Other (includes mostly inert materials such as glass, earth, building materials)	2.1	Glass, miscellaneous	12.3
Notes: Note 1: Audits undertaken for the BERC of C&I waste representative of the BERC. Note 2: WRAP, 2019, National municipal commercial waste composition, England 2017, Prepared by Eunomia Research & Consulting Ltd (Table 2)			

C&I is comparable in composition between Queensland and the UK, containing comparable materials in similar proportions. Similarly to the MSW stream, there are some discrepancies in individual material proportions, however this is not expected to affect the operation of the BERC.

5.4.3 Results

This feedstock comparison provides confidence that the **reference facilities are processing comparable waste streams, and therefore that the technology selected for the BERC is suitable for processing these wastes**. Some discrepancy is to be expected due to the heterogeneous nature of waste, audit size, geographical variation and seasonal variation and differences in waste audit material categorisation, however both the reference facilities and the BERC are designed to accommodate some variability in their feedstock (which in addition may be managed operationally via mixing and feedstock supply arrangements). The variance between data sets is not expected to have a significant impact on the operation of the BERC due to the following:

- Overall energy content is expected to be similar (refer Table 3) and both the reference facilities LHVs and the BERC feedstock LHV are within the bounds of the BERC Capacity Diagram (refer to the Waste Feedstock Report)
- Chemical composition is expected to be similar overall, with very similar amounts of 'hazardous' substances present, which are typically higher in potential contaminants of concern than other streams
- A degree of variability in both MSW and C&I waste composition is to be expected on both a daily and weekly basis.

5.5 Operational Data

The Queensland EfW Policy further requires that proponents proposing to establish a commercial technology should *"Provide at least two years of operational data from the reference facility to enable the department to assess and validate the potential environmental and human health risks of the proposed facility"*.

Table 7 provides a brief analysis of the data requested by the Queensland EfW Policy (where available or easily derived) highlighting any key findings and their relevance to the BERC, or any learnings that have

been incorporated into the design of the BERC as a result. Raw data is available in the appendices and at the links provided in Section 5.3.

The operational data provides confidence that the technologies selected for use at the BERC are capable of managing the proposed feedstock in an environmentally safe manner.

Table 7: Reference facilities – operational data review

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
Waste streams (feedstocks) processed annually including definition and quantity	Total Waste received 191,235t Household & Local authority 69.4% C&I 30.6% Total Waste combusted 191,235t	Total Waste received 188,925t Household & Local authority 67.3% C&I 32.7% Waste unprocessed 215t Total Waste combusted 188,710t	Total Waste received 185,813t Household & Local authority 70.6% C&I 29.4% Total Waste combusted 187,598t	Total Waste received 303,236t Household & Local authority 77.2% C&I 22.8% Total Waste combusted 303,236t	Total Waste received 297,448t Household & Local authority 82.2% C&I 17.8% Facility also received 9t (0.003%) of clinical waste. Total Waste combusted 297,448t	Total Waste combusted 263,843t received, primarily household residual waste	Refer to Section 5.3 for comparison of the feedstock
Electrical and/or thermal efficiency of the facility (gross and net of parasitic loading, if applicable)	Energy Efficiency (R1) 0.71 Gross efficiency (estimated based on design calorific value in Table 3): ~28.8% Net efficiency (estimated based on design calorific value in Table 3): ~25.8%	R1: 0.79 Gross efficiency (estimated based on design calorific value in Table 3): ~28.9% Net efficiency (estimated based on design calorific value in Table 3): ~25.8%	R1: 0.78 Gross efficiency (estimated based on design calorific value in Table 3): ~28.9% Net efficiency (estimated based on design calorific value in Table 3): ~25.8%	R1: Not reported. Gross efficiency (estimated based on design calorific value in Table 3): ~29.3% Net efficiency (estimated based on design calorific value in Table 3): ~26.6%	R1: 0.76 Gross efficiency (estimated based on design calorific value in Table 3): ~29.1% Net efficiency (estimated based on design calorific value in Table 3): ~26.2%	Not Available.	R1 estimated at ~0.8 for the BERC (refer to the Energy from Waste Policy Report for details)
Electricity and/or heat produced per annum (gross and net of parasitic loading), if applicable	Power Generated 147,454 MWh Net electricity 132,300 MWh Parasitic Load 10.6%	Power Generated 146,337 MWh Net electricity 130,454 MWh Parasitic Load 11.2%	Power Generated 140,323 MWh Net electricity 125,199 MWh Parasitic Load 11.3%	Power Generated 229,296 MWh Net electricity 208,761 MWh Parasitic Load 9.0%	Power Generated 223,823 MWh Net electricity 201,322 MWh Parasitic Load 10.4%	Net electricity 184,127 MWh (or ~25.4MWe at 82.7% plant availability) Parasitic Load ~10.6% (or ~3MWe on average)	Net electricity export for the BERC estimated at ~577,600MWh/year (100% MCR, 98.7% Climate derate factor and 1.5MW PoC losses) Parasitic load for the BERC estimated at ~13.4% with

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
							PoC losses or ~11.6% without PoC losses but including on-site IBA processing and APCr stabilisation.
Products (such as fuel or oil) produced per annum, if applicable	No other products produced in the facility	No other products produced in the facility	No other products produced in the facility	No other products produced in the facility	No other products produced in the facility	No other products produced in the facility	No other products proposed to be produced at the BERC
Information and annual quantities of any other products generated	Metals recovered for recycling: 1,507 t Note: thermal treatment residue data is summarised elsewhere in this table	Metals recycling: 2,276 tpa Note: thermal treatment residue data is summarised elsewhere in this table	Metals recycling: 2,957 tpa Note: thermal treatment residue data is summarised elsewhere in this table	Not reported (IBA metals removal by third party offsite) Note: thermal treatment residue data is summarised elsewhere in this table	Not reported (IBA metals removal by third party offsite) Note: thermal treatment residue data is summarised elsewhere in this table	Not reported (IBA metals removal by third party offsite)	Total metals recovered at the BERC expected to be approximately 16,700 tpa.
Quarterly and annual emissions reports as submitted to the regulator	Refer Appendix C.1	Refer Appendix C.2	Refer Appendix C.3	Refer Appendix C.4	Refer Appendix C.5	Refer Appendix C.6	N/A
Statistics on breach of licence conditions (if any), why the breach happened and how the proposed facility would be designed to avoid such breach	Exceedance of 190,000 tpa waste acceptance limit IBA sampling procedure required update [unclear whether this is a non-compliance or just a notifiable event] TOC half-hour license breach (compliant for	13x emissions related breaches (12 of which related to spikes in CO emissions caused by explosions on the grate – typically caused by gas bottles or other inappropriate waste in the residual waste stream, also see below).	1x emissions related breaches (discussed below).	N/A	2.5 hrs of TOC readings missing due to equipment error; however not expected to have been a breach of ELVs during this time.	40 mins of TOC readings missing due to equipment error; however not expected to have been a breach of ELVs during this time.	BERC's licensed throughput is expected to have some flexibility to account for variance in receipt and calorific value. BERC will review procedures on a periodic basis and update the environmental authority as required.

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
	99.89% of the year). Note breach of license due to loss of readings from power supply failure, not from measurements exceeding license limit 2x Emission Limit Values exceedances (discussed below).						The BERC will utilise a waste acceptance protocol and procedures to minimise the risk of explosive items being present in the feedstock. Redundancy is provided in the CEMS, such that if there is a component failure, a standby component will be brought online. Emergency power supply is connected to the CEMS. The BERC will implement measures to minimise OTNOC events.
Statistics on ELV exceedances per annum (or confirmation that there was none), why the exceedance happened and how the proposed facility would be designed to avoid such exceedance	CO half-hourly ELV exceeded due to explosion on the grate (compliant for 99.99% of the year). Hydrogen chloride daily average ELV exceeded on one day (compliant for 99.73% of year). Breach caused by power supply failure of standby CEMS followed by grid disturbance causing plant trip, EDG sequence failure and auto switch from duty to standby CEMS. Abatement issues attempted to be rectified but couldn't	CO half-hourly ELV exceeded due to explosion on the grate (compliant for 99.93% of the year). This occurred on 12x separate occasions. 1x periodic emission measurement exceedance related to heavy metals. Re-tested and found to be "comfortably below" the ELV.	CO half-hour ELV breach. Pressure excursion on the grate causing decrease in oxygen and an instantaneous spike in CO. Secondary air was added to compensate for loss of oxygen, readings brought back down within minutes. As of 15 November 2023, the Environmental Permit for the Gloucestershire EfW sets emission limit which are compliant with BREF-WI	No exceedance of ELV reported. Data shows particulates exceeded 1/2h limit during August but no explanation provided.	No exceedance of emission limit	No exceedance of emission limit. As of 3 December 2023, the Greatmoor EfW was required to comply with BREF-WI BAT-AELs for "Existing Plants" by way of a variation to its Environmental Permit	The BERC will utilise a waste acceptance protocol and procedures to minimise the risk of explosive items being present in the feedstock. This includes visual oversight of the waste bunker. Redundancy is provided in the CEMS system such that if there is a component failure, a standby CEMS component will be brought online. Emergency power supply is connected to the CEMS system. Bag house is compartmentalised to limit emissions in case of filter bag failure.

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
	bring daily average to within ELV.		BAT-AELs for “Existing Plants”				
In the case of thermal EfW, statistics on furnace temperature conditions (i.e. times at which the furnace temperature decreased below 850°C, why the reduced temperature happened, and how the proposed facility would be designed to avoid this issue	No data is provided on furnace temperature; however, it is noted that: “ <i>To ensure that the temperature does not fall below 850°C, auxiliary burners firing low sulphur fuel oil are automatically triggered by online process monitoring equipment. The auxiliary burners are also used to achieve and maintain the minimum furnace temperature during start up and shutdown periods</i> ”			No data is provided on furnace temperature. The Greatmoor facility also utilises auxiliary burners (fuel oil).			The BERC will utilise auxiliary burners (diesel-fuelled) to maintain the required combustion temperature as required at all times when waste is being processed by the facility.
Reports covering annual ash generation, ash composition, and ash disposal or recovery route	IBA produced: 38,311 t All IBA samples non-hazardous IBA transfer to Ilkeston for processing and recycling APCr produced: 4,800t APCr sent to hazardous landfill in Peterborough Note: data presented here is taken from the “Operational Data” tab of report. Slightly different values are presented in the “Perf. Form 1” tab.	IBA produced: 42,414 t All IBA samples non-hazardous IBA transfer to Nottinghamshire/ Derbyshire/ Peterborough for processing and recycling APCr produced: 4,523t APCr sent to hazardous landfill in Peterborough	IBA produced: 41,066 t All IBA samples non-hazardous IBA transfer to Nottinghamshire for processing and recycling APCr produced: 4,233t APCr sent to hazardous landfill in Peterborough Note: data presented here is taken from the “Operational	IBA produced: 58,700 t All IBA samples non-hazardous IBA processing (including metals recovery) offsite APCr produced: 11,396t APCr disposal at Knostrop Treatment Works and Blackburn Meadows Waste Treatment.	IBA produced: 65,038 t All IBA samples non-hazardous IBA processing (including metals recovery) offsite APCr produced: 7,667t APCr disposal at Knostrop Treatment Works and Blackburn Meadows Waste Treatment.	IBA produced: 64,715 t All IBA samples non-hazardous APCr produced: 8,550t	Nominal (100% MCR) values of IBA and APCr production are as follows: IBA: ~180,400 tpa (wet, before maturation and processing) IBA processing onsite. APCr: ~34,200 tpa (before stabilisation, at 100% MCR assuming 4.5% of feedstock to APCr). APCr stabilisation onsite. Refer to the Resource and Waste Management Technical Report for details

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
		Note: data presented here is taken from the “Operational Data” tab of report. Slightly different values are presented in the “Perf. Form 1” tab.	Data” tab of report. Slightly different values are presented in the “Perf. Form 1” tab.				of treatment and reuse/disposal methods.
Reports about the composition and disposal of wastewater streams produced by the proposed facility	No wastewater discharge	No wastewater discharge	No wastewater discharge	No wastewater discharge	No wastewater discharge	No wastewater discharge	Like the reference facilities, BERC will be designed for zero process wastewater discharge during normal operation. Occasionally, if a boiler is to be drained to facilitate maintenance, there may a quantity of boiler quality water that is in excess of that able to be reused within the process once the boiler is returned to service. In that instance, this high quality water will be contained, tested and removed offsite for appropriate disposal.
Information and annual quantity of any other wastes or hazardous materials generated at the reference facility	Not reported	Not reported	Not reported	Leachate - IBA pad: 2,876t (assume recirculated as not included in disposal quantities)	Leachate - IBA pad: 2,537t (assume recirculated as not included in disposal quantities)	Not reported	IBA run-off water (from the IBA storage area) will be captured and recirculated in the IBA maturation process. The IBA lined retention basin has a capacity of ~2,000m ³ (based on the worst case volume flow and a 90 th percentile wet year from Bureau of Meteorology data and IBA hardstand catchment area (~1.1ha))

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
Information and annual quantities of relevant raw material consumed at the reference facility, such as potable water, lime, activated carbon, ammonia, oils and greases	Mains Water: 30,240,000L Ammonia: 341,979kg Activated Carbon: 45,122kg Lime / hydrated lime: 2,575,984kg Fuel oil: 304,854L	Mains Water: 24,495,738L Ammonia: 365,869kg Activated Carbon: 46,533kg Lime / hydrated lime: 2,268,360kg Fuel oil: 164,571L	Mains Water: 24,216,700L Ammonia: 187,230kg Activated Carbon: 45,170kg Lime / hydrated lime: 2,023,470kg Fuel oil: 192,849L	Mains Water: 54,753,900L Ammonia: 290,572kg Activated Carbon: 71,875kg Lime / hydrated lime: 3,837,180kg Fuel oil: 154,856L	Mains Water: 55,299,000L Ammonia: 261,367kg Activated Carbon: 54,604kg Lime / hydrated lime: 2,673,160kg Fuel oil: 187,016L	Not reported	Estimated raw material consumption figures (per year) for the BERC include (100% MCR / 110% MCR) Mains water: ~167,400,000L / 182,400,000 L Urea: ~3,850,000kg / 4,230,000kg Activated carbon: 407,000kg / 450,000kg Quicklime: ~9,200,000kg / 10,100,000 kg Cement (for APCr stabilisation): ~14,700,000kg / 16,200,000kg Diesel: ~1,100,000L/year / for auxiliary burner use (excludes diesel used in materials handling equipment and backup generator) Note: These figures are based on 8000 hours of operation at the design waste throughput and meeting the BREF-WI BAT-AEL (Upper) daily average emission concentration limits.
Preferably maximum and average daily, weekly or monthly emissions (in mg/nm³ or similar appropriate unit) for all pollutants continuously	Refer Appendix C.1	Refer Appendix C.2	Refer Appendix C.3	Refer Appendix C.3	Refer Appendix C.4	Refer Appendix C.6	N/A

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
monitored, and copies of testing reports for emissions that are periodically monitored							
Definition of NOC and OTNOC for the facility and if available the number of hours operated in OTNOC per year	Detailed information of NOC and OTNOC conditions for Gloucestershire facility can be found in the environmental permit (Appendix D.1) (OTNOC is referred to as “abnormal” operation)			Detailed information of NOC and OTNOC conditions for Greatmoor facility can be found in the environmental permit (Appendix D.2) (OTNOC is referred to as “abnormal” operation)			To be developed during detailed design with input from technology provider(s) and agreed with relevant authorities.
Information on any public engagement programs, community engagement groups, requirements on public reporting of data and information on public complaints as available	Public Engagement Facility conducted a range of public engagement events including online outreach events, site visits and community liaison group meetings. Public Complaints 6 noise complaints received; however, none of them were thought to be caused by the facility. Likely source construction on development site adjacent to the facility. 2 odour complaints received, both unsubstantiated. During one complaint the facility was offline	Public Engagement Facility conducted a range of public engagement events including open days and community liaison group meetings. Public Complaints 1 noise complaint received; due to fire alarm. 3 odour complaints received; all unsubstantiated, one during outage.	Public Engagement Facility conducted a range of public engagement events including open days and community liaison group meetings. Public Complaints 1 odour complaint received; unsubstantiated, during outage.	Public Engagement Facility conducted a range of public engagement events including site tours, outreach talks, online sessions, community liaison group meetings. Public Complaints The facility did not report any complaints in the annual performance report; however, complaints data was obtained from website:	Public Engagement • 18 on-line sessions, 737 attendees (446 adults, 291 under-16s) • 41 site visits, 525 visitors (329 adults, 196 under-16s) • 5 Outreach Events: 257 people engaged with (135 adults, 122 under-16s) • Community Liaison Group Meetings Public Complaints In 2021/22 one noise complaint	Public Engagement • 1,188 Visitors • 111 Tours • 2,752 attendees to Outreach Events Public Complaints In 2024 two complaints were raised. One complaint was not relevant to the plant in question. A neighbour called to complain about traffic lights shining into their home. The lights were not functional at that time, so they were covered to reduce the glare.	The BERC will have an environmental management system to ensure adequate monitoring of facility performance (such as odour) to mitigate the risk of offsite impacts. Ongoing training and education of truck drivers, ensuring waste is appropriately contained and driver conduct is appropriate on and off site. Cleanaway has a long-standing track record of good practice with truck drivers and all vehicles interacting with the site will be subject to these expectations. Ongoing engagement with local residents and receptors, particularly with respect to noise and vibration regarding the need for routine testing of noisy equipment, which may

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
	(unlikely to be source of odour).			In 2020/21 one noise complaint was received. Issue identified quickly with positive community feedback (was not related to EfW plant).	was received. Issue identified quickly with positive community feedback (was not related to EfW plant). One odour complaint was received but was unsubstantiated.		include fire pumps and the emergency backup generator. Education regarding plume contents and visibility is also likely to be required.
Mass balance	Total annual inputs (waste, water, consumables): 224,438t Total annual outputs (IBA, APCr, metals): 44,617t Flue gas emitted (inputs – outputs): 179,820t Mass balance has been estimated based on the information provided in the annual performance report (Appendix C.1) as summarised in this table.	Total annual inputs (waste, water, consumables): 216,102t Total annual outputs (IBA, APCr, metals): 49,428t Flue gas emitted (inputs – outputs): 166,674t Mass balance has been estimated based on the information provided in the annual performance report (Appendix C.2) as summarised in this table.	Total annual inputs (waste, water, consumables): 190,071t Total annual outputs (IBA, APCr, metals): 48,257t Flue gas emitted (inputs – outputs): 141,835t Mass balance has been estimated based on the information provided in the annual performance report (Appendix C.3) as summarised in this table.	Total annual inputs (waste, water, consumables): 362,190t Total annual outputs (IBA, APCr, metals): 70,096t Flue gas emitted (inputs – outputs): 292,093t Mass balance has been estimated based on the information provided in the annual performance report (Appendix C.3) as summarised in this table.	Total annual inputs (waste, water, consumables): 355,736t Total annual outputs (IBA, APCr, water, metals): 72,704t Flue gas emitted (inputs – outputs): 283,032t Mass balance has been estimated based on the information provided in the annual performance report (Appendix C.4) as summarised in this table.	Water and consumables not reported. Waste processed and residue production noted above.	Details regarding estimates of process inputs and outputs have been provided in other line items in this table and Table 3.
Energy balance	Total annual energy input (waste combusted	Total annual energy input (waste	Total annual energy input (waste	Total annual energy input	Total annual energy input	Not reported.	Details regarding estimates of energy inputs, efficiencies

Policy Requirement	UBB Gloucestershire Energy from Waste			FCC Greatmoor Energy from Waste			Notes relevant to the BERC
	2021	2022	2023	2021	2022	2023/24	
	+ fuel oil + imported electricity): ~516,204MWh Total annual energy used on site: 14,397MWh Total annual energy exported: 132,300MWh Losses (ACC and steam turbine generator efficiency) and estimation errors account for the balance. Energy balance estimated based on information provided in the annual performance report (Appendix C.1) and literature values (i.e. net CV of fuel oil).	combusted + fuel oil + imported electricity): ~507,986MWh Total annual energy used on site: 15,615MWh Total annual energy exported: 130,454MWh Losses (ACC and steam turbine generator efficiency) and estimation errors account for the balance. Energy balance estimated based on information provided in the annual performance report (Appendix C.2) and literature values (i.e. net CV of fuel oil).	combusted + fuel oil + imported electricity): ~501,452MWh Total annual energy used on site: 15,923MWh Total annual energy exported: 125,199MWh Losses (ACC and steam turbine generator efficiency) and estimation errors account for the balance. Energy balance estimated based on information provided in the annual performance report (Appendix C.3) and literature values (i.e. net CV of fuel oil).	(waste combusted + fuel oil + imported electricity): ~785,078MWh Total annual energy used on site: 21,399MWh Total annual energy exported: 208,761MWh Losses (ACC and steam turbine generator efficiency) and estimation errors account for the balance. Energy balance estimated based on information provided in the annual performance report (Appendix C.3) and literature values (i.e. net CV of fuel oil).	(waste combusted + fuel oil + imported electricity): ~771,045MWh Total annual energy used on site: 20,989MWh Total annual energy exported: 201,322MWh Losses (ACC and steam turbine generator efficiency) and estimation errors account for the balance. Energy balance estimated based on information provided in the annual performance report (Appendix C.4) and literature values (i.e. net CV of fuel oil).		and outputs have been provided in other line items in this table and Table 3.

6. Energy Efficiency

The IED defines criteria for EfW plants to be considered ‘recovery’ operations as opposed to ‘disposal’ (incineration only). For a plant to be considered a genuine energy recovery facility, the R1 calculated must be equal to or above 0.65.

Efficiency will vary depending on final equipment selection and over time, as equipment such as the steam turbine ages. The engineering design contractor will provide a calculation of plant efficiency and the claim shall be demonstrated during the performance test of the plant.

The preliminary theoretical estimate of the R1 efficiency factor for the BERC of ~0.80 (for an annual average waste CV of 10.6 MJ/kg (LHV)) is comfortably above the criteria (>0.65) established to demonstrate that the facility is a recovery operation rather than a disposal/destruction operation, as summarised in Table 8.

Cleanaway notes that the R1 efficiency factor is an annualised estimate, based on a number of factors which will change over time, are variable in nature (e.g. turbine efficiency, boiler efficiency and plant operating performance) and are outside Cleanaway’s control (e.g. electricity demand). As such, the R1 calculation is theoretical and an indicative reflection of the concept design. Cleanaway commits to delivering a facility which meets the R1 criteria of >0.65 as the agreed benchmark in the EU Waste Framework Directive to differentiate a recovery operation from a disposal operation.

Table 8: Preliminary energy efficiency and R1 calculation (subject to change during detailed design and with technology supplier and contractor selection)

Energy Inputs, Outputs, Efficiency & R1	100% MCR	110% MCR	Unit
Fuel heating value	10.6	10.6	GJ/t
Fuel input	279.7	307.7	MW
Auxiliary (Oil) during Normal Operation	-	-	MW
Total fuel in	279.7	307.7	MW
Power output (gross)	84.6	92.6	MW _e
	890	887	kWh/t fuel
Power output (net)	73.2	80.6	MW _e
	771	771	kWh/t fuel
Own consumption estimate (including PoC losses)	11.3	12.1	MW _e
	120	115	kWh/t fuel
Power efficiency (gross)	~30.2%	~30.2%	(gross)
Power efficiency (net)	~26.2%	~26.2%	(net)
R1 Calculation Summary			
Energy Produced (Ep)	1,739,500	N/A	MWh
Energy Input by imported energy WITH steam production (Ef)	3,430	N/A	MWh
Energy Input by imported energy WITHOUT steam production (Ei)	4,410	N/A	
Energy Input to the system from waste (Ew)	2,237,800	N/A	MWh
R1= (Ep - (Ef+Ei)) / (0.97*(Ew+Ef))	0.80	N/A	
(assuming steady operation)			

Key assumptions used in the preliminary R1 calculation include:

- Overall annual average waste CV = 10.6 MJ/kg (LHV)
- 8,000 hour per year plant availability with an annual processing capacity of 760,000 tpa of residual waste at 100% MCR and 836,000t pa of residual waste at 110% MCR
- Engineering estimates for power generation and parasitic (own) power consumption as summarised in Table 8. For consistency with the GHG assessment for the BERC, the estimate of energy produced (Ep) assumes operation at 100% MCR for 8,000 hours per year, adjusted for a 98.7% annual derate factor for operation when ambient air temperatures are above the ACC design ambient air temperature.

- Auxiliary burners for start-up, shutdown and occasional flue gas temperature support (35% auxiliary firing for 7 hours per start-up (with no steam production), 7 hours per start-up (with steam production), assuming 5 start-ups per year).
- Electricity import only during plant maintenance and allowing for 0.5 MW electrical consumption during planned full plant outages (760 hours per year).
- Steam soot blowing has been assumed in the R1 calculation.

7. Best Available Techniques Assessment

The current level of design of the BERC allows for assessment against each of the BAT conclusions listed in the BREF-WI. **The BERC will, via design and operational controls, be compliant with all applicable (32 out of 37) BATC.** Each BAT conclusion is detailed alongside an assessment of the BERC's compliance in Section 7.2.

Where the BREF-WI BAT conclusions relate to fully operational facilities (and are not resolved through the current design), the relevant specialist reports set out how the BERC facility will comply through proposed mitigation measures.

Several BAT conclusions within the BREF-WI are also relevant to the BERC, including those related to dust control, environmental performance, reducing emissions, reducing water consumption and wastewater generation. These conclusions are generally consistent with those listed in the BREF-WI and are therefore not included in this assessment.

7.1 BAT Conclusions – Compliance Summary

Table 9: BAT compliance (refer Section 7.2 for detailed assessment)

BATC #	Compliance	BATC #	Compliance
1	Compliant	20	Compliant
2	Compliant	21	Compliant
3	Compliant	22	Not applicable as the BERC will not process liquid or gaseous waste (refer to the Waste Acceptance Protocol)
4	Compliant	23	Compliant
5	Compliant	24	Compliant
6	Not applicable as no process wastewater stream will be generated	25	Compliant
7	Compliant	26	Compliant
8	Not applicable as the BERC will not process hazardous waste	27	Compliant
9	Compliant	28	Compliant
10	Compliant	29	Compliant
11	Compliant	30	Compliant
12	Compliant	31	Compliant
13	Not applicable as the BERC will not process clinical waste	32	Compliant
14	Compliant	33	Compliant
15	Compliant	34	Not applicable as no process wastewater stream will be generated
16	Compliant	35	Compliant
17	Compliant	36	Compliant
18	Compliant	37	Compliant
19	Compliant		

In summary, the BERC has been designed such that it is compliant with the definition of BAT used by the EU and set out in the BREF-WI. The facility is therefore considered to meet the requirements of the

Queensland EfW Policy (outcome 7) and EfW Guidelines with respect to design aligned to international best practice environmental protection.

7.2 BAT Conclusions – Detailed Assessment

This section of the assessment is provided to outline each of the BAT conclusions and how the BERC complies with each of those conclusions. It demonstrates how the BERC complies with the best practice requirements under the Queensland EfW Policy and EfW Guidelines. Note that where compliance with BAT conflicts with the requirements under local legislation, the local requirements will take precedence. At this stage of project development, it is not possible to demonstrate full compliance with the BAT conclusions, as many of the conclusions relate to fully operational facilities. However, the Project will be designed, procured, constructed, operated and maintained to fulfil the relevant BAT requirements as applicable.

The BREF-WI document discusses the concept of “Existing Plants” and “New Plants”. The requirements for “New Plants”, which are defined as plants permitted post publication of the BREF-WI, are more stringent than for Existing Plants. The BERC will therefore be designed to comply with requirements set out for “New Plants”.

Table 10: Environmental management systems

BAT No.	Description and measures	BAT fulfilled (yes/no)
BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) <i>(Please refer to BREF-WI for the list of features)</i>	The BERC is compliant with this conclusion as follows: An EMS will be established by the plant owner and/or operator (not a design requirement).	Yes; via operational management

Table 11: Monitoring

BAT No.	Description and measures	BAT fulfilled (yes/no)
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.	The BERC is compliant with this conclusion as follows: The preliminary estimate of the R1 efficiency factor for the BERC of ~0.8 is comfortably above the criteria (>0.65) which has been established to demonstrate that the facility is a recovery operation rather than a disposal/destruction operation. Efficiency will vary slightly depending on final equipment selection. The contractor will provide calculation of plant efficiency and the claims shall be demonstrated during the performance test of the plant. Review will be undertaken during the operational phase after any major overhaul or major revision to the facility.	Yes; requirement in tender document
BAT 3. BAT is to monitor key process parameters relevant for emissions to air and water. <i>(Please refer to BREF-WI for the list)</i>	The BERC is compliant with this conclusion as follows: All key process parameters (e.g. flow, O₂, temperature, pressure, water vapour etc.) will be continuously measured and monitored in conjunction with the operation of the CEMS, for flue gas emissions monitoring purposes. This requirement will be included in the tender documents. The BERC will be designed for zero process wastewater discharge, hence monitoring of process parameters associated with wastewater are not relevant. The preliminary BERC design includes a process water storage tank to store process water/cleaning water prior to its reuse in the process. Under normal operation, process water should not require removal from site. The only reasons for process wastewater removal from site would be: • In the unlikely event that the process water tank is full and process water consumers cannot reuse the water as quickly as it is being produced • The requirement to drain down a boiler or other equipment due to maintenance activities and where the available water is in excess of that which could be reused within the process. As a contingency, and in the unlikely event that process wastewater must be removed from site, excess process wastewater will be removed via tanker truck and disposed of at a suitable, accredited wastewater treatment facility following testing in accordance with the wastewater receiver requirements.	Yes; requirement in tender document

BAT No.	Description and measures	BAT fulfilled (yes/no)
	Boiler water is deionized (very clean water with no salts) but may include small particulates such as scale and rust. The exact facility to be used for disposal would depend on the quality of the water which would have to be tested prior to disposal. The BERC commits to testing any wastewater prior to disposal (if any) and selecting a suitable facility in compliance with legislation in Queensland. In Europe, a municipal wastewater treatment plant would be sufficient to treat such water.	
BAT 4. 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. <i>Please refer to BREF-WI for the table.</i>	The BERC is compliant with this conclusion as follows: - For continuous emissions measurement, the BERC will have a CEMS. This will be integrated with the site Distributed Control System (DCS) and provide real-time feedback both to the operators and to the plant control system to control the injection of abatement chemicals. - For periodic measurements (note that it is not technically possible to monitor all emissions continuously) a periodic monitoring and measurement regime will be established. These procedures will be developed prior to operation of the BERC such that they are in place for the start of operations. Dedicated extractive measurement points will be designed to allow this in accordance with recognised Australian and industry standards for periodic measurement. Emissions data (time averaged and subject to appropriate QA/QC processing) will be made available to the EPA in near real-time graphical publication and a summary of monitoring data and compliance with emissions limits published on the internet. Lag time between emissions abatement control and the CEMS system is negligible. The facility will operate sufficiently below the relevant emission limit value to allow feedback control time to act before any short-term emission limit value is breached	Yes; requirement in tender documents, and via operational management and instructions
BAT 5. BAT is to appropriately monitor channelled emissions to air from the incineration plant during OTNOC.	The BERC is compliant with this conclusion as follows: - Once commissioned, the BERC CEMS will operate at all times that a grate-boiler line is operational, monitoring emissions during both NOC and OTNOC. - For non-CEMS emissions, periodic measurements (e.g. every three years) will be requested by plant owner and/or operator during planned start-up/shutdown operations. The procedures for these tests will be finalised prior to operation of the facility.	Yes; via CEMS, and operational management and instructions
BAT 6. BAT is to monitor emissions to water from flue gas cleaning/treatment (FGC) and/or bottom ash 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.	This is not relevant to the BERC as the plant does not produce effluent from the flue gas treatment or bottom ash handling.	Not relevant

BAT No.	Description and measures	BAT fulfilled (yes/no)
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 given below and in accordance with EN standards. <i>(Please refer to BREF-WI for the parameters to be monitored)</i>	The BERC is compliant with this conclusion as follows: The BERC will carry out periodic monitoring and testing as required for each parameter in the table (Note: Either the loss on ignition or the total organic carbon is monitored). Procedures for this monitoring and testing will be finalised prior to operation of the facility. Unless local standards are identified that are equivalent or superior, European standards will be followed for monitoring and testing.	Yes; via operational management and instructions
BAT 8. For the incineration of hazardous waste containing persistent organic pollutants (POPs), BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, wastewater) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.	This is not relevant as the BERC is not a hazardous waste incineration plant.	Not relevant

Table 12: General environmental and combustion performance

BAT No.	Description and measures	BAT fulfilled (yes/no)
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 (a) to (c) given below, and, where relevant, also techniques (d), (e) and (f). (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	The BERC is compliant with this conclusion as follows: (a) The types of waste that can be incinerated are detailed in the WAP for the BERC and shall be consistent with the Queensland EfW Policy. The BERC's reference facilities have demonstrated capability to process residual MSW and C&I waste streams similar to those proposed to be processed by the BERC. The Waste Feedstock Report sets out the design parameters for the thermal treatment of suitable waste streams including the Capacity Diagram, ash content of the waste and size of waste. The reference facilities show operational characteristics materially similar to that proposed for the BERC. (b) Waste characterisation and pre-acceptance procedure will be prepared as part of detailed design. Suppliers of waste to the facility will be pre-registered and procedures will be in place to ensure waste deliveries are in line with the requirements of the Waste Acceptance Protocol. (c) A WAP has been developed. Robust acceptance procedures will be in place. Each vehicle delivering waste will be registered within the plant control systems and number plate recognition systems will be in place. Documentation will indicate the origin and type of waste within the vehicle. There is a dedicated inspection area external to the facility if there is an issue with the documentation or a suspect vehicle enters site. There will also be an internal area (within the tipping hall) that can be used for inspection of delivered waste. Any waste found not to be acceptable will be rejected and the supplier will retain responsibility for disposal offsite. Finally, there will be video monitoring of each tipping bay, linking the waste delivery truck (licence plate) with waste being tipped into the bunker (visual). (d) Waste tracking and inventory will be managed by the facility computer systems, including the pre-registered information on waste delivery and data from the weighbridge systems. This will assist with retaining an	Yes; via operational management and instructions

BAT No.	Description and measures	BAT fulfilled (yes/no)
(f) Verification of waste compatibility prior to the mixing or blending of hazardous wastes	accurate record of the waste types being delivered alongside the weight of each delivery. The system will also track the origin of the waste (i.e. the waste supplier). (e) All waste received on-site will be stored in the bunker. There will be no other waste storage on-site with the exception of a short-term waste inspection area adjacent to the waste bunker, inside the bunker/tipping hall envelope. The waste streams delivered on site (primarily residual MSW and C&I waste) do not have to be kept separate and will be delivered to the same waste bunker. The waste in the bunker will be mixed using the waste bunker crane systems prior to delivery to the chute for combustion. The facility will not accept hazardous waste streams, however, if a load of waste including hazardous material does arrive at site, the facility includes a quarantine area where such material can be quarantined before being disposed off-site at an appropriate, licensed facility. If unacceptable waste bypasses these controls, it can be identified by the crane operator within the bunker and removed for appropriate disposal offsite. (f) No hazardous waste will be accepted on-site for incineration.	
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 environmental management system (EMS) (see BAT 1).	The BERC is compliant with this conclusion as follows: The EMS system will include a section on quality management of environmental performance of the IBA treatment equipment. IBA will be conveyed to a separate building and area on-site for treatment (maturation, metals recovery and mechanical processing if required) and taken off-site for re-use (if possible) or disposal (if not meeting reuse specifications). Note that treated IBA quality must also meet commercial off-taker specifications to facilitate reuse of the material in commercial applications. Detailed procedures will be developed as part of the EMS.	Yes; via operational management and instructions
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 (see BAT 9(c)) including, depending on the risk posed by the incoming waste, the elements given below. <i>(Please refer to BREF-WI for the full list)</i>	The BERC is compliant with this conclusion as follows: Monitoring of incoming waste will be undertaken at all times. The BERC will include the following waste delivery monitoring procedures: • Periodic sampling and testing of key properties / substances (e.g. calorific value/LHV, content of halogens and metals/metalloids) • Weighing of deliveries via weighbridges • Video monitoring of the tipping bays and tipping hall • Visual inspection in the external pre-inspection area, visual/physical inspection within the tipping hall in the pre-tipping inspection area and visual inspection by the crane operator within the waste bunker is considered in the design (as described in the WAP and as part of the future QA/QC procedures for waste acceptance) • Radiation detection at weighbridges As such, upon arrival at the BERC, MSW will be weighed and subject to random visual pre-inspection, random visual and physical inspection of waste loads in the tipping hall and visual inspection by the waste bunker crane operators. Waste delivery vehicles will be tracked and monitored and unloading will be recorded on the BERC's CCTV system.	If relevant: Yes; via operational management and instructions and QA procedures

BAT No.	Description and measures	BAT fulfilled (yes/no)
	The ability to remove waste from the bunker if required is provided via use of the waste crane to backload into vehicles for removal from site. Hazardous waste and clinical waste are not permitted to be received and processed in accordance with the draft Waste Acceptance Protocol for the BERC.	
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 given below. (a) Impermeable surfaces with an adequate drainage infrastructure (b) Adequate waste storage capacity	The BERC is compliant with this conclusion as follows: - The waste reception/tipping hall and waste bunker will be made of impermeable surfaces with adequate drainage e.g. reception hall washdown water will be directed into the waste bunker to be absorbed by and mixed with the waste. A suitable drainage system will be installed around the site for stormwater runoff. Various detention and retention basins are provided for stormwater management. (a) The waste will be stored in the waste bunker with an approximate capacity of up to seven days of operation. The quantity of stored waste is regularly monitored and estimated using a combination of: (i) Weighbridge measurements to understand the waste volume entering the facility and (ii) Waste crane measurements to understand the throughput of waste for the combustion process. Bunker capacity is sufficient to handle peak delivery occasions (such as prior to / following a long weekend) and to maintain the process at steady state overnight and over a long weekend (~seven days storage is provided). In periods of longer shut down waste can be diverted to a suitable nearby landfill.	Yes; design requirement in tender document, and via operational management and instructions
BAT 13. In order to reduce the environmental risk associated with the storage and handling of clinical waste, BAT is to use a combination of the techniques given below. <i>(Please refer to BREF-WI for the list)</i>	Not relevant as clinical waste is not handled.	Not relevant
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 given below. (a) Waste mixing and blending (b) Advanced system control (c) Optimisation of the incineration process	The BERC is compliant with this conclusion as follows: (a) Incoming waste is constantly mixed in the waste storage bunker. (b) An advanced DCS integrates the automatic combustion control system and APC. Combustion control and APC control will be achieved using the DCS. Sensory and monitoring equipment around the plant will feedback in real time to the control system allowing combustion and treatment systems to be optimised (c) The advanced control system for combustion control will include an optimisation protocol for waste feed rates, combustion air injection, temperature and steam flow control. In addition, design criteria on the maximum allowable content of unburnt carbon in bottom ash will be included in the tender documents as a performance guarantee.	Yes; design requirement in tender documents, and via operational management and instructions

BAT No.	Description and measures	BAT fulfilled (yes/no)
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 description in Section 5.2.1), as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).	The BERC is compliant with this conclusion as follows: - Emissions to air will be monitored using the CEMS which will be integrated with the DCS as an advanced control system. Real time feedback from the CEMS will control reagent dosing rates to optimise environmental performance - Additionally, procedures for control and selection of set points will be implemented during commissioning and fine-tuned over time through operational experience and dependent on the incoming waste streams, to optimise process and environmental performance - The facility will also include a raw gas analyser to monitor flue gas %O₂ and key pollutant concentrations (e.g. HCl, SO₂) in the raw flue gases prior to the flue gas treatment system.	Yes; design requirement in tender documents, and via operational management and instructions
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 BERC is compliant with this conclusion as follows: - Operational procedures will be developed in order to reduce emissions to air and to prevent or reduce risk of unplanned shutdown and start-up operations - The plant will be designed with a high level of redundancy (and includes two process lines) to limit the risk of an unplanned shut down of the entire facility - Redundancy includes supplying key equipment in duty/duty or duty/standby configuration so that processing does not need to cease in the case of single equipment failure. This includes items such as, pumps, fans, compartmentalised bag filter, redundant CEMS components and uninterruptible power supply to key systems etc. - The process is designed to be a continuous process, with a large waste bunker capable of holding up to seven days of operational feedstock capacity. Procedures will be put in place, both with respect to (a) operation and maintenance and (b) scheduling of waste deliveries to minimise the risk of downtime. This will be done through standard operational requirements and procedures which are included in waste Supply Agreements for the BERC, such as waste delivery plans to coordinate the continuous delivery of waste, scheduled around planned maintenance.	Yes; design requirement in tender documents, and via operational management and instructions
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 wastewater 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.	The BERC is compliant with this conclusion as follows: The emissions control systems for the BERC have been specified based on BAT. Further work will be undertaken during detailed design to ensure the specified equipment (SNCR, bag filters, dry sorbent injection) are sized appropriately for operation across the entire allowable operating range, as described by the Capacity Diagram. Additionally, continuous automated plant monitoring and control will occur so that APC systems operate with direct, real-time feedback from the CEMS and the ability for the operators to make adjustments based on experience so that chemicals are not over dosed and emissions from the plant remain within the limits set out in the future Operating Licence. A comprehensive maintenance regime will also be put in place to ensure all systems are maintained properly, to ensure optimal availability. This will form part of the overall operation and maintenance procedures for the plant, which will be referred to within the EMS and will follow equipment manufacturers guidelines at a minimum.	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
	The wastewater treatment plant part of this conclusion is not applicable to the BERC, as no process wastewater is generated by the EfW process under normal operating conditions.	
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 following elements: (Please refer to BREF-WI for the list)	The BERC is compliant with this conclusion as follows: The EMS for the BERC will include commentary and procedures on all of the elements set out in BAT conclusion 18. The detailed procedures, processes and equipment will be finalised during detailed design. Techniques will include: The BERC will implement measures to minimise OTNOC events including: • A contractual WAP to control and manage Acceptable Waste and Unacceptable Waste • Redundancy for critical process equipment and systems, where practicable • Emergency backup power supply to critical process equipment and systems • Selection of reputable equipment and technology providers • Adherence to Original Equipment Manufacturer and technology provider operation and maintenance procedures, for managing plant upsets and disturbances • Preventative maintenance and inspection program during the Operation & Maintenance phase and O&M staff training Redundancy for key components has been specified in the design (duty/standby critical equipment, compartmentalised bag filter etc.).	Yes; requirements in tender documents, and via operational management and instructions

Table 13: Energy efficiency

BAT No.	Description and measures	BAT fulfilled (yes/no)
BAT 19. In order to increase the resource efficiency of the incineration plant, BAT is to use a heat recovery boiler.	The BERC is compliant with this conclusion as follows: The plant will be equipped with a steam producing heat recovery boiler on each line and a common steam turbine generator for production of electricity.	Yes; requirement in tender documents
BAT 20. In order to increase the energy efficiency of the incineration plant, BAT is to use an appropriate combination of the techniques given below. (a) Drying of sewage sludge (b) Reduction of the flue gas flow (c) Minimisation of heat losses	The BERC is compliant with this conclusion as follows: (a) Drying of sewage sludge is not applicable as the plant will not accept sewage sludge (b) Flue gas flow will be optimised by controlling primary and secondary combustion air flow as part of the normal operation of the boiler. Advanced combustion control will be used to optimise airflow. Optimisation of airflow optimises the combustion conditions and increases the overall efficiency of the facility. Ultimately, the excess air ratio is determined by the selected technology provider's automated combustion control system and boiler design	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
(d) Optimisation of the boiler design (e) Low temperature flue gas heat exchangers (f) High steam conditions (g) Cogeneration (h) Flue gas condenser (i) Dry IBA handling	(c) Heat losses are minimised by an integrated boiler / furnace system and suitably insulated equipment (d) Boiler design will be optimised by appropriate selection of flue gas velocities and distribution during detailed design. The facility will include convection bundles with water / steam circulation. On-line cleaning systems (mechanical rapping systems) and off-line cleaning systems (during annual planned maintenance) are included (e) The boiler package includes economiser sections to increase heat transferred from the exhaust gas path to the boiler feedwater (f) High steam conditions will be utilised (nominally 60 bar(a) and 425°C at the steam turbine inlet valve) with suitable boiler corrosion protection (g) The facility has been designed to be capable of cogeneration if this is viable in future with nearby industrial heat offtake. Although the BERC will initially generate electricity only, steam offtake is possible (h) A flue gas condenser is not appropriate for this facility as there is no practical use for the recovered low-grade heat. Economisers are included to allow efficient heat recovery within the boilers (i) IBA handling at the BERC is a wet process, which has been selected as it is the most commonly used, tried, and proven ash extraction process technology. The use of a wet process helps to minimise fugitive dust emissions during handling and storage of the IBA (on-site). Water content in the IBA after quenching is approximately 20%. The use of low quality process wastewater as make-up water to the wet ash extraction systems helps to avoid wastewater emissions from the EfW process since the water either evaporates while quenching the hot IBA or leaves the process with the wettened IBA. The gross electrical efficiency of the plant is expected to be approximately 31.8% and net efficiency is expected to be approximately 28.4% (subject to detailed design and final technology provider selection). The preliminary estimate for the R1 value for the BERC is ~0.8.	

Table 14: Emissions to air

BAT No.	Description and measures	BAT fulfilled (yes/no)
BAT 21. In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to: <i>(Please refer to BREF-WI for the list)</i>	The BERC is compliant with this conclusion as follows: - All waste vehicles entering the site shall be fully enclosed and no waste will be tipped outside of the tipping hall. - All waste will be stored in the indoor waste bunker. Therefore, odour will only be present in the tipping hall and waste bunker area. During operation, the tipping hall will be fully enclosed (apart from roller doors opening as trucks enter) and combustion air will be extracted from above the waste bunker (i.e. from both the tipping hall and waste bunker) to maintain a sub atmospheric pressure environment to contain odour and draw odour into the high temperature combustion chambers - When the plant is fully shut down (i.e. both boiler lines are shutdown), an activated carbon filter odour abatement system will be provided to mitigate odour release from the tipping hall and bunker. During planned shutdown of the entire facility, as well as having the secondary filtration system, waste levels in the bunker will	Yes; design requirement in tender documents and via operational management and instructions

BAT No.	Description and measures	BAT fulfilled (yes/no)
	be managed to reduce the volume of waste present to release odour (as far as practicable). This will form part of the management procedures for the site. Liquid waste will not be accepted by the facility therefore; storage of liquid wastes is not applicable	
BAT 22. In order to prevent diffuse emissions of volatile compounds from the handling of gaseous and liquid wastes that are odorous and/or prone to releasing volatile substances at incineration plants, BAT is to introduce them into the furnace by direct feeding.	Not relevant as the plant will not receive liquid and/or gaseous waste.	Not relevant
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 following diffuse dust emissions management features: <i>(Please refer to BREF-WI for the list)</i>	The BERC is compliant with this conclusion as follows: The BERC will use a wet ash extraction system. Hence, IBA will be maintained in a moist condition, which will help to suppress dust emissions. Sorting of IBA (to recover metals and prepare an aggregate (IBAA) product that meets commercial offtake quality specifications) takes place indoors and ventilation air will be filtered prior to exhaust. Procedure for dust management will be included. The EMS, including detailed procedures, will be developed during detailed design.	Yes; design requirement in tender documents and via operational management and instructions
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 given below. (a) Enclose and cover equipment (b) Limit height of discharge (c) Protect stockpiles against prevailing winds (d) Use water sprays (e) Optimise moisture content (f) Operate under sub atmospheric pressure	The BERC is compliant with this conclusion as follows: (a) Handling of IBA takes place in enclosed and covered equipment. (b) Discharge height from IBA conveyor will be limited as far as practicable (detailed design to consider mitigations). (c) Dust from stockpiles will be managed through wind walls or other appropriate measures prior to dispatch. (d) IBA stockpiles will be wetted during maturation to maintain moisture content and suppress fugitive dust emissions. (e) Optimising the moisture content of the IBA prior to metals recovery will be considered during the detailed design, in conjunction with technology suppliers. (f) Not applicable	Yes; design requirement in tender documents and via operational management and instructions
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 given below.	The BERC is compliant with this conclusion as follows: The BERC flue gas treatment will comprise: (a) A bag filter (b) Dry sorbent injection	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
(a) Bag filter (b) Electrostatic precipitator (c) Dry sorbent injection (d) Wet scrubber (e) Fixed or moving-bed adsorption	The combination of these systems will achieve the required emissions control. Dry sorbent injection will involve the injection of activated carbon to reduce metals and metalloids, followed by the extraction of residues using a bag filter. The system will be designed to fulfil the BAT-AEL requirement for channelled dust, metals and metalloid emissions to air, as specified in BATC Table 3.	
BAT 26. In order to reduce channelled dust emissions to 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 5.2.2).	The BERC is compliant with this conclusion as follows: Extracted air will be treated with a bag filter. The system will be designed to fulfil the BAT-AEL requirement for channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air, as specified in BATC Table 4. Also see BAT 23 and 24.	Yes; design requirement in tender documents and via operational management and instructions
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 given below. (a) Wet scrubber (b) Semi-wet absorber (c) Dry sorbent injection (d) Direct desulphurisation (e) Boiler sorbent injection	The BERC is compliant with this conclusion as follows: The flue gas treatment will comprise (c) Dry (lime) sorbent injection in combination with a bag filter. Pre-conditioning of the flue gas with water prior to sorbent injection is foreseen.	Yes; requirement in tender documents
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 technique (a) or both of the techniques given below. (a) Optimised and automated reagent dosage (b) Recirculation of reagents	The BERC is compliant with this conclusion as follows: The flue gas treatment will comprise (a) Automatic reagent dosage (based on CEMS measurements) (b) Recirculation of reagents The system will be designed to fulfil the requirement in BATC Table 5 (New plant, upper end of BAT-AEL range).	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
BAT 29. In order to reduce channelled NOx emissions to air while limiting the emissions of CO and N₂O from the incineration of waste and the emissions of NH₃ from the use of SNCR and/or SCR, BAT is to use an appropriate combination of the techniques given below. (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	The BERC is compliant with this conclusion as follows: (a) Optimisation of the incineration process: the incineration process will be optimised using the advanced automated combustion control system integrated into the DCS to monitor and control combustion airflow and fuel feed rate. (c) The NOx emission control system will comprise SNCR, using either ammonia or urea solutions as the reagent. (f) SNCR systems will be optimised with automatic dosing control. Additionally, the boiler itself will be designed appropriately (using computational fluid dynamics (CFD) modelling) to ensure suitable distribution and mixing of the reagent with the flue gases, optimal injection level and operation within a defined temperature window. The system will be designed to fulfil the requirement in BATC Table 6 (New plant, upper end of BAT-AEL range).	Yes; requirement in tender documents
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 (a), (b), (c), (d), and one or a combination of techniques (e) to (i) given below. (a) Optimisation of the incineration process (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 BERC is compliant with this conclusion as follows: (a) The design of the furnace/boiler and the flue gas treatment will generally be made in combination with an advanced control system as discussed throughout this BAT assessment. (b) A WAP defines the types of waste that may be accepted at the BERC as well as acceptance and inspection protocols. Mixing of waste prior to thermal treatment to ensure the waste is as homogeneous (less heterogeneous) as possible. (c) Boiler cleaning will comprise on-line (e.g. mechanical rapping) / off-line cleaning (during planned maintenance). (d) Rapid flue gas cooling is achieved via boiler design (economiser section) and flue gas conditioning water spray system to cool the flue gas through the formation temperature range for dioxins and furans. (e) The flue gas treatment will comprise of dry sorbent injection with activated carbon or similar reagents. The system will be designed to fulfil the requirement in BATC Table 7 (New plant, upper end of BAT-AEL range).	Yes; design requirement in tender documents and via operational management and instructions

BAT No.	Description and measures	BAT fulfilled (yes/no)
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 given below. (a) Wet scrubber (low pH) (b) Dry sorbent injection (c) Injection of special, highly reactive activated carbon (d) Bromine boiler addition (e) Fixed or moving – bed adsorption	The BERC is compliant with this conclusion as follows: (b) The flue gas treatment will comprise injection of dry sorbent (activated carbon or similar reagent) for the reduction of mercury emissions within the flue gases. The bag filter will be used to remove residues. The system will be designed to fulfil the requirement in BATC Table 8 (New plant, upper end of BAT-AEL range).	Yes; requirement in tender documents

Table 15: Emission to water

BAT No.	Description and measures	BAT fulfilled (yes/no)
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.	The BERC is compliant with this conclusion as follows: There is no excess process wastewater at the BERC during normal operation. All process wastewater is collected separately and used in the process. Therefore, there is no requirement for treatment of wastewater streams. Rainwater run-off from the EfW building roof will be collected and conveyed to rainwater harvesting tanks. When sufficient volume has been collected, this water will be re-used within the process, to offset the consumption of imported potable or recycled water. Site run-off from roads and other hardstand areas will be collected by a conventional pit and pipe system. The stormwater quality treatment process for the site has been designed to comply with Seqwater stormwater pollutant reduction targets. This includes gross pollutant traps and a bioretention basin with base filter area. Following treatment and detention, the stormwater will discharge to the existing drainage line on site. Water from the IBA maturation building and IBA sorting building roofs will be harvested for reuse, while stormwater and run-off water associated impermeable hardstand areas and roadways where IBA and IBAA are stockpiled, turned and where IBAA product is loaded onto trucks will be segregated and stored to enable reuse for managing IBA stockpile moisture content during maturation and for dust suppression of IBAA product stockpiles awaiting dispatch. Washdown water collected from the waste reception, handling and storage areas is returned to the waste bunker (see BAT 12 (a)). Cleaning water from the process hall (boiler/FGT hall) will be collected in drain trenches in the floor and used for cooling of the IBA.	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
	An on-site greywater system to manage wastewater from showers and hand washing will be given consideration at the next design stage. Treated greywater may be reused on-site as make-up to the process Recycle Water Tank. Further investigation is required to consider reuse of greywater for landscape irrigation purposes. An on-site black water system will manage wastewater from toilets, sinks in kitchen areas and showers and sinks not connected to the greywater system. This wastewater will be transferred offsite by tanker truck.	
BAT 33. In order to reduce water usage and to prevent or reduce the generation of wastewater from the incineration plant, BAT is to use one or a combination of the techniques given below. (a) Wastewater free FGC techniques (b) Injection of wastewater from FGC (c) Water reuse-recycling (d) Dry bottom ash handling	The BERC is compliant with this conclusion as follows: (a) The flue gas treatment techniques proposed for the BERC are comprised of wastewater free techniques. (c) In general water is reused/recycled e.g. boiler blowdown water is reused in APCr stabilisation and reject water from boiler make-up water production is reused for IBA cooling and/or in the flue gas treatment. The plant will be designed for optimal water usage and zero process wastewater production during normal operation.	Yes; requirement in tender documents
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 given below, and to use secondary techniques as close as possible to the source in order to avoid dilution. (Please refer to BREF-WI for the list)	Not relevant. No external treatment of water takes place as the system will be designed as process “wastewater” free during normal operation.	Not relevant

Table 16: Material efficiency

BAT No.	Description and measures	BAT fulfilled (yes/no)
BAT 35. In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.	The BERC is compliant with this conclusion as follows: Residues from the flue gas treatment (APCr) will not be mixed with the IBA.	Yes; requirement in tender documents
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 given below based on a risk assessment depending on the	The BERC is compliant with this conclusion as follows: (a) Oscillating or vibrating screens will be used for an initial separation of the bottom ash. (d) Recovery of ferrous and non-ferrous metals will be made with magnets and eddy-current separators. (e) The bottom ash will undergo a maturation/ageing process that stabilises the mineral fraction of the bottom ash.	Yes; requirement in tender documents

BAT No.	Description and measures	BAT fulfilled (yes/no)
hazardous properties of the slags and bottom ashes. (a) Screening and sieving (b) Crushing (c) Aeraulic separation (d) Recovery of ferrous and non-ferrous metals (e) Ageing (f) Washing	Other techniques may be included as part of the detailed design of the IBA treatment and sorting process, to ensure that the IBAA product meets offtake customer end-use quality specifications.	

Table 17: Noise

BAT No.	Description and measures	BAT fulfilled (yes/no)
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 given below. (a) Appropriate location of equipment and buildings (b) Operational measures (c) Low noise equipment (d) Noise attenuation (e) Noise control equipment/infrastructure	The BERC is compliant with this conclusion as follows (refer to the Noise and Vibration Technical Report for further details of mitigation measures): (a) Noisy equipment (e.g. turbine, shredder, ID Fan, pumps etc.) will be placed in an enclosed area/room and/or be adequately noise insulated as required. (b) The plant will generally be operated by skilled and educated staff and a proactive maintenance system will be implemented. (c) The use of low-noise equipment will be utilised as required to comply with noise emission limits. (d) Noise attenuation equipment will be used once determined or confirmed during detailed design. Some equipment (e.g. steam turbine generator, emergency diesel generator) is placed within dedicated rooms for noise attenuation.	Yes; design requirement in tender document and via operational management and instructions

8. Environmental Management System

As Australia's largest full-service waste management company, Cleanaway is experienced in the development and implementation of the policies and procedures associated with an Environmental Management System. The BERC will implement an ISO14001 certified EMS for the plant in preparation for plant operations. The EMS will incorporate the requirements and conditions of the Environmental Authority for the BERC. During the construction and commission phase, the site will be subject to the EMS of the construction contractor.

The BERC will be designed with a high level of automation with a CMS, an ACCS, a CEMS and other emergency shutdown systems. Process measurements will be recorded for evaluation, process optimisation, process troubleshooting and for reporting purposes (after the necessary time averaging and corrections, to allow comparison with emission limit values, which are also time averaged and presented at reference conditions i.e. dry, at reference temperature and pressure, and 11% oxygen).

BAT 1 of the BATC states that to improve the overall environmental performance, BAT is to elaborate and implement an EMS. BAT 1 includes a list of features to be incorporated into a robust EMS. Cleanaway will develop and implement such an EMS for the BERC. As outlined in the BATC an BREF-WI the EMS is to incorporate processes and procedures to monitor residues and residue handling as well as fugitive emissions (e.g. dust and odour) and emissions to the air. Cleanaway will develop various management plans and procedures as part of the EMS to ensure that adequate controls are present and implemented to avoid or minimise impacts so far as reasonably practicable.

Safety in Design processes and procedures will be implemented throughout the engineering design stages of the project development. During operation and maintenance activities, a permit to work system will be utilised to ensure that hazards are identified and appropriate risk management controls are in place prior to any maintenance work being carried out. Maintenance procedures shall be put in place that will provide for condition monitoring of plant and equipment and planned preventative maintenance will be managed via a computerised maintenance management system (CMMS), to reduce the likelihood of plant upsets and failures which may result in abnormal operating conditions, also known as OTNOC.

9. Commissioning and Performance & Availability Testing

Commissioning of EfW facilities is typically undertaken in two phases:

- Cold Commissioning
- Hot Commissioning.

The actual commissioning steps and procedures will be quantified during future contract negotiations with the selected engineering, procurement and construction (EPC) contractor, with input from the selected technology provider, and detailed in a Commissioning Plan and various commissioning procedures to be developed during the detailed engineering design phase. After commissioning, the facility will be subjected to a range of process performance tests, to confirm that the process can achieve a range of performance guarantees relating to key operational performance process variables such as:

- Moving grate throughput and performance when operating throughout the Capacity Diagram/moving grate operating envelope
- Flue gas temperature, steam quality and energy recovery efficiency
- Parasitic load and electrical generation efficiency
- Flue gas emission concentrations below applicable emission limit values and APC consumable consumption rates
- Water and auxiliary fuel consumption rates
- Residue quality, recyclable metals recovery efficiency, residue resource recovery and residue stabilisation to facilitated disposal (where applicable)
- Overall plant and turbine availability (typically evaluated during the first 12-24 months of operation).

Subject to the project procurement and contracting structure, the performance guarantee testing is to be successfully completed prior to commercial operation by the EPC contractor. The first 12-24 months of operation is typically classified as the defect liability period, during which the EPC contractor will be required to rectify any defects relating to equipment warranty claims or the design and construction of the Project.

It is expected that the technology provider will be engaged by Cleanaway to provide operation and maintenance training and support services for a period of 6-24 months after handover to operations.

9.1 Cold Commissioning

Cold commissioning is the name given to the period when all systems achieve construction completion and are made safe to allow hot commissioning activities to commence. This is a key milestone in the construction delivery program. Commissioning activities are to be undertaken in accordance with an approved Commissioning Plan, using commissioning procedures prepared by or with input from the equipment or technology provider and approved by Cleanaway, as the Project owner.

Cold commissioning involves the systematic checking and preparation of all systems and undertaking functionality checks of standalone and packaged equipment, to the extent possible without firing of auxiliary fuels or the combustion of waste feedstock.

Typical cold commissioning activities include the following (some activities can be undertaken in parallel):

- Establishing the water connection to allow flushing and first filling of firewater and potable water circuits and associated tanks, and testing of firewater and fire protection systems

- Energisation of the electricity grid connection, including the main plant transformer and associated switchgear
- Commissioning of the EDG, UPS and battery back-up systems
- Energising of electrical switchboards, electricity distribution transformers, with systems to be deisolated under a permit to work system, when risk assessments confirm that it is safe to do so, to facilitate functional testing
 - Testing of plant and instrument air compressors
 - Checking and testing of all electrical, safety interlocks/protection systems and control system functions, to ensure their correct functionality
 - Energising the CMS, CEMS and other computerised control systems
 - Checking and testing of instruments
 - Checking and testing of drives and bump testing of motors
- Cleaning, flushing or air blowing of piping and equipment, including chemical cleaning of the boiler steam-side internals
- First fill of chemicals (water treatment chemicals and chemicals for boiler feedwater quality control) and consumables (lime, powdered activated carbon, urea solution) tanks and silos, and diesel fuel for auxiliary diesel fuel storage tank and other diesel storage tanks
- Commissioning of the boiler make-up water treatment unit and filling of the boiler make-up water storage tank. Testing of the demineralised water quality will confirm the satisfactory operation of the water Treatment unit.
- Checking and testing of auxiliary systems such as steam turbine lubrication systems
- Checking and testing of IBA conveyor and materials handling equipment and systems associated with IBA sorting and metals recovery
- Checking and testing of APCr stabilisation materials handling equipment
- Checking and commissioning of the component cooling system
- Testing of the secondary odour control unit
- Calibration and testing of weighbridges and traffic management systems
- Calibration and testing of the waste cranes
- Pre-commissioning of the CEMS analysers and associated computer systems, including calibration of the various analysers with test equipment and/or calibration gases.

Site acceptance tests (SATs) are required to be completed for all systems on completion of cold commissioning activities (for each system, package and individual pieces of equipment). All commissioning activities are documented for verification. Cleanaway or their representative shall attend all system SATs to verify the systems have been successfully and safely cold commissioned and the facility is safe and ready for hot commissioning.

9.1.1 Wastes and Emissions

Since no combustion of waste or auxiliary fuel occurs during cold commissioning, there will be no significant air emissions during this period. There will be some emissions associated with testing the EDG, however, the EDG is not expected to run for extended periods of time, given that electricity will be sourced from the grid post grid connection energisation.

Other wastes and emissions will include:

- Wastewater from the boiler chemical clean
- Cleaning chemicals and/or wastewater and associated residues from equipment cleaning.

Wastewater that is suitable for reuse may be directed to the process water storage pit in readiness for hot commissioning, otherwise wastes and residues will be temporarily stored prior to appropriate disposal off-site.

9.2 Hot Commissioning

In preparation for hot commissioning, the first loads of waste deliveries by pre-authorised waste delivery vehicles will be permitted to enter the site, in accordance with the 'process on arrival' detailed in the site WAP. Timing of waste deliveries must be controlled to meet the commissioning schedule in terms of volume and waste type, to facilitate testing and operation of the moving grate combustion system at any point on the Capacity Diagram (operating envelope).

As the name implies, hot commissioning involves the first combustion of fuel, initially diesel auxiliary fuel prior to first firing of waste feedstock. All auxiliary systems (CMS, CEMS, boiler water treatment, steam turbine auxiliary systems, IBA conveyor and IBA and APCr materials handling systems), utility services (firewater and fire protection systems, potable water, cooling water, plant and instrument air) must be operational and available. The hot commissioning period can be expected to take approximately 3-4 months. During this period, some noise and air emissions may temporarily exceed expected limits associated with normal operating conditions, due to more frequent shutdowns and start-ups and the potential for process upsets.

The following sections describe the typical stages of hot commissioning; however, the specific details will depend on final equipment and technology selection. The CEMS on each boiler-line shall be commissioned and operational prior to commencing hot commissioning activities. Final calibration and verification of the CEMS will be undertaken when the combustion control system has been successfully commissioned and achieved stable combustion.

9.2.1 Boiler Hot Commissioning

The boiler make-up water unit is operated to fill the boiler make-up water storage tank with demineralised water as demineralised water is transferred to the boiler feedwater tank (or deaerator) and into the boiler.

Depending on the final boiler design and configuration, a portion of the water walls will likely be covered in refractory, a heat-resistant material that protects the boiler tubes in the highest temperature parts of the combustion chamber, while also helping the boiler to achieve its high temperature residence time performance criteria ($\geq 850^{\circ}\text{C}$ for ≥ 2 seconds after last injection of combustion air). Refractory typically requires a period of curing and drying, to allow the material to set and to drive off moisture.

The refractory first dry-out should be completed using third party auxiliary burners to control the dry-out at lower temperatures (the as-built auxiliary diesel burners are typically too powerful to follow the first dry-out requirements). The refractory second dry-out curve will see the refractory exposed to temperatures $>850^{\circ}\text{C}$. The second dry-out will be completed using the as-built auxiliary diesel burners. The auxiliary burners are used to warm-up each boiler in a careful and controlled manner, allowing the refractory to cure and dry.

During boiler hot commissioning, the primary emissions will be diesel fuel combustion products emitted to the atmosphere via the flue gas stack and wastewater from boiler blowdown and drain down. This wastewater will be directed to the process water storage pit and will be reused in the process for IBA quenching. Any process wastewater in excess of reuse requirements and storage capacity will be transferred offsite by tanker truck for disposal at the local municipal wastewater treatment plant.

9.2.2 Steam Blowing

All steam piping upstream of the steam turbine must be thoroughly cleaned prior to commissioning of the steam turbine and other parts of the steam-water system. This is achieved using a process known as steam blowing. Steam blowing involves generating steam in the boiler using heat supplied by the auxiliary burners and allowing this steam to expand and move at high velocities through the pipework before it is released into

the atmosphere via a temporary vent with a silencer. This process is used to blow out rust, scale and foreign matter introduced during piping fabrication and construction activities.

The process also provides an opportunity to monitor boiler water quality.

The high pipe and exhaust steam velocities during steam blowing events will inevitably result in intermittent periods of loud noise, despite the presence of the silencer. Neighbouring facilities will be alerted to the planned steam blowing activities and the expected timing and duration, to minimise concerns and inconvenience.

During steam blowing, the primary emissions will be diesel fuel combustion products emitted to the atmosphere via the flue gas stack and wastewater from boiler blowdown and operation of the boiler make-up water treatment unit, which will be collected for reuse. Any process wastewater in excess of reuse requirements and storage capacity will be transferred offsite by tanker truck for disposal at the local municipal wastewater treatment plant.

9.2.3 First Firing (Typically One Boiler at a Time)

With the CEMS operating normally, the ACCS operating and sufficient waste feedstock in the waste bunker, the furnace temperature will be raised above 850°C for at least 2 seconds after final injection of combustion air, as required for normal operation, whenever waste is present on the moving grate. A load of waste will be deposited in the boiler feed hopper by the waste crane. The waste will gradually be pushed onto the grate by the ram feeder at an increasing rate, to allow the combustion system to ramp-up.

During this phase of hot commissioning, more frequent start-ups and shutdowns can be expected, as new systems (such as flue gas treatment and emission control systems) come on-line for the first time. Furthermore, the ACCS and control systems associated with the SNCR and FGT dosing system will require tuning. Consequently, it is possible that there will be several short-term occurrences of emissions higher than the emission limits applicable to normal operating conditions, noting that hot commissioning would be considered OTNOC according to the IED and flue gas flow rates would initially be lower than expected during normal operation.

The steam turbine generator will also be brought online once boiler operations stabilise, allowing the generator to be synchronised with the electricity grid and electricity to be exported, once approval to do so has been obtained from AEMO. However, electricity generation is expected to be intermittent, due to the more frequent boiler start-ups and shutdowns.

Once each boiler is operating stably, stack testing will be used to confirm activated carbon dosing rates for those pollutants, such as volatile heavy metals and dioxins and furans, that cannot be monitored continuously.

9.3 Performance, Reliability and Availability Testing

9.3.1 Performance Testing – Operability, Throughput and Electricity Generation

During the performance testing period, the plant will run at close to full capacity with respect to both throughput and electricity generation for an extended period of time, as defined in the EPC contract. Both boilers and the steam turbine will be in operation, although tuning and testing of systems will occur continuously throughout this period.

During plant performance testing, the entire plant operates continuously for approximately two weeks, at high waste throughput (i.e. throughputs corresponding to > 90% thermal input throughout the allowable waste CV range established by the Capacity Diagram). During this period, statutory and contractual testing requirements that need to be undertaken with Energex and AEMO in relation to the electrical system, grid connection and power export will be undertaken.

The performance tests will include a wide range of tests, including the following:

- Third party stack emissions tests for contractual guarantees (i.e. meeting BAT-AEL (Upper) daily average and IED 30-minute average emission limits for all pollutants of interest)
- Combustion flue gas temperature and residence time tests ($\geq 850^{\circ}\text{C}$ for ≥ 2 seconds)

- IBA carbon burn-out testing (Total Organic Carbon or Loss-On-Ignition)
- Waste throughput tests
- Ferrous and non-ferrous metal recovery tests
- Stabilised APCr by-product testing to confirm suitability for disposal to landfill
- Power and steam output tests demonstrating the plant efficiency
- Noise emission level tests.

Checks and tests will be undertaken to confirm that noise emissions are within design limits and that odour is being effectively managed.

The performance tests are expected to take around one to two months. The performance tests are required to be successfully completed prior to the EPC contractor achieving the commercial operation date (COD) milestone.

Note that proof of R1 compliance for a recovery operation under the EU Waste Framework Directive R1 guidance is reported after the first year of operation and every subsequent year of operation.

9.3.2 Reliability Testing

The reliability test is typically one month duration, during which time all plant areas will be required to demonstrate reliable operation i.e. with a reliability > 90% for the period. Operation will be undertaken at a range of loads demonstrating plant flexibility, however overall, the plant will be required to operate at high capacity (high thermal input). The CEMS must be in normal operation during this period, or the plant will not be considered available. The plant must also comply with guaranteed levels of emissions during this period or be deemed to be unavailable under the test methods. Some occasional emission exceedances may occur, due to unexpected equipment or operational performance at this early stage of operation, which may or may not have occurred during the hot commissioning phase. A root cause analysis will be undertaken to identify the root cause and to develop the necessary controls to mitigate the cause and to prevent its reoccurrence. This will be undertaken by the EPC contractor and any defects identified will be rectified by the EPC contractor in consultation with the operations staff. All exceedances above emission limits associated with normal operating conditions will be recorded for reporting with the performance and reliability testing documentation.

Once the reliability test has been successfully passed, both boilers will be shutdown to facilitate a final plant inspection by Cleanaway, their representative, and/or an independent engineer, to verify that operation during the performance and reliability testing has not compromised the mechanical integrity of the plant. Following this inspection, and passing all performance and reliability tests, the COD milestone will be achieved.

9.3.3 Availability Test

The availability test is a final performance test which occurs after the facility is handed over for commercial operations to commence. The test is to demonstrate that all parts of the process plant can operate reliably and demonstrate the guaranteed availability to both process waste and generate electricity. As this test may have a contractual duration of up to 2 years' long and requires the facility to operate normally, all emissions to the environment should be consistent with normal operation, with all systems functioning normally and in compliance with Environmental Authority requirements.

10. Conclusion

This report provided the technical process description for the BERC to describe the state of knowledge regarding EfW and provided a response to the Queensland EfW Policy outcomes 2, 6 and 7, which relate to drawing upon international experience and suitable reference facility operational performance to develop the facility.

The BERC will use commercially proven technologies and processes that have been in operation internationally for decades, including moving grate combustion, semi-dry APC and SNCR for emissions control.

Suitable reference facilities for the BERC have been selected, which illustrate the selected technologies' ability to meet key performance requirements. This report has provided a summary of key insights from the reference facilities' operational data, in order to inform the design of BERC and also to meet the approvals requirements of the Queensland EfW Policy and EfW Guideline. Reference facilities have been selected which:

- Function in an environmentally-sound manner, as illustrated by the data provided
- Process similar feedstock at a similar annual throughput using a similar process (technology selection) including pollution control equipment, to provide the most representative data available
- Have been fully operational for at least two years.

This report demonstrates that the BERC proposal meets the key requirements of the Queensland EfW Policy, specifically Policy Outcomes 2, 6 and 7. Drawing on international expertise and operational data from established reference facilities, the proposal confirms the performance and suitability of the selected technology in line with Outcome 2. Details of the energy efficiency for the conceptual design of the BERC estimates the R1 efficiency factor is comfortably above the criteria, as required under Outcome 6. Furthermore, the facility's design and environmental management approach have been developed with clear reference to the BAT and the relevant BREF Documents, as required under Outcome 7.

In summary, the BERC has been designed such that it is compliant with the definition of BAT used by the EU and set out in the BREF-WI, which is updated periodically to keep up to date as technologies and techniques improve over time. The facility therefore meets the requirements of the Queensland EfW Policy and EfW Guideline with respect to design aligned to best practice for environmental protection.

Appendix A

Detailed Project Description

A.1 Detailed Process Description

The BERC will extract energy (as heat) and other useful resources from the residual waste feedstock using a combustion process. This process utilises a series of proven technologies, which include each of the following:

- Moving grate combustion system
- Semi dry flue gas treatment (FGT) system
- SNCR NO_x removal system.

These technologies and processes are detailed in the following sub-sections along with ash and solid residue handling and other Balance of Plant (BoP) items i.e. those auxiliary processes and systems required to support the main process equipment.

Whilst technology providers have not yet been selected, the design undertaken to date includes preliminary process assessments, which give confidence to key project parameters. Outcomes of these process assessments, such as the process flow diagram and mass balance, are discussed in this appendix.

A.1.1 Process Flow Diagram and Mass Balance Stream Table

Please refer to Appendix B for a preliminary conceptual Process Flow Diagram (PFD), including water-steam-power cycle and a preliminary conceptual mass balance stream table. The process design, mass and energy balance and equipment configurations are preliminary and subject to change during detailed design and tendering (for technology provider and contractor selection). The mass balance stream table provides preliminary expected values for the key inputs (feedstock, combustion air, reagents and consumables, and process water consumption) and key outputs (IBAA product, recovered recyclable ferrous and non-ferrous metals, stabilised APCr and cleaned flue gas) and are subject to change during detailed design and tendering (for technology provider and contractor selection). A summary of the flue gas stack design parameters and overall energy input, preliminary estimated gross electricity generation and preliminary estimated own power (parasitic) consumption are included in tables on the PFD and in Section 6.

A.1.2 Acceptable Residual Waste Feedstocks

The Project will receive approximately 760,000 tpa at 100% MCR and 836,000 tpa at 110% MCR of a combination of mainly residual MSW and residual C&I waste with a design CV of 10.6 MJ/kg (LHV) and assuming 8,000 hours per annum availability. The design will aim to accommodate any combination of these common residual waste streams, however the concept design has assumed a typical split of approximately 70% MSW and 30% C&I waste. The EfW facility will be designed to maintain operational availability of at least 8,000 hours/year per line with a nominal throughput for each line of 47.5 tph at 100% MCR and 52.25 tph at 110% MCR, at the design CV.

Only wastes which are consistent with the Queensland EfW Guideline Policy outcome 4 definition of residual waste will be accepted as waste feedstock. Examples of non-residual waste include (but are not limited to) uncontaminated comingled recyclables from yellow lid bins; source-separated green waste; and MSW, C&I and Construction and Demolition (C&D) waste that has not been source separated. Please refer to the Waste Feedstock Report for a detailed definition of acceptable residual waste and details of key controls to ensure that only truly residual waste is accepted for thermal treatment at the BERC.

Table 18 summarises the physical composition results for both residual MSW and residual C&I waste averaged over two seasonal waste audits undertaken for Cleanaway by waste audit and analysis specialist HRL. A “shoulder” season waste audit was undertaken in May 2023, while a “dry” season waste audit was undertaken in September 2023. Natural variability in this feedstock (due to factors such as seasonality, changes in consumer behaviour, changes in legislation and changes in commercial and municipal waste suppliers) is to be expected over the course of the year and across the design life of the facility. However, such variability is expected to remain within the operational capability of the proposed technology.

Table 18: Residual waste feedstock waste audit composition data (% by weight) averaged over two audits (May/June and September 2023)

Waste Category	MSW average composition %	C&I average composition %
Paper and Cardboard	17.65	28.41
Nappies	5.30	1.57
Wood	2.73	15.60
Plastics & Expanded Polystyrene (EPS)	6.77	7.49
Soft plastics (film)	7.21	10.59
Ferrous metals	1.72	1.85
Non-ferrous metals	0.90	0.48
Food organics	26.25	27.71
Garden organics	12.04	0.10
Other putrescible	1.40	0.01
Textiles	7.17	3.41
Electronic equipment, household chemicals & pharmaceuticals	4.78	0.73
Glass	3.05	1.72
Other – potentially combustible	0.38	0.24
Other - inert	2.68	0.12
Total	100	100

HRL also undertook analytical testing of waste samples collected during the audit process, to determine the combustion characteristics of each waste stream. The results of the analytical testing are summarised in Table 19.

Table 19: Residual waste feedstock analytical combustion characteristics

Parameter		MSW – Combined Average	C&I – Combined Average
Test	Unit		
Ash Yield at 550°C	% (db)	23.0	11.8
Moisture Content	% (ar)	38.5	31.8
Carbon	% (db)	43.8	51.0
Hydrogen	% (db)	5.8	7.2
Nitrogen	% (db)	1.1	1.0
Sulphur	% (db)	0.12	0.09
Chlorine	% (db)	0.64	0.56
Calorific Value Gross Dry	MJ/kg (db)	19.8	21.2
Calorific Value Gross Wet	MJ/kg (ar)	12.2	15.7
Calorific Value Net Wet (<i>Note 1</i>)	MJ/kg (ar) (LHV)	10.6	14.0
Volatile Matter	% (db)	68.9	78.6
Fixed Carbon	% (db)	8.2	9.7

Note 1: This value is the calorific value that represents the LHV referred to throughout the BERC documentation.

A.1.2.1 Feedstock Variability

Residual mixed solid waste streams are inherently variable, with changes in both waste composition and their combustion characteristics due to seasonal effects, changes in consumer behaviour, collection services, recycling technologies, product stewardship, and changes in government policy and regulation (e.g. waste levy, landfill bans, single use plastic bans, container return scheme). As a consequence, the chemical and physical properties of the feedstock will vary from hour to hour, throughout the operational life of the Project.

The design of the moving grate combustion system allows the facility to operate continuously (at 100% thermal input) on waste with an LHV in the range 8.8 – 14.6 MJ/kg, and down to 70% thermal input on waste with an LHV of 7.4 – 10.6 MJ/kg, without the need for auxiliary firing, as illustrated by the operating envelope or Capacity Diagram (see Figure 6). Short-term operation at up to 110% thermal input (10% thermal overload) is permitted to accommodate the inherent variability in feedstock combustion characteristics. Similarly, the facility will be designed to process waste with a broad range of ash content, moisture content, and other key physical and chemical properties (such as sulphur and chlorine content). These parameters impact the sizing of the boiler, air pollution control systems, ash and residue handling systems, and auxiliary systems.

Please refer to the Waste Feedstock Report for further details on the assessment of potential changes associated with feedstock variability and waste arising over the operational life of the BERC.

A.1.3 Waste Reception and Waste Bunker Storage

All waste deliveries arriving at the BERC will be fully enclosed vehicles or loads. Waste accepted for processing must be in accordance with the BERC WAP. The WAP is expected to be a schedule attached to all contractual Waste Supply Agreements (WSAs) between the BERC and waste suppliers. The enclosed tipping hall will be designed with automated fast-acting roller doors and will be maintained under negative air pressure to minimise the potential for fugitive dust/odour emissions. Good housekeeping in the waste reception/tipping hall will prevent accumulation of potentially odorous materials outside of the waste bunker, while the grab cranes will constantly pre-mix the waste in the waste bunker, to minimise potentially anaerobic conditions. The crane operator's area of the control room has a direct line of sight into the waste bunker, while the waste bunker and tipping hall are under constant CCTV surveillance, to allow the grab crane operator to observe waste deliveries and remove oversized or unacceptable waste from the bunker for shredding or disposal (if the material is unacceptable waste).

A.1.3.1 Process on Arrival and Waste Acceptance Protocol

Waste deliveries will enter the BERC site via a security gate house and proceed to the weighbridge where the vehicle will be checked for excessive levels of radiation, weighed and their delivery details recorded. Waste delivery vehicles may be selected at random to proceed to a designated pre-inspection area to allow the BERC operations staff to verify the waste and where feasible, visually inspect the load to confirm its suitability as acceptable waste. No waste deliveries will be unloaded or tipped outside of the reception hall.

Waste feedstock supplied by Cleanaway and third-party suppliers will be managed in accordance with the BERC WAP which defines both acceptable and unacceptable waste types, along with waste arrival and inspection protocols, quality assurance and quality control (QA/QC) processes, contingency plans and processes to handle unacceptable waste deliveries. The waste acceptance process essentially involves pre-qualification of waste suppliers and waste types (through contractual WSAs incorporating the BERC WAP), and a defined process on arrival involving the following: vehicle recognition, supplier verification, radiation detection check, logging of all waste deliveries (tonnes) and inspection of the waste at various stages (Figure 7) for size and suitability, aiming to maintain the composition and combustion characteristics of the waste feedstock within an acceptable range and to remove unacceptable materials that may result in unacceptable contaminant levels or may cause damage to plant and equipment. Oversized or bulky acceptable waste can be fed to an onsite shredder located in the waste bunker area before being fed to the boiler. After unloading, waste delivery vehicles will exit via the outgoing weighbridge, to facilitate confirmation of the tonnes of waste delivered to or rejected by the BERC. The waste grab crane will record the mass (tonnes) of all waste fed to each grate-boiler line for thermal treatment.

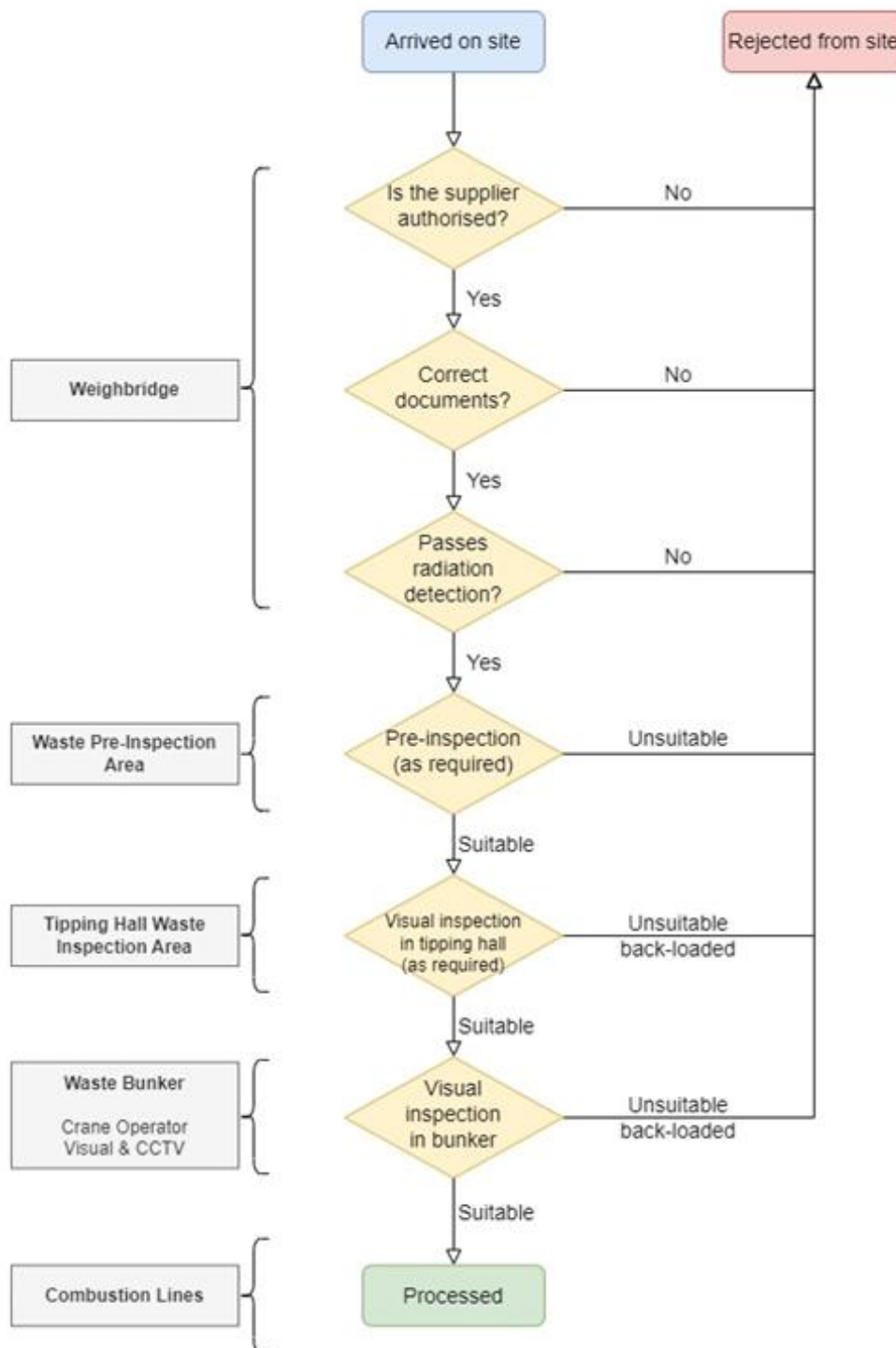


Figure 7: Overview of process on arrival for a waste delivery to the EfW facility

Other QA/QC processes such as periodic sampling of waste will also be undertaken to determine certain key parameters of the waste profile including ash, moisture, chlorine, sulphur and metallic aluminium, while waste supplier audits will be used to confirm that waste suppliers are adhering to agreed source separation protocols to ensure that waste arising is truly residual waste.

A.1.3.2 Waste Reception/Tipping Hall

Waste will be delivered to the Project via a waste reception hall or tipping hall, expected to operate 24 hours per day, 7 days/week. An indicative tipping hall layout showing individual tipping bays and a random waste inspection area is shown in Figure 8.



Figure 8: Indicative tipping hall layout (note: preliminary, subject to change during detailed design and final selection of a technology provider and confirmation of waste delivery vehicle types)

The tipping hall will be designed to cope with the facility ‘peak hour’, which is the hour in the day where the largest number of vehicles is expected to require processing. Two waste delivery scenarios were considered; one where both A-Doubles and side-tipping type B-Doubles would deliver waste to the facility, and another where only B-Doubles would deliver waste. The scenario with only B-doubles has the highest number of daily waste vehicle deliveries and is therefore used as the basis for technical assessments.

For the base scenario, peak hour waste delivery truck arrivals for the BERC have been estimated at 24 trucks/hour for 100% MCR and 28 for 110% MCR. The estimated number of total waste vehicle arrivals is approximately 108 vehicles per weekday (total of arrivals plus departures, reducing to ~72 vehicles per day on Weekends) at 100% MCR and ~119 vehicles per weekday at 110% MCR (reducing to ~80 vehicles per day on Weekends).

Negative pressure will be maintained in the tipping hall and waste bunker areas by locating the boiler primary combustion air intake ducts above the waste bunker. This will preferentially draw potentially odorous air from within the tipping hall and waste bunker area directly into the boiler furnace, where odours are destroyed by the high temperatures in the combustion chamber.

Adjustable louvres in the façade of the tipping hall will allow air inflow (for the furnace combustion air system), even if the entry and exit roller doors are closed. Tipping hall louvres and entry and exit roller doors will typically be closed when the plant is not operating. However, a dedicated stand-by odour control unit is proposed to manage odour in the tipping hall and waste bunker areas in the event of an extended full plant outage, to maintain safe working conditions for operation and maintenance staff, if maintenance work is to be undertaken within the tipping hall or waste bunker areas.

The tipping hall shall include a waste inspection area where random waste loads arriving in compactor size vehicles can be temporarily unloaded for inspection and shall include a waste rejection point to allow removal of unsuitable waste from the bunker.

Tipping hall bays shall include a protection mechanism to mitigate the risk of vehicles overreaching into the bunker.

A.1.3.3 Waste Bunker, Waste Crane and Waste Shredder

The waste bunker shall be designed to store approximately five days of waste at full capacity, with a maximum storage capacity of approximately seven days with stacking of waste against closed bays. An example of waste stacking in a waste bunker is shown in Figure 9. The waste bunker is monitored by CCTV

in the plant control room. Two grab-type waste cranes will service the waste bunker. The waste cranes have four primary functions:

- ensuring waste is stacked so that space is available to receive incoming waste deliveries
- pre-mixing and stacking waste in the bunker prior to feeding each boiler
- feeding waste to each boiler hopper, as required by the ACCS
- removing unacceptable waste from the bunker.

The waste cranes weigh each load of waste that is transferred from the bunker to the feed hopper. The weight of each load of waste placed in each boiler feed hopper shall be recorded in the plant CMS, for use by the ACCS and for EfW performance reporting purposes. The waste cranes will be capable of operating in fully automatic mode, semi-automatic mode and manual mode (via a crane operator chair located in the control room, overlooking the waste bunker area). The cranes can also be used to move oversize waste from the waste bunker and into a bulky waste shredder, for resizing. The shredder will be located so that shredded oversize waste can be returned directly to the waste bunker for thermal treatment.



Figure 9: Example of waste stacked in a waste bunker

During delivery hours, the waste crane operators will monitor the operation of the grab cranes, to mix and distribute the waste, and move oversized acceptable waste into the shredder for resizing. The mixing operation of the grab crane is important for the stable operation of the combustion system and flue gas treatment system, by working to ensure that individual waste loads are mixed together prior to being fed to each grate combustion system. This prevents significant quantities of similar waste materials from being fed into the combustion chamber.

The waste bunker area will be equipped with continuous thermal monitoring to detect hot spots or potential fires. Although such incidents are rare, appropriate measures are in place to manage them effectively. Firewater cannons will be provided to deal with hot spots or fires in the waste bunker, while the grab crane can be used to break up hot spots and expose affected materials to the water cannons.

A.1.4 Thermal Treatment and Energy Recovery

The selected thermal treatment technology is moving grate combustion technology. Moving grate combustion technology is an established and proven EfW technology for mixed solid waste applications, that

has been used globally for decades. In that time the technology has been subject to continual improvement responding to regulatory, industry and public demands. Approximately 90%¹⁰ of facilities that thermally treat MSW and C&I waste to produce electricity and heat use moving grate combustion technology. This market dominance is due to the technology being robust and flexible, with a proven ability to process mixed waste feedstocks with a high degree of reliability and operational availability, with minimal (if any) upfront pre-treatment. Other technologies such as gasification, pyrolysis and continuous fluidised bed boilers either require a more consistent feedstock composition or require significantly more upfront pre-treatment, and therefore, typically have a poor track record for reliability and availability – unacceptable for critical waste management infrastructure. A schematic illustration of the moving grate combustion system and the integrated heat recovery boiler system is presented in Figure 10.

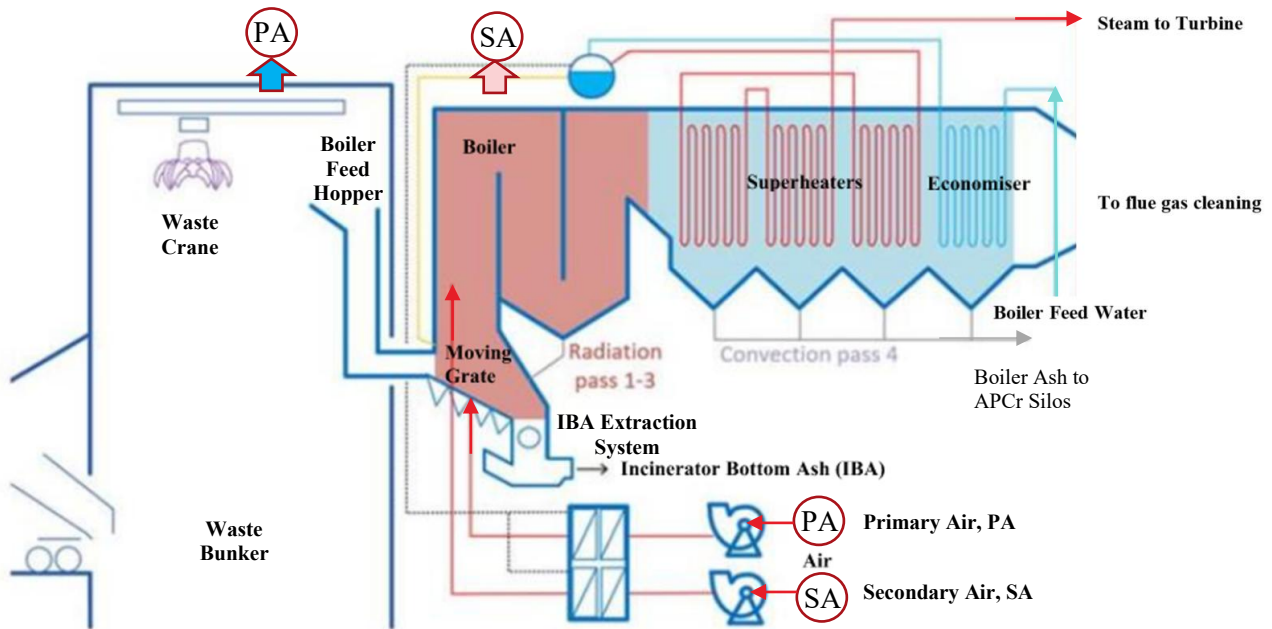


Figure 10: Moving grate combustion schematic

A.1.4.1 Boiler Feed Hopper

The boiler feed hopper provides several important functions including:

- Receiving waste loads deposited by the grab crane, under level control
- Ensuring waste is available for feeding when called upon by the ACCS
- Preventing uncontrolled air ingress into the furnace, by using the waste as a plug
- Preventing fire or hot furnace gases from entering the waste bunker area
- Feeding and distributing waste onto the moving grate and into the furnace by way of a hydraulic ram, under the control of the ACCS.

The boiler feed hopper is fitted with a damper to prevent backflow of fire or hot furnace gases into the waste bunker area. Under normal operation, the boiler combustion chamber will operate under slight vacuum conditions (generated by the action of the ID fan), as such, hot flue gases will preferentially flow into the boiler and towards the FGT system, rather than back into the waste bunker area.

A.1.4.2 Moving grate combustor

A key feature of the moving grate combustor is that no pre-sorting or pre-treatment of the incoming waste is required apart from resizing of oversize/bulky waste material and pre-mixing of waste within the waste bunker (to homogenise the feedstock as far as possible) using the waste crane. Under the control of the ACCS, waste feedstock in the feed hopper is periodically pushed by ram-feeders onto an inclined moving

¹⁰ Section 2.3.1 in the BREF-WI

grate where the thermal treatment occurs. The grate consists of grate bars with slits through which preheated primary combustion air (drawn from above the waste bunker) is injected. Secondary combustion air is injected directly into the combustion chamber above the moving grate as needed, to ensure complete burnout of the combustion gases. The secondary combustion air is typically drawn from the warm boiler building headspace, which helps to enhance boiler energy efficiency. Each of these components including the ram-feeders, the moving grate bars and combustion air fans are controlled by the ACCS. This acts to maintain a steady flow rate (setpoint) for the steam leaving the boiler steam drum and a steady flue gas % by adjusting process variables such as waste feed rate, grate speed and primary and secondary combustion air flows. The pre-mixing of waste in the waste bunker and the operation of the ACCS (to stabilise boiler operation), are primary controls which act to minimise the formation of potential pollutants such as NO_x and CO, as well as helping to prevent spikes in other potential pollutants.

Waste travels by gravity down the stepped grate, assisted (and mixed) by the mechanical movement of the grate bars. Once exposed to the hot environment within the furnace section of the boiler, the fresh incoming waste begins to dry. As the dried waste travels further down the stepped grate, the combustible components in the waste gasify (decompose from a solid into a gas) and then combust at high temperature directly above the grate (see Figure 11).



Figure 11: Example of a moving grate combustion system during start-up as waste is being fed onto the moving grate

At modern facilities, the grate is divided into several sections which are each controlled by the ACCS. As such, the ACCS facilitates a highly efficient combustion process, with the complete combustion process typically taking about two hours.

While the waste feedstock is heterogeneous in nature, the moving grate combustion system can safely accommodate a range of feedstock characteristics (composition and CV) whilst maintaining a steady thermal input by varying the grate speed and feed rate, as shown in the Capacity Diagram in Figure 6. This shows that the BERC will be designed to process waste with a CV of between 7.4 and 14.6MJ/kg (LHV) while continuing to operate at 100% thermal input. As calorific value decreases, the feed rate must increase to maintain the same thermal input. As such, the BERC will be able to vary mechanical load/throughput between 33.6 tonnes per hour (t/h) and 57 t/h per grate-boiler line to accommodate this variability in the feedstock.

A.1.4.3 Wet Incinerator Bottom Ash Extraction System

Ash, being the non-combustible components in the waste, drops off the end of the grate and into an ash extraction system also referred to as an ash discharger. The ash extractor or discharger has a water bath or quench, which both cools the ash and acts as a water seal to prevent uncontrolled air ingress, since the boiler

operates under slight vacuum conditions. This ash residue is known as IBA. Moist and cooled IBA will be transferred via an enclosed conveyor to the onsite IBA treatment area for maturation and processing, as described in Section A.1.6.

A.1.4.4 Furnace and Energy Recovery (Boiler System)

The design of the combustion chamber (above the moving grate) is such that flue gas resulting from the incineration of waste is raised to a temperature of at least 850°C for at least two seconds, after the last injection of combustion air, even under the most unfavourable conditions. Each combustion chamber is equipped with at least one auxiliary burner. This burner is switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C while waste is being incinerated. The auxiliary burners are primarily used during start-up of each grate-boiler line, to pre-heat the furnace and boiler, and during shut-down of each grate-boiler line. This stabilises boiler operations and ensures that flue gas temperatures are maintained at all times while waste is being incinerated. The high temperature residence time criteria is a primary control to ensure complete combustion of the waste feedstock and the destruction of organic compounds in the flue gas. This is also a requirement of the IED.

The energy within the hot flue gas is efficiently recovered within a steam boiler as depicted in Figure 12. The radiant section of the boiler is designed to achieve the abovementioned high temperature residence time criteria and is also the location of:

- Secondary air injection nozzles
- Auxiliary burners
- Injection nozzles for the SNCR system for secondary NO_x abatement, as detailed in Section A.1.5.6.

The radiant section typically consists of up to three vertical flue gas passes comprised of water walls connected to a steam drum. In this high temperature section, the flue gases are cooled by raising steam, to protect the heat exchanger tube bundles in the convection section from extreme temperatures. A hopper at the bottom of the second and third passes facilitates the collection of radiant boiler ash (coarse particulate matter carried over from the boiler), which separates from the flue gas stream by gravitational separation, as the flue gas changes direction. Hoppers located underneath the tube bundles in the convection section likewise recover particulate matter termed convective boiler ash that is intermittently dislodged from the tube bundles by mechanical rappers. This reduces tube fouling and the potential for tube failure and the associated loss of valuable steam into the flue gas system. Further information regarding the handling of boiler ash is provided in Section A.1.6.

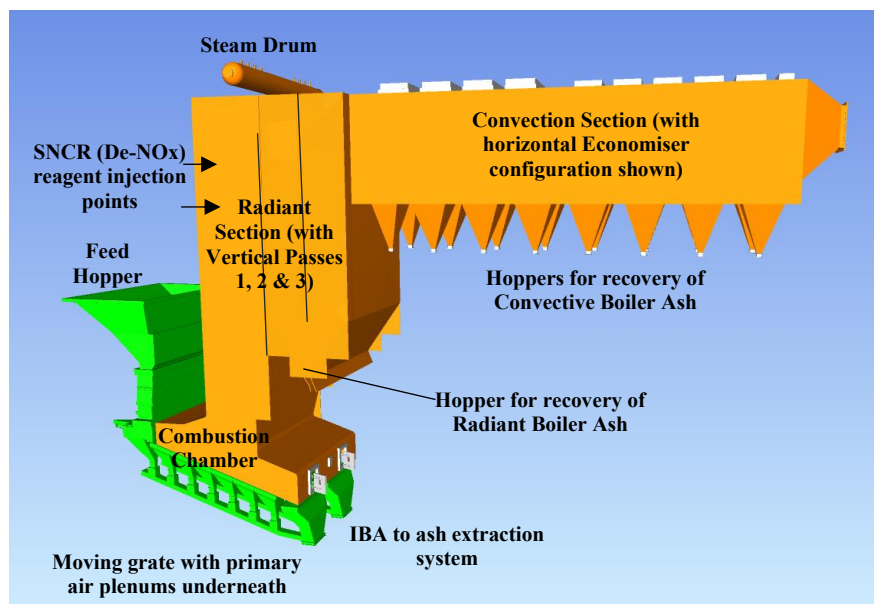


Figure 12: Indicative boiler layout (note: preliminary, subject to change during detailed design and final selection of a technology provider)

The steam generated and superheated in the boiler energy recovery system is sent to a steam turbine generator, where the high pressure and high temperature steam is used to turn a shaft attached to a generator. The generator converts mechanical energy into electricity. The energy efficiency is enhanced by the selection of high steam quality (temperature and pressure) and other heat integration features, such as combustion air preheating, and the use of an economiser heat exchanger section to preheat the boiler feedwater. The economiser section of the boiler also facilitates rapid cooling of the flue gas within the temperature range where de-novo synthesis of dioxins and furans may occur and is therefore a primary control used to limit the formation of dioxins and furans. The economiser will be designed to lower the flue gas temperature to around 160°C at the economiser exit, which is the inlet to the FGT system.

A.1.4.5 Water-steam power cycle description and preliminary mass balance

- Steam generation and steam superheating in the boiler
- Steam turbine generator
- ACC for condensing steam turbine exhaust team at sub-atmospheric pressure using forced draft ambient air cooling. The ACC will be sized to limit the amount of power output derating to $\sim 1.3\%$ per annum i.e. to account for operation during the ambient air temperature is above the design ambient air temperature of the ACC
- Steam turbine bypass direct to ACC for start-up, Power Island Mode and other operating scenarios (discussed in further detail below)
- Condensate pre-heating (subject to detailed design)
- Deaerator or boiler feedwater tank where a small amount of steam is used to strip air and oxygen from the recirculating condensate. The tank also provides residence time for the condensate before it is recirculated to the boiler
- Boiler feedwater pumps, which pressurise the boiler feedwater so that it can be returned to the boiler steam drum, via the boiler economiser (feedwater preheater) section.

Figure 13: Preliminary water-steam power cycle

Small amounts of steam are withdrawn from the steam turbine at medium and low pressures to provide various process heating and live steam injection requirements such as combustion air preheating and condensate preheating and deaerator steam injection. The pass out steam nozzles will be prepared for future process heat duties both onsite and offsite (i.e. potential future steam export to neighbouring industrial customers).

A steam turbine bypass is provided to facilitate the following operating and maintenance scenarios:

- EfW plant start-up i.e. before the steam quality is suitable for introduction to the steam turbine
- EfW plant shutdown i.e. when steam quality is no longer suitable for introduction to the steam turbine
- Steam turbine bypass mode, which allows the facility to continue to process waste even if the steam turbine generator is temporarily offline, with electricity imported from the grid to meet the internal parasitic load requirements of the facility
- Power Island Mode, where the steam turbine generator operates at minimum load to supply the parasitic (own consumption) needs of the BERC in the event that the external electricity grid is unavailable or unable to accept generation capacity from the BERC. An EDG and a dedicated UPS will be provided to ensure that the BERC can shutdown safely in the event of a major power system failure.

The steam turbine generator will generate electricity at 22 kV (to be confirmed during Basic Engineering). The generator is expected to be connected to a main plant transformer, which will facilitate the bi-directional flow of electricity to and from the grid. During normal operation a portion (~12%) of the generation capacity will be used to satisfy the internal parasitic load of the entire BERC facility, with the remainder to be stepped up to 110 kV for export into the local electricity grid via an onsite switchyard. In the event that the steam turbine generator is offline, electricity can be imported from the grid at 110 kV and stepped down to 11 kV (via the main plant transformer and redundant HV auxiliary transformers) for distribution to various HV to LV auxiliary power distribution transformers, which further reduce the voltage to 400V and 690V for distribution to individual electricity loads throughout the facility.

A make-up water treatment system provides demineralised make-up water to replace boiler blowdown and other boiler water losses, and a chemical dosing system is used to adjust boiler feedwater chemical properties such as pH, to mitigate the risk of boiler corrosion and potential damage to the steam turbine.

A.1.5 Air Pollution Control

APC or abatement technologies can be divided into two distinct areas for consideration:

- Treatment for dust (particulates), acid gases, heavy metals, dioxins and furans and other organic compounds (referred to as FGT)
- Treatment for NO_x (referred to as NO_x reduction).

In addition to the above abatement technologies, the ACCS (which acts to maintain stable combustion conditions) is the primary control used to minimise the formation of pollutants such as CO, particulates, TOC, dioxins and furans, all of which are byproducts of incomplete combustion (also see Section A.1.4.2).

A.1.5.1 Emission limit values

Emission limit values (ELV) set out the legislative context for limiting emissions of various compounds within the cleaned flue gases. A detailed description of emissions legislation and ELV is provided within the Air Quality Assessment. There are several key legislative (or related) documents in relation to BAT for achieving legislated ELV that have been considered, including:

- Queensland Environmental Protection (Air) Policy 2019 (Air EPP)
- National Environment Protection Measure, 2021 (Air NEPM)
- IED 2010/75/EU
- The BREF-WI, 2019 and the associated BATC, 2019.

Each of these documents provides quantitative objectives and/or emission concentration levels or concentration ranges which guide the setting of ELV. The introduction to the BATC, 2019 states that:

*“Best available techniques (BAT) conclusions are the reference for setting permit conditions for installations covered by Chapter II of Directive 2010/75/EU and competent authorities should set emission limit values which ensure that, **under normal operating conditions** [emphasis added], emissions do not exceed the emission levels associated with the best available techniques as laid down in the BAT conclusions.”*

The ELV that have been used for the design of the BERC are shown in Table 20. A summary of these are as follows:

- The BERC will be designed such that none of the half-hour average stack emission concentrations exceed the ELV for relevant parameters in the IED under normal operating conditions (NOC)
- The BERC will be designed such that none of the daily average stack emissions concentrations exceed the upper-end of the Best Available Technique – Associated Emission Level (BAT-AEL) range for those parameters summarised in the BATC, 2019 under NOC.

Modelling of the stack emissions and their resultant impact on ambient air quality objectives has been completed for the Project and is discussed in the Air Quality Assessment.

Where a BATC, 2019 BAT-AEL concentration level or range is not specified, such as for short term disruptions and for time averaging periods less than 24 hours, the IED emission limit (for time averaging periods less than 24 hours) and IED provisions for OTNOC and evaluation of compliance will apply. This has been done for practical reasons, given the inherent short-term variability of mixed waste streams, while also ensuring that daily ELV are not to be exceeded. The IED details how daily average emission concentrations are to be determined based on valid half-hour (30 minute) average emission concentration measurements. As such, the IED and the BATC, 2019 are intricately linked, and should not be read or applied in isolation of each other. The emission limit values presented in Table 20 include values from both the IED and the BATC, 2019.

Table 20: Emission limit values for the BERC (normal operating conditions)

Parameter	Unit (Reference dry flue gas at 11% O ₂ , 273.15K, 101.325kPa)	Daily average ELV (BATC, upper end of BAT-AEL range) (Note 5)	Half-hour average ELV (IED*, 100%) (Note 6)
TOC	mg/Nm ³	10	20
Dust	mg/Nm ³	5	30
HCl	mg/Nm ³	6	60
HF	mg/Nm ³	1	4
SO ₂	mg/Nm ³	30	200
NO _x as NO ₂	mg/Nm ³	120	400
NH ₃	mg/Nm ³	10	-
CO (Note 1)	mg/Nm ³	50	100 (Note 1)
Result of spot sampling			
Hg	µg/Nm ³	20 (Note 3)	-
	mg/Nm ³	10 (Note 4)	
Cd + Tl	mg/Nm ³	0.02	
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	mg/Nm ³	0.3 (Note 2)	
Dioxins and Furans	ng I-TEQ/Nm ³	<0.04	
Dioxins and Furans + dioxin like PCBs	ng WHO-TEQ/Nm ³	<0.06	

Parameter	Unit (Reference dry flue gas at 11% O ₂ , 273.15K, 101.325kPa)	Daily average ELV (BATC, upper end of BAT-AEL range) (Note 5)	Half-hour average ELV (IED*, 100%) (Note 6)										
* The BATC, 2019 does not indicate a BAT-AEL range for half-hour average ELVs, therefore the IED has been used for these ELVs. <i>Note 1:</i> The CO ELV is not part of the Column A regime (i.e. 100% of all half-hour average emission values). Half-hour average values for CO must be below 100 mg/Nm³ for 100 % of the time. As an alternative to the half-hour ELV, 100 % of all 10-minute average CO emission values shall be below 150 mg/Nm³. <i>Note 2:</i> The sum of 9 metals include the metals and their compounds: Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V. <i>Note 3:</i> From BAT 31 (BATC, 2019), the averaging period for Hg can be either daily average or average over the sampling period of a minimum of 30 minutes and a maximum of 8 hours. From BAT 4 (BATC, 2019), for plants incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), the continuous monitoring of emissions may be replaced by long-term sampling (no EN standard is available for long-term sampling of Hg) or periodic measurements with a minimum frequency of once every six months. In the latter case the relevant standard is EN 13211. <i>Note 4:</i> Result of long-term sampling. From BAT 31 (BATC, 2019) the BAT-AEL for long-term sampling may apply in the case of plants incinerating waste with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition). <i>Note 5:</i> IED Annex VI Part 6 Monitoring of Emissions clause 1.3: At the daily emission limit value level [where the daily average is defined in the BATC, 2019 as being the ‘Average over a period of one day based on valid half-hourly averages’. Also [see Note 5 below], the values of the 95 % confidence intervals of a single measured result (see Note 5) shall not exceed the following percentages of the emission limit values: <table><tr><th>Emission</th><th>Units</th></tr><tr><td>CO</td><td>10%</td></tr><tr><td>SO₂ / NO_x</td><td>20%</td></tr><tr><td>Particulate / TOC</td><td>30%</td></tr><tr><td>HCl/HF</td><td>40%</td></tr></table> <i>Note 6:</i> IED Annex VI Part 8 Assessment of compliance with emission limit values clause 1.2: The half-hourly average values and the 10-minute averages shall be determined within the effective operating time (excluding the start-up and shutdown periods if no waste is being incinerated) from the measured values after having subtracted the value of the confidence interval specified in point 1.3 of Part 6 [see Note 4 above]. The daily average values shall be determined from those validated average values. To obtain a valid daily average value no more than five half-hourly average values in any day shall be discarded due to malfunction or maintenance of the continuous measurement system. No more than ten daily average values per year shall be discarded due to malfunction or maintenance of the continuous measurement system.				Emission	Units	CO	10%	SO ₂ / NO _x	20%	Particulate / TOC	30%	HCl/HF	40%
Emission	Units												
CO	10%												
SO ₂ / NO _x	20%												
Particulate / TOC	30%												
HCl/HF	40%												

To allow the facility to operate such that emissions are maintained below the upper end of the BAT-AEL range under normal operating conditions, the design has incorporated the following key factors:

- All key techniques and technologies proposed for the BERC (i.e., for thermal treatment, APC, process control and emissions monitoring) are identified as BAT in the BREF-WI. Reference facility performance indicates that the technologies are suitable and can be applied for the BERC, noting that the reference facilities (as existing facilities) were only required to comply with the BREF-WI BAT-AELs as of the end of 2023 (i.e. 4 years after issue of the BREF-WI)
- Key BAT APC techniques and technologies have been selected based on being the best fit for the BERC, with due consideration of implications for energy and resource efficiency, reagents and consumables, complexity, operability and maintainability, and capital and operating costs.

A.1.5.2 Validation against outcomes of air quality modelling

The Air Quality Assessment has concluded that:

"In summary, the daily average (i.e., under normal operating conditions) and short-term average air quality modelling results demonstrate that with the proposed emission limit settings, based on the upper end of the BAT-AEL range associated with implementation of BAT for emission control and flue gas treatment, the Project (in isolation) is predicted to have an insignificant impact on air quality, as measured against the relevant health-based and environmental based air quality objectives."

By implication, compliance with emission limit values based on the upper end of the BAT-AEL will result in actual measured emissions below those emission limit values.

A.1.5.3 Flue gas monitoring

Flue gas monitoring will be undertaken in accordance with relevant BAT from the BREF-WI (BAT 3, BAT 4, BAT 5 and BAT 6). A description of the CEMS is provided in Section A.1.5.6.

Table 21 provides a summary of the parameters to be monitored within the flue gas.

Table 21: Monitoring of air emissions

Parameter (Note 4)	Proposed Type of monitoring	Minimum monitoring frequency	BAT reference
Flue gas oxygen	Continuously monitored via CEMS	Continuous	BAT 3
Flue gas moisture	Continuously monitored via CEMS	Continuous	BAT 3
Flue gas flow rate	Continuously monitored via CEMS	Continuous	BAT 3
Flue gas temperature	Continuously monitored via CEMS	Continuous	BAT 3
Flue gas pressure	Continuously monitored via CEMS	Continuous	BAT 3
Dust (from waste incineration)	Continuously monitored via CEMS	Continuous	BAT 25
Metals and metalloids (except mercury) (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Tl, V)	Periodic	Every six months	BAT 25
HCl	Continuously monitored via CEMS	Continuous	BAT 27
HF	Continuously monitored via CEMS (Note 1)	Continuous	BAT 27
SO₂	Continuously monitored via CEMS	Continuous	BAT 27
NO_x as NO₂	Continuously monitored via CEMS	Continuous	BAT 29
N₂O (as NO₂)	Periodic	Once per year (when SNCR is operated with Urea)	BAT 29
NH₃	Continuously monitored via CEMS	Continuous	BAT 29
CO	Continuously monitored via CEMS	Continuous	BAT 29
TOC	Continuously monitored via CEMS	Continuous	BAT 30
Dioxins and furans (PBDD/F, PCDD/F) Dioxin-like PCBs	Periodic	Once every month for long-term sampling (Note 3) Note: dioxin-like PCBs to be proven low during a flue gas testing campaign at the start of operations in accordance with industry guidelines (then not required if proven low)	BAT 30
PAH (as Benzo[a]pyrene)	Periodic	Once per year	BAT 30

Parameter (Note 4)	Proposed Type of monitoring	Minimum monitoring frequency	BAT reference
Hg	Continuous, then periodic once proven stably low during a flue gas testing campaign at the start of operations in accordance with industry guidelines (Note 2)	Continuous / Every six months	BAT 31
Note 1: Reference: BREF-WI BAT 4 Note (4). Note 2: Reference: BREF-WI BAT 4 Note (5). To be verified during a flue gas testing campaign at the start of operations in accordance with industry guidelines. - This approach is described in the BREF-WI, BAT 31 - Both reference facilities monitor mercury emissions periodically, in line with this approach - Lab results (presented in the Feedstock Report) showed Hg levels to be below detection levels in the feedstock, therefore it is reasonable to assume emission levels will be low - If the flue gas testing campaign once the facility is operational finds that mercury levels are not stably low, a mercury analyser will be maintained in the CEMS for each boiler line. Note 3: BAT 4 requires sampling monthly for long-term monitoring unless emissions are demonstrably stable. In addition, monitoring of Dioxin-like PCBs does not apply where the emissions of dioxin-like PCBs are proven to be less than 0,01 ng WHO-TEQ/Nm³. To be demonstrated by monthly raw flue gas monitoring during commissioning. Note 4: Parameters used to convert raw CEMS concentration measurements to concentrations at reference conditions specified in the IED for monitoring of emission from waste incineration (i.e. Dry, 273.15K, 101.325kPa and 11% Oxygen).			

A.1.5.4 Semi-dry flue gas treatment (FGT) system

Since the BERC is situated in a non-sewered location, wet scrubbing systems which produce a continuous amount of process wastewater were not considered appropriate. Wet scrubbing systems also consume larger quantities of water, which is undesirable. Consequently, the BERC is proposing to use a semi-dry FGT system. It is classified as semi-dry as an amount of water (typically process wastewater/reuse water) is used in the FGT process to condition the flue gases prior to or during treatment. The process generates no effluent wastewater, as the water is evaporated into the flue gases. There are forms of dry system that use no water; however, these systems can be less flexible when responding to fluctuations in flue gas pollutant loading and typically require higher reagent dosing rates and therefore, produce larger quantities of APCr, which requires treatment prior to disposal. As such, semi-dry scrubbing is the preferred FGT configuration for the BERC.

A semi-dry FGT system includes the following key equipment:

- Water addition or water spray for conditioning of flue gases. This may, but not necessarily occur in a quench tower, depending on the finally selected technology provider's process configuration
- A reactor, which provides residence time for mixing of an alkaline reagent (either hydrated lime or sodium bicarbonate) for neutralisation and removal of acid gases (HCl, HF and SO₂), and for mixing of powdered activated carbon to capture heavy metals, volatile organic compounds, dioxins and furans
- A baghouse filter to remove residual dust and APCr from the flue gas.

As illustrated schematically in Figure 14, in a semi-dry FGT system, flue gases leave the boiler section of the facility and flow into a reactor vessel (or a quench tower followed by a reactor), which provides residence time for mixing of the consumables with the flue gas. An indicative FGT system layout is illustrated in Figure 15.

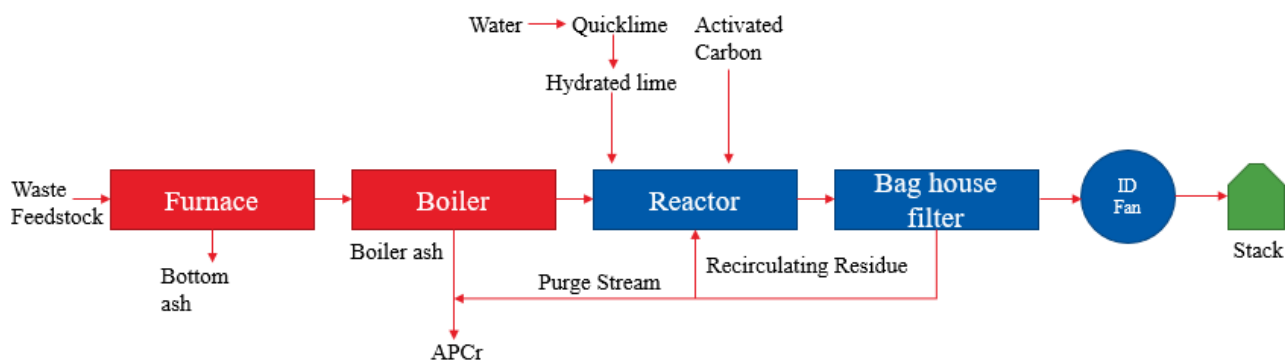


Figure 14: Semi-dry FGT system schematic

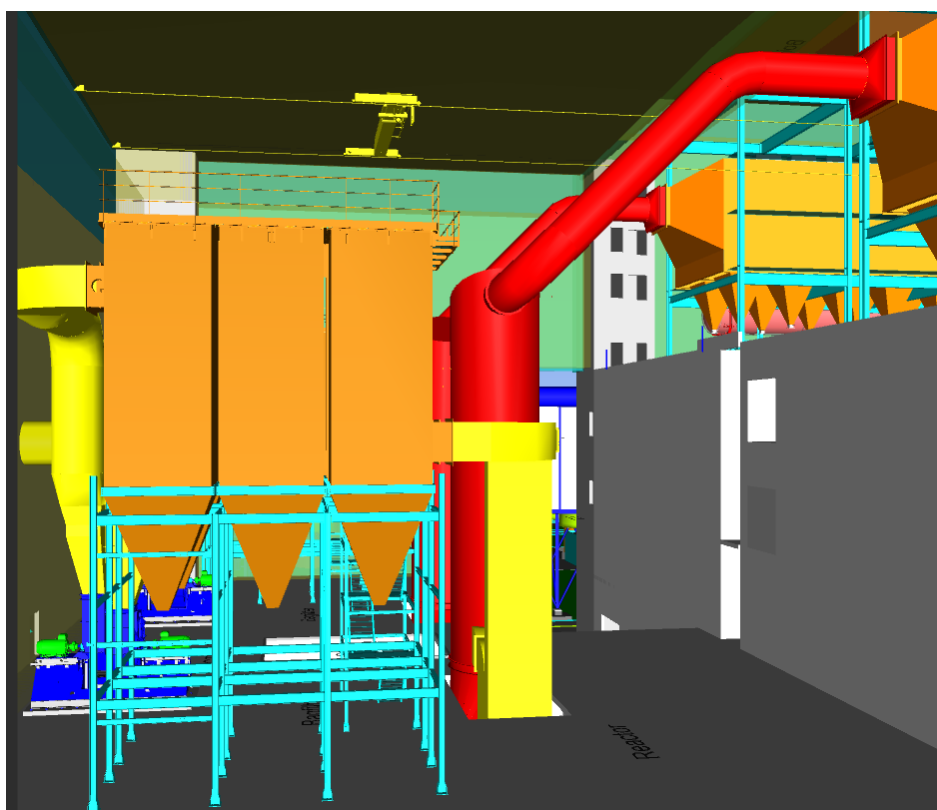


Figure 15: Indicative FGT system layout (note: preliminary, subject to change during detailed design and final selection of a technology provider)

Fresh hydrated lime and powdered activated carbon are injected into the reactor along with recirculated baghouse filter residue containing unreacted lime and powdered activated carbon. Water is either injected upstream of the reactor, or directly into the reactor. It is also proposed to hydrate quicklime with water in on-site quicklime hydrators to produce hydrated lime for injection into the reactor. The lime dosing rate is determined by the CEMS and associated real time feedback control using raw flue gas composition monitoring at the FGT inlet, to ensure acid gas emission limits are adhered to, while the powdered activated carbon injection rate is established during commissioning and verified during periodic testing for heavy metals and dioxins and furans. The flue gases and spent consumables flow out of the reactor and into the baghouse filter section. The baghouse filter removes the solid residue mixture of dust and spent lime and powdered activated carbon from the flue gases. The dust includes the remaining boiler fly ash entrained within the flue gases from the combustion process. The solid residue forms a filter cake on the outside of each filter bag, which provides further residence time for acid gas neutralisation reactions and adsorption of heavy metals and other potential pollutants.

The baghouse filter bags are periodically pulsed to remove the bulk of the solid residue, which drops into hoppers below the filter bags. The baghouse filter residue is then recirculated to the reactor to optimise the usage of lime and powdered activated carbon consumables. A purge stream is taken from the recirculating baghouse filter residue, to prevent the build-up of fly ash, acid gas neutralisation reaction products and spent powdered activated carbon. This purge stream is combined with Boiler Ash (BA) from the convective section of the boiler, to form the APCr by-product solid residue stream.

Cleaned flue gas is drawn through the baghouse filter bags by an ID fan, which pushes the flue gas past the CEMS analysers and up the vertical flue and into the atmosphere at a height of 95 m above ground level. Each grate-boiler line has a dedicated ID fan and a dedicated flue, with each flue (i.e. two flues, one per line) to be housed within a single multi-flue stack. Under normal operation, the ID fan places the boiler combustion chamber, boiler radiant and convective sections and the FGT system under negative pressure (slight vacuum conditions), such that if there are leaks in the flue gas system, air will preferentially flow into the flue gas system rather than hot flue gases flowing out into the EfW building. However, boiler leaks are undesirable, as this increases the volume of flue gas moving through the system and the ID fan power demand, hence flue gas oxygen content is continuously monitored for evidence of system leaks.

A.1.5.5 NO_x reduction system - Selective Non-Catalytic Reduction

SNCR allows reduction of NO_x without the use of a catalyst. Aqueous urea solution (or ammonia solution) is injected in the afterburning chamber of the furnace where the temperature is sufficient such that urea decomposes into ammonia and ammonia decomposition products, which then react with NO and NO₂. Some excess ammonia is needed to make sure sufficient contact between ammonia decomposition products and NO/NO₂ occurs. The required volume of ammonia increases as the demand for NO_x reduction increases. For optimal results, the process requires careful control of the urea or ammonia injection points and flow rate together with combustion control and flue gas temperature profile monitoring. The process causes some unreacted ammonia to leave the boiler with the flue gas (ammonia slip). Typical requirements for ammonia slip are $\leq 10 \text{ mg/Nm}^3$ (dry flue gas at reference conditions and 11% O₂).

Waste thermal treatment in moving grate facilities typically produces NO_x concentrations within the untreated flue gases of 300 mg/Nm^3 to 400 mg/Nm^3 (at dry flue gas at reference conditions and 11% O₂). With the application of proven optimisation techniques such as flue gas temperature monitoring, injection level optimisation and adjustment of reagent injection rates based on continuous monitoring of both NO_x and NH₃ emissions, SNCR technology can achieve NO_x levels of between 100 mg/Nm^3 and 120 mg/Nm^3 . This is within the acceptable range set out in the BREF-WI.

Air quality modelling for NO_x emissions (refer to the Air Quality Assessment) in line with achievable limits for SNCR technology has shown the BERC is predicted to comply with the relevant criteria at all off-site locations within the study area (for both average and short-term emissions limits).

A.1.5.6 Continuous Emissions Monitoring System

Each grate line will be equipped with a dedicated CEMS and a stand-by CEMS, for redundancy. The CEMS will be required to operate during both NOC and OTNOC.

The CEMS will be calibrated and commissioned during the plant commissioning stage after construction, in readiness for hot commissioning, and first firing of waste as described in Section 9.2. Once commissioned, the CEMS will provide continuous monitoring of the flue gas to confirm that the BERC is compliant with the half-hourly and daily average emission limits of the Environmental Authority for the BERC. The CEMS analysers will either be located in a straight section of flue gas ducting or on each flue inside the flue gas stack, to comply with the sampling position criteria specified in *AS 4323.1 Stationary source emissions selection of sampling positions and measurement of velocity in stacks*.

The CEMS also assists the CMS with process automation by providing real time feedback to the control systems to make automatic adjustments to the injection rates for reagents associated with the flue gas treatment and emission control systems.

Continuous monitoring will be installed for all pollutants that must be continuously monitored including NO_x, CO, particulates, TOC, HCl, HF, NH₃, Hg and SO₂ (see Table 21).

For pollutants with levels below limits of detection or where continuous monitoring is not feasible, routine sampling and testing will be established to ensure that the facility complies with environmental obligations (also see Table 21). Auxiliary parameters such as flow rate, temperature, pressure, moisture content, oxygen and CO₂ will also be measured as part of the CEMS. The flue gas oxygen content at the boiler exit is also measured and used as an input to the ACCS, when the ACCS is making adjustments to the boiler primary and secondary air injection rates. Furthermore, raw gas HCl and SO₂ analysers located at the boiler exit provide feedforward input to the CMS for control of the lime injection rate into the semi-dry scrubbing system.

A.1.5.7 Features the BERC will use to Suppress or Minimise Point Source Emissions to the Air

Table 22 presents a summary of the key BAT features and Operation and Maintenance (O&M) practices that are proposed by the BERC to suppress or minimise point source emissions to the air.

Table 22: Features the BERC will use to suppress or minimise point source air emissions

Feature	Description of how point source emissions are suppressed or minimised
Implementing BAT	This overarching feature ensures best practice is at the centre of engineering design, construction, commissioning, operation and maintenance of the BERC. The EU IED requires the preparation of Best Available Techniques reference documents (BREFs e.g. the BREF-WI) to drive continuous improvement in design, performance and emission standards. These BREFs are required to be updated every eight years.
Waste acceptance protocol	The waste acceptance protocol is a contractual document as well as a guide for EfW operations, to ensure that only truly residual waste is accepted for thermal energy and resource recovery. The waste acceptance protocol defines what is acceptable waste and establishes the key requirements for waste acceptance as well as contingencies for rejecting unacceptable waste. A strong and practical waste acceptance protocol will help to ensure that unacceptable waste with the potential to increase emissions is either not brought to site or is rejected upon arrival. The waste acceptance protocol also covers operational requirements such as removing oversized materials from the bunker for resizing in the shredder or disposal offsite (if incompatible). BAT is to monitor waste deliveries to ensure that waste is in compliance with the requirements of BAT 9 – 11 from the BATC (2019) relating to waste acceptance, understanding the waste characteristics, monitoring of waste deliveries, weighing and tracking.
Shredding of oversized materials	Resizing oversized combustible materials will aid premixing of waste in the bunker and reduces the likelihood of blockages in the combustion chamber or bottom ash extraction system.
Premixing of waste in the waste bunker	Premixing of waste in the waste bunker by the grab crane is an important aspect of maintaining stable combustion and boiler performance. Other than shredding of oversize waste materials, premixing is the only form of waste pre-processing required by modern moving grate combustion type EfW technologies. Premixing helps to ensure that waste from multiple sources and multiple waste types are well mixed before being fed to the boiler feed hopper, so that larger quantities of high CV or low CV waste (e.g. waste that is high in ash or moisture) or large quantities of wastes with elevated levels of sulphur or Chlorine are not fed directly to the boilers.
Thermal EfW Technology Selection	Thermal waste processing technology that is robust and flexible to respond to waste feedstock variability and commercially proven at scale is critical to suppressing and minimising emissions due to: • Engineering design, materials of construction and automated combustion controls • Technology provider experience and expertise • Fewer start-ups and shutdowns caused by process and/or waste composition related issues. Several moving grate combustion technology providers can satisfy this selection criteria.

Feature	Description of how point source emissions are suppressed or minimised
Automated Combustion Control System	All modern EfW facilities have an ACCS as part of the CMS to control steam production from the boiler by adjusting the feed rate of waste, controlling flue gas oxygen content by adjusting primary and secondary combustion air injection, controlling combustion temperatures and adjusting the grate (stoking) speed to control waste residence time on the grate. Stable combustion helps to ensure maximum energy recovery efficiency while balancing the trade-off between limiting primary NO _x formation (minimised by reducing combustion air) and CO formation (minimised by increasing combustion air and stable combustion). Emissions of Total Organic Carbon (TOC) are also minimised by stable, high temperature combustion. CO emission concentrations in the flue gas are continuously monitored as a proxy for monitoring combustion system performance.
High temperature residence time	The IED requires that flue gas from non-hazardous waste incineration has a residence time of at least 2 seconds while the flue gas temperature is at least 850°C, after the last injection of combustion air. This high temperature residence time helps to ensure the destruction of organic compounds (TVOCs, dioxins and furans, PAHs) and carbon burnout in particulate matter and IBA. Auxiliary fuel fired burners controlled by the ACCS, which are primarily used to warm up the boiler during start-up or to assist the boiler during a boiler shutdown, will intervene to maintain the flue gas temperature above 850°C, if there is insufficient waste combustion occurring in the combustion chamber to maintain the minimum high temperature residence time criteria while waste is being combusted.
Boiler design to capture particulate matter	Modern EfW boilers are designed with multiple vertical passes which introduce changes in direction of the flue gas flow path, as the flue gas travels through the boiler, while also exchanging heat with boiler water to raise and then superheat the steam. The change in direction allows gravitational separation of particulate matter (boiler ash), which is recovered in hoppers for periodic removal from the boiler. On-line cleaning and rapping systems also work to dislodge particulate matter which may stick to the boiler tubes, potentially reducing heat transfer efficiency. This dislodged particulate matter, also known as boiler ash, is likewise collected in hoppers at the base of the boiler.
Continuous and Periodic Emission Monitoring	The IED establishes continuous emission monitoring requirements for waste incineration. The BREF-WI provides further guidance on BAT for emissions monitoring. The CEMS enable real-time monitoring of key pollutants which may be present in the flue gas downstream of the air pollution control systems. This monitoring is also utilised by the plant CMS to control injection of reagents to ensure emissions are always controlled below emission limit values during normal operation. The CEMS also provides information and insight to operations staff on the performance of the combustion system and air pollution control systems, including alerts regarding malfunctions in each of those critical systems. For those pollutants that cannot be monitored and measured continuously, or do not warrant continuous monitoring due to the nature of the feedstock, the BAT 4 of BATC provides guidance on best practice periodic monitoring and measurement. Also see Table 21.

Feature	Description of how point source emissions are suppressed or minimised
BAT flue gas treatment and emission controls	Secondary NO_x abatement can be achieved by either SNCR with a reducing agent such as urea or ammonia solution within the boiler combustion chamber or by Selective Catalytic Reduction (SCR), typically with ammonia solution as part of the flue gas treatment system. NO_x abatement requires precise monitoring of flue gas temperature and automated control of reagent injection, to minimise ammonia slip, using feedback from the CEMS (NO_x and NH₃). [See Section A.1.5.5] Acid gas removal is achieved using a scrubbing process involving alkaline reagent(s) to neutralise acid gases such as HCl, HF and SO₂, converting those pollutants into neutral salts for removal. Once again, feedback from the CEMS is used to control fresh reagent make-up. [See Section A.1.5.4] TVOCs, dioxin & furan and other organic compounds (e.g. PAHs) if detectable, will typically be present in very low concentrations due to the high temperature residence time in the combustion chamber. De novo formation of dioxins and furans is limited by rapid flue gas cooling through the boiler economiser with final polishing of organic compounds achieved by injecting powdered activated carbon into the flue gas upstream of the baghouse filter. While TOC and CO are monitored continuously by the CEMS, dioxins and furans are monitored periodically by spot sampling. Volatile heavy metals are also abated by the activated carbon. [See Section A.1.5.4] Dust (fly ash) removal and recovery of solid acid gas neutralisation by-products and activated carbon sorbent is achieved using a baghouse fabric filter, capable of high efficiency removal of particulate matter including fine particles (PM₁₀ and PM_{2.5}). The residue recovered in the baghouse is recycled to the upstream reactor, since this residue contains unreacted reagents. This reagent recycle ensures efficient use of reagents, with a smaller purge stream used to prevent the build-up of spent reagents and neutralisation reaction products. [See Section A.1.5.4]
Control and Monitoring System to initiate or signal a boiler-line shutdown & IED OTNOC provisions	If the BERC CMS (which includes the ACCS) is unable to maintain the minimum high temperature residence time or a component failure means that continued operation would likely breach daily average emission limits, then the impacted line will be shut down in accordance with the provisions in the IED. The IED also includes various provisions for OTNOC, to allow EfW facility operators to rectify malfunctions and issues within a finite period of time, after which the line or facility would need to be shutdown to allow malfunctions and issues to be rectified offline. These provisions seek to reduce the frequency of boiler line or plant start-ups and shutdowns, which are also classified as OTNOC by the IED.
Operation and Maintenance practices	Careful adherence to the BERC waste acceptance protocol and plant operation in accordance with technology supplier operating procedures will help to ensure stable plant operations. Plant upsets, start-ups and shutdowns can be minimised by implementation of an effective preventative maintenance program, which is also considered BAT by the BREF-WI. Combined, the waste acceptance protocol and preventative maintenance program help to ensure a high degree of operational availability and fewer unplanned boiler stops and re-starts i.e. minimising OTNOC.
Community engagement and education	Source separation of waste and using the correct waste disposal option/bin is not only beneficial to the environment, but also beneficial to the performance of the BERC. Not putting inappropriate waste such as gas cylinders, paints, batteries, chemicals and hazardous waste such as asbestos will minimise reagent consumption and APCr production, minimise operational disruption at the BERC and maximise energy and resource recovery efficiency by the Project.

A.1.6 Ash and residue handling

The BERC's thermal treatment process will generate two main byproduct streams, IBA and APCr.

The BERC will undertake on-site ash and residue handling which includes:

- Quenching of IBA in a water bath to reduce the temperature and thermally treat gases generated in the combustion chamber
- On-site maturation of IBA under cover in a building for approximately 45 days (at 100% MCR capacity)
- Recovery of metals within IBA for recycling
- Temporary stockpiling of IBAA product prior to dispatch to a customer
- Stabilisation (solidification) of APCr.

The IBA consists of the non-combustible components of the waste feedstock along with some of the bound ash in the waste that remains after the waste has been incinerated, and therefore, IBA is the primary solid residue stream (i.e. >90 wt% of the ash content in the waste feedstock) produced by the moving grate combustion process. IBA is discharged from the end of the moving grate into a water bath which will quench the ash to reduce the temperature. During the quenching process, gases and steam generated will return to the combustion chamber and be thermally treated.

Boiler ash collected within the high temperature (radiant) section of the boiler will be mixed with the IBA, as is common practice in some EU Member States (e.g. Norway and Denmark) which place a high level of importance on maximising resource recovery. In the UK, it is not uncommon for all of the boiler ash (from both radiant and convective sections of the boiler) to be blended with IBA prior to its processing for reuse, however, the Project is not proposing to adopt that practice for BERC due to the potential levels of hazardous contaminants which are typically present in convective boiler ash. Refer to Figure 18 for the process proposed at the BERC.

The BERC's IBA will be matured on-site in a three-sided building to partially immobilise contaminants and reduce the leachability of compounds. This consists of storage for a period of approximately 2-12 weeks (to be confirmed during commissioning) during which the IBA undergoes chemical reactions with carbon dioxide in the atmosphere. The IBA stockpiles will be turned and also sprayed with water to suppress dust and maintain moisture content (if necessary).

The IBA stream will contain recyclable metals, a significant portion of which can be recovered for recycling. Both ferrous and non-ferrous metals will be recovered on-site in an IBA sorting facility similar to that shown in Figure 16, in the IBA treatment area. The remaining inert material is referred to as IBAA. Further processing may be undertaken within the IBA treatment area as required by re-use applications, for example crushing or size grading to prepare the sorted IBA for use as an aggregate in construction applications.



Figure 16: Typical IBA sorting system

The following high-level procedure for loading of IBA / IBAA is indicative of common procedures to manage dust:

1. Pre-Loading Preparation

- Ensure material moisture content is maintained at an optimal level (typically 15–20%) to suppress dust
- Inspect loading area for any accumulated dry material and clean as necessary

2. Loading Operations

- Use enclosed or covered loading systems where possible
- Reduce drop heights when transferring material to minimize dust generation
- Operate at controlled speeds to prevent unnecessary agitation of material

3. Dust Suppression Measures

- Apply water sprays or misting systems during loading and transfer if required
- Dust suppressants for prolonged storage or high-risk conditions such as weather events
- Ensure spray systems are functional and calibrated regularly following PPMs

4. Housekeeping

- Clean spillage promptly to prevent dry material from becoming airborne if present
- Maintain paved surfaces and apply water or sweeping to reduce dust accumulation

5. Monitoring

- Conduct visual checks during loading for excessive dust
- Record and report any deviations or incidents in the site log

6. Personal Protective Equipment (PPE)

- Ensure operators wear appropriate PPE (dust masks, goggles) during loading activities.

APCr contains spent flue gas treatment reagents as well as residual boiler fly ash that has remained entrained within the flue gases through the flue gas treatment stages and may contain higher concentration levels of heavy metals. Therefore, treatment is required to immobilise contaminants. Convective boiler ash that is collected within the low temperature (convective) stages of the boiler are included in this stream as they typically contain higher levels of hazardous substances. APCr is collected within the baghouse filters and will be conveyed to silos for temporary storage.

A treatment area has been provided on-site for the stabilisation (reduction in leachability) of the APCr prior to transport off-site for disposal at an appropriate landfill. Stabilisation by solidification is described in the BREF-WT and involves mixing APCr with cement, water and potentially other binding agents such as pozzolans (alumino-silicious material that reacts with lime and water) to increase the strength of the treated materials, immobilise the contaminants in a bound cementitious matrix and reduce leachability and exposure pathways. Chemicals of potential concern (COPC) (such as heavy metals) are therefore subject to chemical stabilisation and immobilisation reactions with components in the binding material, the combination of which is to be confirmed during commissioning. It is expected that the curing time for APCr will be approximately seven days (to be confirmed during commissioning).

For the BERC it is proposed that the APCr will be combined with cement and water and poured into big-bags, in a room inside the main EfW building, as illustrated in Figure 17. Once the filled big-bags are self-supporting, they will be moved by forklift to a dedicated storage area where they will be stored under cover during the curing period. Once cured, the cement blocks will be moved outdoors for temporary storage prior to being loaded onto trucks for disposal at an appropriately licenced landfill.

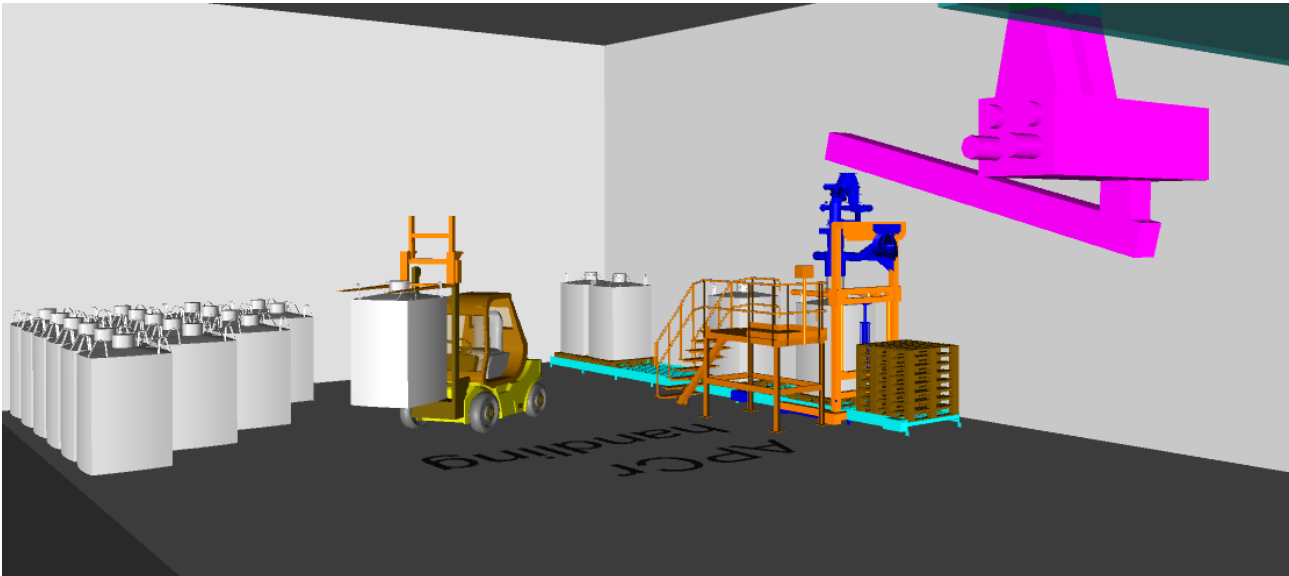


Figure 17: Indicative on-site APCr stabilisation system layout (note: preliminary, subject to change during detailed design and final selection of a technology provider)

The collection and handling of residues is illustrated in Figure 18. Further information regarding ash and residue handling and composition is included in the Resource and Waste Management Technical Report.

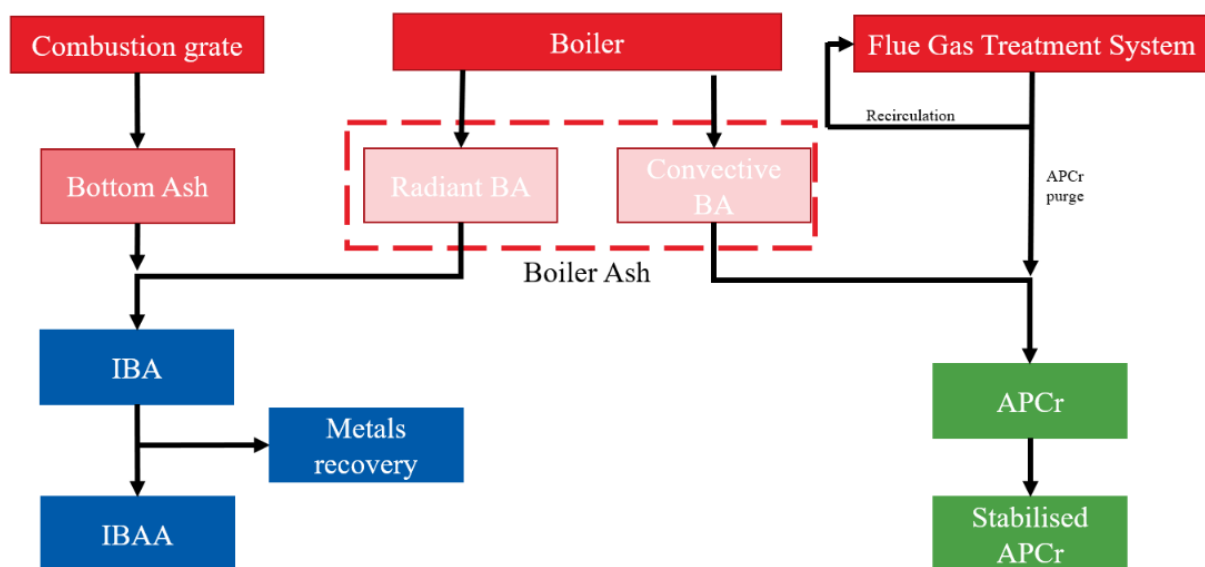


Figure 18: Process residues from thermal treatment

A.1.7 Balance of Plant

A.1.7.1 Boiler Make-Up Water Treatment

While the water-steam cycle is effectively a closed loop system, in addition to chemical dosing, a small continuous blowdown of boiler water is used to manage the boiler feedwater quality. This is important for both the boiler integrity and performance, and to provide steam of a suitable quality to the steam turbine. In addition, there are other losses from boiler drain valves, soot-blowing steam (if applicable, for on-line boiler tube cleaning) and vent steam losses from the deaerator and the ACC ejector system, for maintaining the vacuum conditions at the exit of the steam turbine and in the ACC. This water loss requires the continuous addition of high-quality demineralised make-up water. Modern boiler make-up water treatment systems utilise a combination of reverse osmosis and electro-deionisation, which are highly reliable and require

significantly less chemical addition than older acid and alkali-based demineralisation water treatment processes.

A.1.7.2 Cooling Water

The component cooling water system is a common system serving both boiler lines. Its purpose is to supply cooling water to various consumers connected to the system, such as auxiliary cooling for various components of the steam turbine and components of the moving grate system. A closed loop fin-fan radiator cooler system with recirculation pumps, a buffer vessel and make-up water system are proposed for the BERC, to minimise water consumption relative to conventional open-loop cooling water systems.

A.1.7.3 Plant and Instrument Air

The plant and instrument air system is common to both lines. Plant or process air is used for pneumatic transport, machines, tools, pressure cleaning etc, while oil-free instrument air is used for control and regulation purposes. The system includes dedicated air compressors, buffer tanks and a distribution system, to distribute both air qualities throughout the process plant areas. The compressed air system design will be based on redundant and separate units, to enable on-line maintenance and to ensure high integrity of supply for critical systems.

A.1.7.4 Emergency Diesel Generator

The main purpose of the EDG is to safely shut-down the boiler(s), in case of a loss of electricity from the grid and if Power Island mode is unsuccessful. The EDG will be tested regularly (monthly).

The main systems foreseen supported by the EDG may include the following:

- Feed water pumps
- CMS (connected via UPS), CEMS analysers and auxiliaries (connected via UPS)
- One air compressor
- Turbine lube oil pumps
- ID Fan auxiliary motor
- Grate motor controls
- Bottom ash vapour extraction fans
- UPS/Battery
- Emergency lighting for the entire EfW Facility and other buildings.

A.1.7.5 Diesel Fuel

Diesel fuel is required for various purposes at the BERC including:

- Auxiliary fuel for grate-boiler line start-up, shutdown and flue gas temperature control
- EDG fuel
- Refuelling for mobile plant and equipment.

Cleanaway will consider the use of biodiesel as an alternative where security of supply and pricing make it a feasible alternative to conventional diesel.

A.1.7.6 Non-Process Wastewater Management

The proposed site is in a non-sewered area. Non-process wastewater includes wastewater generated from site amenities such as kitchens, toilets, showers and handwashing during the operations phase and is estimated to equate to approximately 4,000 L/day in total, for all sources. To minimise wastewater treatment and potable water consumption, it is intended that greywater from handwashing and showers will (where practical and feasible) be managed separately from wastewater from toilets and kitchen areas, to facilitate its reuse as

process make-up water. Further investigation is required to consider potential reuse of greywater for on-site landscape irrigation.

Wastewater from toilets and some kitchen areas equates to an estimated 2,000 L/day and will be stored in temporary on-site holding tanks (i.e. septic tanks) with periodic pump-out of wastewater for transfer via tanker truck to the Beaudesert wastewater treatment plant for treatment. At future design stages landscape irrigation utilising treated wastewater may be explored, subject to the necessary site assessments and approvals. The Proponent shall investigate the opportunity to connect to a future precinct gravity sewer should this be provided by Queensland Urban Utilities.

A.1.7.7 Other

Other balance of plant equipment and systems are expected to include:

- Stormwater management system with rainwater captured from building roofs for process reuse. Within the IBA storage, run-off water will be segregated in a dedicated lined retention basin for reuse within the IBA storage and maturation area for dust suppression and stockpile moisture management. The broader site stormwater system will include gross pollutant traps, biofiltration and detention basins appropriately sized to accommodate major rainfall events
- Maintenance cranes and ancillary hoisting equipment, to facilitate operation and maintenance related lifting activities
- A fire detection and fire suppression system
- A process water, recycled water and process drain system to ensure that all process wastewater is segregated from stormwater and groundwater.

A.1.8 Start-up and shutdown procedures

The following high-level start-up and shutdown procedures are preliminary and subject to change due to technology provider and contractor selection, detailed design development and alignment with original equipment manufacturer (OEM) operation and maintenance instructions.

A.1.8.1 Typical Cold Start-Up Procedure for a Moving Grate Boiler Line

1. Pre-Start Checks:

- Bunker Management plan in place to stabilise CV throughout operation
- Ensure that all safety systems and monitoring instruments are operational and de-isolated for start-up
- Ensure the CEMS is operational and calibrated
- Via CCTV, inspect the moving grate incinerator and ensure all components are in good condition
- Confirm availability of all reagents and consumables
- Verify the availability of diesel fuel (ensure diesel storage tanks have sufficient capacity) and check the operational readiness of auxiliary fuel burners
- Confirm the removal of any ash from the previous operating period and confirm ash discharger water bath is full and IBA conveyors and oversize grizzly are operational and fully inspected as per prestart checklist protocol
- Check that the SNCR and semi-dry flue gas scrubbing systems are prepared for operation
- Confirm boiler make-up water storage tank capacity
- [If both boilers are shutdown] Conduct waste crane pre-inspections

2. Bringing Combustion Air and Flue Gas Systems Online for Boiler Purge Sequence:

- Once pre-start checks are completed, initiate boiler purge sequence to remove residual combustible gases from the furnace and flue gas path to prevent explosion risk:
 - Primary (combustion) Air fans ‘ON’
 - Secondary (combustion) Air fans ‘ON’ to maintain the proper airflow
 - Flue gas Induced Draft (ID) fan ‘ON’ to maintain negative pressure in the combustion chamber

3. Ignition of Auxiliary Fuel Burners:

- Verify purge sequence completion via control system interlock before enabling burner ignition
- Auxiliary (diesel fuel) burners ‘ON’
- Gradually increase the burner flame to initiate the warming of the incinerator chamber
- Continuously monitor the temperature rise in the combustion chamber and ancillary systems

4. Initial Heating Phase:

- Maintain the auxiliary burner operation (in accordance with the boiler warm-up sequence (over ~12 hours), prior to introducing waste) until the flue gas achieves the high-temperature residence time criteria of at least 850°C for at least 2 seconds (T2S) after last injection of combustion air
- Monitor combustion parameters and adjust burner operation as necessary

5. Boiler Drum Pressurisation:

- Boiler pressurisation: Monitor and gradually increase steam pressure within the boiler
- [If both boilers were shutdown] Air Cooled Condenser (ACC) fans ‘ON’
- Boiler Feedwater Pumps ‘ON’
- Water circulation: Maintain water circulation through the boiler as the pressure rises, avoiding thermal stresses
- [If both boilers were shutdown] Use the steam turbine bypass valve to dump steam to the ACC for recirculation to the boiler
- Monitor boiler water chemistry and steam quality measurements

6. Checks for Emission Control Systems:

- Ensure the SNCR system is online and operating normally prior to introducing waste
 - Verify the injection system and reagent supply
 - Monitor NO_x reduction performance
- Ensure the semi-dry flue gas scrubbing system is online and operating normally
 - Check the lime dosing system and baghouse/filter operation
 - Check powdered activated carbon dosing system operation
 - Monitor the performance of the scrubbing system and baghouse filter

7. Waste Feedstock Introduction:

- Activate the grab crane to load waste into the feed hopper
- Open feed chute to introduce waste onto the grate and allow waste to cover the grate [this process will happen a few times before fully online on waste]
- Monitor T2S

- Gradually increase the feed rate, ensuring stable combustion and maintaining the necessary temperature
8. CEMS Reporting:
- CEMS emissions measurements “reportable” once the boiler line is in ‘Waste Operation’, the ID Fan is running, flue gas oxygen content has stabilized below a specified O₂% and the feeding sequence is running
 - Verify that the emissions measurements meet licence limits
9. Automatic Combustion Control System (ACCS) engaged:
- ACCS in ‘Auto’ mode (i.e. the control system which adjusts the waste feed rate, grate speed, and combustion air flows to maintain optimal combustion conditions and controls live steam flow to a setpoint) once the grate is covered with waste feedstock and combustion is stable
 - Confirm that the ACCS is maintaining the boiler live steam flow at the setpoint
 - Monitor flue gas temperatures through boiler
10. Transition to Full Operation:
- Progressively increase the boiler live steam setpoint to its operational load, once stable combustion is achieved, and the incinerator is operating at the desired parameters
 - Reduce reliance on auxiliary burners gradually as the waste materials maintain the combustion temperature
 - Auxiliary burners ‘OFF’
 - Monitor CEMS emissions measurements, T2S, and check all critical systems, including SNCR and flue gas treatment
 - [If both boilers were shutdown] Prepare for steam turbine generator start-up sequence and grid synchronisation.

A.1.8.2 High-Level Normal Shutdown Procedure for a Boiler Line:

1. Initiate Shutdown Sequence:
 - Close feed chute to stop waste feed
 - Maintain Combustion Conditions:
 - Auxiliary Burners ‘ON’: Engage diesel fuel fired auxiliary burners to support combustion conditions (high temperature flue gas residence time) and ensure complete burnout of residual waste on the grate
 - Combustion Air Supplies: Keep primary and secondary air fans running to ensure adequate air supply for complete combustion
2. Safety Measures:
 - Monitor T2S
3. Controlled Cool Down:
 - Gradual temperature reduction: Gradually reduce the temperature within the combustion chamber to prevent thermal shock to the components
 - Support combustion: Continue using auxiliary burners, but with reducing load to maintain stable combustion while residual waste is present on the grate
 - Control airflows: Adjust airflows carefully to maintain controlled burning and cooling

4. System Flushes and Purges:

- Auxiliary burners ‘OFF’ once residual waste is fully combusted
- Shutdown SNCR system: Disconnect and safely purge the SNCR system to remove any remaining reagent (e.g., urea solution)
- Shutdown flue gas scrubbing system:
 - Stop activated carbon dosing
 - Stop lime dosing

5. Fan Shutdown Sequence:

- Primary and Secondary Air Fans ‘OFF’: Sequentially shut down the primary and secondary air fans once the combustion chamber temperature reaches safe levels and residual waste is fully combusted
- Induced Draft (ID) Fan ramp down: Gradually shut down the ID fan to manage flue gas evacuation and cooling

6. Boiler Cooldown:

- Boiler pressure reduction: Monitor and gradually reduce steam pressure within the boiler
- Water circulation: Maintain water circulation through the boiler to evenly cool down the system, avoiding thermal stresses

7. Shutdown boiler feedwater pumps and ACC.

A.1.8.3 High-Level Procedure for Responding to an Unplanned Shutdown of a Boiler Line

In the event of a major power failure causing an unplanned shutdown, the EDG will start-up automatically to maintain critical systems (e.g. ID Fan auxiliary motor, Primary Combustion Air Fan, one boiler feedwater pump (if not diesel driven), IBA vent fan, component cooling water pump, UPS back-up etc.) while the UPS will keep the DCS and CEMS operational while the plant is safely shutdown.

1. Immediate Detection:

- Monitor systems: Continuously monitor operational and safety systems
- Identify shutdown: Detect the unplanned shutdown and identify alarms indicating the specific cause

2. Initial Response:

- Close feed chute: Immediately close the feed chute and stop introducing new waste feedstock into the combustion chamber
- Alert relevant personnel: Inform operators and relevant staff immediately about the unplanned shutdown
- Assess the situation: Quick assessment to determine the likely cause and severity of the shutdown
- Prioritise safety: Ensure safety protocols are strictly adhered to

3. Maintain Combustion with Auxiliary Burners:

- Auxiliary burners ‘ON’: Use the diesel fuel-fired auxiliary burners to maintain combustion conditions if there is residual waste on the grate
- Adjust airflows: Maintain primary and secondary combustion air supplies to ensure complete burnout of residual waste

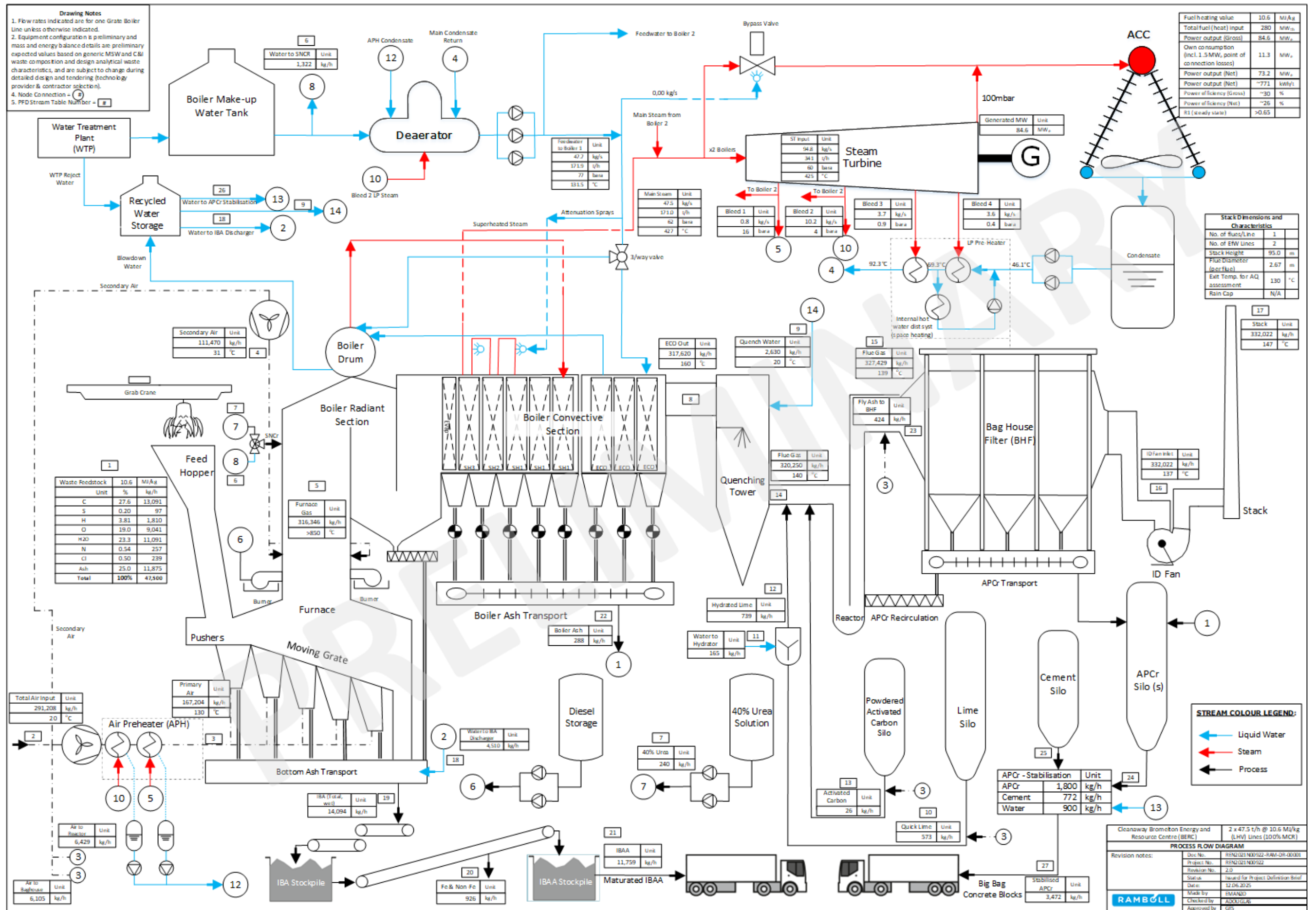
4. Monitor System Conditions:

- Temperature and emissions: Monitor T2S

- Combustion stability: Maintain combustion conditions with auxiliary burners while shutting down
5. Stabilise Emission Control Systems:
- SNCR system: Verify the operation of the SNCR system to manage NO_x emissions
 - Semi-dry flue gas scrubbing system: Ensure proper functioning of lime injection and activated carbon dosing systems to control pollutants
6. Manage Flue Gases:
- ID Fan Operation: Keep the ID fan running to manage and evacuate flue gases
7. System Inspection:
- Identify malfunctions: Conduct diagnostics to identify the likely root cause of the unplanned shutdown
 - Inspect key components: Check all the main components including burners, fans, air supply systems, grate elements, emission control systems and sensors
8. Cooling Down Process:
- Controlled cool down: Gradually reduce auxiliary burner firing to avoid thermal stresses
 - Boiler pressure reduction: Monitor and decrease steam pressure within the boiler
 - Water circulation: Maintain water circulation through the boiler to evenly cool down the system, avoiding thermal stresses (should a tube leak be present, continue to feed water into the boiler to avoid thermal shock)
9. Shutdown Boiler Feedwater Pumps and ACC
10. Implement Corrective Actions:
- Perform Repairs: Execute necessary repairs and adjustments to rectify identified issues
 - Replace Faulty Components: Replace any defective parts that caused the shutdown
 - Verify Repairs: Test repaired systems to ensure functionality
11. System Inspection and Cleaning:
- Combustion chamber: Inspect for residual waste, ash, or damage
 - Clean grate: If necessary, perform thorough cleaning of the moving grate
 - Emission systems: Inspect and clean SNCR and semi-dry flue gas scrubbing systems.

Appendix B

Preliminary Conceptual Process Flow Diagram & Mass Balance Stream Table



PRELIMINARY CONCEPTUAL PROCESS FLOW DIAGRAM MASS BALANCE STREAM TABLE
FOR 1 OF 2 GRATE-BOILER LINES

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
	Daily Average Emission Limit Value	Generic Blended Waste Feedstock with Design Analytical Waste Characteristics	Total Air Input (Combustion Air + Reactor + Baghouse Filter)	Primary Combustion Air and Other Air to Furnace	Secondary Combustion Air and Other Air to Furnace	Furnace	Water make-up to SNCR	40% Urea solution to SNCR	Economiser Outlet Flue Gas to Quench	Water make-up to Quench	Quicklime (90% Purity)	Water to Lime Hydration	Hydrated Lime to Semi-Dry Scrubber Reactor	Powdered Activated Carbon	Flue Gas to Reactor	Flue Gas to Baghouse Fabric Filter	ID Fan Inlet	Flue Gas to Stack	Water to Bottom Ash Discharger	Bottom Ash (incl. metals and unburnt carbon & Boiler Ash)	Recovered recyclable Fe and non-Fe metals	IBA Aggregate (after aging, sorting & evap. losses)	Boiler Ash to APCr Silo	Fly Ash to Baghouse Fabric Filter	APCr purge to Stabilisation (including Boiler Ash)	Cement to APCr Stabilisation	Water make-up to APCr stabilisation	Stabilised APCr	
Phase		Solid	Gas	Gas	Gas	Gas	Liquid	Liquid	Gas	Liquid	Solid	Liquid	Solid	Solid	Gas	Gas	Gas	Gas	Liquid	Solid	Solid	Solid	Solid	Solid	Solid	Solid	Liquid	Solid	
Temperature deg.C			20	175	26	=850			160						140	139	137	147											
	mg/Nm3 (Ref. @11%)	wt%	kg/h	kg/h	kg/h	kg/h	mg/Nm3 (Ref. @11%)	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	mg/Nm3 (Ref. @11%)	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	
C		27.6%	13,091																										
S		0.2%	97																										
H		3.8%	1,810																										
O		19.0%	9,041																										
H2O		23.3%	11,091																										
N		0.5%	257																										
Cl		0.5%	239																										
Ash		25.0%	11,875																		14,094		11,759	288	424	713			
Fe & Non-Fe metals																						926							
Flue Gas																													
FG TOC	10					0.27	1.0		0.27						0.27	0.27	0.27	0.27	1.0										
FG NOx	120					96	350		33						33	33	33	33	120										
FG CO2						47,694			47,709						47,709	47,713	47,716	47,716											
FG SO2	30					97	352		97						97	8	8	8	30										
FG N2						210,369			208,944						208,944	213,758	218,329	218,329											
FG H2O						29,658			32,712						35,342	35,391	35,445	35,445											
FG O2						23,972			23,966						23,966	25,434	26,835	26,835											
FG Ar						3,496			3,496						3,496	3,576	3,653	3,653											
FG HCl	6					221	795		221						221	1.6	1.6	1.6	6.0										
FG NH3	10																	1.0											
Dust	5					713	2,608		424						424	1513	1.4	1.4	5.0										
Hg (Long-Term Average)	0.010					0.031	0.11		0.01582						0.01582	0.00174	0.00174	0.00174	0.006										
Cd + Tl	0.02					0.26	0.94		0.13						0.13	0.003	0.003	0.003	0.01										
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	0.3					30.18	110		17.43						17.43	0.07	0.05	0.05	0.2										
Air				291,208	167,204	111,470																							
Quicklime											573																		
Hydrated Lime													739																
Activated Carbon														25															
FGTr																									1,088				
Cement																										772			
Stabilised APCr																												3,472	
40% Urea								240																					
Water								1322		2630		165							4510			1,409					900		
Total Mass Flow		100%	47,500	291,208	167,204	111,470	316,346	1322	240	317,620	2,630	573	165	739	25	320,250	327,429	332,022	332,022	4,510	14,094	926	13,168	288	424	1,800	772	900	3,472

Drawing Notes

- Flow rates for one Grate Boiler Line.
- Mass and energy balance details are preliminary expected values, based on generic MSW and C&I waste composition and design analytical waste characteristics, and are subject to change during detailed design and tendering (technology provider & contractor selection).

Cleanaway Bromelton Energy and Resource Centre (BERC)		2 x 47.5 t/h @ 10.6 MJ/kg (LHV) Lines (100% MCR)	
PROCESS FLOW DIAGRAM – MASS BALANCE STREAM TABLE			
Revision notes:	Doc No.	REN2 021 N00 92 2-RAW-DR-00 001	
	Project No.	REN2 021 N00 92 2	
	Revision No.	2.0	
	Status	Issued for Project Definition Brief	
	Date:	12.06.2025	
	Made by	EMANZO	
	Checked by	ADOU GLAS	
	Approved by	GES	

Appendix C

Reference Facility Annual Performance Reports

Refer to separate folder for Appendices C.1 - C.5,
Appendix C.6 included below.

Buckinghamshire Residual Waste Performance Report 2023/2024

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1.0 Introduction

Buckinghamshire Council Waste Management Project

Annual Service Report

Contract Year 8

1st April 2023 – 31st March 2024

A challenging year defined by ongoing issues with the Bottom Ash Extractor in particular. The plant did not meet the base case assumptions for waste burnt however did still manage to exceed megawatts of electricity generated.

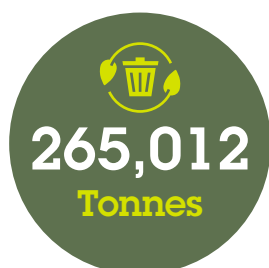
Additionally, the sustained elevated price of electricity coupled with a prudent hedging strategy has resulted in over performance when compared to base case revenue generation.

There were 18 significant periods of forced-outage during this contract year; resulting in 41 days and 6 hours of lost availability (excluding the planned outage which was an additional 21 days) from 9 discrete causes. Nine periods were related to the bottom ash conveyor totalling 21 days 4 hrs (or 507 hours and 41 minutes), 2 were related to non conforming waste (2 days 19 hrs), one due to grate damage following a significant slag/clinker fall (5 days 11.5hrs), one due to a blockage in the 2nd/3rd pass ash conveyor as a result of a gas bottle explosion (4 days 23.5hrs) and 5 other unrelated items resulting in 6 days and 19hrs of lost availability.

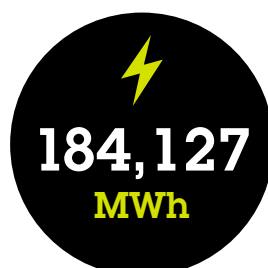
Map 1 – Location of FCC facilities



During the eighth contract year:



of residual waste were processed for energy recovery, with 111,721 tonnes of waste processed directly from BC.



of electrical power was exported to the National Grid system – over 10,000 MWh above the base case assumption.



were welcomed to the Visitor Centre as part of 111 separate tours.



The operation of High Heavens WTS saved an estimated 146,997 delivery miles to Greatmoor EfW.



6.3% below the base case model of 89.0%.



The average turnaround time at both sites was under 8 minutes (weighbridge to weighbridge).

2.0 Waste management

Total waste volumes handled

During this contract year, FCC Environment have processed 263,843 tonnes of residual waste across both facilities.

BC Contract Waste was delivered by all the Buckinghamshire Kerbside Teams and also from Household Recycling Centres (HRC). Bulky waste from the Kerbside collections, as well as HRCs, is shredded and delivered to Greatmoor EfW via High Heavens Waste Transfer Station (WTS), reducing waste that would otherwise be sent to landfill. In addition to BC Contract Waste, Greatmoor EfW also receives Third Party Residual waste. A full summary of the total waste inputs across both facilities is featured in Table 1.

Table 1 – Summary of waste inputs processed at High Heavens WTS and Greatmoor EfW in this contract year by supplier

Waste inputs	Tonnes
Aylesbury Vale Area	36,148
Household Recycling Centres	4,034
High Heavens WTS	69,888
Shredded Bulky Waste	1,651
Total BC Inputs	111,721
Third Party Residual Waste	153,291
Total inputs to Greatmoor EfW	265,012

3.0 High Heavens Waste Transfer Station

3.1 Background

High Heavens WTS is situated at the High Heavens Waste Treatment Complex in High Wycombe, located in the south of the county.

This BC waste treatment complex contains several waste operations and the WTS was developed specifically for residual waste.

The WTS was constructed and commissioned by FCC Environment and entered into commercial operation in November 2015, in advance of the original June 2016 handover. It is used as the local delivery point by the Southern kerbside teams and HRCs to transfer residual

waste to be processed at Greatmoor EfW. Waste is loaded onto articulated vehicles to transfer to Greatmoor EfW, reducing the number of transport miles required, compared with RCVs delivering directly to the EfW facility. This also reduces the time, costs and associated environmental impacts of the service, allowing the waste services to operate more efficiently in the areas that are needed. As a condition of planning permission, there is a designated transport route (45.3 miles) between High Heavens WTS and Greatmoor EfW, which maximises the use of major roads and motorways whilst reducing the use of minor roads that are not suitable for larger vehicles.

Map 2 – High Heavens WTS and Greatmoor EfW, and transport route across Buckinghamshire



3.2 Waste inputs

During this contract year, High Heavens WTS processed over 71,433 tonnes of residual waste, demonstrating the benefits of bulking waste from a highly populated region.

Table 2 identifies the amount of waste delivered to High Heavens WTS by supplier.

Table 2 – Tonnes of waste delivered into High Heavens WTS during the contract year by supplier

Waste inputs	Tonnes
South Kerbside	60,680
Household Recycling Centre Residual	7,761
Contaminated IN ex HH GFBW FCC	45
Shredded Bulky Waste	2,947
Total	71,433

3.3 Waste outputs

The majority of waste from High Heavens WTS is bulked residual waste destined for Greatmoor EfW.

No ad-hoc waste was delivered into High Heavens in the contract year.



3.4 Waste transfer

Transport savings through bulk transfer of waste from High Heavens WTS.

FCC Environment transfers waste between High Heavens WTS and Greatmoor EfW using their own haulage vehicles.

Bulking operations of BC Contract Waste at High Heavens WTS successfully reduced transportation miles by 146,997 miles during this contract year. The breakdown of this is shown in Table 3 below.

Table 3 – Summary of vehicle movements and associated miles saved due to bulk waste transfer from High Heavens WTS

Waste transferred	Vehicle movements saved	Miles saved due to bulk transfer of waste from High Heavens WTS
South Kerbside	11,800	130,461
Household Recycling Centre Residual	766	13,098
Shredded bulky waste	82	3,438
Total	12,648	146,997

The transportation saving is calculated by analysing the delivery tonnes and mileage travelled from each location and adding the bulking transfer mileage to Greatmoor EfW. The transportation mileage saving takes into account a predetermined route (45.3 miles) from High Heavens WTS to Greatmoor EfW, as defined in the planning permission. We have used the theoretical vehicle mileage for direct deliveries into Greatmoor EfW, rather than the actual mileage to High Heavens WTS.

Since year 3 of the contract (April 2018 to March 2024), the average residual waste payload collected from High Heavens WTS improved by 2.7%, from 23.93t to 24.59t per collection. The improved payload is part of High Heavens WTS commitment to continual improvement in the area of transport savings by reducing the number of deliveries required throughout the year.



3.5 Environmental management

High Heavens WTS operates under a Pollution Prevention and Control permit (PPC number XP3091ER) issued by the Environment Agency.

There were no PPC permit breaches during this contract year.

Full details of the Environmental Permit (XP3091ER) can be found [here](#).

3.6 Complaints

No complaints were raised during the contract year at High Heavens WTS.

4.0 Greatmoor EfW

4.1 Background

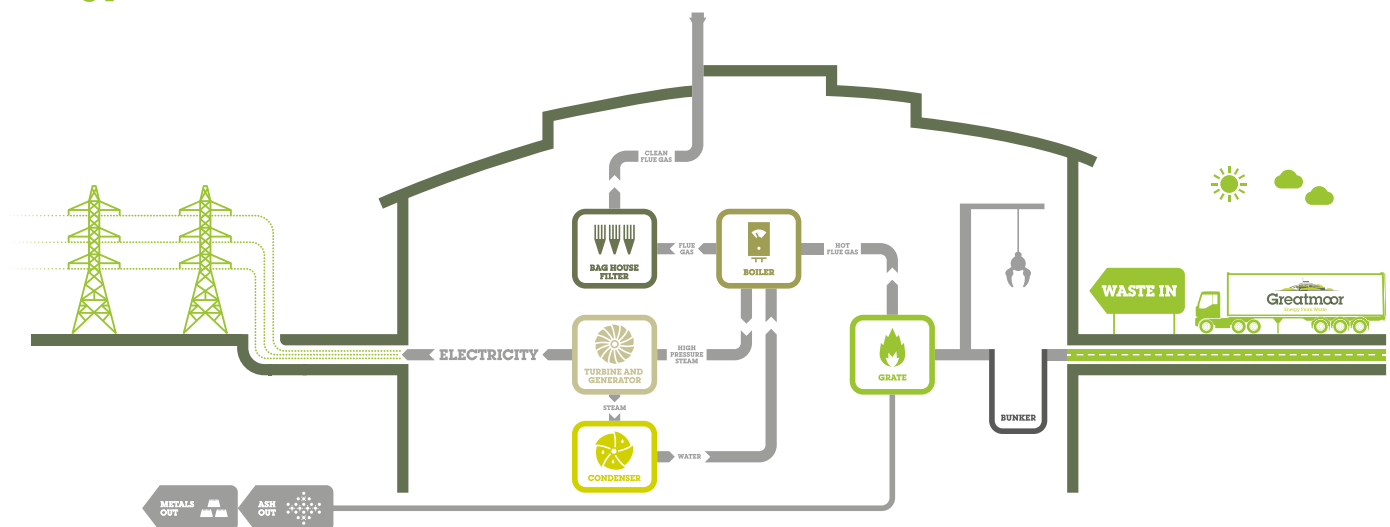
FCC Environment operate and maintain the Greatmoor EfW facility that is located to the north of Buckinghamshire County and adjacent to the FCC Environment Calvert Landfill site.

Construction of the EfW plant commenced in September 2013 and the plant became fully operational in June 2016.

Greatmoor EfW processes non-recyclable household residual waste that would have previously been sent to landfill for disposal. The process involves incinerating the waste to recover energy, which then heats a boiler to produce high pressure, high temperature steam. This steam is used to drive a Steam Turbine Generator to generate enough electricity to power over 68,000 homes¹.

The EfW process generates by-products (residues), such as ash and combustion exhaust gases. The Incinerator Bottom Ash (IBA) is removed after the combustion stage and is continually inspected, with all non-combustible materials separated and recycled, with the remaining ash used as landfill aggregate. The Air Pollution Control residues (APCr or Fly Ash) produced are removed from the combustion exhaust gases and sent to a facility to be neutralised before being landfilled. Combustion exhaust gases are treated through a complex Flue Gas Treatment (FGT) process that removes harmful emissions before being released to the atmosphere. All emissions to the atmosphere are rigorously controlled and managed by the onsite team and continually monitored by the Environment Agency.

The process of producing Energy from Waste



¹ Based on current OFGEM estimates that the 'average' home uses 2.7MWh of electricity per annum.

4.2 Waste inputs

A total of 263,843 tonnes of household residual waste were delivered and processed at Greatmoor EfW during this contract year.

The breakdown of waste inputs is presented in Table 4.

Table 4 – Tonnes of waste delivered into Greatmoor EfW during the contract year by supplier

Waste inputs	Tonnes
Aylesbury Vale Area	36,148
Household Recycling Centres	4,034
High Heavens Waste Transfer Station	69,888
Shredded Bulky Waste	1,651
Total BC inputs	111,721
Third Party Residual Waste	153,291
Total inputs to Greatmoor EfW	265,012

4.3 Waste outputs

Power generation

The Steam Turbine Generator is designed to generate up to 32.8 megawatts (MW) of electrical power. Although the boiler and feed system are not designed to be able to sustain this level of output for anything other than short periods.

The facility house load can be up to 6 MW (but is generally around 3 MW) and so, on average, a consistent 26 MW of power is exported to the National Grid system. The contract base case expected exports of 23 MW of electrical power and the measurement of how many MW are generated over the specified amount of time is referred to as Megawatt hours (MWh). In this contract year Greatmoor EfW exported 184,127 MWh of electrical generation.

Figure 1 – Monthly electrical power exported from Greatmoor EfW versus the contract base case



The amount of electricity generated naturally varies over the contract year, as highlighted in Figure 1. This is due to changing ambient air temperature and wind direction (affecting the efficiency of the Air Cooled Condenser). More significant dips in amount of power exported are due to planned and unplanned outages (see Section 6, Table 9).

Residual outputs

From the 263,843 tonnes of residual waste treated at Greatmoor EfW, 73,266 tonnes of ash and residues were removed from the process, representing approximately 27.8% of all waste handled sent for landfill disposal. This is up from 24.4% last year as a result of the numerous start-ups and shut-downs and a change in applicable law relating to discharge limits leading to an increase in lime use and so APCr production. Table 5 provides a breakdown of residual waste outputs from Greatmoor EfW during the contract year.

Non-conforming waste materials are unsuitable for the EfW process and are removed during the pre-sorting and inspection stages. These materials are removed from the waste source to prevent impacting on the plant's combustion efficiency and emissions control. As highlighted above, the volume of non-conforming waste material received at Greatmoor EfW is very low and FCC Environment have waste inspection procedures to ensure the amount of non-conforming waste from Buckinghamshire Council and Third Party suppliers remains so.

Table 5 – Residual waste outputs from Greatmoor EfW

Waste outputs	Tonnes
APCr (Before treatment)	8,550
IBA (Before separation)	64,715
Non-conforming waste	2
Total outputs	73,268

4.4 Environmental management

Greatmoor EFW is regulated by the Environment Agency under the Environmental Permit reference EPR/UP3734HT.

On 16th March 2023 the Permit was varied by the Environment Agency to incorporate industry-wide changes as a result of Best Available Technique (BAT) conclusions. Three Improvement Conditions were added to the Permit and have been complied with as follows:

- Improvement Condition IC10 required a test of the DeNOx system and a report detailing performance parameters at lowered NOx emission levels. The trial was completed over three months, and a report submitted to the EA on 30th November.
- Improvement Condition IC11 and 12 required a report to be submitted to the EA on whether the waste feed can be shown to have low and stable Mercury content (IC11); and whether dioxin emissions to air are stable (IC12). Both were complied with and submitted on 24th August 2023.
- The varied Permit also includes various changes to emission limit values that applied from 3rd December 2023. Greatmoor EFW remains compliant with all conditions in the (varied) Permit.

EfW plants incorporate abatement technology to control the emissions to atmosphere. Greatmoor EfW has Continuous Emissions Monitoring (CEMS) equipment installed in the exhaust gas system to constantly monitor for harmful emissions. This real time data is recorded and presented to the Environment Agency as evidence that the facility complies with the PPC emissions limits. The Greatmoor EfW operations staff continually analyse the CEMS emissions data to ensure the plant is operated with PPC regulations. If there is any approach to these limits, the operator will take action to prevent an environmental incident ensuring the requirements of the Environmental Permit are maintained.

IBA and APCr residues are periodically inspected and tested by an independent UKAS accredited laboratory to ensure the residue characterisation has not changed and is being appropriately managed.

The PPC Permit UP3734HT requires FCC Environment to prepare and submit quarterly and annual reports detailing the facility's environmental performance. Regardless of this requirement, FCC Environment proactively manages the facility's environmental performance with the Environment Agency in real time. As demonstrated in the following section, there was only one Permit breach at Greatmoor EfW during the contract year.

Full details of the Environmental Permit (UP3734HT) can be found [here](#).

Permit monitoring requirements

The emission monitoring requirements are set out in Schedule 3 of the Environmental Permit. There are two types of substance emissions monitoring, continuous (all the time) and periodic (bi-annually).

Continuously monitored emissions are measured using CEMs technology. Exhaust gas sample probes extract concentration samples that analyse and measure each emission parameter. This information automatically updates on the plant control system and is recorded in a dedicated read only data acquisition system. The facility operations team constantly monitor this CEMS data against the plant performance.

Periodic extractive sampling is carried out twice a year by a competent UKAS accredited specialist contractor. Extractive exhaust gas samples are removed independently from the CEMS equipment and analysed in laboratory conditions.

Emissions limits

The Environmental Permit specifies Emission Limit Values (ELV) for all emission substance monitoring. The plant emissions must not exceed these limits to ensure compliance. In the event of plant abnormal operation affecting the emissions to atmosphere above the ELVs, the Environment Agency shall be formally notified. During this contract year no ELVs were exceeded.

The ELVs specified in the Permit refer to half hourly and 24-hour averages displayed in Table 7.

As noted above, some of these ELV's changed on 4th December 2023, following an Environment Agency initiated variation of the Permit.

Table 6 – Environmental emission monitoring requirements

Substance	Continuously	Periodically
Particulates	✓	
Total organic carbon	✓	
Hydrogen chloride	✓	
Carbon monoxide	✓	
Sulphur dioxide	✓	
Nitrogen oxides	✓	
Ammonia	✓	
Nitrous oxide		✓
Hydrogen fluoride		✓
Cadmium & Thallium		✓
Mercury		✓
Heavy metals		✓
Dioxins and furans		✓
Dioxin-like PCBs		✓

Table 7 – Half hourly average and daily average Emission Limit Values (ELV) by Substance

Substance	Half hour average (mg/m ³)	Daily average (mg/m ³)	
		until 3rd Dec 2023	until 4th Dec 2023
Particulates	30	10	5
Hydrogen chloride	60	10	8
Nitrogen oxides	400	200	180
Sulphur dioxide	200	50	40
Total organic carbon	20	10	10
Ammonia	n/a	n/a	15
Substance	10 min average (mg/m ³)	Daily average (mg/m ³)	
Carbon monoxide	150	50	

Continuous monitoring limits

Figure 2 – Maximum percentage of emission value during contract year

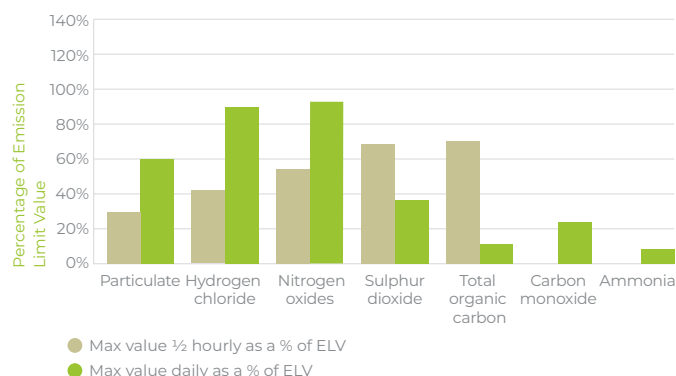


Figure 2 depicts the maximum concentration percentage half hourly and full daily emission for the period of April 2023 to March 2024 (these are instantaneous values and not average percentage values). The graph takes account of the new (lower) Daily ELVs for particulates, Hydrogen Chloride, Nitrogen Oxides, Sulphur Dioxide, and Ammonia. The graph shows there were no exceedances of the nominal half hourly ELVs during the reporting period

Permit Notification

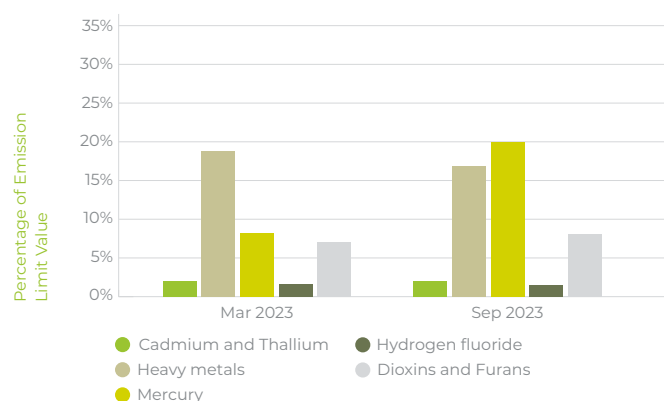
In the year from April 2023 to March 2024 there was one Notifiable Incident at Greatmoor EFW. This occurred on 9th October 2023 when the Duty FID failed on a pressure fault and the flame went out and the standby FID then failed to operate with the same (pressure related) fault. Unresponsive FIDs meant the TOC readings were not monitored or recorded for up to 40 minutes before the plant was shut down (waste feed ceased). After FID repair the plant was re-started the following day. The Environment Agency agree that TOC levels would not have exceeded ELV and therefore issued the lowest possible score of C4 for failure to monitor and record TOC levels.

Periodic monitoring

A requirement of the PPC Permit is to complete independent stack emission testing for Dioxins, Furans, Cadmium and Thallium, Heavy Metals, Mercury and Hydrogen Fluoride.

Figure 3 depicts the maximum concentration percentage levels for the period of April 2023 to March 2024. The graph shows that at no point during the contract year did the facility produce harmful emissions that approached or exceeded the ELVs. N.B. these are instantaneous values and not average percentage values.

Figure 3 – Bi-annual emission values for Cadmium & Thallium, Heavy Metals, Mercury, Hydrogen Fluoride and Dioxins & Furans during the contract year



Summary of Environmental Compliance

In addition to monitoring and reporting emissions to air, FCC Environment has a responsibility to monitor the quality of IBA produced by the facility to ensure the characterisation remains non-hazardous. All data taken and analysed by a UKAS accredited research facility showed that the IBA remains non-hazardous; ensuring the waste fuel and combustion system is as per design.

Greatmoor EfW's environmental performance has consistently achieved the PPC Permit ELV levels throughout the contract year. Both continuous and periodic monitoring indicates that the EfW facility operates within Environment Agency regulations.

4.5 Complaints

During the contract year there were two complaints raised at Greatmoor EfW.

The first complaint was received in October 2023 from a motorist who was concerned about the behaviour of an FCC driver delivering to Sutton Courtney. It was explained to the complainant that this vehicle was not connected with Greatmoor and that their complaint would be passed on to the relevant manager at Sutton Courtney. The complainant was put in contact with the relevant manager. No further action required.

The second complaint was received in November 2023 when a neighbour called into complain about the traffic lights on the access road shining into their house. The lights were not in functional use at the time and so the lights were covered to reduce the glare. No further communication was received from the complainant.

5.0 Integrated Management System

FCC Environment operates an Integrated Management System (IMS) to achieve and maintain ISO 9001, ISO 14001, ISO 45001 and ISO 50001 accreditations.

Greatmoor EfW and High Heavens WTS are operated and managed under the IMS requirements that have successfully achieved the British Standards Institution accreditations.

5.1 Internal auditing in this contract year

An IMS audit was conducted on 17th October 2022 at High Heavens WTS; zero NCRs (Non-Conformance Reports) were raised. The next biennial audit is planned for 12th September 2024.

Greatmoor EfW received a BSI audit on 12th December 2023 and an internal IMS audit on the 24th July 2023. No NCRs were issued as a result of the BSI audit, and 7 minor IMS NCRs were raised. All NCRs were closed out within the contract year. A summary of all NCRs received during the internal IMS audit during this contract year are provided in Table 8.

Table 8 – Summary of closed out non-conformances

Audit	Summary of NCR	Completed
IMS	Please identify the documents that Greatmoor collates for archiving and assign a retention period for them on the SFs index, using IMS-FRM-059 as a guide.	Nov 2023
IMS	Develop an additional SWP/MS for the use of the FLT around the new racking and in and out of the stores where required.	Nov 2023
IMS	When next IMS update available ensure that named documents are listed in the briefings where the changes are communicated.	Nov 2023
IMS	Show that LOLER inspections for the Linde forklift are saved on the plant file for the machine.	Nov 2023
IMS	Confirm that a programme is in place to address the previous reported results from legionella monitoring with allocated responsibilities and a timescale to resolve outstanding issues.	Nov 2023
IMS	Obtain relevant Duty of Care checks on ASM Metals and confirm all documentation is correct.	Aug 2023
IMS	Assign an author for the Greatmoor Fire prevention plan to conduct the required reviews for significant changes and annual reviews.	Aug 2023

6.0 Maintenance management

Maintenance management ensures the EFW plant remains reliable, safe to operate and demonstrates compliance with statutory legislation.

During this contract year Greatmoor EFW has continued with the Q4 maintenance management system and has improved and worked on its set up and utility. All the work on site is managed through this and used by Engineering as well as operations. Q4 is the main system for controlling maintenance, safety from the system (Safety Rules, Permits etc), inventory control and resource planning. This software package allows for detailed maintenance activity scheduling, tracking, and recording of plant history to ensure successful maintenance management. During the contract year, all maintenance activities were raised through this package. There is a pre-planning meeting and a planning meeting every week to organise the workload and this is shared with the Operations Department as they need to check all relevant documents before the work can start. As well as the meetings mentioned there is also a regular weekly meeting to ensure all site defects have been captured and correctly prioritised, this is the main meeting used to capture all Operational issues to minimise all operator burdens, work arounds and maximise output.

The Engineering stores carry all our critical spares, and we also use a suitably secure warehouse in Brackley for non-urgent spares, and spares used only during a prolonged shutdown (such as the annual planned maintenance outage). The Brackley site has CCTV cameras and a fire alarm system that is linked directly back to Greatmoor.

Greatmoor EFW carries out an annual shutdown to undertake lifecycle maintenance and overhaul to maintain plant performance, reliability and safe operation. During this year, the annual shutdown was carried out once again in May but started 36hrs early due to a contractor coming on site to take a copy of some of our software programs. This was a planned activity but an error by the contractor

during the back-up lead to a complete loss of the digital control system. This unfortunate event (caused by the inadvertent use of a known, reserved intranet address) took several hours to identify at which point it was decided to start the outage early since some contract resource was available.

During the 2023 outage the following works were carried out;

- A full strip down of the grate and realignment. This was included since the grate was catching and not being allowed to move fully or expand as the boiler warmed up.
- IBA belts 1 and 2 drop off chutes replaced due to heavy corrosion.
- Air leak surveys were carried out and as many identified repairs as possible were completed during the outage, savings by conducting this work were estimated at circa £70k, but more importantly it reduced the loading on the installed air compressors improving their longevity and reliability.
- Waste cranes 1 and 2 main drive units were replaced (preventative maintenance).
- The fabric filter cleaning system was completely redesigned to enable more rapid response to any failed filter bags leading to a rise in dust emissions (new BREF regulations have reduced the time available to isolate sources of dust emissions and so this upgrade was required).
- There was also the start of a valve replacement program expected to last 3 years initially.
- There was other works carried out during the Outage that was part of the planned Maintenance for 12 monthly.

Return to service post outage was delayed due to a leak on weld on a repaired pipe in the boiler (well within what is considered a normal failure rate for welds of this type but still disappointing) and time lost through scaffolding issues (May is a busy time for outages throughout industry and experienced resources are not always available to relatively small scale, and duration, projects such as the Greatmoor outage).

Some other works that were completed throughout the year; a rebuild of the bearings of one of the HP air compressors, a redesign of the scrapers on the IBA belts to aid belt cleaning and reduce debris carried over in the 'belly' pans, the process water pumps were completely replaced with a new design optimised to the current operating conditions. Also, the facilities used by contractors (particularly during outage) have been upgraded to make them more appealing and to reduce the carbon footprint of the outage (eg permanently plumbed in toilet and washing facilities to remove the need to transport black and grey water off site).

A change in legislation has meant that our existing fluorescent light fittings and halogen lamps are no longer available and are not supported. This has led to an ad hoc programme to replace, what are now considered to be, ecologically unfriendly light fittings with equivalent LED items. The site retained a significant stock of lamps and tubes to ensure that the replacement programme does not need to be rushed. Other electrically based maintenance includes an extended, site-wide, thermographic survey on all electrical equipment and fittings; similarly, all installed 'fixed' wires were tested to ensure they were not suffering from undue degradation, and all were found to be 'ok'. The preferred Uninterruptible Power Supply (UPS) contractor (Gutor) completed their annual appraisal of all UPS battery banks and replaced several cells that were faulty (all had either been identified as degraded previously or were done as a precautionary measure since other cells in the battery were being replaced).

The plant's insurers have made several recommendations for improvements based on their extensive knowledge base as a result of their exposure to similar technologies around the world. Firstly all 23 underground isolation valves for the fire-fighting water ring-main have been upgraded with above ground indicator posts to allow quick and simple operation and to aid identification of any valves left in the wrong configuration. This upgrade had the added benefit of reducing repeated heavy lifting/manual handling tasks and so eliminated a potential industrial safety issue. A further recommendation was that the plants IT and Industrial Control Systems (ICS) were reviewed to ensure that they remained sufficiently resilient and secure some 10 years after their design and installation. Following their advice, a new fibre connection was installed along with a host of new network switches with a view to keeping hackers out whilst still allowing our contract partners remote access to monitor performance.

6.1 Maintenance issues

Plant Breakdowns

On occasion the EFW plant will breakdown due to mechanical and electrical faults, resulting in a full plant shut down. Table 9 identifies breakdown failures and downtime hours, with more details on each occurrence provided in the following section.

Table 9 – Summary of major plant breakdowns during this contract year

Date	Breakdown	Returned to service date	Total loss (hours)
08 Apr 23	Seized 2nd/3rd pass fly ash extractor conveyor belt	12 Apr 23	119hrs 30'
25 Apr 23	Blocked Bottom Ash Conveyor	30 Apr 23	118hrs 17'
16 May 23	Partial loss of Digital Control System (DCS)	17 May 23	34hrs 48'
08 Jun 23	Failure of Start Up Vent valve during warm up	09 Jun 23	31hrs
03 Sep 23	Bottom Ash Extractor drive end (DE) sprocket failed	05 Sep 23	52hrs 58'
02 Oct 23	Damage to grate bars because of slag/clinker fall	07 Oct 23	131hrs 31'
09 Oct 23	Loss of both FID Detectors	10 Oct 23	18hrs 5'
16 Oct 23	Concrete on grate	18 Oct 23	37hrs 3'
04 Nov 23	Sporadic loss of both FID Detectors	05 Nov 23	15hrs 3'
24 Dec 23	Bottom Ash Extractor drive end (DE) chain	27 Dec 23	67hrs 25'
02 Jan 24	Bottom Ash Extractor drive end (DE) sprocket failed	09 Jan 24	169hrs 2'
10 Jan 24	Concrete on grate	11 Jan 24	30hrs 10'
24 Jan 24	BAE NDE issues delay to restart due to burner failure	24 Jan 24	10hrs 13'
30 Jan 24	BAE Drive End (DE) sprocket failure	31 Jan 24	19hrs 40'
08 Feb 24	Sheared actuator bush on Feed regulator valve	11 Feb 24	64hrs 46'
29 Feb 24	BAE NDE Sprockets fouled	02 Mar 24	34hrs 5'
21 Mar 24	BAE NDE Sprockets fouled	22 Mar 24	23hrs 30'
31 Mar 24	BAE NDE Sprockets fouled	31 Mar 24	12hrs 31'
Total			990hrs 0'

7.0 Community liaison

FCC employs a dedicated Waste Awareness and Education Manager with the aim to raise public awareness of waste issues, including waste prevention, reuse and recycling through educational initiatives.

Greatmoor EfW has an on-site visitor centre which hosts site tours of the facility for local community groups and schools. Tours includes showing visitors the control room to demonstrate how the plant is operated, along with views of waste tipping into the bunker, and loading the system by the large grab crane. Visitors can also look inside the furnace inspection hatch to see waste being burnt.

As well as hosting on-site tours, FCC also carry out outreach visits to schools and other organisations within the county. The Waste Awareness and Education Manager attends school classes and assemblies to educate and raise awareness about recycling and waste management.

7.1 Greatmoor EfW Visitor Centre

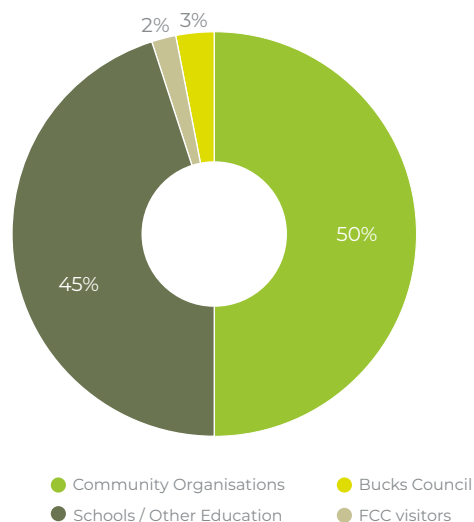
The headline figures for 2022–23:

- 1,188 Visitors
- 111 Tours
- 2,752 attendees to Outreach Events
- 96.8% Excellent or Very Good feedback from visitors, across 6 key questions

Table 10 – Number of visitors over the contract year

	1st April 2023 – 31st March 2024
Adult Visitors	667
Under 16s	511
Total Visitors	1,188
No of Tours	111

Figure 4 – Breakdown of visitors by sector



During the contract year there were a total of 1,188 people attended at the Visitor Centre over 111 tours.

7.2 Outreach Visits

Table 11 – Details of outreach visits

Type of Visit	No of Visits	No of Under 16s	No of Adults	No of Assemblies / Presentations	No of Activity Sessions
Primary Schools	12	1,290	81	6	18
Secondary Schools	1	162	9	0	7
Careers Events	4	132	61	0	0
Community Groups	22	18	607	20	2
Community Events	11	94	298	0	2
Total	50	1,696	1,056	26	29

7.3 Summary of visitor feedback

FCC encourages feedback from those visiting Greatmoor EfW by providing feedback forms after tours to highlight positive feedback and also identify areas for improvement to continuously focus on delivering the best service possible. Feedback from visitors has been excellent, comments included the structure of the visits and suitable levels of detail for the audience providing attendees with a classroom overview to gain an initial understanding followed by seeing the plant in action. Visitor feedback has also shown commitment to change behaviours towards recycling, reuse and waste minimisation.

Table 12 – Feedback Summary

Tour Section	% Excellent or Very Good 2023/24
Introduction	98.2
Guided Tour	99.1
Visitor Centre Facilities	98.2
Visitor Centre Staff	99.1
Information provided before visit	93.5
Greatmoor website	92.7

7.4 Local Employment

There are a total of 52 members of staff working on the Contract, 46 at Greatmoor EfW and 6 at High Heavens WTS. 67% of the staff employed on the contract live within Buckinghamshire itself, with others from the local surrounding areas of Oxfordshire, Northamptonshire and Berkshire. There are currently no staff who travel from outside of the local vicinity of the contract, so the majority are from the area demonstrating good levels of local employment. Contract staff required for the Outage continue to be recruited via a local agency and are mainly drawn from the contract area. Where possible supplies and stores are also drawn from the local area e.g. all catering is supplied from a company based in Waddesdon, the Outage village is supplied by a company with a site at the Wescott business park.

7.5 Liaison Group Meetings

Since April 2023 there have been two Greatmoor Community Liaison Group (CLG) meetings. The meetings occur regularly and from Service Commencement have been held in conjunction with the Calvert Landfill Community Liaison Group. These sessions are attended by local residents, parish councillors, interest groups, EA officers, councillors and FCC. The Greatmoor CLG is an opportunity for members to ask questions in relation to the EfW and raise issues of concern. One planned CLG was cancelled at short notice at the request of the chair of the CLG due ill health.

8.0 Conclusion

The eighth contract year has proven to be problematical for a number of commercial and engineering reasons.

Whilst the continuing contract dispute has had little effect on the day to day running of the contract it does cast a significant and noticeable shadow.

Reliability and availability have not been at the levels we have come to expect, some 41.25 days were lost to unplanned outages or forced shutdowns. The tables in section 7 clearly show that the biggest loss has been due to the Bottom Ash Extractor. This despite the extensive rebuild carried out by our long term contract partner in this field during the 2023 outage and the fact that some £1.5 million has been spent on this particular piece of equipment in the last 5 years. However much was spent, over 51% of all losses (some 507hrs or 21 days) can be associated to this piece of equipment. The challenge for the ninth year of the contract is to address the root causes of the BAE unreliability and eliminate them during the 2024 outage. This is being addressed by involving the Original Equipment Manufacturer (OEM) in a design review and rebuild, using their approved contractors and spares.

Otherwise FCC Environment is proud to report that we have continued to operate and maintain the Greatmoor EfW and High Heavens WTS facilities safely and with the utmost respect for the environment.

High Heavens WTS operational availability has remained 100% for household residual waste deliveries. Greatmoor EfW operational availability achieved 82.7%, which was 6.3% below the base case.

Once again, both Greatmoor EfW and High Heavens WTS have met, or exceeded, all the requirements of their respective Environment PPC Permits throughout this contract year. This ongoing success further demonstrates FCC Environment's credibility as a responsible operator and commitment to operating all plant and facilities within national regulations and guidelines.

High Heavens WTS continues to provide a significant reduction in waste transport mileage by bulking waste to be delivered to Greatmoor EfW. Easing congestion on the Counties roads, improving RCV availability and smoothing the delivery schedule at Greatmoor (hence reducing waiting times for customers).

In 2023, FCC Environment carried out a successful EfW plant outage achieving all the required, mandated and elective maintenance work, without accident or environmental incident and returned the plant back to operations after only a short delay due to the failure of a boiler tube weld.

Visitor numbers continue to increase, and the 10,000 visitor is expected in Q3 of 2024. Feedback across the board remains consistently positive reflecting the high standard of education being delivered. The visitor centre also continues to be developed with the addition of more touch screens, a new model of a steam turbine and wider range of PPE in all sizes to ensure all visitors are safe. Out-reach activities are becoming more important to the waste education programmes across the County and these programmes benefit from the mutual support offered to the Greatmoor Education Officer by the FCC Buckinghamshire HWRC Education Officer.

Yet again neither Greatmoor EfW nor High Heavens WTS have had a single Lost Time Accident for either FCC Environment employees or their contractor partners in this contract year. However, again and regrettably, there have been some minor accidents resulting in harm to workers on site. FCC Environment believe that all accidents are avoidable and are committed to protecting their staff, contractors and site visitors: as a result, all accidents (however minor) were investigated and there is a continuous overview looking for common causes or threads. The incumbent safety advisor is now fully trained and delivering continuous H&S oversight and advice.

For more information about FCC Greatmoor, please visit www.greatmoor.co.uk

For more information about FCC Environment, please visit www.fccenvironment.co.uk

For more information about Energy from Waste from Buckinghamshire Council, please visit www.buckinghamshire.gov.uk

9.0 Glossary

Air Pollution Control residue (APCr)

By products of the flue gas cleaning process and typically include ash, carbon and lime due to fly ash materials emitted from the combustion process and injection of neutralising agents to clean the gases before being released to the atmosphere. These materials are hazardous and are removed and disposed of by authorised licence holders for appropriate collection and disposal.

Automatic Number Plate Recognition (ANPR)

Is a technology that uses optical character recognition on images to read vehicle registration plates to create vehicle location data. It can use existing closed-circuit television, road-rule enforcement cameras, or cameras specifically designed for the task.

Buckinghamshire Council (BC)

BC is the administrative body governing the county of Buckinghamshire who are responsible for the collection and disposal of the county's residual waste and therefore act as both the Waste Disposal Authority and Waste Collection Authority. BC are in a 30 year contract with FCC for the treatment of this waste for energy recovery as a more sustainable alternative than landfill disposal.

Carbon monoxide (CO)

Carbon monoxide is a common naturally occurring chemical but can also be produced from human activity. It is a colourless, odourless poisonous gas.

Community Liaison Group (CLG)

An organised group involving local community representatives, residents and other interest groups to facilitate communication, share information and encourage engagement for those who may be affected by the operation of the waste management facilities. These sessions are hosted by the council and operators to provide a transparent platform for attendee's to ask questions.

Continuous Emissions Monitoring systems (CEMs)

Continuous emissions monitoring system (CEMs) technologies are used to constantly monitor emissions from the Energy from Waste process against the emission limit values specified within the Environmental Permit. Gas samples are extracted using a sample probe and analysers used to measure concentrations of each parameter.

Contract waste

Waste materials that are included in the residual waste treatment contract between FCC and BC. This includes all residual household waste collected across the county and residual wastes disposed of at the Household Recycling Centres.

Dioxins and Furans

Dioxins (polychlorinated dibenzodioxin, PCDD) and furans (polychlorinated dibenzofuran, PCDF) are families of complex chemicals containing chlorine. There are several hundred dioxin substances. They are crystalline solids which dissolve in organic (carbon-containing) solvents, fats and oils – but not in water.

Emission Limit Value (ELV)

Emission Limit Values (ELV) are specified limits for various pollutant emissions from the Energy from Waste process and are set out as conditions of the Environmental Permit. Emissions must be monitored against the ELV for each pollutant and reported to the Environment Agency. Emissions must remain within the specified limits to maintain compliance with the Environmental Permit.

Energy from Waste (EfW)

Incineration process in which residual waste is converted into thermal energy to generate steam that drives turbines for electricity production. Energy from waste is a method of recovery and therefore preferable over landfill disposal.

Environment Agency (EA)

The Environment Agency (EA) is a non-departmental public body sponsored by the United Kingdom government's Department for Environment, Food and Rural Affairs (DEFRA), with responsibilities relating to the protection and enhancement of the environment.

Environmental Permit

The Environmental Permitting (England and Wales) Regulations 2016 requires waste management facilities to obtain an environmental permit before they are allowed to operate. Both Greatmoor EfW and High Heavens WTS are operated under Environmental Permits, which are regulated by the Environment Agency.

FCC

FCC Environment is one of the UK's leading waste and resource management companies who has been contracted by BC for the treatment of the county's residual waste.

Flue Gas Treatment (FGT)

FGT is the cleaning process to remove pollutants from flue gasses emitted during combustion. The treatment includes a series of chemical processes and filters to neutralise gases and remove particulates before releasing to the atmosphere.

Heavy metals

A metal of relatively high density, or of high relative atomic weight and includes Arsenic, Antimony, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Nickel, Thallium, Vanadium.

Household Recycling Centre (HRC)

A facility where members of the public can reuse, recycle and dispose of their household waste.

Hydrogen chloride (HCl)

Hydrogen chloride is a naturally occurring chemical, but can also occur in manufacturing processes. It is a colourless, reactive gas with a strong, pungent odour. In solution with water it forms hydrochloric acid.

Hydrogen fluoride (HF)

Under normal conditions, Hydrogen fluoride will be a colourless gas, which has a sharp, pungent smell. It is highly toxic and irritating, but non-flammable. Hydrogen fluoride is however usually found as a strong solution in water, whereby it is Hydrofluoric acid. Hydrofluoric acid is an extremely strong acid. It will severely corrode metals, glass, minerals and many organic (carbon-containing) substances – and will release highly flammable hydrogen in the process.

Incinerator Bottom Ash (IBA)

Incinerator bottom ash (IBA) is a form of ash produced as a residue from the incineration of waste in Energy from Waste (EfW) facilities. This material is discharged during combustion and is often processed to recover ferrous metals prior to onward treatment or disposal of the ash products.

Integrated Management Systems (IMS)

An integrated management system (IMS) combines related management systems of a business into one system for easier management and operations. Quality, Environmental, and Safety management systems are often combined and managed as an IMS through combined policies and procedures for more efficient and robust management processes.

Landfill disposal

A disposal site where residual waste is buried, spread into layers and compacted. Modern landfills are engineered to prevent any pollutants from leaking into the surrounding soil and water courses. Landfill is considered the least sustainable method of waste disposal and therefore other methods of recycling and energy recovery are sought before landfill.

Megawatt (MW)

A unit of electricity equal to 1 million watts, or 1,000 Kilowatts. This unit of electricity is the constant used to represent the power generated from energy from waste recovery. Greatmoor EfW is designed to generate 22MW of electricity which is sufficient to power 40,000 homes.

Nitrogen oxides (NO_x)

The term 'nitrogen oxides' (NO_x) is usually used to includes two gases – nitric oxide (NO), which is a colourless, odourless gas and nitrogen dioxide (N₂O), which is a reddish-brown gas with a pungent odour. These contribute to acid rain, depletion of the ozone layer and have detrimental effects on health. They are also greenhouse gases.

Particulates

Particulates is the term used to describe tiny particles in the air, made up of a complex mixture of soot, organic and inorganic materials with a particle size less than or equal to 10 microns diameter (10 microns is equal to one hundredth part of a mm).

Refuse Collection Vehicle (RCV)

A vehicle commonly referred to as a dustcart specially designed to collect waste and/or recycling, and transport the collected materials to an onwards waste treatment facility.

Residual waste

Waste tonnages that remain after reuse, recycling and composting activities have taken place. This typically refers to everything that is disposed of in household black bin bags.

Sulphur dioxide (SO₂)

Sulphur dioxide is man-made and naturally occurring colourless gas with a penetrating odour. It dissolves in water to form an acidic solution. Sulphur dioxide gas is one of the main chemicals that causes acid rain, which can damage crops and forests and acidify sensitive soils and water bodies.

Third Party waste

Residual waste that is not included in the residual waste treatment contract between FCC and BC. Third Party waste includes other municipal waste contracts that FCC have with nearby local authorities. Third party waste is processed at Greatmoor to fill the capacity of the plant, increase landfill diversion and maximise electricity generation for Buckinghamshire.

Total Organic Carbon (TOC)

Total Organic Carbon is a measurement of Volatile Organic Compounds (VOC). VOC is a term used to classify a large group of liquids and gases (containing carbon) that are gaseous or easily vaporize at room temperature.

Waste transfer station

A waste transfer station is a building used for the bulking of residual waste prior to onward transfer of waste to a treatment or disposal facility. The transfer station operating on the residual waste contract is High Heavens located in High Wycombe in the South of the County. This site services the southern district who's RCVs tip residual waste on site prior to bulk waste transfer to Greatmoor EfW.

Appendix D

Reference Facility Environmental Permit

Refer to separate folder for Appendices D.1 to D.4.