Purpose of this document

This document summarises the Works Approval application submitted for the proposed Prospect Hill Energy from Waste (EfW) facility. Works Approval from the Victorian Environment Protection Agency (EPA) is required for the project to proceed.

The Energy from Waste (EfW) facility.

Prospect Hill International Pty Ltd is proposing to develop an EfW Plant in Lara near Geelong, Victoria. Every year, this project would divert approximately 400,000 tonnes of waste from landfill. It would also generate approximately 35 megawatts of electricity which would be fed into the grid, enough energy to power up to 50,000 homes.

The project aligns with Victorian Government waste policy. This policy supports energy from waste as a transition solution to reducing the use of landfill and allowing energy to be generated from materials that cannot be recycled. It would also reduce greenhouse gas emissions, with a net reduction of approximately 300,000 tonnes of CO_2 equivalent emissions each year.

Importantly, for the Lara community, the facility would create hundreds of jobs during construction and approximately 30 ongoing roles for the life of the facility.

Meeting the highest global standard

The facility is designed to meet European standards for EfW, the highest in the world. It would also meet all relevant EPA State Environment Protection Policies.

For the design this means:

- Integration of technologies to control odour emissions
- Facility monitoring that meet National Association of Testing Authorities and Monitoring Certification Scheme requirements
- Technologies to control gas recirculation and an enhanced gas treatment system
- Increased energy efficiency
- Measurement and pursuit of further landfill diversion opportunities

Community engagement

Community engagement is and continues to be a critical part of the project. Engagement undertaken to date raised awareness of the project in the local community and gave people an opportunity to ask questions, provide feedback and raise concerns.

An introductory fact sheet and cover letter were distributed via Australia Post to all local residential and commercial properties in July 2020. The cover letter introduced the project and included an invitation to an information session. The fact sheet provided a high-level project summary, indicative project timelines, information about project rationale and benefits, introductory information about EfW, and project contact details.

The information session was held online due to COVID-19 requirements; however, it proved a valuable forum for feedback. Questions and feedback received in the session fell into the following themes:

- Technology proposed for the plant

- The site selection process
- Air emissions, including modelling, prevailing winds, emissions and pollutants
- Information about Prospect Hill International
- Logistics required for the running of the plant
- How waste can be turned into energy

Results of the technical investigations

Waste feedstock

The facility plans to divert 400,000 tonnes of household and commercial waste from landfills. The waste feedstock would be sourced from a number of Victorian councils, with a preference for that from the Geelong, Surf Coast and Bellarine areas. The waste feedstock would exclude all material used within existing recycling programs.

A range of measures would be used to monitor the quality and type of waste delivered to site, including:

- Number plate recognition software to track incoming and outgoing vehicles
- Random waste delivery audits for quality control
- Inspection for waste contamination. Where suspected hazardous waste is found it will be removed from the feedstock and stored correctly

Operational wastes

The facility would generate bottom ash, boiler ash and air pollution control residues. These would be disposed of at suitably licenced landfill. However, the facility will seek opportunities to safely reuse these materials to further reduce its environmental footprint.

Greenhouse gas

The greenhouse gas emissions for the project were assessed in accordance with the Protocol for Environmental Management. The construction of the project is expected to produce 25,538 tonnes of greenhouse gas emissions. However, when operational, the project is expected to reduce greenhouse gas emissions by approximately 8 million tonnes over 25 years.

Air quality

The EPA require EfW facilities to meet European Commission standards for emissions. An air quality assessment was undertaken to confirm whether the EfW facility would meet these standards. The air quality assessment found that the proposed EfW facility would meet these standards.

Noise

An acoustic impact assessment impact assessment was also undertaken. It found that the proposed EfW facility would comply with the existing requirements through the use of several on site mitigation measures.

Health

A Human Health Risk Assessment was conducted in accordance with national guidelines available from the 2017 Centre for Health Equity Training, Research and Evaluation. The assessment found that the project would have a negligible impact on community health, with one exception. The assessment identified a positive health impact associated with the employment opportunities with the facility.

Conclusion

The proposed EfW facility will create local skilled jobs while providing a better outcome for the environment by diverting waste from landfill. It will also provide improved energy security for all Victorian's by generating approximately 35 megawatts of baseload electricity, enough energy to power up to 50,000 homes.

The facility is designed to meet the highest global standards and all relevant EPA requirements. Importantly, it is also designed with proven air and noise emissions control technology as well as advanced odour control systems to avoid amenity impacts on the Lara community.

The assessments undertaken demonstrate that the facility would be appropriately located in the Lara industrial precinct and can effectively operate with minimal environmental and social impacts.

Prospect Hill EfW Project

Works Approval Application

2

10 February 2021

Prospect Hill International Pty Ltd

Prospect Hill EfW Project

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Glossary of terms and abbreviations

Acronyms, abbreviations and glossary	Definition
2010 EC IED	*Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)*
2019 EC BREF	*European Commission Waste Incineration Best Available Techniques (BAT) Reference Document (2019 EC BREF)*
AAQ NEPM	National Environment Protection Measure for Ambient Air Quality
ACN	Australian Company Number
AEP	Annual Exceedance Probability
Ag	Silver
Al	Aluminium
APC	Air Pollution Control
APCr	Air Pollution Control residues
As	Arsenic
AS	Australian Standard
ARI	Average recurrence interval
Au	Gold
AUD	Australian Dollars
AWT	Alternate Waste Treatment
Ba	Barium
B(a)P	Benzo(a)Pyrene
BMO	Bushfire Management Overlay
C&I	Commercial and Industrial
Ca	Calcium
CBD	Central Business District
CCTV	Closed circuit television
Cd	Cadmium
CFA	Country Fire Authority
CEMP	Construction Environmental Management Plan
CEMS	Continuous Emissions Monitoring System
CFB	Circulating Fluidised Bed
CHMP	Cultural Heritage Management Plan
CH_4	Methane
Cl	Chlorine
cm	centimetres

Acronyms, abbreviations and glossary	Definition
Co	Cobalt
CO	Carbon Monoxide
$CO(NH_2)_2$	Urea
CO_2	Carbon Dioxide
COVID-19	coronavirus disease 2019
Cr	Chromium
CR(VI)	Hexavalent Chromium
CSIRO	Commonwealth Science and Industry Research Organisation
Cu	Copper
CV	calorific value
dB	decibels
dB(A)	A-weighted decibel
DBEIS	Department for Business, Energy & Industrial Strategy (UK)
DDO18	Design and Development Overlay – Schedule 18
DELWP	Department of Environment, Land, Water and Planning
EES	Environment Effects Statement
EfW	Energy from Waste
EP Act	*Environment Protection Act 1970*
EPA	Environment Protection Authority Victoria
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	Engineering, Procurement and Construction
ERF	Emissions Reduction Fund
ESA	UK Environmental Services Association
F	Fluoride
Fe	Iron
FFDI	Forest Fire Danger Indices
FGR	flue gas recirculation
FGT	Flue Gas Treatment
FOGO	food organics and garden organics
FZ	Farming Zone under the Greater Geelong Planning Scheme
g/kg	grams per kilogram
GED	general environmental duty
GHG	Greenhouse Gas
GHG Protocol	Greenhouse Gas Protocol
GJ	gigajoules

Acronyms, abbreviations and glossary	Definition
GLC	Ground Level Concentration
GREP	Geelong Ring Road Employment Precinct
ha	hectares
HAZOP	Hazard and operability study
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
Hg	Mercury
HI	hazard index
hPa	hecotpascals
IAP2	International Association of Public Participation
IBA	Incinerator bottom ash
IN2Z	Industrial 2 Zone under the Greater Geelong Planning Scheme
ISWA	International Solid Waste Association
IWRG	Industrial Waste Regulatory Guidelines
Jacobs	Jacobs Group (Australia) Pty Ltd
JSPDI	Jiangsu Power Design Institute
K	Potassium
kJ	kilojoules
km	kilometres
$ktCO_2e$	kilotonnes of carbon dioxide equivalent
kW/kWh	kilowatt/kilowatt hours
LGA	Local Government Area
LGCs	Large-scale generation certificates
LHV	Lower heating value
LOI	Loss of Ignition
LoS	level of service
LPG	Liquified Petroleum Gas
m/s	metres per second
m	metres
m^3	cubic metres
mgbl	Metres below ground level
MCERTS	Monitoring Certification Scheme
MCR	Maximum continuous rating
MEA	Maximum Extent Achievable
Mg	Magnesium

Acronyms, abbreviations and glossary	Definition
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mg/Nm^3	milligrams per normal cubic metre
ML	Megalitres
mm	millimetres
Mn	Manganese
MNES	Matters of National Environmental Significance
MSW	Municipal Solid Waste
$MtCO_2e$	million tonnes carbon dioxide equivalent
MW	megawatts
MWe	megawatts electrical
MWh	megawatt hours
MWRRG	Metropolitan Waste and Resource Recovery Group
Na	Sodium
NFPA	National Fire Protection Association
NATA	National Association of Testing Authorities
NCC	*National Construction Code*
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NGA	National Greenhouse Accounts
NGER	National Greenhouse Gas and Energy Reporting
NH_3	Ammonia
Ni	Nickel
NIRV	*Noise from Industry in Regional Victoria*
NO_x	oxides of nitrogen
NO_2	Nitrogen dioxide
NSA	Noise Sensitive Area
N_2O	Nitrous Oxide
O&M	Operations & Maintenance
OEMP	Operations Environmental Management Plan
OEMS	Operations Environmental Management System
O_3	Ozone
P	Phosphorus
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead

Acronyms, abbreviations and glossary	Definition
RCP	representative concentration pathways
PEM	Protocol for Environmental Management
PHI	Prospect Hill International Pty Ltd
PIW	Prescribed Industrial Waste
$PM_{2.5}$	particulate matter ≤ 2.5 micrometres
PM_{10}	particulate matter ≤ 10 micrometres
ppb	parts per billion
ppm	parts per million
the Project	The Prospect Hill Energy from Waste Project
PS	power station
PSI	Preliminary Site Investigation
PVC	Polyvinyl Chloride
Q&A	question and answer
RCV	*Refuse collection vehicles*
the regulations	*Environment Protection (Scheduled Premises and Exemptions) Regulations 2007*
RET	Renewable Energy Target
RMNLs	recommended maximum noise levels
RLZ	Rural Living Zone under the Greater Geelong Planning Scheme
Sb	Antimony
SBR	secondary beneficial reuse
SEPP	State Environment Protection Policies
SEPP (AAQ)	State Environment Protection Policy (Ambient Air Quality)
SEPP (AQM)	State Environment Protection Policy (Air Quality Management)
SEPP (Waters)	State Environment Protection Policy (Waters)
Si	Silicon
SLR	Sea Level Rise
SNCR	Selective Non Catalytic Reduction
SO_2	Sulfur Dioxide
SO_4	Sulphate
TOC	Total Organic Carbon
tCO2e	tonnes of carbon dioxide equivalent
TDS	Total Dissolved Solids
Tl	Thallium
tpa	tonnes per annum
tph	Tonnes per hour

Acronyms, abbreviations and glossary	Definition
TPM	Total Particulate Matter
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
V	Vanadium
VG	Victorian Government
VOC	Volatile Organic Compound
W/m^2	watts per square metre
WAC	Waste Acceptance Criteria
WAC-I	Waste Acceptance Criteria – inert
WAC-NH	Waste Acceptance Criteria – non-hazardous
WAC-H	Waste Acceptance Criteria – hazardous
WID	Waste Incineration Directive
WRI	World Resources Institute
Zn	Zinc
µg/L	micrograms per litre
$µg/m^3$	micrograms per cubic metre
µm	micrometres

Executive Summary

Prospect Hill International Pty Ltd (PHI) is proposing to develop an Energy from Waste (EfW) Plant (the Project) in Lara near Geelong, Victoria. The proposed Project aims to divert approximately 400,000 tonnes per annum (tpa) of Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) waste from landfill and generate approximately 35 megawatts of electricity (MWe). The Project proposes to use well-known and proven, conventional moving grate boiler technology to convert the waste to energy, which will be fed into the existing grid.

The Project is strategically aligned with the Victorian Government's recently released 10-year policy and action plan for waste and recycling (DELWP, 2020). The policy recognises the role of energy from waste as a transitionary solution to meeting diversion from landfill ambitions and recovering the energy potential of residual waste that cannot be recycled. Residual waste is projected to increase in line with population growth and EfW plants in Australia are expected to assist in reducing waste going to landfill until the circular economy is realised. The Project also is projected to have a positive impact on greenhouse gas emissions, saving ~300,000 tonnes of CO_2 equivalent emissions each year.

If successfully implemented, the Project is anticipated to provide enough electricity to power up to 50,000 homes and contribute to the Lara community by creating hundreds of jobs during construction and approximately 30 permanent jobs for the duration of the operations of the Project.

Approvals

The first stage of approvals required for the Project are the Works Approval (Victorian Environment Protection Authority) and Planning Permit (Department of Environment, Land, Water and Planning – DELWP). Subsequent key approvals that will be required prior to construction and operation include:

- Commissioning Approval (currently known as "s30A Approval") – EPA
- EPA Operating Licence - EPA

Best practice

Best practice with regards to EfW plants in Vitoria, includes compliance with:

- The European Union's Waste Incineration Directive 2000/76/EC (WID), which was recast into the 2010 EC IED (European Commission, 2010)
- The European Commission (2019) Best Available Techniques (BAT) Reference Document for Waste Incineration (2019 EC BREF)

The 2010 EC IED is seen as the benchmark or leading standard globally for EfW air emissions and sets stringent emission limits and monitoring requirements which include continuous emissions monitoring of total particulate matter (TPM); sulfur dioxide (SO_2); oxides of nitrogen (NO_x); hydrogen chloride (HCl); carbon monoxide (CO); total organic carbon (TOC); and hydrogen fluoride (HF). The Continuous Emissions Monitoring System (CEMS) is a collection of sophisticated and reliable in-line instruments, located in the flue gas piping, with a computerised data acquisition and process control system.

The 2019 EC BREF outlines the best available techniques for the industrial processes covered under the 2010 EC IED. The 2019 EC BREF recommendations have led to updates to emission limits that operating combustion plants within EU countries will need to comply with by 2023. As the Project will be operational post 2023, it has been designed to be in accordance with best available techniques and emission limits documented in the 2019 EC BREF.

Best practice considerations which have been investigated and applied for the Project include:

- The use of negative air pressure in the tipping hall and waste bunker to control potential odour emissions
- A National Association of Testing Authorities (NATA) and Monitoring Certification Scheme (MCERTS) certified CEMS system for measuring all pollutant and duct process condition parameters as required for on-line measurement under the 2010 EC IED and *State Environment Protection Policy (Air Quality Management)* (SEPP AQM)
- Flue gas recirculation for control of oxides of nitrogen generation in the furnace
- Selective Non Catalytic Reduction (SNCR) using urea solution for oxides of nitrogen control in the upper zone of the furnace
- A combined dry and semi dry lime sorbent flue gas treatment system
- Energy recovery in a combined heat and power mode yielding higher energy efficiency and surpassing the 2010 EC IED R1 energy recovery benchmark
- Measurement and pursuit of further landfill diversion opportunities with particular focus on bottom ash recycling and re-use
- Elevation of the residual waste stream of approximately 400,000 tpa +/-10% from Disposal (landfill) to higher order uses in the Wastes Hierarchy including Recovery of energy and Recycling and potentially Re-use

Community engagement

The key aims of community engagement undertaken for the Project to date was to raise awareness of the Project in the local community and give community an opportunity to ask questions, provide feedback and raise concerns.

An introductory fact sheet and cover letter were developed and distributed via Australia Post to all residential and commercial properties in the local area in July 2020. The cover letter introduced the Project and included an invitation to an online information session, while the fact sheet provided a high-level project summary, indicative project timelines, information about project rationale and benefits, introductory information about EfW, and PHI's contact details. It was PHI's preference to conduct a face-to-face information session at a location in Lara, however government restrictions due to COVID-19 unfortunately prevented such a session. PHI endeavours to hold further information sessions as face-to-face, subject to government restrictions (e.g. number of participants).

The online information session was delivered on Tuesday 28 July 2020 from 7.30 to 8.30pm. The session was delivered using Microsoft Teams and took the format of a 20-minute broadcast-style presentation followed by a 40-minute question and answer (Q&A) session. Attendees were able to submit questions throughout the session using the chat function, and as many questions as possible were verbally answered by members of the project team on the night. Five key themes of community interest were identified during the information session:

- Technology – questions about the technology PHI is proposing
- Location – questions about the site selection process
- Air emissions – questions around modelling, prevailing winds, emissions and pollutants
- Company – questions relating to PHI as a company
- Waste – questions relating to the logistics required for the running of the plant and the process of turning waste into energy

Waste feedstock

The Project plans to treat 400,000 tonnes of household rubbish (MSW) and waste from commercial operations (C&I) such as schools, shopping centres and offices. It is anticipated that the MSW waste feedstock will be sourced from a number of Victorian councils, with a preference for waste from the Geelong, Surf Coast and

Bellarine areas. The feedstock would be collected post source recycling and therefore will not impact on recycling programs. C&I waste is intended to be sourced from a range of commercial waste management companies and from commercial operations.

The waste delivery protocol will involve a range of measures to assess the quality and type of waste that is delivered, including:

- Number plate recognition software to track incoming and outgoing vehicles. The location of waste origin and vehicle will be recorded for auditing purposes and to identify trends (if any) in the disposal of unsuitable wastes
- Random waste delivery audits for quality control
- All hazardous wastes will be stored correctly while onsite and appropriately disposed offsite
- Before entering the tipping hall, waste will be visually inspected by staff for any obvious contamination, problems or hazards. If a problem or hazard is suspected, the vehicle will move to an inspection area. If the waste is unsuitable but not hazardous (e.g. oversized waste like fridges) it will be loaded into a 30m^3 bin skip, and if hazardous (e.g. batteries) it will be loaded into a different 30m^3 hazardous waste storage container. Waste will be inspected again as it is tipped into the bunker and removed to a separate area if necessary. Skips will be emptied when full and disposed of appropriately.

Operational wastes

The key waste types generated during operation of the Project are bottom ash, boiler ash and air pollution control residues (APCr).

Bottom ash is a solid residue removed from the combustion chamber after the waste has been combusted and has a coarse and granular ash consistency. Metals are separated from the bottom ash and recycled or reused. Bottom ash comprises between 20 to 25% of the weight of the feedstock. Initially, bottom ash will be disposed of at suitably licenced landfill however it is PHI's intention to find opportunities locally to reuse this material, as is commonly done in Europe.

Boiler ash and APCr are products in a fine particulate form that are carried along with the flue gasses and collected in bag filters within the flue gas treatment plant. This waste product will be collected in silos and disposed of to an appropriately licenced prescribed waste landfill.

Greenhouse gas

The greenhouse gas emissions for the Project have been assessed in accordance with the Protocol for Environmental Management (PEM): greenhouse gas emissions and energy efficiency in industry.

The total GHG emissions estimated for the construction phase of the project are 25,538 tonnes of carbon dioxide equivalent (tCO_2e). During operations, the total emissions from the combustion of waste and waste logistics has been calculated as 194,534 tCO_2e/year. These emissions are displaced by electricity emissions of 209,358 tCO_2e/year, which results in the Project having a positive greenhouse impact of -14,824 tCO_2e each year – i.e. a net reduction of greenhouse gas emissions of 14,824 tCO_2e each year.

In addition to the energy-related emissions above, the diversion of waste to the EfW Plant from landfills results in a further saving of 400,000 tCO_2e/year.

The cumulative GHG emissions over an assumed 25-year life of the EfW plant shows a net GHG benefit of approximately 8 MtCO_2e.

Air quality

The Victorian EPA require that, in order to demonstrate best practice, emissions to air from EfW plants must meet the emission standards outlined in:

- 2010 EC IED (European Commission, 2010). This document regulates emission to air from EfW plants in Europe through the application of Best Available Techniques (BAT) for air emission controls and sets stringent emission limits for pollutants
- *Best Available Techniques (BAT) Reference Document for Waste Incineration* (EC, 2019a). This document includes a review of emissions measurements in the 2010 EC IED and provides recommendations for updates
- Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration (European Commission, 2019b). This updates the BAT conclusions that must be applied in the 2010 EC IED

Air emissions from the proposed Plant were analysed and estimated following EPA's guidelines: *Energy from waste* (EPA, 2017a), and *Demonstrating Best Practice* (EPA, 2017b). An air quality impact assessment was undertaken for the Project in accordance with the *State Environment Protection Policy (Air Quality Management)*, or 'SEPP (AQM)', and the EPA's guidelines for use of the regulatory model, AERMOD.

A conservative strategy was applied for the assessment based on testing conservative, high estimates for air pollutant emissions from the proposed EfW, in conjunction with approximately 40,000 hourly meteorological conditions determined specifically for the Project locality between Lara and Corio.

Key components of the air quality impact assessment methodology were:

- A conservative approach was used to estimate emissions for each substance based on a review of the IED air emission limits, and a review of the literature with a primary focus on a European Commission 2019 review of many operating EfW plants in Europe.
- Air pollutant emissions from the proposed, single, tall stack for the Project were modelled as a continuous source; i.e. for all hours in each of five simulated years.
- The modelling included wake and downwash effects associated with the Plant's main buildings and stack.
- The combined effects of the Project emissions plus estimates for background based on local measurements represent the expected, cumulative (total), worst-case, air quality impacts.

The air quality assessment results for all substances are summarised in the following paragraphs.

Carbon monoxide (CO)

The AERMOD results demonstrated that CO emissions from the Plant will have negligible impact on existing levels of CO and will not cause any exceedances of the SEPP (AQM) design criterion (29 milligram/m^3). Several years of CO monitoring by the EPA Geelong South monitoring station show that all CO concentrations in the Geelong area have been low, with the majority of concentrations less than 10% of the monitoring objective. The conclusion for CO is there is a very low risk of the Project causing air quality impacts due to CO emissions.

Nitrogen dioxide (NO_2) and ozone (O_3)

Most NO_2 in the atmosphere is not a direct emission from combustion – NO_x from the combustion of fuels (including waste) comprises mostly NO and smaller amounts of NO_2. In the atmosphere, NO may be oxidised to NO_2 by a reaction with ambient ozone (O_3). The EPA's monitoring data show there is always some ambient O_3 available for this reaction. The EPA Geelong South results for NO_2 show that, in general, NO_2 concentrations are low, with the monitoring objective for NO_2 not exceeded at any time over 2014-2019. Maximum hourly averages over the whole period were less than 50% of the monitoring objective.

The AERMOD results for NO_x emissions from the Plant were assessed in two ways: (1) assuming a very high 100% conversion rate of NO_x to NO_2 to determine the maximum possible contributions to existing NO_2 levels; and (2) based on measured, high NO_x concentrations, a NO_2/NO_x conversion ratio of 30% was used and added to the hourly-varying, background NO_2. There were no model-predicted exceedances of the design criterion for NO_2. Collectively, these results showed that NO_x emissions from the Plant are unlikely to cause exceedances of the SEPP (AQM) design criterion for NO_2.

Sulfur dioxide (SO_2)

The SO_2 monitoring results from EPA Geelong South over 2014-2019 were low, demonstrating a low risk of air quality impact due to existing, local emissions of this substance. The AERMOD results for SO_2, including conservative estimates for background SO_2 for each annual meteorological simulation, did not cause any exceedances of the design criterion for SO_2.

Particulate Matter 10 (PM_{10})

EPA Geelong South and EPA Footscray monitoring data show existing, high concentrations of PM_{10} are expected for the Project study area due to a variety of sources; e.g., raised dust, and fires. Over a 6-year period to the end of 2019 there were 3-11 exceedance days per year at Geelong South, and 0-7 exceedance days per year at EPA Footscray. Although, none of the measurements exceeded Victoria's *SEPP (Ambient Air Quality)* or 'SEPP (AAQ)' objective for annual average PM_{10} (20 $\mu g/m^3$). The Plant will employ BAT controls on the particulate emissions from the stack, so the PM_{10} emissions will be low relative to background levels.

The AERMOD results for PM_{10} due to emissions from the Plant including the hourly-varying, background PM_{10} levels, showed the results were heavily dominated by high background levels. The AERMOD results showed emissions from the Plant are unlikely to cause additional exceedances of the design criterion and the SEPP (AAQ) monitoring objectives. Contributions of PM_{10} from the Plant were small relative to high background PM_{10}.

Particulate Matter 2.5 ($PM_{2.5}$)

EPA Geelong South and EPA Footscray monitoring data showed existing, high $PM_{2.5}$ concentrations are expected for the Project study area (the case for $PM_{2.5}$ is similar to PM_{10}). Sources of the high background $PM_{2.5}$ levels include road traffic; i.e., petrol and diesel combustion, domestic wood burning, and, occasionally, controlled burns and bushfires that could be distant from Geelong and Lara. Measurements of $PM_{2.5}$ were obtained at Geelong South over 2016-2019 and 2014-2019 at EPA Footscray. Over these monitoring periods, there were 0-2 exceedance days per year at Geelong South, and 0-4 exceedance days at EPA Footscray. However, none of the annual averages exceeded the SEPP (AAQ) objective for annual average $PM_{2.5}$ (8 $\mu g/m^3$).

The AERMOD results for $PM_{2.5}$ due to emissions from the Plant were similar to those for PM_{10}. The $PM_{2.5}$ results included hourly-varying, background $PM_{2.5}$ concentrations, and again the combined results were heavily dominated by these high background levels. The AERMOD results showed emissions from the Plant are unlikely to cause additional exceedances of the design criterion and the SEPP (AAQ) monitoring objectives. Contributions of $PM_{2.5}$ from the Plant were small relative to high background $PM_{2.5}$.

Hydrogen Fluoride (HF)

The AERMOD results for hydrogen fluoride (HF), using a conservative (high) emissions estimate, did not cause exceedances of the SEPP (AQM) design criteria for maximum 24-hour average, maximum 7-day average, and maximum 90-day average HF concentrations. The modelling shows there is a low risk of air quality impact due to HF emissions expected from the Plant.

Other substances – general

A suite of other substances was assessed for the Project using emissions estimates based on the substance lists and emissions limits provided in EU (2010) and EC (2019b). These were: hydrogen chloride (HCl), ammonia (NH_3), dioxins and furans, PAHs as B(a)P, and hydrocarbons or TVOCs, and metals such as arsenic, cadmium, chromium, lead, and nickel. In general, the background levels of these substances are expected to be small; close to or less than their measurement limits of detection.

Results for other substances – non metals

There were no exceedances of SEPP (AQM) design criteria for HCl, NH_3, dioxins and furans, PAHs as B(a)P, and hydrocarbons. All the hydrocarbon emissions were assumed to be formaldehyde, a conservative step in the assessment given formaldehyde is a higher risk hydrocarbon in combustion products.

Results for other substances – metals

There were no exceedances of SEPP (AQM) design criteria, (where criteria were available), for all the metals that could be tested. In relation to the first IED metals group total, (Cd+Tl), review of the literature indicated the majority of Cd+Tl emissions from EfW is cadmium (Cd), therefore the assessment was based on all the emission being Cd. There is no design criterion for thallium (Tl), but the assumption of 100% Cd is expected to be conservative for the assessment.

The IED emissions limits do not distinguish between organic and inorganic mercury (Hg). The maximum EfW emission was assessed against both SEPP (AQM) design criteria for Hg (organic and inorganic). The risk of air quality impact from mercury emissions expected from the Plant, was found to be low.

In relation to the second IED metals group total: Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V; from a review of the literature, assessment of each of these individual elements was by conservative (high) estimates of fractions of the IED emission limit for the total. None of the AERMOD-predicted concentrations for the individual metals exceeded their SEPP (AQM) design criteria, (where criteria were available). While there were no exceedences of design criteria, the highest risk metals/elements were identified as: highest-risk; cadmium (Cd); equal second-highest risk; arsenic (As) and chromium-6 (Cr VI); and third-highest risk; nickel (Ni).

Conclusion

The air quality impact assessment tested the air emissions expected from the proposed Plant by conservative estimates for emissions of the individual substances, and air dispersion modelling. AERMOD predicted concentrations of air pollutants from the proposed Plant, added to existing air pollutant concentrations, were found to be minimal in relation to SEPP (AQM) design criteria. Emissions from the EfW Plant will meet all IED and SEPP (AQM) emission limits.

Apart from PM_{10} and $PM_{2.5}$, predicted air emissions from the Plant caused no exceedances of the SEPP (AQM) design criteria, by testing with EPA's regulatory model, AERMOD. The AERMOD results showed that emissions of PM_{10} and $PM_{2.5}$ are unlikely to cause additional exceedances of their design criteria, with the results heavily dominated by existing high background PM_{10} and $PM_{2.5}$ levels.

Monitoring shows that existing levels of PM_{10} and $PM_{2.5}$ are high due to sources such as raised dust, smoke from fires and wood burning, and road traffic. These background levels are high relative to the small contributions expected from the Plant, which will employ world's best practice, Best Available Techniques emissions controls. Further, the modelling showed that particulate emissions from the Plant are unlikely to cause additional exceedances of the SEPP (AAQ) maximum 24-hour average and annual average monitoring objectives.

Noise

Recommended maximum noise levels for representative Noise Sensitive Areas (NSAs) were calculated using the methodology in the EPA Guidelines *Noise in Regional Victoria* (NIRV). Predicted noise levels from operation of the Project at the representative NSAs were modelled for all time periods and for both neutral and predominant meteorological conditions. It has been assumed with regards to the modelling of the Project that the plant will be designed in accordance with best available techniques for noise reduction and that all equipment will operate continuously and simultaneously for day, evening and night scenarios. Noise mitigation measures include:

- The steam turbine hall, flue gas cleaning hall, tipping hall and boiler room will be constructed with steel, with a thickness of 20 centimetres (cm)

- The pump house, demineralisation water plant and compressor house, as well as the FW/RW pump room will be constructed with a concrete wall with a thickness of 20 cm
- Wet-cooling tower units are assumed to be area sources on top of the cooling towers

The noise predicted at each property for each of the day/evening/night time periods has been compared against recommended maximum noise levels and have been found to comply at all sensitive receptor locations.

Health Impact

The Health Impact Assessment (HIA) was conducted as a desktop assessment in accordance with national guidelines available from the Centre for Health Equity Training, Research and Evaluation (CHETRE) (Harris 2007) and enHealth (enHealth 2012a, 2017). The HIA has been undertaken on the basis of technical assessments completed in relation to emissions to air, noise, waste management and transport.

A summary of HIA outcomes and enhancement/mitigation measures is provided in Table E.1.

Table E.1: Summary of HIA outcomes

Health aspect/issue	Potential health impacts considered	Impact identified	Types of measures that could be implemented to enhance positive impacts or mitigate negative impacts
Air quality – Inhalation exposures	Range of health effects associated with exposure to pollutants released to air from the proposed facility	All exposures: negative but negligible. More specifically: ▪ No acute risk issues of concern ▪ No chronic risk issues of concern. Particulate exposures are negligible and essentially representative of zero risk ▪ Incremental carcinogenic risks are negligible and essentially representative of zero risk	The proper operation and maintenance, and monitoring, of the pollution control/flue gas equipment
Air quality – multiple pathway exposures	Range of health effects associated with exposure to pollutants released to air from the proposed facility, that may then deposit and accumulate in soil homegrown fruit and vegetables and other farm produce	All exposures: negative but negligible. More specifically: ▪ No chronic risk issues of concern for multiple pathway exposures ▪ All calculated risks for individual exposure pathways are negligible and essentially representative of zero risk ▪ All calculated risks for combined multiple pathway exposures are negligible and essentially representative of zero risk	The proper operation and maintenance, and monitoring, of the pollution control/flue gas equipment

Health aspect/issue	Potential health impacts considered	Impact identified	Types of measures that could be implemented to enhance positive impacts or mitigate negative impacts
Odour	Annoyance, stress, anxiety	Not significant and negligible	The proper operation of the tipping hall as proposed to ensure fugitive odour emissions are effectively managed on-site
Noise	Sleep disturbance, annoyance, children's school performance and cardiovascular health	Modelled noise impacts, low potential for health impacts	Additional assessment of the project detailed design is required, and application of appropriate and reasonable mitigation measures is required to ensure compliance with noise guidelines for the community
Economic Environment	Reduction in anxiety, stress and feelings of insecurity	Positive improvements in health and wellbeing	The identified positive outcomes in the local community can be enhanced by encouraging employment of people who live within the local community
Traffic and transport	Injury or death, stress and anxiety	Negative but minimal	Details to be determined at the detailed design phase of the project
Presence of hazardous waste in feedstock and generation of waste	Possible injury if incorrectly disposed of	Negative but minimal	Further development of the proposed feedstock delivery protocols into an operational management plan to address the discovery and proper disposal of hazardous waste, should it be present in feedstock. Appropriate testing and management of waste materials generated during operations with compliance with all relevant current regulations in relation to waste disposal and/or re-use.

Overall conclusion

The proposed Prospect Hill EfW Project is a significant project for Lara and the broader Geelong region, which has suffered from the closure of large manufacturing plants over recent years. Prospect Hill sees this project as an opportunity to bring back some of those skilled jobs to the area and hopes to employ people who may have been impacted by skilled job losses in recent years. The Project is also important for Victoria as it provides an environmentally and economically sound alternative solution to sending residual waste to landfill and provides improved energy security for all Victorian's by generating approximately 35MW of baseload electricity to the grid.

The Project has been designed to ensure it will meet the best practice European emission standards and all relevant EPA State Environment Protection Policies (SEPPs). Importantly, it has been designed with state-of-the-art air and noise emissions control and advanced odour control systems to ensure very low amenity impacts on the surrounding Lara community.

Environmental and social impacts associated with the Project have been assessed through detailed risk assessments and robust technical assessments, the results of which all demonstrate that the Project is well located in the industrial precinct of Lara and can operate with minimal environmental and social impacts.

1. Introduction

1.1 Introduction

This document supports a Works Approval Application (WAA) to Environment Protection Authority Victoria (EPA) for development of a proposed Energy from Waste (EfW) plant in Lara. This document is organised into chapters and supporting appendices, which follows the requirements outlined in the EPA (2017a) Works Approval Application Guideline (EPA Publication 1658).

The structure of this document is outlined below:

Chapter 1: (this Chapter): An introduction to the Project, summarising the scope of the proposed works, details of the proponent, scope and purpose of this WAA, and the rationale and benefits of the Project

Chapter 2: Provides an overview of the Project site

Chapter 3: Details of the regulatory approvals (legislation, regulations and guidelines) applicable to the Project

Chapter 4: Details how the Project will meet Best Practice guidelines

Chapter 5: Provides an overview of community and stakeholder consultation undertaken to date and future planned consultation activities

Chapter 6: The findings of a project-wide environmental risk assessment for the Project

Chapter 7: Technical description of the Project, including details of the proposed engineering processes

Chapter 8: Describes the waste inputs of the Project

Chapter 9: Describes the waste outputs of the Project

Chapter 10: Details water use and surface water management measures

Chapter 11: Details the energy use and greenhouse gas (GHG) emissions associated with the Project

Chapter 12: Reports the findings of the air quality impact assessment

Chapter 13: Reports the findings of the noise impact assessment

Chapter 14: Reports the findings of the human health impact assessment

Chapter 15: Reports the findings of the cultural heritage, ecology, traffic and visual impact assessments

Chapter 16: Provides an overview of environmental management measures that would be implemented to manage the potential impacts

Chapter 17: List of resources used throughout this main document

Appendix A to M: Maps, reports, specialist assessments and other supporting information, as referenced throughout this main document

1.2 Project overview

The Prospect Hill Energy from Waste Project (the Project) proposes the development of an EfW plant near Lara, Geelong. The Project proposes to use conventional moving grate boiler technology, with a steam boiler and steam turbine to recover energy by combusting non-hazardous Municipal Solid Waste (MSW) supplemented with Commercial and Industrial (C&I) waste. The plant aims to divert approximately 400,000 tonnes per annum (tpa) of MSW and C&I waste from landfill and generate approximately 35 megawatts of electricity (MWe) which will be fed into the existing grid.

The cost of the Engineering, Procurement and Construction (EPC) contracts associated with the proposed Project is currently estimated to be approximately AUD$300 million. With regard to the fee for the assessment of the WAA, the WAA incurs the maximum number of fee units therefore the total fee payable upon submission of this WAA is **$66,645**.

1.3 Applicant details

Prospect Hill International (PHI) is the proponent of the proposed Project and is the owner of the Project site at 164-200 McManus Road, Lara, Victoria. The Australian Company Number (ACN) of PHI is 617 544 224.

1.3.1 Contact details

Street address	Prospect Hill International Pty Ltd 132 Whitehorse Road Deepdene Victoria 3103	Postal address	Attn: Mr Jian Qi Prospect Hill International Pty Ltd 132 Whitehorse Road Deepdene Victoria 3103

Jacobs Group (Australia) Pty Ltd (Jacobs) has assisted with this report and the associated technical assessments. For general enquiries in relation to this application, please contact Roger Winders (Jacobs) on +61 (03) 8668 3493.

1.4 Track record

Prospect Hill International is an Australian private company located in Melbourne, established in 2017 specifically for the development of the proposed Prospect Hill EfW Project in Lara. The company Directors have extensive experience in international, large-scale engineering and industrial projects.

Prospect Hill is working with leading design company, Jiangsu Power Design Institute (JSPDI), to provide technical and design services for the proposed plant. JSPDI brings considerable EfW project development experience, having worked with numerous large EfW technology suppliers and project developers, including Everbright International, on more than 100 EfW projects worldwide.

Locally, Prospect Hill has partnered with Jacobs, a technical professional services consultancy, to provide engineering support and undertake the environmental and social assessments required to support the regulatory approvals process for this Project.

1.5 Scope and purpose of the Works Approval application

This Works Approval application seeks statutory approval to develop an EfW plant to generate electricity for export to the electricity network.

Works Approvals are issued by EPA under the *Environment Protection Act 1970* (EP Act) for the development of, or upgrades to, industrial sites scheduled under the *Environment Protection (Scheduled Premises and Exemptions) Regulations 2007* (the regulations).

The Project site would be deemed a 'Scheduled Premises' on the basis that it falls under the category A08 (Waste to Energy) under the regulations. A Works Approval is required for the Project pursuant to Section 19A of the EP Act and an EPA Licence would also be required to be obtained.

The Works Approval, once issued, would allow for construction of the Project to take place. It not only addresses construction risks, but also sets the scene for commissioning and subsequent operation in terms of the scope of environmental risks. Once constructed, in accordance with EPA regulatory requirements and the guidance and conditions set out in the Works Approval, PHI will apply for an EPA licence in order to operate the facility, with specific conditions around operation and environmental performance requirements of the Project.

1.6 Rationale for the Project

Despite increases in recycling rates, waste management remains is a major issue in Victoria. More than four million tonnes of waste is sent to Victorian landfills each year (Sustainability Victoria, 2019).

The Victorian Department of Environment, Land, Water and Planning (DELWP) has developed a circular economy policy titled *Recycling Victoria – A new economy*, which outlines Victoria's goals for waste management and development of a circular economy (DEWLP, 2020). Through this policy, DELWP outlined the role that EfW technologies would have in an integrated waste and resource recovery system, with EfW facilities able to divert waste from landfills and use it to create valuable energy. While transitioning to a circular economy, the policy outlines that generating energy from waste is preferential to sending waste to landfill, once valuable recyclable materials have been removed. DELWP (2020) recognises a role for EfW investment in Victoria, and supports EfW projects where they:

- Meet best-practice environment protection requirements, including air pollution controls (APCs)
- Reduce the amount of waste sent to landfill and do not displace reuse or recycling
- Do not inhibit innovation in reuse or recycling of materials
- Meet best-practice energy efficiency standards
- Reduce GHG emissions compared to the waste and energy services they displace
- Have sustainable business models that create jobs and economic development
- Work well with local communities in which they operate

Throughout this Works Approval application, it has been demonstrated that the Project will provide a key service diverting waste from landfills and providing electricity to the network while addressing each of the above requirements.

1.7 Project benefits

If successfully implemented, the Project will have a range of important benefits for the local community and for the state/country, including the following:

- Convert waste that can't be recovered by recycling, reuse or waste avoidance into ~35 MWe, enough to power up to 50,000 homes
- Contribute to the Lara community by creating hundreds of jobs during construction and approximately 30 permanent jobs for the duration of the operations of the Project
- Reduce GHG emissions. The Project results in a saving of ~300,000 tonnes of CO_2 equivalent emission each year
- Contribute to energy security in Victoria by providing a new source of sustainable baseload power to the electricity grid
- Reduce the amount of waste going to landfill, leading to environmental and social benefits (less pollution, better amenity)

2. Project site

2.1 Site location

The Project is located near Lara, approximately 11 kilometres (km) north of the Geelong Central Business District (CBD) and 58 km southwest of the Melbourne CBD, within the City of Greater Geelong Local Government Area (LGA). Lara has a population of approximately 16,000 and the City of Greater Geelong has a population of approximately 250,000 (Australian Bureau of Statistics, 2016; 2018).

Figure 2.1: Regional Context and Figure 2.1 below shows the Project location in a regional context.

The proposed Project is to be located on 164-200 McManus Road (Lots D and 3 PS710783E). The site is surrounded by a mix of large-scale industrial land uses, other undeveloped sites, and some residential land uses. Surrounding industrial land uses predominantly include the management of hazardous materials, including an Elgas fuel storage site and Viva fuel refinery to the site's south-west. Land uses to the east of the site include the Accensi agricultural chemical plant and a waste storage facility, previously managed by Central Recyclers. Some low-density residential land uses exist to the site's north-west along Minyip Road, Lara.

The nearest sensitive receptor is identified as a residential dwelling located approximately 350 metres (m) north/northwest of the site and the boundary of the township of Lara is approximately 1.2 km away from the site in a north-north easterly direction.

The Project site is within the Corangamite Catchment Management Authority's management area and the Victorian Volcanic Plain bioregion.

2.2 Site description

The Project site comprises an area of approximately 16 hectares (ha).

The Project site is generally flat with bare earth and no visible above-ground structures. Based on the site history, the site has never been developed and has remained vacant for over a century. It is possible the site has been used at some stage for some agricultural use (cropping and grazing) which could have included pesticide and fertiliser use.

The site has been significantly disturbed and modified through previous land use. The current state of the site appears to reflect recent storage of bulk earth materials, with all top soil and natural features removed from the site as part of historical land management. The periphery of the site appears to be bunded. A large proportion of the site appears to be cleared of all vegetation, with areas retaining vegetation appearing to be largely composed of grassy weeds.

2.3 Planning context

The *Planning and Environment Act 1987* controls land use and development in Victoria. The planning scheme of each local government municipality is the instrument through which development is controlled and land use zones are defined. The Project is located within the City of Greater Geelong and is subject to the provisions of the Greater Geelong Planning Scheme.

Planning zones around the Project site are shown in Figure 2.3. The Project is located within the Industrial 2 Zone (IN2Z). The site is surrounded by a mix of industrial, agricultural and low-density residential use land. The area immediately north of the site boundary is within the Farming Zone (FZ) whereas the area northwest of the site is zoned Rural Living (RLZ) under the Greater Geelong Planning Scheme, which provides an informal buffer between this precinct and the township of Lara. Lots in the immediate east, west and south of the site are all within IN2Z.

Planning approval for the Project will be required:

- For the use and development of the subject site for the purposes of a Waste to Energy facility under the IN2Z
- To construct a building or to construct or carry out works under the Design and Development Overlay – Schedule 18 (DDO18)

Planning approval may also be required for the Project to:

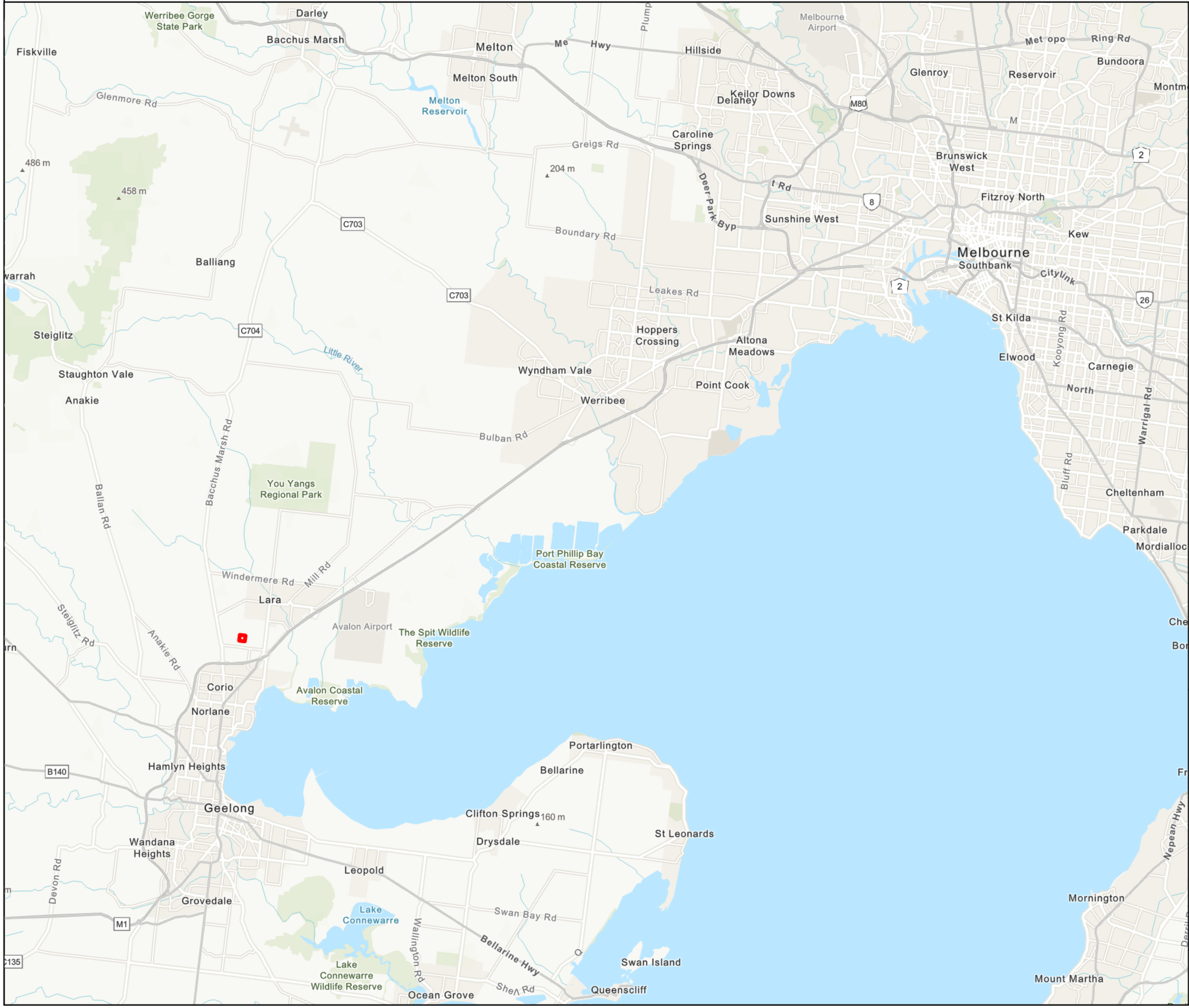
- Remove, destroy or lop native vegetation under Clause 52.17 (Native Vegetation)
- Reduce or waive the number of car parking spaces required under Clause 52.06 (Car Parking)
- Reduce or waive the number of bicycle spaces and facilities required under Clause 52.34 (Bicycle Facilities)

The site is located within the Geelong Ring Road Employment Precinct (GREP). The GREP is Geelong's largest designated industrial development precinct and includes over 500 ha of land zoned for heavy industrial purposes.

PHI currently owns the Project site at 164-200 McManus Road, Lara (D\PS710783E). A copy of the Certificate of Title is included in Appendix B. The Project site is currently proposed to be subdivided into two separate parcels, including one for the road reserve (R1\PS742703) and one for the main property (4\PS742703). The proposed road parcel is located within the FZ under the Greater Geelong Planning Scheme.

Works associated with the EFW plant will be confined to the main property (4\PS742703) and works within the road parcel (R1\PS742703) will include roadworks associated with the completion of Production Way.

Figure 2.1: Regional context



Project site

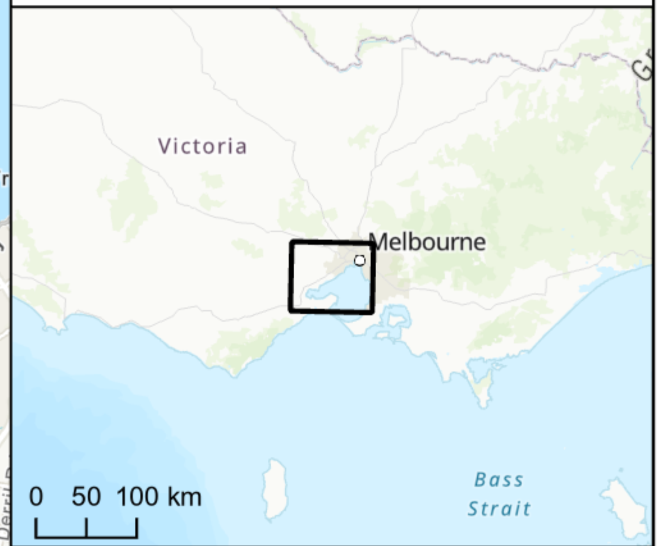
N

IS305100
GDA 1994 MGA Zone 55

A3
1:250,000

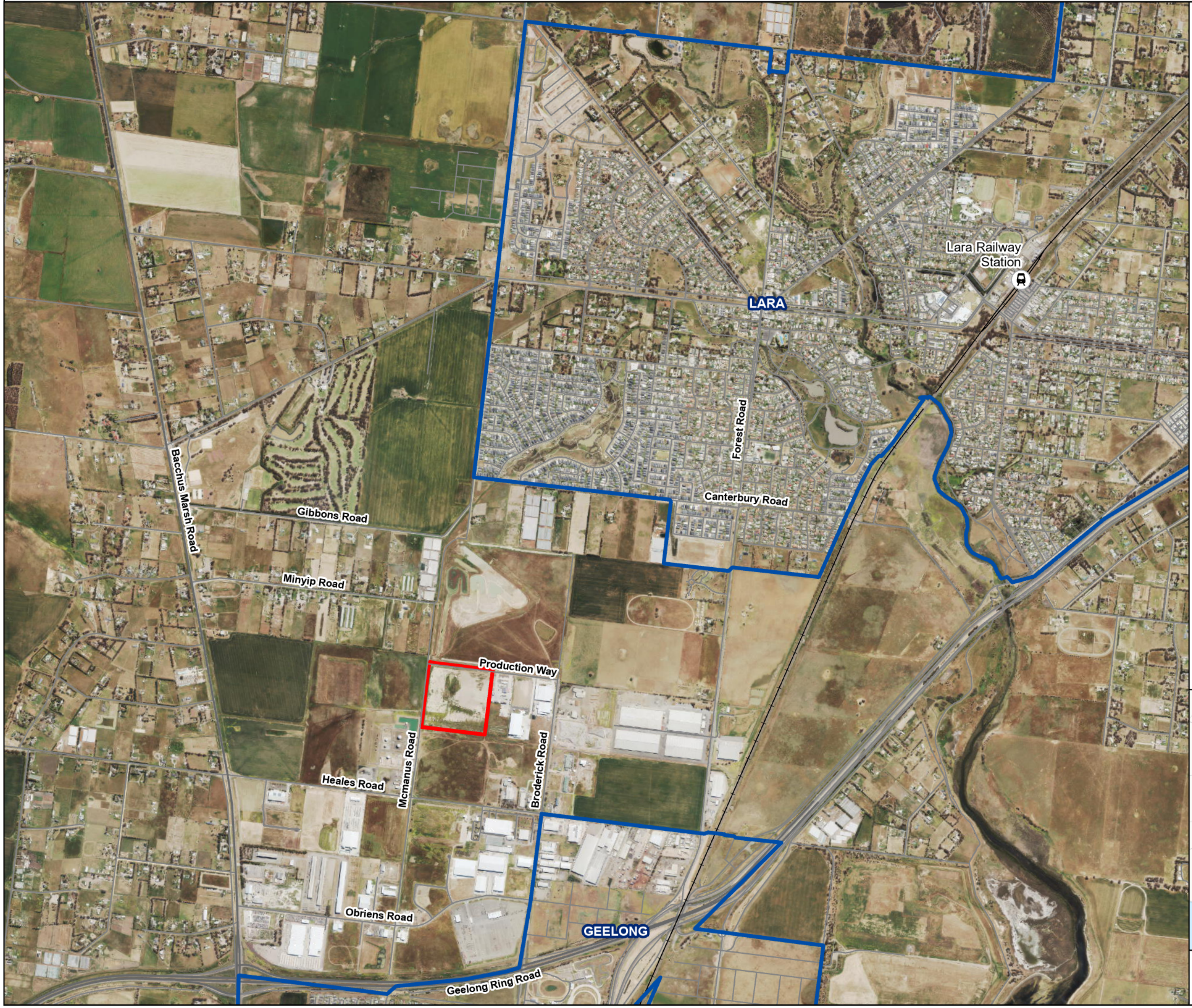
0 5 10 km

DATA SOURCES
© Commonwealth of Australia (Geoscience Australia) Geodata Topo 250k Series 3; Vicmap Data © State of Victoria; Jacobs.
Vicmap, Esri, HERE, Garmin, METI/NASA, USGS, Vicmap, Esri, HERE, Garmin, FAO, NOAA, USGS



Jacobs

Figure 2.2: Project location



Project site

Major urban area

N

IS305100
GDA 1994 MGA Zone 55

A3
1:22,500

0 500 1,000 m

DATA SOURCES
© Commonwealth of Australia (Geoscience Australia) Geodata Topo 250k Series 3; Vicmap Data © State of Victoria; Jacobs.
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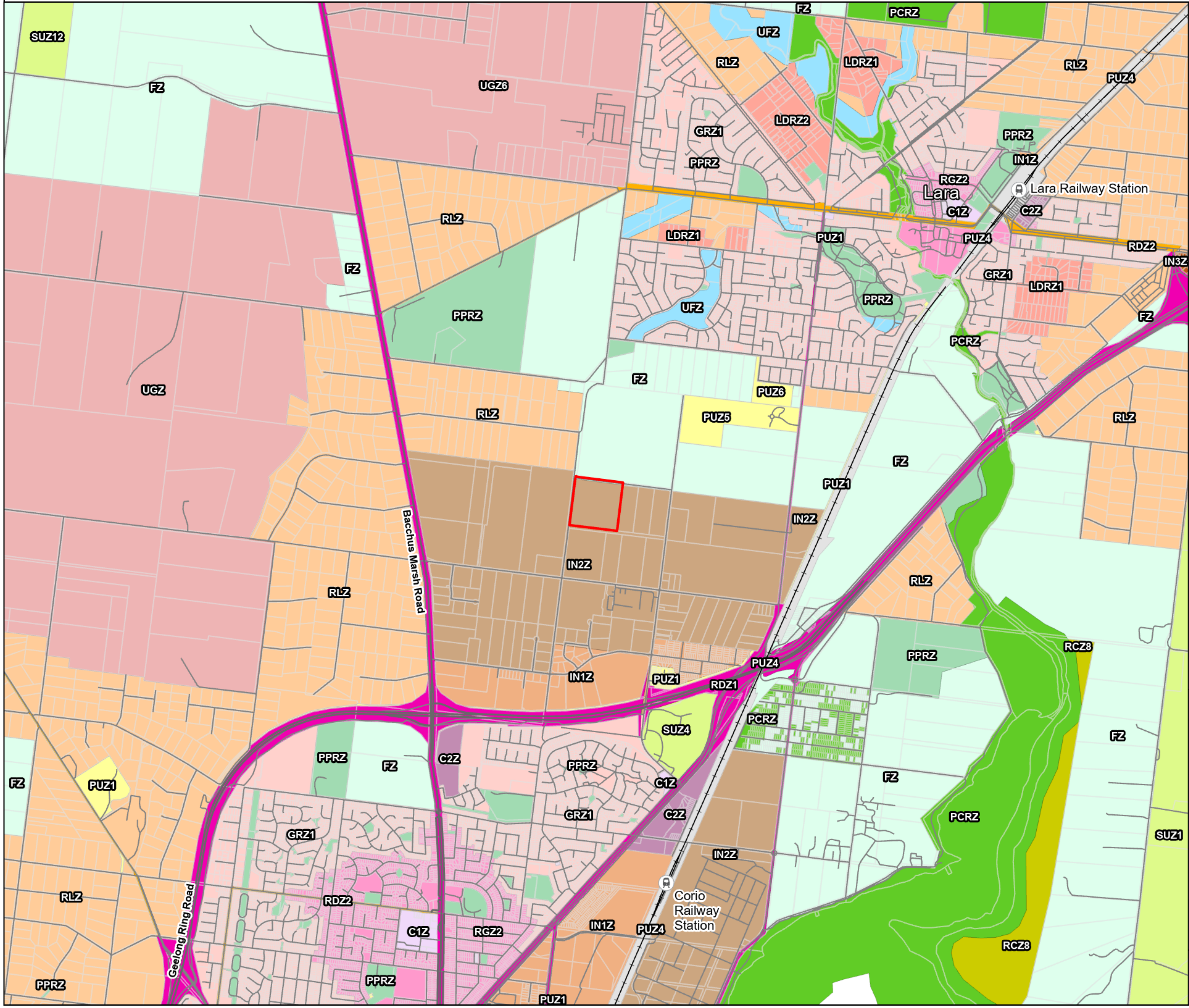
Jacobs

Path: J:\IE\Projects\03_Southern\IS305100\Spatial\ArcPro\IS305100\IS305100_Environmental.aprx\IS305100-CRTO-000077_Figure_2_2_ProjectLocation_A3_Landscape
Created by WARDA on 4/09/2020

Figure 2.3: Planning context



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Vicmap, Esri, HERE, Garmin, FAO, NOAA, USGS

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3. Regulatory approvals

3.1 Legislation

EfW plants in Victoria currently require a Works Approval under the EP Act. The EP Act however has recently been amended by the *Environmental Protection Act 2017* and the *Environment Protection Amendment Act 2018* and the transition to the new regulatory regime is scheduled for 1 July 2021. The new Environmental Protection legislation focuses on preventing waste and pollution impacts, rather than managing those impacts after they have occurred. The cornerstone of the new legislation is the general environmental duty (GED). The GED will focus how Victorian businesses, industry and the community can help prevent harm. The GED requires anyone conducting an activity that poses risks to human health and the environment to understand and minimise those risks. In anticipation of this new legislation coming into effect next year, a thorough analysis of the risks associated with this Project has been undertaken and is presented in Chapter 6. Any activities that pose a risk to human health and the environment have been further assessed by technical specialists and potential impacts mitigated to ensure the Project can operate safely and without harm people and the environment.

The Project is subject to a range of other environmental and development related approvals required under various Commonwealth and State legislation. Table 3.1 summarises the applicability of the legislation and additional (new) approvals required prior to the commencement of development or operations. These approvals are not directly relevant or dependant on the Works Approval application (with exception to the EPA Licence application), however this information is provided to understand the broader regulatory context.

Table 3.1: Approvals considered and their applicability to the Project

Approval	Project phase	Legislation	Applicable	Regulator	Description
Environmental Impact Assessment	Construction/ operation	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act)	No	Department of Agriculture, Water and Environment	An EPBC Act referral has not been prepared as Matters of National Environmental Significance protected under the EPBC Act are not anticipated to be impacted.
Environment Effects Statement (EES)	Construction/ operation	*Environmental Effects Act 1978* (Vic)	No	DELWP	The Project does not trigger referral criteria for an EES
Commissioning Approval (30A)	Commissioning	EP Act (Vic)	Yes	EPA	Subject to Works Approval, PHI will need to apply for a commissioning approval (during construction of the plant) to allow for emissions during the commissioning phase of the project.
EPA Licence	Operation	EP Act 1970 (Vic)	Yes	EPA	Subject to Works Approval, PHI will apply for an EPA Licence prior to commissioning of the plant.

Approval	Project phase	Legislation	Applicable	Regulator	Description
Planning Permit	Construction/ operation	*Planning and Environment Act 1987* (Vic)	Yes	DELWP	The Project Site is zoned as IN2Z under the Greater Geelong Planning Scheme. In the IN2Z, a planning permit is required for the use of land for the purpose of a Waste to Energy facility and to construct a building or construct or carry out works.
Cultural Heritage Management Plan (CHMP)	Construction	*Aboriginal Heritage Act 2006* (Vic)	No	Aboriginal Affairs Victoria	Whilst the proposed works are defined as a high impact activity, the project area does not intersect with any designated areas of cultural heritage sensitivity. Therefore, a mandatory CHMP is not required. A voluntary CHMP has not been recommended as the Project Site has been heavily disturbed.
VicRoads	Construction	*Planning and Environment Act 1987* (Vic)	Possibly	VicRoads	The site is currently proposed to be subdivided into two separate parcels, including one for the road reserve (R1\PS742703) and one for the main property (4\PS742703). The status of this application for subdivision is unconfirmed. The proposed Production Way road parcel is located within the FZ under the Greater Geelong Planning Scheme. PHI is required to complete construction of Production Way as a condition of purchase for the property from Greater Geelong City Council. A planning permit is not required for the use and development of land for the purposes of a road, pursuant to Clause 62.01 and Clause 62.02-2 of the Greater Geelong Planning Scheme.
Bushfire Management Overlay	Construction	*Planning and Environment Act 1987* (Vic)	No	Country Fire Authority (CFA)	The Project Site does not have a Bushfire Management Overlay (BMO).
Permit to take	Construction	*Flora and Fauna Guarantee Act 1988* (Vic)	No	DELWP	The Project Site is highly unlikely to support any native vegetation, threatened species and/or threatened species habitat or threatened ecological communities. Further, a *Flora and Fauna Guarantee Act 1998* 'Permit to Take' would not be required as the Project is within private land.
Native vegetation removal	Construction	*Planning and Environment Act 1987* (Vic)	No	DELWP	Native vegetation is not present on the site.

Approval	Project phase	Legislation	Applicable	Regulator	Description
Major Hazard Facility	Operation	*Occupational Health & Safety Act 2004* (Vic)	No	WorkSafe Victoria	The Project does not trigger referral criteria for a Major Hazard Facility.
Dangerous Goods	Operation	*Occupational Health & Safety Act 2004* (Vic)	Yes	WorkSafe Victoria	Under this legislation there is a requirement to consult with the CFA regarding storage and handling arrangements for Dangerous Goods.

3.2 Regulations, guidelines and policies

The key regulations and guidelines relevant to the Project are outlined in Table 3.2.

Table 3.2: Key regulations and guidelines relevant to the Project

Regulation/Guideline	Purpose
General	
EPA Publication 1517.1: Demonstrating best practice (EPA, 2017b)	Provides guidance on how to demonstrate compliance with best practice requirements
EPA Publication 1658: Works approval application guideline (EPA, 2017a)	Explains what is required in a works approval application
EPA Publication 1657: Works approval assessment process (EPA, 2017c)	Provides an overview of the works approval process
EPA Publication 480: Environmental guidelines for major construction sites (EPA, 1996)	Best practice environmental management measures to reduce impacts from construction sites
Environment Protection (Scheduled Premises) Regulations 2017	Prescribes the premises that are subject to works approval, financial assurance and/or licensing by EPA
EPA Publication 1559.1, Energy from Waste (EPA, 2017d)	Outlines how the EP Act is applied to the assessment of proposals that recover energy from waste. It states that EfW plants will be assessed against the following criteria: ▪ Suitability of EfW as an option ▪ Waste acceptance and preparation for energy recovery ▪ Siting, design, construction and operation of EfW facilities ▪ Thermal efficiency of EfW plants
Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (2010 EC IED) (European Commission, 2010)	A European Union directive which commits European Union member states to control and reduce the impact of industrial emission on the environment
European Commission Waste Incineration Best Available Techniques (BAT) Reference Document (2019 EC BREF) (European Commission, 2019)	Outlines best practice techniques for disposal or recovery of waste in waste incineration plants and the disposal or recovery of waste involving the treatment of slags and/or bottom ashes from the incineration of waste. Includes measures for emissions to air, emission to water and the efficiency of the recovery of energy and of materials from the waste
Waste	
EPA Guideline, Waste Categorisation Publication Industrial Waste Resource Guidelines (IWRG) 600.2 (EPA, 2010)	Provides a definition of all waste types
Industrial Waste Resource Guidelines – Solid Industrial Waste Hazard Categorisation and Management. EPA Publication IWRG 631 (EPA, 2009)	Guidance for waste generators and treaters in categorising their solid industrial waste based on the hazard posed by those wastes and determining the hazard category of prescribed industrial wastes (PIWs) that come from manufacturing sources, that are not contaminated soils and that are destined for disposal at a landfill
Recycling Victoria – A New Economy (DELWP, 2020)	Outlines the Victorian Government 10-year policy and action plan for waste and recycling
Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP)	30-year roadmap to improve Victoria's waste and recycling infrastructure

Regulation/Guideline	Purpose
Environment Protection (Industrial Waste Resource) Regulations (2009), and Amendment Regulation (2016)	Prescribes the definition of PIW
Waste Management Policy (Combustible Recyclable and Waste Materials) 2018 (EPA, 2018a)	Outlines the responsibility of a waste and resource recovery facility to manage and store combustible waste materials in a manner that minimises the risks of harm to human health and the environment from fire
Air quality	
National Environment Protection Measure for Ambient Air Quality, or the 'AAQ NEPM' (NEPC, 1998)	Aims to improve the health of Australians through improved air quality. The standards relate to six criteria air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants (O_3), sulfur dioxide (SO_2), lead (Pb) and coarse particulate matter (PM_{10} and $PM_{2.5}$)
State Environment Protection Policy (Ambient Air Quality) or the SEPP (AAQ) (EPA, 1999a)	Incorporates the standards of the AAQ NEPM except for a more stringent value adopted for annual average PM_{10} (VG, 2016)
State Environment Protection Policy (Air Quality Management) or the SEPP (AQM) (EPA, 1999b)	Provides best practice and continuous improvement for all relevant indicators and reductions to the Maximum Extent Achievable (MEA) for the more hazardous air pollutants
Noise	
Noise from Industry in Regional Victoria (NIRV, Publication 1411, October 2011) (EPA, 2011)	NIRV sets out procedures for setting levels for industry noise emissions with the recommended maximum noise levels (RMNLs) the maximum allowable
Health	
Health impact assessment guidelines (enHealth, 2017)	Provide an outline of the key steps required to complete a health impact Assessment and the role of key stakeholders
Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards (enHealth, 2012)	Provides a national approach to environmental health risk assessment

4. Environmental best practice

Under the EP Act sources of emissions or discharges to the environment must be managed in accordance with ‘best practice’. EPA publication 1517.1 ‘Demonstrating Best Practice’ outlines how EPA assesses best practice and provides guidance on how to demonstrate compliance with best practice requirements. A definition of best practice, provided in the SEPP (AQM), is:

> *“The best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity”*

The principle of integration of economic, social and environmental (i.e. triple bottom line) considerations (section 1B of the EP Act and as noted in the guidelines) also makes it clear that best practice needs to be cost-effective and commensurate to the significance of the environmental issues being addressed. This aligns with the risk-based approach and has been fundamental to the consideration of environmental best practice throughout the design process.

The EPA has advised that best practice in regard to EfW plants includes compliance with the European Union’s Waste Incineration Directive 2000/76/EC (WID), which was recast into the 2010 EC IED (European Commission, 2010) and The European Commission (2019) Best Available Techniques (BAT) Reference Document for Waste Incineration, which was drawn up in the framework of the implementation of the 2010 EC IED.

The 2010 EC IED is seen as the leading standard globally for EfW air emissions and sets stringent emission limits and monitoring requirements including continuous emissions monitoring of total particulate matter (TPM); sulfur dioxide (SO_2); oxides of nitrogen (NO_x); hydrogen chloride (HCl); carbon monoxide (CO); total organic carbon (TOC); and hydrogen fluoride (HF). The Continuous Emissions Monitoring System (CEMS) is a collection of sophisticated and reliable in-line instruments, located in the flue gas piping, with a computerised data acquisition and process control system.

The 2019 EC BREF is prepared by a European Commission technical working group to review best available techniques for the industrial processes covered under the 2010 EC IED. The 2019 EC BREF recommendations has led to updates to emission limits that operating combustion plants within EU countries will need to comply with by 2023. As the Project will be operational post 2023, it has been designed to be in accordance with best available techniques and emission limits documented in the 2019 EC BREF.

4.1 Methodology

The methodology used to assess the Project against best practice requirements follows the process in EPA Publication 1517.1 and is described below:

- Conduct a Risk Assessment to determine potential environmental issues. A risk assessment of the Project’s potential impacts was conducted to determine the key risks that would be the focus of best practice assessment and is described further in Chapter 6
- Define the scope of the best practice assessment. Using the results of the risk assessment, the scope of the best practice assessment can be defined
- Conduct a review of available options. Provide a summary of the potential options available for the Project, including the ‘do nothing’ option
- Best practice analysis. Conduct an analysis of the Project’s emissions including referencing evidence in accordance with Table 3 of EPA Publication 1517.1, which outlines evidence or analysis based on:
  - Literature review
  - Benchmarking
  - Application of the wastes hierarchy

- Integration of economic, social and environmental considerations
- Integrated environmental assessment
- Best practice assessment. Provide an integrated conclusion to the analysis and justification for the preferred design

4.1.1 Risk assessment

A risk assessment was conducted to ensure appropriate controls would be implemented for the Project to mitigate environmental risks to an acceptable level. Further details on the risk assessment conducted for the Project are discussed in Chapter 6.

4.1.2 Scope of best practice assessment

The results of the risk assessment enabled the best practice assessment to be focussed on the higher risk aspects. Following risk assessment process, PHI worked on reducing the potential environmental impacts of the Project by developing mitigation measures that could be incorporated into the project's design. This led to most of the Medium and High operational risk items being reduced to Low risks as identified during the risk assessment process.

Given that the environmental impacts due to construction would be temporary (of short duration) and that best practice construction measures are proposed to be utilised in accordance with EPA Publication 480 (Environmental Guidelines for Major Construction Sites), the best practice assessment focussed on the potential operational impacts of the Project and how the design could be enhanced to minimise environmental impacts.

4.1.3 Options overview

Throughout the planning, concept design and environmental assessment of the Project, an iterative options analysis has been undertaken. This process has been implemented to every component of the Project, with the key components summarised as follows:

- Consideration of the 'do nothing' approach:

Without the Project, the main benefits would not be achieved, including the diversion of waste from landfills and achieving a net reduction in GHG emissions

- Site selection

During the feasibility stage of this project several potential project sites were assessed using the following key criteria: zoning of the land, road access, availability of services, site readiness and potential social and environmental impacts. The key factors that make the Lara site suitable for the Project are:

- The site is located within the GREP. The GREP is Geelong's largest designated industrial development precinct and includes over 500 ha of land zoned for heavy industrial purposes
- The site is located within an industrial planning zone (Industrial 2 Zone or "IN2Z") which is designated for large industrial purposes like an EfW plant. Under the Greater Geelong Planning Scheme, one of the purposes of the IN2Z is "To provide for manufacturing industry, the storage and distribution of goods and associated facilities"
- Geelong and the surrounding region have suffered from the closure of large manufacturing plants over recent years. PHI sees this project as an opportunity to bring back some of those skilled jobs to the area and hopes to employ people who may have been impacted by skilled job losses in recent years
- The site is located close to potential waste sources, including Geelong, the Surf Coast and Bellarine as well as the growing region of western Melbourne
- The site has good transport links, being close to the Princes Freeway and Geelong Bypass
- Trucks that transport waste to the plant will be able to access the site through roads in the industrial zone and not have to travel on residential streets.

- Conceptual project layout:

A number of iterations of the conceptual project layout were developed. The proposed layout was based on the physical and planning constraints of the site and on reducing potential emissions at sensitive receivers

Refer Appendix M for further details

- EfW Plant process design:

A number of equipment options were considered for most components of the plant. The proposed plant process design was determined based on the performance of plant implemented internationally and whether these would meet best practice requirements if implemented for the Project

Refer Chapter 7.4 for further details

4.2 Best practice analysis

A summary of the best practice considerations relevant to the key environmental risks are discussed below.

4.2.1 Literature review

Throughout the planning, concept design and environmental assessment of the Project, a number of publications relating to environmental best practice were reviewed to inform the decision-making process. This included EPA Victoria Guidelines, SEPPs, and relevant European Commission reference documents. The relevant best practice guidelines discussed in Chapter 4.1, with a full list of regulations and guidelines reviewed throughout the development of this Works Approval application listed in Chapter 3.2.

4.2.2 Benchmarking

Benchmarking has been used throughout the decision-making process as a tool to analyse relevant performance indicators for the Project. Although there are currently no comparable MSW EfW Plants operational in Australia, the technology has been used extensively internationally. Details of this benchmarking, including examples of technology meeting the required emission standards in practice at existing reference plants, are described throughout the detailed process description of the EfW Plant in Chapter 7.

4.2.3 Application of the wastes hierarchy

The wastes hierarchy is one of eleven principles of environment protection contained in the EP Act. The application of the wastes hierarchy has been an active part of Project decision-making processes. The EfW feedstock will comprise primarily of MSW which represents a relatively predictable baseload feedstock having relatively consistent compositions.

MSW waste will be supplemented with other residual waste sourced from the C&I sector, but only from those businesses generating waste appropriate for treatment by EfW. Importantly, the Project would not negatively impact on the higher order management including recycling or reuse, as the MSW and C&I to be used is proposed to be acquired post source segregation.

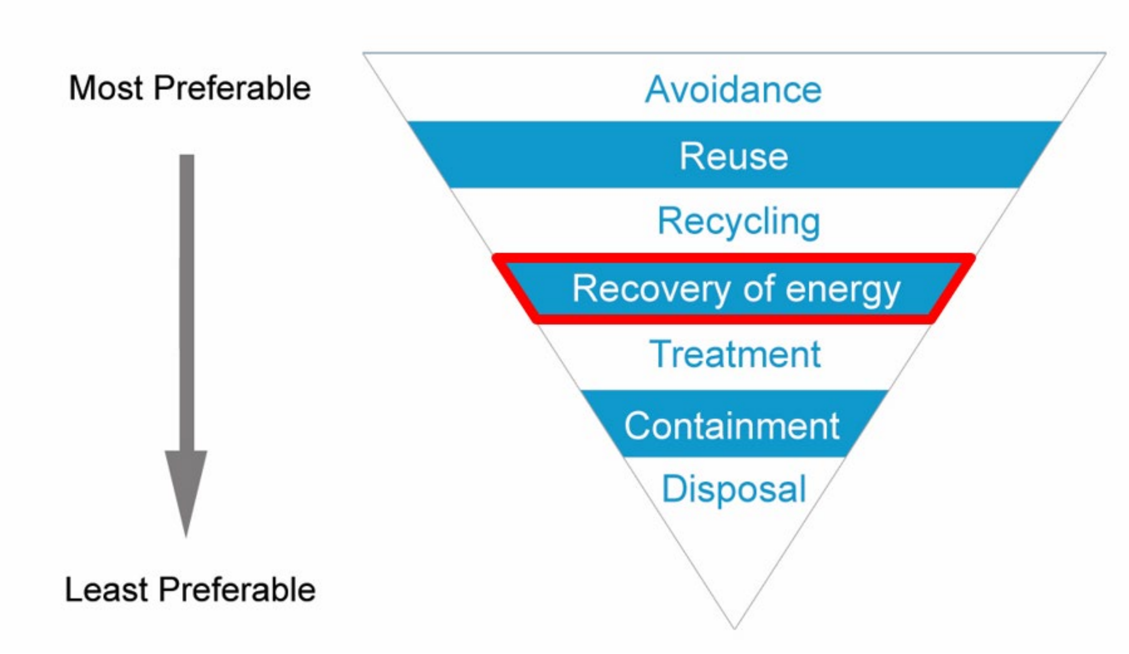
The treatment of co-mingled recycling does generate a residual waste stream. Diverting this residual waste stream from disposal (landfill) to an EfW plant would indicate that the two processes are complementary.

Ferrous metal present in the feedstock is effectively cleaned of contaminants that could inhibit recycling processes and will remain with the bottom ash after the combustion process. These metals will be separated and sorted from bottom ash and sent for recycling.

These actions are supportive of resource recovery options where the overall proposal provides a best practice option for waste management and environmental protection. The use of MSW and C&I wastes will divert these wastes from landfill (the current fate) and recover the energy. This will result in a higher order use of wastes according to the Wastes Hierarchy, moving from “Disposal” to “Recovery of energy” and “Recycling” for metals.

The development of bottom ash for beneficial use (e.g. as road base) would see a further transference from "Disposal" to "Re-use".

Figure 4.1: Wastes hierarchy showing the order of option of preference and EfW (EPA, 2019)



4.2.4 Greenhouse gas reduction

By moving up the wastes hierarchy, another significant environmental benefit is the substantial reduction in overall GHG emissions, predominately from the reduction of waste going to landfill. Although the EfW Plant will have direct emissions of approximately 190,000 tonnes of carbon dioxide equivalent (tCO_2e) per year, the net benefit of the Project from avoiding emissions is approximately 315,000 tCO_2e per year; (Chapter 11). By comparison, landfill of the waste alone would result in emissions of approximately 300,000 tCO_2e per year.

The emissions profiles of Victoria and Australia (and the proportion reduction that this Project would represent) are (for 2018 – latest dataset available):

- Australia – 537,446 kilotonnes of carbon dioxide equivalent ($ktCO_2e$) / year – 0.06% reduction
- Victoria – 102,189 $ktCO_2e$ / year – 0.31% reduction

In line with the Protocol for Environmental Management: GHG emissions and energy efficiency in industry (EPA, 2002) (PEM), and to satisfy the objectives of SEPP (AQM), PHI will commit to identifying and implementing best practice in relation to energy use and GHG emissions associated with the design and development of the EfW Plant.

4.2.5 Energy efficiency

The thermal efficiency of the EfW plant must meet the criteria as defined in the Victorian EPA's Energy from Waste Guideline (EPA, 2017). This states that:

> *"For dedicated EfW plants, the proponent should demonstrate the thermal efficiency of the proposed technology using the R1 Efficiency Indicator as defined in the European Union's Waste Framework Directive 2008/98/EC (WID). For a plant to be considered a genuine energy recovery facility, R1 will be expected to be equal or above 0.65. Alternatively, if R1 is below 0.65, proponents will be expected to provide a justification as to why this value cannot be reached."*

The R1 figure for the proposed EfW plant is 0.76, which comfortably exceeds this value, and represents the fact that both electrical and steam outputs are being utilised in line with best practice. See Chapter 11, Appendix C for calculation details.

4.2.6 Air emissions

With respect to air pollutant emissions, the SEPP (AQM) defines 'best practice' as: 'the best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity'.

The SEPP (AQM) requires application of best practice and continuous improvement for all relevant indicators and reductions to the Maximum Extent Achievable (MEA) for the more hazardous air pollutants (class 3 indicators).

In the case of air emissions, best practice can be distinguished from the requirement to reduce emissions of hazardous air pollutants to their MEA. An MEA requirement gives less consideration to cost and places more emphasis on minimising risk to human health than a 'best practice' or 'best practicable measures' requirement.

In contrast, a degree of pragmatism and cost effectiveness is implied in the EPA (2017d) Guideline 1517.1, Demonstrating Best Practice, which assists with the assessment of best practice. The EPA's approach to assessing best practice is to use a risk-based approach as discussed in Chapter 4.1.1.

EPA Publication 1517.1 (EPA, 2017d) outlines suggested evidence or analysis techniques that can be used to demonstrate an assessment of best practice for a Works Approval Application. Specifically, EPA (2017a) provides a range of information and best practice requirements relevant to air pollution emissions from EfW facilities.

EPA Publication 1559.1 (EPA, 2017b) outlines how the EPA assesses the proposed implementation of best practice technology and operations and provides guidance on how to demonstrate compliance with requirements. The guideline states that air emissions associated with processing of waste (for EfW) are consistent with the SEPP (AQM).

More specific guidance is as follows:

Health protection must be an inherent feature during the design, approval process and operation of EfW facilities. In the case of air emissions, EPA currently considers thermal treatment technology as best practice if:

- Emissions of Class 3 indicators as set out in SEPP(AQM) are reduced to the Maximum Extent Achievable (MEA) which involves the most stringent measures available.
- Emission discharges, under both steady and non-steady state operating conditions, meet all the emissions standards set in the European Union's Waste Incineration Directive 2000/76/EC (WID), which was recast into the Industrial Emissions Directive 2010/75/EU (IED). The IED sets stringent emission limits and monitoring requirements which include:

  (1) Continuous emissions monitoring of total particulate matter (TPM); sulfur dioxide (SO_2); oxides of nitrogen (NOx); hydrogen chloride (HCl); carbon monoxide (CO); total organic carbon (TOC); hydrogen fluoride (HF). In addition, there must be at least non-continuous air emission monitoring of other pollutants such as heavy metals, dioxins and furans, a minimum of two measurements per year, which should be more frequent during the initial operation of the plant. This monitoring should capture seasonal variability in waste feedstock and characteristics.

  (2) Additionally, in order to guarantee complete combustion, the IED requires all plants to keep the combustion or co-combustion gases at a temperature of at least 850°C for at least two seconds after the last injection of air. If waste with a content of more than 1 per cent of halogenated organic substances, expressed as chlorine, is combusted, the temperature must be raised to 1,100 °C for at least two seconds after the last injection of air.

- Finally, the combustion of waste or RDF as fuel replacement in an existing facility should have comparable or reduced emissions to atmosphere in comparison to the emissions from the standard fuel it replaces, with appropriate risk controls in place.

Discussion on the consideration of the EPA and European Commission requirements for air emissions in the decision-making process and Air Quality Assessment are provided in Chapters 7 and 12 and Appendix D. Air Emissions from the EfW Plant will need to meet these requirements, and a number of best practice emission control measures would be implemented as outlined in Chapter 4.2.8.

4.2.7 Odour

The main sources of odour from the EfW plant will be the tipping hall and waste bunker, which are in areas that will receive waste.

To control fugitive emissions, the tipping hall and waste bunker will be maintained under negative air pressure, continuously controlling odour emissions whilst one of the boilers is operational.

On rare occasions, there may be a short-term boiler outage causing the waste combustion lines to go offline. It is anticipated that systems and procedures will be in place to minimise any odours generated from waste remaining in the bunker. As a minimum, these include: a stack ventilation shutdown system to maintain negative pressure in the bunker and tipping hall, and an odour filtration system prior to the discharge point located on the facility roof for good dispersion.

Odorous emissions from the waste are expected to be well controlled and contained within the Plant infrastructure. Any odorous releases from the Plant are anticipated to be rare, short-term events.

4.2.8 Selection of preferred emissions control and reduction technologies

As discussed in Chapter 4.2.6, emissions to air from EfW plants in Europe are tightly regulated by the 2010 EC IED, which has subsumed the regulations that were formerly known as the WID. This legislation sets out the stringent emissions levels for pollutants and is considered a tougher compliance standard than the regulations applying to non-waste burning, large combustion plants such as coal and biomass power stations. In December 2019, the EU finalised the drafting of an update to their Best Reference Document for Waste Incineration[1] (2019 EC BREF) which made a series of recommendations about improvements to emission controls amongst other things. It is expected that in the next revision of the current 2010 EC IED, the 2019 EC BREF emission limit recommendations will become a requirement for all new EfW plant across Europe. When adopting BAT emission control techniques, modern EfW plants can comfortably comply with the 2010 EC IED, and new plant with best practice emission controls can comply with the 2019 EC BREF limits. The relevant average emission limits under both the 2010 EC IED and 2019 EC BREF are provided in Chapter 7.4.

Air emissions from the main stack are the most regulated and controlled emissions from an EfW plant, and a facility is required to have CEMS for the majority of pollutants to ensure compliance with the best practice requirements. Table 4.1 provides a summary of the types of emissions found in low concentrations in flue gas (from MSW and C&I feedstock) and the Best Available Techniques (BAT) typically used to control these emissions.

Table 4.1 Flue gas emissions and treatment

Flue gas emissions	BAT Treatment
Oxides of Nitrogen (NOx)	Controlled by combustion control and a selective non-catalytic reduction (SNCR) system with the injection of ammonia or urea into the hot flue gases
Oxides of Sulphur (SOx)	Controlled by the injection of lime (alkaline) reagent into the flue gas to absorb and neutralise the acid gas compounds
Halogens (e.g., HCl, HF)	Controlled by lime (alkaline) reagent injection, neutralisation and adsorption
Particulates	Boiler ash and APC residues are filtered out in the bag filter system
Heavy Metals (e.g., Hg, As, Cd, etc)	Controlled by the injection of activated carbon into the flue gas which is subsequently collected downstream in the bag filter system
Volatile organic compounds including dioxins and furans	Destroyed by high temperature in the furnace. The reformation of these compounds is inhibited by controlling the flue gas cooling and using activated carbon injection and bag filters to absorb and remove any residuals

4.2.9 Noise

Noise emissions from Project operations may occur from various equipment including blowers, fans, cooling towers, turbines and boilers. All of the equipment specifications will have point source noise limits (A-weighted decibels [dB(A)]) based on WorkSafe limits, and the Project will comply with *Noise from Industry in Regional Victoria* (NIRV, Publication 1411, October 2011*)*. Some equipment of this nature will be enclosed to minimise noise impacts.

Particular noise generating equipment includes the cooling towers. Best practice design has been incorporated and the cooling tower system will be an induced mechanical draft counter-flow wet-cooling tower with multiple cells, each with a low noise variable speed fan. Other noise mitigating design elements in the EfW Plant will include the cranes in the storage bunker, which will be designed for low noise and minimal vibration during all modes of operation, and the reduction of noise emissions from steam blowing during hot commissioning through the use of a temporary silencer. Details of the noise assessment can be found in Chapter 13.

4.2.10 Biological control

Biocide and anti-scaling dosing systems are proposed for the cooling tower, which will minimise biological organisms or scale build-up within the cooling water system. The cooling towers shall comply with statutory requirements of the *Victorian Public Health and Wellbeing Act 2008* and the Victorian Public Health and Wellbeing Regulations 2019 and the *National Construction Code* (NCC).

4.2.11 Economic, social and environmental consideration

The best practice analysis described in this chapter highlighted the following examples of broader economic, social and environmental benefits from the Project:

- Convert waste that can't be recovered by recycling, reuse or waste avoidance into ~35 MWe, enough to power up to 50,000 homes
- Contribute to the Lara community by creating hundreds of jobs during construction and approximately 30 permanent jobs for the duration of the Project
- Reduce GHG emissions, with a saving of ~300,000 tCO_2e emission each year
- Contribute to energy security in Victoria by providing a new source of sustainable baseload power to the electricity grid
- Reduce the amount of waste going to landfill, leading to environmental and social benefits (less pollution, better amenity)

4.2.12 Conclusion

There are numerous considerations for the Project that have been made in accordance with environmental best practice. The Project itself, where residual MSW and C&I wastes are diverted from landfill for a higher use on the wastes hierarchy (energy recovery), can be considered best practice use of waste. Other best practice considerations which have been investigated and applied for the Project include:

- Adherence to the 2010 EC IED and 2019 EC BREF for air emissions from the EfW Plant – the plant design will be in accordance with these requirements
- The use of negative air pressure in the tipping hall and waste bunker to control potential odour emissions
- A National Association of Testing Authorities (NATA) and Monitoring Certification Scheme (MCERTS) certified CEMS system for measuring pollutant and duct process condition parameters as required for on-line measurement under the 2010 EC IED and SEPP AQM
- Flue gas recirculation for control generation of nitrogen oxides in the furnace
- Selective Non Catalytic Reduction (SNCR) using urea solution to control nitrogen oxides in the upper zone of the furnace
- A combined dry and semi dry lime sorbent flue gas treatment system
- Energy recovery in a combined heat and power mode yielding higher energy efficiency and surpassing the 2010 EC IED R1 energy recovery benchmark
- Measurement and pursuit of further landfill diversion opportunities for bottom ash, with a focus on recycling and re-use
- Elevation of the residual waste stream of approximately 400,000 tpa +/-10% from Disposal (landfill) to higher order uses in the Wastes Hierarchy including Recovery of energy, Recycling and potentially Re-use.

5. Community and stakeholder engagement

5.1 Engagement overview

The communications and engagement approach for the Project is based on a foundation of openness, honesty and timeliness, and is consistent with the International Association of Public Participation (IAP2) spectrum for public participation. The spectrum is founded on the premise that different stakeholders will have varied levels of involvement in decision-making. It also assists in assigning a level of involvement with different stakeholder groups. Based on the scope for community involvement during these stages of the project, the level of engagement has largely operated at the 'inform' and 'consult' levels.

PHI's engagement objectives for these stages of the project have been to deliver an inclusive and robust communications and engagement process that:

- Manages community expectations about the level of influence they can have on the project
- Enables the development of relationships with stakeholders by raising early project awareness and gathering feedback
- Makes it clear how to access information about the project, provide feedback and keep informed
- Promotes project benefits through establishing clear and consistent messaging to ensure stakeholders understand the project purpose and how it will contribute to a more sustainable waste management chain
- Records evidence of engagement activities undertaken

It is important to note that while this consultation summary report covers engagement activities completed to date, PHI intends to continue engaging with the local Lara community throughout the project life cycle.

5.2 Engagement and COVID-19

While preparing to deliver stakeholder engagement activities in early 2020, the project team acknowledged that the global environment had entered a state of rapid and unprecedented change, with the coronavirus disease 2019 (COVID-19) pandemic having significant impacts across the community. Victorian Government limits on public and non-essential gatherings contributed to changes to the engagement approach, with a key change being the replacement of face-to-face community information sessions with an online information session.

5.3 Engagement process

The key aims in this early phase of the project were to raise awareness of the project and its benefits, and to give the community an opportunity to ask questions, provide initial feedback and raise concerns.

5.3.1 Website

A website has been developed for the project at https://prospecthill.com.au/, with content including an overview of the project, information about PHI, frequently asked questions and a web contact form. The site URL has been (and will continue to be) included on all project collateral.

The website has been updated throughout the project, with new information being added as it becomes available. This has included a soft copy of the project fact sheet and login details for the online information session.

5.3.2 Phone number

A 1300 phone number has been established for stakeholders to call to find out more information about the Project. The number goes directly to voicemail and the appropriate team member phones the caller back within three business days. The number has been (and will continue to be) included on all project collateral.

5.3.3 Email address

A PHI email address has been established for community members and other stakeholders to use as a point of contact. Senders receive an automatic reply with receipt of response and the project team replies to their email within three business days. The email address has been (and will continue to be) included on all project collateral.

5.3.4 Fact sheet and cover letter

An introductory fact sheet and cover letter were developed and distributed via Australia Post to all residential and commercial properties in the area bounded by Elcho Road, Patullos Road, Forest Road South, the Princes Freeway and Bacchus Marsh Road (approximately 1,600 properties) in July 2020 (Figure 5.1). The fact sheet was also uploaded to the project website and both documents were supplied to the City of Greater Geelong and EPA.

The cover letter introduced the Project and included an invitation to the online information session, while the fact sheet provided a high-level project summary, indicative project timelines, information about project rationale and benefits, introductory information about EfW, and PHI's contact details.

5.3.5 Online information session

On Tuesday 28 July 2020 from 7.30 to 8.30pm the project team delivered an online information session about the Project. Attendees were not required to register their interest prior and accessed the event via a link on the PHI website.

The session was delivered using Microsoft Teams and took the format of a 20-minute broadcast-style presentation followed by a 40-minute question and answer (Q&A) session. Attendees were able to submit questions throughout the session using the chat function, and as many questions as possible were verbally answered by members of the project team on the night. A summary of the key themes raised during the session can be found in Chapter 5.4.

5.4 Feedback and themes

5.4.1 Feedback channels and data

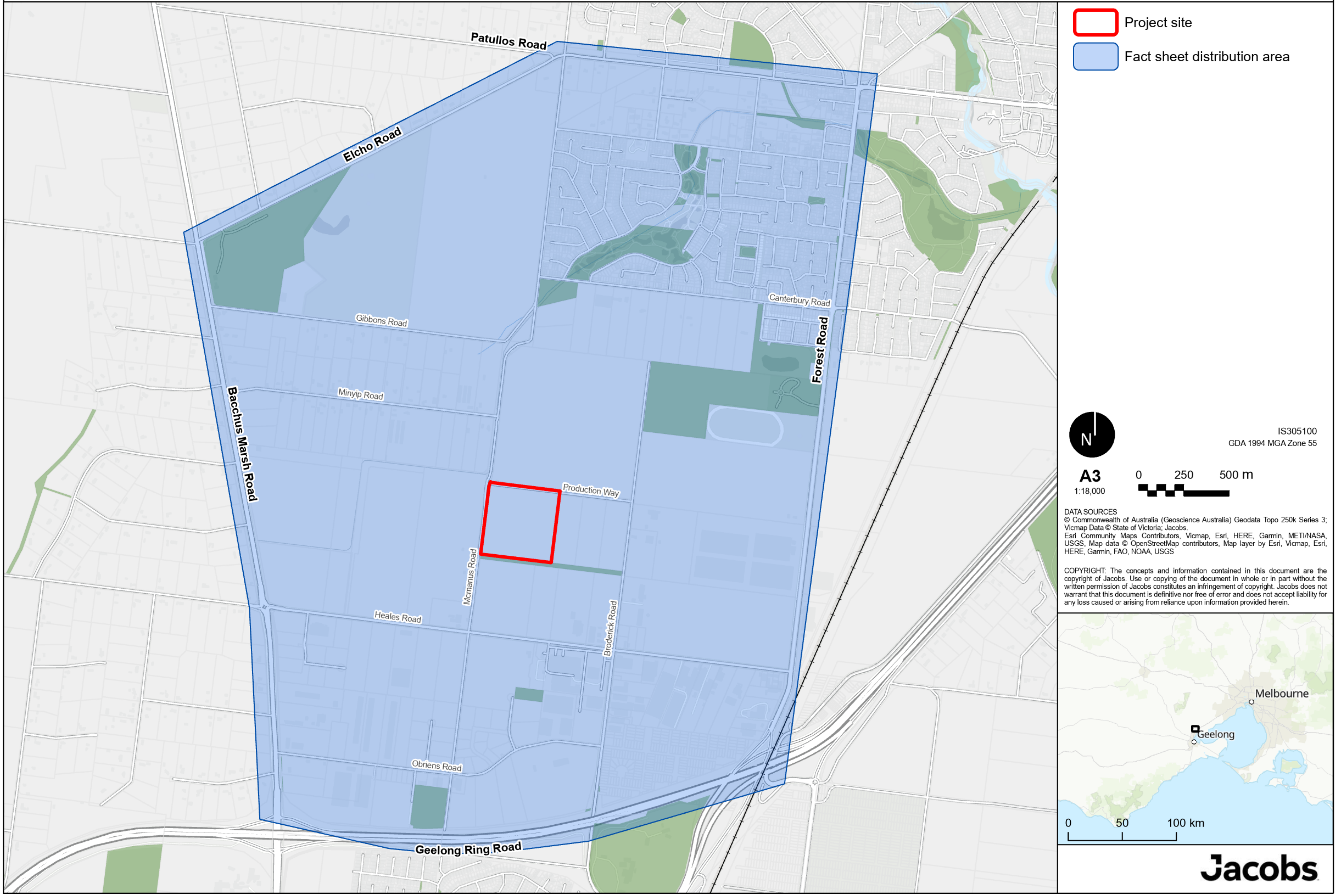
To date, community members and other stakeholders have engaged with the project team about the proposed EfW plant via all available channels, including:

- 10 contacts from stakeholders via the website contact form
- 11 contacts from stakeholders via email
- 5 contacts from stakeholders via phone
- 56 attendees at the online information session

The project team will continue to monitor the communication channels and respond to stakeholders as the project progresses.

A reporter from the Geelong Advertiser also contacted PHI via email and following engagement with the project team published two articles in the newspaper about the project on 25 July 2020 and 31 July 2020.

Figure 5.1: Fact sheet distribution area



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Jacobs

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Created by WARDA on 4/09/2020

5.4.2 Themes

The key stakeholders and community members engaged as part of this project to date have been diverse and highly engaged when interacting with the project team about the proposed EfW plant.

One of the most pleasing aspects of the process has been that among the range of observations and challenges identified by community members, many people have come to the conversation with detailed and informed questions.

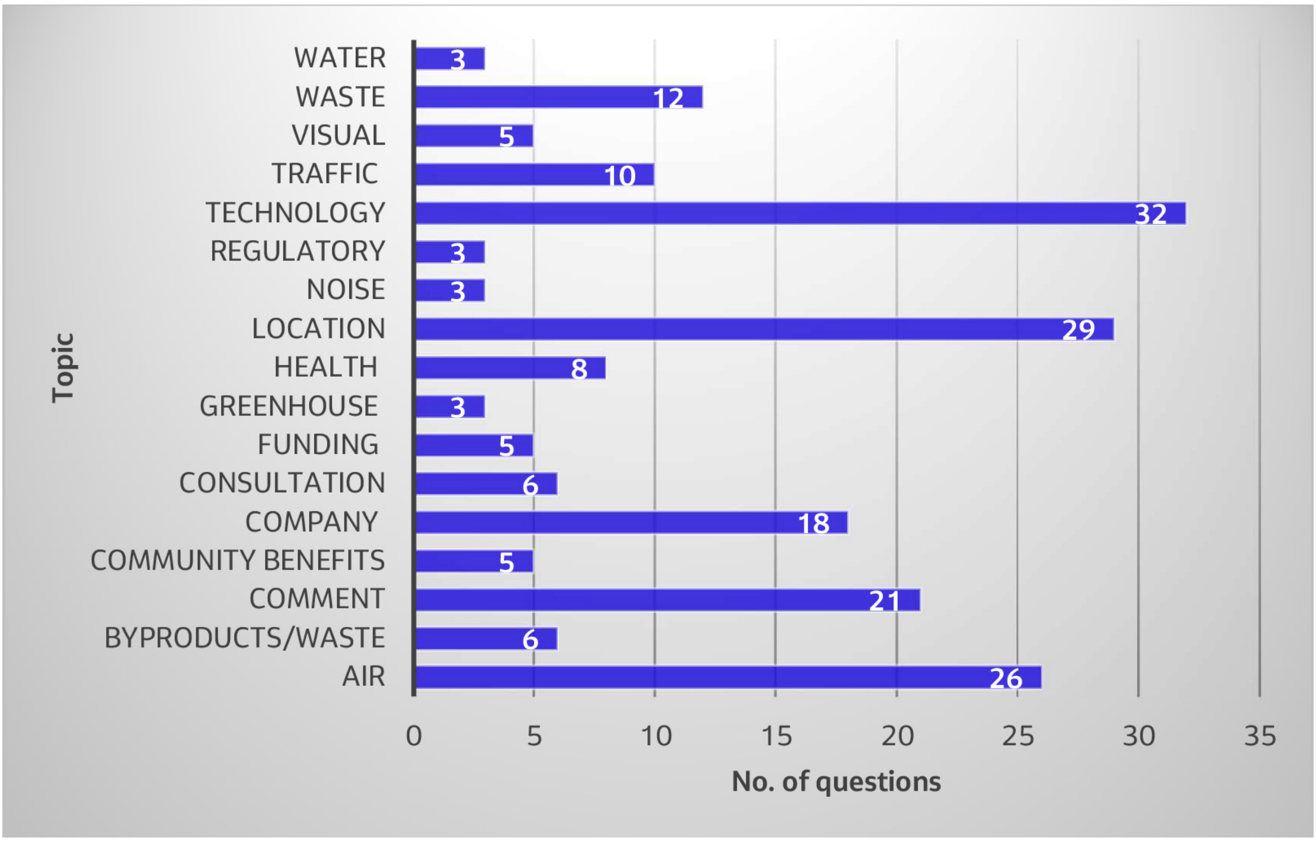
Different stakeholders have different perspectives and priorities related to the proposed plant specifically and to EfW as a broader concept. Nevertheless, PHI has identified several clear themes throughout the engagement period.

While the data displayed in Figure 5.2 below relates specifically to the online information session, these broader themes also correlate with those identified in communication received via other channels.

Attendees of the online information session on Tuesday 28 July were able to submit questions anonymously using the chat function on Microsoft Teams. Attendees posted just under 200 questions and comments throughout both the presentation and Q&A portions of the session, 15 of which were answered verbally by the Project Director and other members of the project team on the night.

The remainder of questions were grouped based on the below broad themes and answers to the questions that exist within each were uploaded to the PHI website in August 2020.

Figure 5.2: Online Information Session question and feedback themes



5.5 Key themes

Five key themes have been identified from the broader theme list and are explored in more detail below.

5.5.1 Technology

Many of the questions received across all channels throughout the engagement period have concerned the technology that PHI is planning to use for the proposed EfW plant.

In addition to general requests for more information about the technology proposed, stakeholders and community members have highlighted specific elements that are of particular interest to them, including the temperature achieved during combustion, the energy output in megawatts, whether natural gas is required to start combustion, the by-products of the combustion process, and whether there are examples from elsewhere around the world for comparison purposes.

5.5.2 Location

The location of the proposed plant has also been raised as a query or concern by many stakeholders. A large proportion of the contacts within this theme have simply related to stakeholders wishing to understand why this specific site in Lara was selected for the proposed plant.

This includes the criteria for selection and whether the site was suggested by any specific party. In addition, some stakeholders also expressed concern at the proximity of the site to housing, most particularly to the Lara township.

5.5.3 Air emissions

Throughout the engagement process the project team received a wide range of questions that fall under the theme of air emissions. Questions and comments have concerned elements such as air modelling, stack emission analysis, prevailing winds, emissions and pollutants.

Many stakeholders have expressed a wish to understand the type of assessments being completed to inform the application processes, with emphasis on accessing the results of these assessments when available.

5.5.4 Company

Questions relating to PHI as a company also form a key theme of the engagement to date.

Stakeholders and community members have asked a range of questions across all platforms on topics such as whether the company is private or government owned, the company's experience in delivering projects of this type, funding models, funding sources and project partners.

5.5.5 Waste

The final key theme is waste, with questions in this area focussing mostly on the logistics required for the running of the plant and on the actual process of turning waste into energy.

Stakeholders asked questions about the potential sources of waste (including whether it will come from Melbourne or Geelong), the types of waste proposed to be processed, the amount of waste to be processed and the procedure for identifying and removing harmful wastes from the feedstock on arrival at the plant.

5.6 Next steps

PHI intends to continue engaging with the local Lara community throughout the project life cycle. The existing channels – email, online contact form and 1300 phone number – will continue to be monitored by the project team and all enquiries will be responded to via these channels. The project team will also update the website with new information as it becomes available.

Feedback received will be considered as part of the design process, and the results of environmental assessments will be uploaded to the project website when available.

Further targeted consultation activities, such as the distribution of additional fact sheets or the holding of information sessions, are currently being considered by the project team. In addition, as part of the planning and design phase of the project, the project team is considering ways to deliver further benefits for the local community. PHI has a strong desire to conduct a face-to-face information session in the local Lara community but is cognisant of government restrictions related to COVID-19.

While PHI acknowledges that methods of interaction with the community will need to evolve with the COVID-19 pandemic, the company remains committed to meaningful interaction with the community.

6. Risk assessment

6.1 Introduction

Under the new *Environment Protection Act 2017* and the *Environment Protection Amendment Act 2018,* there is a new approach to environment protection issues which focuses on preventing waste and pollution impacts, rather than managing those impacts after they have occurred. This general environmental duty (GED) will focus how Victorian businesses, industry and the community can help prevent harm. The GED requires anyone conducting an activity that poses risks to human health and the environment to understand and minimise those risks.

The risk assessment presented in this chapter identifies the key risks of the Project and proposes mitigation measures to minimise these risks. It identifies risks associated with construction, operation and non-routine operational events. EPA Publication 1658 Works Approval Application Guidelines (June 2017) does not specifically require proponents to address plant decommissioning risks as part of a Works Approval application. As such, these issues will be addressed during subsequent design and development phases of the project.

The Project Risk Register is a live document and will be updated throughout the Project, as the approach to design, construction and operation of the site is refined (along with the understanding of the risks). Detailed design is an iterative process and as it matures, more detailed risk reviews, including a hazard and operability study (HAZOP), will be undertaken to ensure the development of appropriate controls.

The outcomes of these risk assessments will be incorporated into the following:

- The Construction Environmental Management Plan (CEMP) applicable to construction of the Project
- The Operational Environmental Management Plan (OEMP) applicable to commissioning and operation phases of the Project

Any significant changes to the risk profile that are not reflected in the current risk register will be communicated to EPA if they differ materially to those described in this Works Approval application.

6.2 Risk assessment methodology

The risks outlined in this chapter have been identified through:

- Qualitative environmental risk assessment undertaken prior to completion of the design
- Completion of technical assessments in support of this Works Approval application which provide greater detail on individual risk items (e.g. air quality modelling, engineering processes for the Project and waste management).

The overall risks of the Project have been predicted by determining the likelihood of a risk occurring (Table 6.1) and the consequence if it does occur (Table 6.2). The risk matrix (Table 6.3) and criteria (Table 6.4) have been adopted from EPA Publication 1695.1 Assessing and controlling risks for business (EPA, 2019b).

Table 6.1: Likelihood criteria

Likelihood	Frequency
Certain	Expected to happen regularly under normal circumstances
Likely	Expected to happen at some time
Possible	May happen at some time
Unlikely	Not likely to happen in normal circumstances
Rare	Could happen but probably never will

Table 6.2: Consequence criteria

Likelihood	Description
Severe	Permanent or long-term serious environmental harm / life threatening or long-term harm to health and wellbeing
Major	Serious environment harm / high-level harm to health and wellbeing
Moderate	Medium level of harm to health and wellbeing or the environment over an extended period of time
Minor	Low environmental impact / low potential for health and wellbeing impacts
Low	No or minimal environmental impact, or no health and wellbeing impacts

Table 6.3: Risk matrix

Consequence	Likelihood				
	Certain	Likely	Possible	Unlikely	Rare
Severe	Extreme	Extreme	High	High	Medium
Major	Extreme	High	High	Medium	Medium
Moderate	High	High	Medium	Medium	Low
Minor	High	Medium	Medium	Low	Low
Low	Medium	Medium	Low	Low	Low

Table 6.4: Risk ratings

Risk Level	Description
Extreme	Totally unacceptable level of risk
High	Unacceptable level of risk. Controls must be put in place to reduce or lower levels
Medium	Can be acceptable if controls are in place. Attempt to reduce to low
Low	Acceptable level of risk. Attempt to eliminate risk but higher risk levels take priority

6.3 Risk assessment outcomes

Table 6.5 provides the risks identified through the environmental risk assessment, potential impact of these risks, proposed mitigation measures and resultant risk incorporating these mitigations. Positive Project influences are also included where identified. The results of this risk assessment were used to focus the best practice assessment of mitigation measures. The Project team worked to reduce the potential environmental impacts by integrating mitigation measures into the plant's design. This led to most of the Medium and High operational risks being reduced to Low residual risks.

Table 6.5: Risk assessment

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
001	Project risk	Feasibility/ Operations	Waste sourcing	PHI is unable to secure long term feedstock supply from local municipal councils.	Project cannot source sufficient waste to operate plant	Major	Possible	High	Engage with the Waste and Resource Recovery Groups and local Councils about upcoming tenders for waste collection and disposal	Major	Unlikely	Medium
002	Noise emissions	Construction and Commissioning	General noise emissions during construction	Earthworks on site General construction activities Vehicle movements to and from site Assembly of plant	Reputational damage Complaints from community or stakeholders Nuisance / disturbance of community amenity Complaints from construction workforce Notice from EPA	Minor	Possible	Medium	Contractor EPC tender evaluation and selection process CEMP prepared by the contractor and approved by Council Construction undertaken in accordance with EPA Publication 480 and SEPPs, including scheduling operation of noisy machinery, maintenance of equipment and noise monitoring Use of a temporary noise damper on the steam blowing vent during start up and commissioning Advise local residents when unavoidable or excessive noise will occur Operator induction and training Rigorous and proactive complaints management process	Minor	Unlikely	Low
003	Noise emissions	Operation	General noise emissions during operation	Primary noise sources include blowers, fans, cooling towers, turbines and boilers Transport of feed material to site	Complaints from community or stakeholder Non-compliance with the NIRV (EPA Publication 1411) Health impacts to workforce Notice from EPA	Moderate	Possible	Medium	Design enclosure for key noise-generating plant (boilers, turbines, tipping hall, flue gas treatment) Contractor commissioning plan OEMP Operational & Maintenance (O&M) manuals and effective maintenance schedules Specification of low noise fans for cooling towers Adherence to permitted hours for operation and waste transport Operator training Further evaluation of controls during detailed design	Moderate	Unlikely	Low
004	Noise emissions	Non-routine or emergency	Noise emissions during non-routine event	Unexpected plant shutdown Emergency scenario: plant failure Boiler trip event leading to safety valve release Turbine trip	Complaints from community of stakeholders Amenity impacts Health impacts to employees/contractors Notice from EPA	Minor	Possible	Medium	Emergency procedures and emergency shutdown procedures Turbine bypass condenser avoiding venting via safety valve Advise local residents when expected and unavoidable excessive noise work will occur. Orientate valves away from sensitive receptors where possible Rigorous and proactive complaints management process Further evaluation during detailed design	Minor	Unlikely	Low

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
005	Air Quality	Construction	General air emissions (dust and non-EfW combustion emissions)	Earthworks Vegetation clearance Site preparation Mobile plant emissions Vehicle movements (wheel generated dust) Temporary plant	Complaints from community of stakeholders Amenity impacts Health impacts to employees/contractors Notice from EPA	Minor	Possible	Medium	CEMP prepared by the contractor and approved by PHI and council Construction undertaken in accordance with EPA Publication 480 Operator induction and training Implementation of appropriate dust control measures including soil stockpile management, dust suppression watering, vegetation clearance minimisation and revegetation, windbreaks and silt fences Maintenance of construction plant and in good working order to minimise exhaust emissions	Minor	Unlikely	Low
006	Air Quality	Operations	General air emissions (dust and non-EfW combustion emissions)	Vehicle movements (wheel-generated dust from roads) Transport of waste residues, reagents, equipment Unloading materials from transport Handling and transportation of residues (e.g. bottom ash, Air Pollution Control residues (APCr))	Complaints from community of stakeholders Amenity impacts Health and/or nuisance impacts to employees/contractors Notice from EPA or non-compliance with operating conditions	Moderate	Possible	Medium	Preparation and implementation of OEMP Further evaluation of controls during detailed design Enclosure of key plant (i.e. boilers, turbines, tipping hall, flue gas treatment) Vehicle and container washing facility Dispatch of APCr waste in sealed containers Dispatch of bottom ash to be quenched in water to minimise dust generation Delivery of MSW feedstock in enclosed containers Operational & Maintenance (O&M) manuals and effective maintenance schedules Operator training	Moderate	Unlikely	Medium
007	Air Quality	Operation and non-routine event	Odour, particulate or smoke emissions during operations	Plant start-up Plant failure Operator error Waste from tipping hall stored for too long Failure of tipping hall ventilation system Incomplete fuel (MSW) combustion Waste deliveries to/from site.	Complaints from community or stakeholders Amenity impacts Health impacts to employees / contractors Notice from EPA	Minor	Unlikely	Low	Design of tipping hall to avoid odour escape, including the following features: ▪ Tipping hall maintained under negative pressure ▪ Automated roller doors for vehicle entry ▪ Odours and air captured and combusted through boilers ▪ Boiler design to eliminate most VOCs and odours ▪ Odour monitoring and application of deodorisers if required Delivery of MSW feedstock in enclosed containers Back-up power systems to provide emergency power during non-routine events Detailed plant design, including air emissions controls, to meet EPA and EU emission standards Multiple boilers which can operate independently	Minor	Rare	Low
008	Air Quality	Commissioning	General air emissions (combustion air pollution products)	Plant start-up Plant failure Plant design Operator error Incomplete fuel (MSW) combustion Monitoring systems out of calibration Poor fuel quality/composition	Complaints from community or stakeholders Amenity impacts Health and/or nuisance impacts to employees Non-compliance with Commissioning Approval	Minor	Unlikely	Low	Emission, stack testing and in-line monitoring systems Emission control systems Detailed plant design to meet EPA and EU emission standards Implementation of commissioning and start-up procedure Operational manuals Fuel quality maintained through waste acceptance procedures Clean-burning gas used to start-up boiler	Minor	Rare	Low

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
009	Air Quality	Operations	General air emissions (combustion air pollution products)	Plant start-up Stack emissions Operator error Incomplete fuel (MSW) combustion Poor fuel quality / composition Monitoring systems out of calibration	Complaints from community or stakeholders Amenity impacts Health and/or nuisance impacts to employees Non-compliance with operating conditions Notice from EPA	Minor	Possible	Medium	Emission, stack testing and in-line monitoring systems Emission control systems Detailed plant design to meet EPA emission standards Implementation of commissioning and start-up procedure Operational manuals Fuel quality maintained through waste acceptance procedures	Minor	Unlikely	Low
010	Air Quality	Non-routine or emergency	General air emissions (combustion air pollution products)	Plant start-up Unexpected plant shutdown / power failure Operator error Failure of flue gas treatment system	Complaints from community or stakeholders Health and/or nuisance impacts to employees or community Non-compliance with air quality criteria set out in the State Environmental Protection Policy (SEPP) Air Quality Management Non-compliance with operating conditions	Moderate	Possible	Medium	Implementation of hazard controls (HAZID and HAZOP studies) EfW Control systems (on line analysers and monitoring equipment) Emergency Management Plan Plant operator training	Moderate	Unlikely	Medium
011	Air Quality	Operation	Reduction of total CO_2 emissions for the management of the waste feedstock	Diversion of waste from landfill Recovery of energy and displacement of electrical power needs	Cumulative GHG emissions over an assumed 25-year life of the EfW plant shows a net GHG benefit of approximately 8 $MtCO_2e$.	Moderate	Certain	High positive impact	Not required.	Moderate	Certain	High positive impact
012	Surface Water	Construction	Impact to surface water quality	Loss of containment of chemicals Spills and leaks from mobile plant, diesel generators, mobile lighting towers Erosion and increased sedimentation (particularly during high rainfall events) Increase in stormwater runoff from plant Vegetation clearance Earthworks	Reduced water quality (primarily sediment load) Public complaints (environmental damage, social values, recreational usage) Non-compliance with SEPP Waters of Victoria Notice from EPA (pollution abatement notice) Transport of contaminants offsite	Moderate	Possible	Medium	Development and implementation of CEMP Design of plant, bunding, chemical storage and spill management systems in accordance with EPA Publication 1698 Liquid storage and handling guidelines and relevant Australian Standards Development of chemical management and handling procedures Emergency Response Procedures Operator training	Moderate	Unlikely	Medium

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
013	Surface Water	Operations	Impact to surface water or trade wastewater quality	Increase in stormwater runoff from plant Increase in wastewater generation from cooling towers Plant failure Loss of containment of chemicals Spills and leaks Leachate from bunker	Reduced water quality Impacts to soil quality Public complaints (environmental damage, social values, recreational usage) Impacts to human health Health and/or nuisance impacts to employees Non-compliance with SEPP Waters of Victoria Non-compliance with operating conditions Non-compliance with Trade Waste Discharge Agreement conditions Damage to sewer infrastructure	Moderate	Possible	Medium	Appropriate design of drainage network and stormwater detention pond for 1:100 year average recurrence interval (ARI) Design plant to reuse water as much as possible Design of plant, bunding, chemical storage and spill management systems in accordance with EPA Publication 1698 Liquid storage and handling guidelines and relevant Australian Standards Sediment and erosion management Operational & Maintenance (O&M) manuals and effective maintenance schedules Emergency Response Procedures Operator training	Moderate	Rare	Low
014	Surface water	Construction and operations	Site contamination	Loss of containment from oil/water separator or neutralisation pit: ▪ Not enough freeboard allowed in ponds ▪ Overflow ▪ Operator error Spills or leaks of chemicals or fuel occurring in non-bunded areas e.g. during transport Leakage of waste water ponds Leakage through hardstand or bund structures	Local or regional groundwater contamination Non-compliance with SEPP Waters of Victoria Impacts to soil quality Release of contaminated leachate Health impacts to employees/contractors Non-compliance with EPA operating licence conditions Notice from EPA (pollution abatement notice)	Moderate	Possible	Medium	Design of plant, bunding, chemical storage and spill management systems in accordance with EPA Publication 1698 Liquid storage and handling guidelines and relevant Australian Standards Operational & Maintenance (O&M) manuals and effective maintenance schedules Emergency Response Procedures Operator training	Minor	Rare	Low
015	Land contamination	Operation	Offsite contamination	Spills or leaks of waste materials during transport to / from the site Vehicle incident Waste fire in transport vehicle	Impacts to offsite soil, surface water or groundwater quality Damage to infrastructure Health impacts to employees, contractors or the public Reputation damage Notice from EPA (pollution abatement notice)	Moderate	Unlikely	Medium	Vehicle inspection and maintenance programs Waste inspection protocols Transport Emergency Response Plan	Moderate	Rare	Low

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
016	Waste	Construction	General waste disposal	Construction materials (e.g. steel, concrete, other waste building materials etc.) Organic food wastes from construction workforce Escape of waste materials from the site / from vehicles during transport No segregation of waste materials Incorrect disposal Non-compliance with waste management procedures	Litter Vermin (birds and animals) Stormwater runoff from waste storage areas / stockpiled material Nuisance odour / health impacts to employees/contractors Materials not recovered for recycling / recovery Breach in waste transport disposal requirements	Minor	Possible	Medium	CEMP prepared by the contractor and approved by PHI and council Construction waste managed in accordance with EPA Publication 480 Environmental Guidelines for Major Construction Sites, including: ▪ Waste minimisation ▪ Provision of bins for workers ▪ Segregation of wastes for reuse, recycling and disposal ▪ Covering of vehicles carrying materials or waste	Minor	Unlikely	Low
017	Waste	Operations	Disposal of APCr and boiler ash	Waste generated from the flue gas treatment / APC equipment	Contamination of soil Release of contaminated leachate Increased hazardous waste requiring disposal Potential increase in contaminants for bottom ash	Moderate	Possible	Medium	Explore treatment and reuse options for bottom ash, including in road base or other construction materials Conduct leachability tests to determine waste categorisation and resultant disposal requirements Investigate contamination standards to provide "bookends" for bottom ash contamination. Develop strategy around waste management Separate approvals may potentially be required to stockpile material at a receiving site	Moderate	Unlikely	Medium
018	Waste	Operations	Management and disposal of rejected waste	Waste supply outside waste acceptance criteria	Increased waste volume disposal Increased hazardous waste requiring disposal Decreased waste recovery efficiency and energy generation	Moderate	Possible	Medium	Understand the composition of feedstock material by undertaking a waste compositional analysis Screening protocols and inspections for waste input feedstock Development of waste input feedstock acceptance criteria Additional sorting of waste via waste crane grab in bunker Containment bay in tipping hall for rejected waste Waste input feedstock acceptance criteria included in waste supply contracts Protocol and procedure for waste classification	Moderate	Unlikely	Medium
019	Waste	Operations	Disposal of bottom ash	Waste generated from the moving grate following combustion Waste generated inorganic content greater than expected	Release of contaminated material Increased waste volume disposal Incorrect waste disposal classification	Moderate	Possible	Medium	Explore reuse options for bottom ash including in road base or other construction materials Conduct leachability tests to determine waste categorisation and resultant disposal requirements Containment during transport Waste input feedstock acceptance criteria Waste input feedstock auditing at landfills and transfer stations to better determine waste composition	Moderate	Unlikely	Medium
020	Flora and fauna	Construction and operations	Loss of flora or fauna during construction and operational activities	Vegetation clearance Disturbance of fauna (noise)	Loss of habitat Death of fauna	Minor	Unlikely	Low	Flora and Fauna Desktop Assessment concluded that native vegetation did not persist on the Project Site and that previous site development further compromised the likelihood of significant statutory issues relating to flora and fauna. CEMP prepared by the contractor and approved by PHI and council	Minor	Unlikely	Low

I.D.	Risk type	Project phase	Risk description	Cause	Potential impact	Consequence	Likelihood	Risk level	Mitigation	Consequence	Likelihood	Mitigated Risk Level
021	Cultural Heritage	Construction	Impact to unexpected cultural heritage	Vegetation clearance Excavations Site preparation	Damage/destruction of cultural heritage or artefact Relationship with traditional land owners	Moderate	Unlikely	Medium	Cultural heritage due diligence did not identify an areas of cultural heritage sensitivity on the site. CEMP prepared by the contractor and approved by PHI and council Stop works if any items of cultural heritage are discovered	Moderate	Rare	Low
022	Visual amenity	Construction and operations	Reduced visual amenity due to the Project	Construction activities Project design Emission stack (80 m height) Building elevation Additional lighting	Reduced visual amenity Lighting visible from distance at night	Moderate	Possible	Medium	EfW plant is to be constructed in the context of an existing industrial area Plant design to minimise impact to community, including consideration of colour scheme Landscape design to minimise visibility Light sources to minimise light spill	Moderate	Unlikely	Medium
023	Traffic	Construction and operations	Increased traffic movements	Transport of materials to site Transport of feed waste to site	Interaction with vehicles/people Increased road traffic Noise	Moderate	Possible	Medium	CEMP prepared by the contractor and approved by PHI and council Operational traffic flow modelling to be conducted Implementation of Operational Traffic Management Plan	Minor	Unlikely	Low
024	Community objection to the Project	Construction	Concern or anxiety from residents, landowners, and special interest groups with regard to the perceived risks and potential impacts on air and water quality, property values and quality of life in the area.	Poor communication to the community regarding the Project, its benefit and any perceived impacts Lack of involvement from community and stakeholders in the Project Insufficient community consultation able to be undertaken due to COVID-19 distancing restrictions	Project delays or deferment Reputational damage Anxiety about perceived risks leads to loss of support and confidence in PHI and the Project Adverse media coverage regarding the risks Complaints from community or stakeholders	Major	Possible	High	Conduct community consultation sessions throughout the planning of the Project to discuss the benefits of the Project (or a virtual session if required by COVID-19 distancing restrictions) Regular open and transparent communications provided to the community and stakeholders Undertake a stakeholder assessment – Identify all stakeholders / their interests, influence and importance and use this in developing the Stakeholder Engagement Plan.	Major	Unlikely	Medium
025	Positive community impact	Construction & Operation	Support Victorian waste policy and targets	Diverting waste from landfill Recovering energy Recovery and recycling of metals Reuse of residues for beneficial purposes	Help to achieve Victorian targets for the avoidance of waste and recovery / reuse of materials	Moderate	Possible	Medium positive impact	Not required	Moderate	Possible	Medium positive impact
026	Positive community impact	Construction & Operation	Reduction in anxiety, stress and feelings of insecurity	Increase in availability of local jobs	Improvement in health & wellbeing	Moderate	Possible	Medium positive impact	Not required	Moderate	Possible	Medium positive impact

7. Project description

7.1 Overview

This chapter provides a description of the technology, the concept design and project implementation processes for the proposed Project. PHI is working with a leading design company, Jiangsu Power Design Institute (JSPDI), to provide technical and design services for the proposed plant. JSPDI brings considerable EfW project development experience, having worked with numerous large EfW technology suppliers and project developers, including Everbright International (Everbright), on more than 100 EfW projects worldwide.

7.2 Key plant parameters

The key plant parameters for the Project are detailed in Table 7.1. A more detailed summary of the concept design can be found in Appendix M. This information has been provided to the Victorian EPA as reference and is to be treated as commercial-in-confidence. It should be noted that some of the performance parameters shown below (e.g. steam conditions, power output, auxiliary load, etc) are not guaranteed values and may change slightly during the detailed design phase of the project once the final equipment has been selected.

Table 7.1: Key Plant Inputs and Parameters

Design parameter / input	Value	Comment
Plant design life	25 years / 200,000 hours	
Number of boiler lines	2	
Number of steam turbines	2	
Annual plant fuel consumption	400,000 tonnes/annum	Based on 2 x 200,000 tonnes/annum boiler lines
Estimated calorific heating value	9.5 MJ/kg (LHV)	Indicative value only, to be confirmed through further waste characterisation
Annual auxiliary fuel consumption	Up to 20,350 GJ/annum	Based on input received from the preferred technology supplier. Based on total for two boilers.
Plant availability factor	~90%	Subject to detailed design and to be agreed with contractual guarantees
Typical operating hours per annum	7,884 hours	
Operational regime	24 hours/7 days per week	Except planned and unplanned shutdowns
Design waste throughput per boiler	26.7 tonnes/hour	
Target main steam conditions from boiler	440°C, 64 bar (abs)	
Target O_2 in flue gas (wet)	7%	At economiser outlet
Fly ash to bottom ash ratio	20 % / 80%	Preferred technology supplier assumption
Stack exit temperature	Approximately 140°C	
Stack height	80 m	
Connection voltage	Proposed at 66 kV	
Potable water source	Barwon Water potable water main	
Waste water and sewage discharge point	Barwon Water sewer main	
Stormwater discharge point	City of Greater Geelong stormwater system	
Natural gas source	AusNet Services gas main	
Estimated gross plant power output	40,700 kW	Based on ambient site conditions for two units
Auxiliary load	4,720 kW	Based on ambient site conditions. Estimated to be approximately 11.6% of gross output.

Design parameter / input	Value	Comment
		Depending on the final design and equipment selection, it is estimated that the maximum auxiliary load may be up to 17% of gross output
Estimated net plant power output	35,980 kW	Based on ambient site conditions. For the purposes of the R1 Efficiency calculation, a conservative estimate using an auxiliary load of 17% was used.
Plant net heat rate (LHV)	14,101 kJ/kWh	Based on ambient site conditions and an auxiliary load of approximately 11.6% of gross output.
Plant net efficiency (LHV)	25.53%	Based on ambient site conditions and an auxiliary load of approximately 11.6% of gross output.

7.3 Plant layout

A conceptual site layout has been prepared (refer to Figure 7.1) on behalf of PHI, to inform the works approval and planning processes and also potential Engineer Procure Construct (EPC) contractors of the general expectations of site location, plant orientation, road access and existing site interfaces. It is expected that this layout will be updated and refined by the EPC contractors at the tender and detailed design stages of the project.

The trucks enter the site from the north-east corner, while site personnel would enter from the south-west entrance and park near the offices. This is a safety aspect to mitigate the potential of light vehicles interacting with heavy vehicles.

The trucks would be weighed on the site weighbridge and then travel to and from the tipping hall to unload the MSW, with trucks also travelling to the bottom ash storage and air pollution control residue silos to pick up by-product/residue and deliver it elsewhere. There would also be truck deliveries of consumables and chemicals required for the plant operations.

The plant is laid out with simple waste logistics and principal process flows in mind. Waste deliveries to the tipping hall discharge directly into the adjacent waste bunker, where the waste is mixed by the grab cranes. The cranes also feed the waste into the boiler, where it is incinerated and in turn generates heat to create steam to produce power via the steam turbine. The flue gas is then filtered in the flue gas treatment area and exits through the flue stack.

The site also contains ancillary plant such as cooling towers, HV switchroom and electricity grid connection, switchyard, water treatment plant, pump house, fire water tanks and pumps, as well as wastewater and stormwater detention ponds. Final sizing of equipment and plant areas will be confirmed during the detailed design.

Provision has also been made for an additional future train to the east of the main process plant, which could increase the waste input by a further 200,000 tonnes per annum (tpa) to 600,000 tpa in total.

This Project has also made an allowance for onsite bottom ash treatment and maturation/storage, prior to the residues being despatched offsite for use as an aggregate product and/or recovery of ferrous and non-ferrous metals. This includes a bottom ash pre-treatment storage area which is typically sized to allow for approximately 10 days of storage. The bottom ash from the boiler is transferred via an overhead conveyor into the bottom ash treatment facility. This area will also include a bottom ash process hall, including metals recovery and aggregate material sizing and a long-term maturation storage area. The long-term storage area for this particular site was sized to allow for approximately 12 weeks' worth of maturation, which includes a natural carbonation process to lower the leachability of trace metals content to levels safe for use as construction aggregate.

Figure 7.1: Site layout

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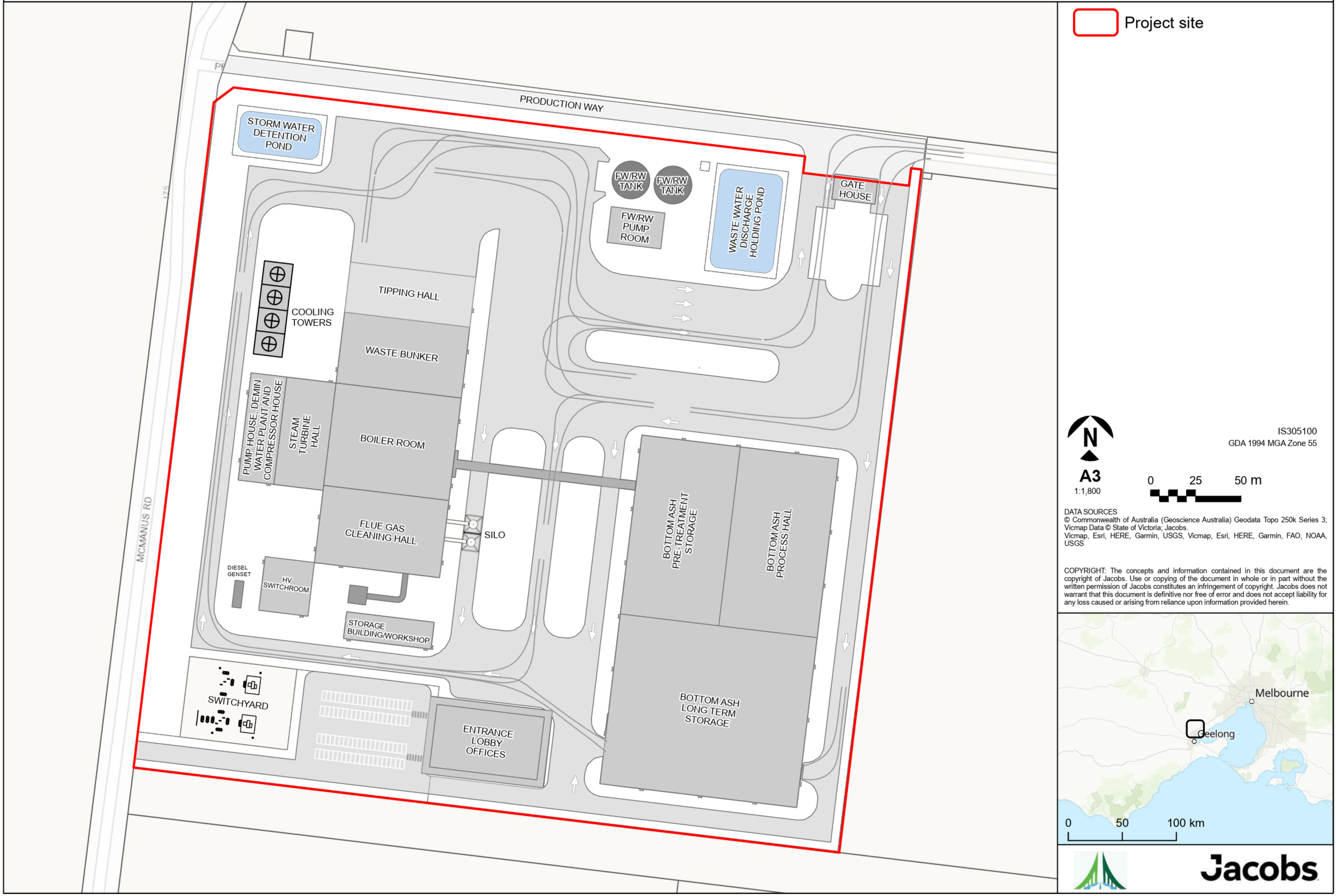


Path: J:\IE\Projects\03_Southern\IS305100\Spatial\ArcPro\IS305100\IS305100_Environmental.aprx\IS305100-CRTO-000092_Figure_07_1_Site_Layout_A3_Landscape
Created by WARDA on 18/09/2020

7.4 Detailed Process Description of EfW Plant

7.4.1 General Plant Overview

Based on a nominal waste feedstock of 400,000 tonnes per annum, and an average waste calorific value of 9.5 MJ/kg on a Lower Heating Value (LHV) basis, it has been estimated that the plant will produce a nominal maximum gross electrical output of approximately 40.7 MWe at average ambient temperature conditions. The plant will comprise two boiler lines utilising moving grate combustion technology, with electricity exported to the Powercor 66 kV grid system. Each line will have a dedicated water-cooled condensing steam turbine generator.

The plant will not be supplying any process steam to industrial users, as there is currently limited opportunity to do so within practical steam transmission distances from the site. The net electricity production after allowing for auxiliary loads at the EfW plant is approximately 36 MWe.

An indicative mass and energy balance is provided in Appendix M. This graphical format shows the typical main process configuration, with mass and energy flows for both the boiler air and gas system, up to the chimney, and for the principal water and steam systems.

The electrical energy produced from the new EfW plant is expected to be approximately 269,630 MWh per annum of net exportable electricity, based on approximately 7,884 hours of operation per year (90% availability factor) and a 95% load factor.

In addition to the electricity produced from the EfW plant, it is expected that up to approximately 20,350 GJ/annum of natural gas will be required as auxiliary fuel. Auxiliary fuel is used predominately before or after a boiler outage to shut-down or start-up the boiler. It may also occasionally be used to provide combustion stability for the boiler where the incoming waste have a lower calorific value than expected for short periods of time, or the boiler needs to operate at lower loads. The burner will also operate whenever the combustion chamber temperature drops below 850^0C as per the 2010 EU IED requirements.

The combustion technology proposed for the Project is generally described as a mass burn combustion grate technology, which is a long established and effective method for thermally treating MSW and C&I waste. Jacobs as lead consultant appointed for this development phase of the Project, has prior involvement in many EfW projects in other parts of the world. Jacobs' experience is that the vast majority of these moving grate technology projects have been completed and commissioned successfully, meeting both the local authority (i.e. council or waste authority) and environmental agency requirements, following commencement of operation.

A simplified overall process schematic of the EfW process, using MSW and C&I waste, is presented in Figure 7.2. The process for electrical and steam generation is also described below for completeness.

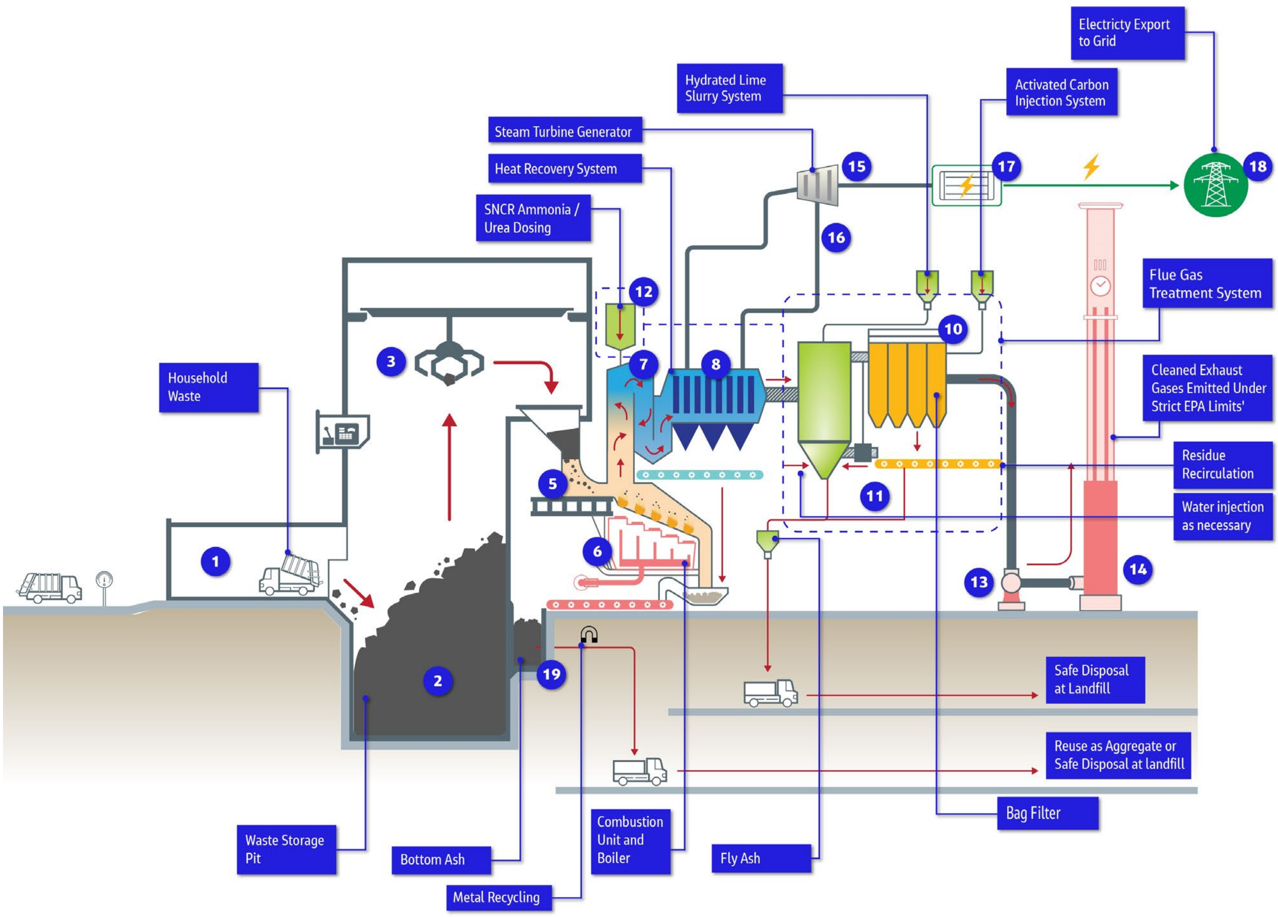
MSW and C&I will be delivered to the facility directly by refuse collection vehicles (RCV) or other bulk solids handling vehicles (e.g. container tipping vehicles, bulk tippers and walking floor trucks) via waste transfer stations and enters the fully enclosed tipping hall building (1). Any double configuration trailers (i.e. A-double, B-double), will be de-coupled onsite before entering the tipping hall. The waste transport vehicles typically enter the tipping hall building in reverse and side-tippers will not be accepted at the facility.

The waste transport vehicles will then back up into a tipping bay position and tip their waste into the waste bunker (2), where the waste is mixed and lifted by the overhead waste cranes (3) into the waste feed hopper (4).

For this Project, there are two independent combustion grate lines proposed with each boiler's output feeding separate steam turbine generators (two turbines in total). It is expected that at least two or more cranes operating above the waste bunker will be required to process the necessary quantities of waste and deliver it to each waste feed hopper system, while providing redundancy in the feeding system.

Waste is pushed from the bottom of the hopper onto the combustion grate (6) via a hydraulically driven ram feeder (5). As the waste enters, it is combusted on the topside of the combustion grate. Combustion air is introduced at various controlled points underneath the grate (called primary air) and also above the grate (called secondary and sometimes tertiary air) to promote good mixing of the flue gases and optimise combustion. The overall movement of the grate is designed to promote complete combustion. This combustion control is very important to promote complete burnout of the waste at a high temperature. The plant will be designed such that the flue gas resulting from the combustion of the waste has a flue gas residence time in the main furnace pass of at least two seconds, at a temperature of at least 850°C to ensure complete combustion of organic carbon compounds. This is one of the requirements in the 2010/75/EU Industrial Emissions Directive and also the 2019 EC BREF.

Figure 7.2: Overall Simple Process Schematic of the Combustion Plant



Primary air is usually drawn from the tipping hall and waste bunker building, and typically undergoes preheating through the use of heat exchangers using steam from the steam turbines or the deaerator to promote waste drying on the grate. This approach maintains the tipping hall and waste bunker under negative air pressure, thus continuously controlling odour emissions whilst one of the boilers is operational. Depending on the design of the boiler, there is also the possibility to draw primary air from within the boiler house structure.

The primary combustion air enters the boiler from underneath the grate, which helps with the waste drying process and promotes some mixing of the waste while on the grate. In case of a fire in the waste bunker, the primary air system can also draw air from within the boiler house structure (as mentioned above). The primary air also helps to cool the grate during combustion to avoid overheating.

Secondary combustion air can be drawn from either the waste bunker or from within the boiler house structure. The optimal source of the secondary air intake will be selected in the detailed design phase. A common approach is to draw some air from within boiler house to recover some radiative heat losses and to keep ambient temperature in the boiler house below a safe ambient level for operations and maintenance staff. The secondary air can also be pre-heated via heat exchangers, again using steam extracted from the steam turbine or the deaerator as the heating source. This is ultimately dependent on the eventual calorific value of the waste fuel, and thus will be determined during the detailed design phase.

Non-combustible material, known as bottom ash, falls off the end of the grate and is handled by the bottom ash extractor (19), where it can be cooled by either a water quench (wet system), or air (dry system), before being conveyed to bottom ash storage/treatment area. The plant will adopt a wet boiler bottom ash system. Bottom ash falling off the grate will fall into a water filled slag extractor bath. The water system has the advantage of quickly quenching and cooling the ash, whilst also mitigating the risks of downstream dust generation in handling and processing systems.

The Project also proposes to develop an onsite bottom ash treatment plant system. The bottom ash treatment plant will most likely consist of a pre-treatment and storage area, a processing hall and a long-term storage/maturation area. The processing hall will be contained in an enclosed shed with a dust extraction system discharging to a bag filter system to prevent emissions to the environment. This system will also provide efficient metal recovery systems to remove ferrous and non-ferrous metals onsite. Only coarse ferrous and non-ferrous metal recovery will be employed on the ash handling conveyers between the ash extractor and onsite storage. The bottom ash is estimated to be 12-25 % of the feed waste quantity, by weight.

The treated bottom ash will then be loaded into vehicles and transported offsite for reuse as construction aggregate, elements unsuitable for use as aggregate disposed to a licensed landfill. The successful reuse of bottom ash aggregate will depend on achieving EPA regulatory acceptance of the product quality for its intended use, and also on the successful development of a bottom ash local aggregate offtake market in Victoria. Refer to Chapter 9.2.1 for further details regarding the treatment of bottom ash.

The boiler itself is comprised of the furnace area where the waste is combusted and where, if required, the auxiliary fuel system is used to help with combustion stability and maintaining the combustion temperature. Following the furnace, the boiler has a series of empty passes (which have no convective heating banks) with water cooled tube walls only. These water cooled tube walls run between the furnace and the first convective superheater/evaporator tube bundles in the gas path (7). This allows the flue gases to cool, which subsequently reduces the risk of ash build up and corrosion of the superheaters and evaporator convective heat recovery elements.

Heat is then further recovered from the flue gases in the economiser pass (8) to improve energy recovery efficiency. This is made up of a number of convective tube elements designed for reliable and efficient heat transfer between the flue gases and the boiler feedwater before it begins to evaporate into steam. The example diagram shows both a horizontal boiler pass (superheaters and evaporators) and a horizontal economiser pass. A vertical economiser pass is also quite common in industry. A vertical superheater boiler pass could also be adopted, which could allow for a smaller boiler house building, however it could present slightly greater complexity for operations and maintenance in the future.

Boiler ash will be collected from the various boiler pass and economiser pass hoppers and transferred to either the bottom ash treatment system, or the air pollution control residue (APCr) system, depending on the end use/disposal methodology adopted for the Project. This will consider the quality of those ashes against Victoria's Industrial and Prescribed waste classification system.

Flue gases leaving the boiler are typically treated with powdered activated carbon to absorb volatile organic components such as dioxins and furans and heavy metals such as mercury. Flue gases are also treated with a dry or semi-dry lime dosing system (9) to neutralise acid gas pollutants such as hydrochloric acid, sulfuric oxides, etc. The lime injected can either be dry quicklime (CaO) powder, hydrated with water through a process onsite, or hydrated lime ($Ca(OH)_2$) delivered from offsite. All options are available for bulk delivery to the site.

Mobile ash particulates and flue gas treatment residues entrained in the flue gases are captured in the bag filter plant (10). The APCrs collected in the bottom of the bag filters (11) are normally conveyed to a storage silo ready for disposal to an appropriate landfill. Some recirculation of APCr into the flue gas treatment system upstream of the bag filters will assist in optimising reagent use. The APCr is typically transferred from the silo by gravity to a pneumatic type tanker truck, or alternatively after water conditioning, into a covered top loading vehicle for transfer to landfill.

For some EfW plants processing hazardous wastes, a second stage wet scrubber is introduced which may be used to further treat flue gases. However, this is not considered necessary for MSW and C&I feedstock to meet the European air emission limits. This option will not be employed for this project due to the additional raw water and wastewater treatment requirements and additional water emissions generated.

Emission to air of oxides of nitrogen are normally controlled by a Selective Non-Catalytic Reduction (SNCR) system, which injects ammonia or urea into the flue gases at the top of the furnace (12). The use of either ammonia or urea provides similar levels of performance in terms of nitrogen oxides reductions. Aqueous urea is a less hazardous material than aqueous ammonia and is sometimes preferred for this reason. A flue gas recirculation system will be incorporated into the boiler, which will also assist in the control and reduction of nitrogen oxides.

Safe negative pressure conditions are maintained in the furnace and boiler so that hot combustion gases do not escape to the atmosphere. Furnace pressure is controlled by an induced draft fan (13), which draws the cleaned flue gases up the chimney (14). The chimney needs to be designed to a height sufficient to disperse the gases to achieve the State Environment Protection Policy (SEPP) requirements for ambient air.

The high pressure and temperature steam generated within each boiler, typically at around 60-70 bar(a) and 400-450°C, will be piped to separate steam turbine generators (15). This Project is expected to have one steam turbine per boiler unit. The steam turbine will be rated to accept steam from the boiler when operating at 110% maximum continuous rating (MCR). In the turbine, the steam will drive the turbine blades converting the mechanical energy to electricity in the generator.

Steam exhausted from the turbine is cooled via a water-cooled condenser (16) which generates a partial vacuum at the turbine exhaust and facilitates energy extraction from the steam. The water-cooled condenser is supplied by water from a semi-closed loop mechanical induced draft cooling tower system. The system requires make-up water to account for evaporation losses and water blowdown to prevent excessive salt build up in the cooling water circuit. It is envisaged that the cooling towers required for each steam turbine condenser will be arranged in a single row.

Electrical power generated by the turbogenerators will supply the auxiliary load required by the EfW plant. The majority of the generator's (17) electrical output is stepped up in voltage in a transformer to the proposed 66 kV for connection to the Powercor electrical network (18). This connection point allows the electricity generated by the EfW plant to be exported to the Victorian electricity grid.

It should be noted that the plant can also continue to operate if the external electrical grid is not available for whatever reason. In this method of operation, the plant will continue to supply the auxiliary load required for operation and will divert the majority of the steam from the boiler into the steam turbine bypass system. This is commonly referred to as Island Mode Operation. Under this mode of operation, the majority of the steam energy will be sent to the condenser for cooling, with only enough steam passing through the turbine to supply the plant's electrical load. This method of operation should not occur very frequently as the Victorian electricity network has a high level of availability and if it does occur, should only be for relatively short periods of time (hours/days), unless there is a major network issue. The plant can also operate in Turbine Bypass Mode, which allows the plant to continue to operate in the event of a technical problem with the steam turbine, again by bypassing all steam directly to the condenser. Steam turbine problems that would necessitate this mode of operation have a very low frequency of occurrence. These methods of operation however are considered critically important to the plant, as they allow it to continue to process waste and meet its contractual requirements under waste disposal agreements.

The critical and more unique aspects of the Project are the combustion grate, furnace, steam boiler and flue gas treatment systems which are discussed in more detail in the following chapters. These elements of the plant are considered the most challenging elements of the overall energy from waste process to design and construct to deliver a reliable, efficient and environmentally sound energy generation and waste treatment solution.

The balance of the plant (including steam turbine, generator, condensing and feed-heating plant, water treatment, turbine cooling systems, cooling towers, electrical switchyard, storage tanks, pumps and other ancillary systems) are considered to be relatively standard equipment and present a low risk to the Project.

7.4.2 Waste reception, tipping hall and storage bunker

7.4.2.1 General

All of the waste feeding systems shall be capable of handling waste deliveries under the following range of scenarios:

- Compactor collection vehicles (also known as refuse collection vehicles) carrying sourced MSW particularly from nearer locations/ regions which do not generate sufficient waste volumes for larger vehicles and locations which do not have waste transfer facilities capable of loading larger bulk transfer vehicles or containers. These typically have up to 10 tonnes of waste carrying capacity and are generally nearly full for most trips. These collection compactors will discharge directly into the waste bunker. A typical refuse collection vehicle is shown in Figure 7.3
- Nineteen-meter semitrailer bulk waste vehicles – These will most likely be arriving from waste transfer facilities, for example, from Citywide's Dynon Rd facility, with bulk transfer vehicle loading capacity. These typically have a carrying capacity 25-30 tonnes and are routinely full nearly all loads
- C&I waste delivery vehicles of the self-unloading trailer types (e.g. self-tippers or walking floor type), discharging directly into waste bunker
- Roll on/roll off skip carrying vehicles for waste deliveries, recovered metals despatch, and tipping hall rejected waste disposal

Figure 7.3: A Typical Compactor Type Refuse Collector Vehicle

Various other high productivity freight vehicles may also be expected to be used in the future if the appropriate road and infrastructure is available. These can only operate under permit on roads classified to accommodate them. Some of these vehicles include:

- 26 m B-doubles – carrying capacity up to 38 tonnes
- 30 m A-doubles – carrying capacity up to 45-50 tonnes
- Various high productivity freight vehicle combinations to such as Type 1 A-doubles ~36.5 m

Refer to the Traffic chapter (Chapter 15.4) for further details regarding expected vehicles and the logistics associated with the plant.

The origin of the waste is still an unknown at this time, as it depends on which local government areas the plant's operators are able to secure waste supply agreements with, and the arrangements these local government areas have in place, or develop, for forward logistics to the site.

7.4.2.2 Site access and waste reception

Access to the site for waste delivery vehicles from Production Way will be via a security gatehouse with adjacent barrier and 'out of hours' lockable gate, provided within the EPC Works. The gate house will be located onsite and will aim to be located sufficiently far from the entrance off Production Way to accommodate one waste vehicle queuing awaiting entry without queuing occurring on Production Way.

All internal site roads and intersections within the site, and intersections with Production Way for carrying waste carrying vehicles, shall be designed for safety, minimisation of external impacts and time efficiency. The design will allow for the transit of all of the waste vehicle types, waste quantities, waste qualities, and expected numbers of vehicle movements for ingress and egress of those deliveries in and out of the site.

All intersections and turning areas shall be designed for the longest possible vehicle types expected, currently 30 m A-doubles, but in the future, vehicles up to 36.5 m length may be used. The road design will minimise the risks of vehicle collisions, allowing good visibility at all intersections. One-way traffic systems will be used where possible to prevent vehicles encountering each other in head-on scenarios.

The site's road systems shall be designed to minimise the risk of collisions with pedestrians and other plant and equipment onsite. Areas frequented by pedestrians will be segregated from the main waste vehicle routes, and barriers, overpasses and safe crossing areas shall be provided as necessary where pedestrian access is unavoidable.

A waste vehicle quarantine area will need to be provided for loads that are outside the plant's waste acceptance criteria. The quarantine area will be located adjacent to the waste road route within the site, allowing vehicles to wait in the bay without blocking the flow of other vehicles.

7.4.2.3 Weighbridges

Two bi-directional calibrated road vehicle weighbridges will be located at the main entrance on Production Way to allow efficient weighing of incoming and outgoing heavy vehicles and satisfy regulatory requirements for waste load tracking. The weighbridges shall allow:

- Weighing of incoming waste carrying vehicles arriving from the public road
- Weighing of all trucks carrying major consumables such as lime, urea and activated carbon
- Weighing of outgoing empty waste vehicles, and empty plant consumables vehicles exiting to the public road
- Weighing of incoming and outgoing bottom ash and APCr carrying vehicles, entering and exiting from the public road
- Provision of bypass lanes for vehicles that do not need to be weighed

A typical road vehicle weighbridge and office is shown below in Figure 7.4.

Figure 7.4: A typical road vehicle weighbridge and office for recording waste and load weights

The weighbridges will be calibrated and certified to a suitable accuracy to meet commercial and regulatory requirements. An automatic ticket printing system and a back-up contingency system will be provided to meet load documentation requirements. This will include an automated system for recording weight and number plate data, with data exported to the Plant LAN and the control system to record tonnages of all incoming and outgoing wastes and residues processed or despatched from site. The weighbridge area shall be covered by CCTV cameras, with connection to screens provided in the weighbridge office and the central control room.

7.4.2.4 Waste Tipping Hall

The waste tipping hall will be a fully enclosed building maintained under negative pressure whenever one of the combustion lines is in operation. This is done to control odour and dust. Entry / exit for waste vehicles to the tipping hall shall be through automated fast acting (such as plastic or fabric types) roller doors which open when a vehicle approaches, and close when a vehicle has passed through.

An automated traffic control system shall be provided notifying vehicles of which bay to unload into, with manual intervention possible from the central control room, or by the tipping hall operations supervisor. The tipping hall design will also allow operation of a front-end loader for cleaning up waste spillages from the tipping floor into the bunker. The building shall be designed to eliminate the need for pedestrians to enter the waste reception area during normal operation. An example of an enclosed tipping hall is shown in Figure 7.5.

Figure 7.5: Waste Delivery Vehicle Exiting the Enclosed Tipping Hall at Lakeside EfW Plant in the UK

The vehicle flow path in / out of the tipping hall will be designed to avoid collisions. The floor of the tipping hall will be suitably designed with consideration of the static and dynamic loads of the vehicles and other anticipated operations. A high-quality abrasion resistant floor finish will be provided suitable for front end loader for waste clean-up activities.

The layout and dimensions of the approach to the tipping hall, the access doors and the internal building area themselves will accommodate all vehicle types, bearing in mind the vehicle dimensions and necessary turning circles. The height of the tipping hall shall be sufficient to allow a tipping of the longest acceptable trailer type at an 80^0 angle to horizontal.

A waste reject load-out area will be provided in the tipping hall building. The tipping hall shall extend at the side of the last tipping bay into the waste bunker to allow space for a waste rejects load-out area. The quarantine area will be provided with separate areas as appropriate for the segregation of untreatable waste (large objects, rubble, soil, plasterboard etc.), and include adequate space for skips and containers to hold segregated hazardous materials (e.g. asbestos, paint and solvents, waste oils, gas cylinders, fluorescent tubes, chemicals etc). The load out area will be used if needed to load waste from the bunker into articulated trailers by means of the overhead cranes. Sufficient space will be provided for a waste audit pad that allows up to 10 tonnes of waste to be spread and inspected.

Tipping bays will be designed to prevent collision of cranes with tipping vehicles and to prevent the risk of tipping and other vehicles falling into the waste bunker during unloading.

Optimal visibility, inherent controls and guidance systems for drivers to navigate the vehicle flow paths shall be provided in the design, through the following methods:

- Traffic control systems such as lights and automated door opening
- Appropriate location of doors and roads
- Adequate lighting
- Mirrors
- Painted lines on the floor
- Vehicle reversing guides
- Impact barriers

Other additional measures shall be provided to reduce the risk of tipping vehicles falling into the bunker as follows:

- Floor safety lines indicating distance from bunker
- Wheel kerbs to be mechanically protected against abrasion
- Safety barriers or beams

7.4.2.5 Waste Bunker

The waste bunker shall have a waste storage capacity of up to five days of nominal design waste throughput below the height of the tipping hall floor. The bunker shall also be designed to allow stacking of waste above the tipping hall floor height against the wall separating the bunker from the boiler house, to give additional storage during emergency events.

The bunker shall be designed as a water retaining structure to prevent permeation of waste leachate into the ground below or adjacent to the bunker. The permeability of the bunker shall be tested with a water test prior to placing into service, and if unacceptable permeability levels are found, it will need to be made good before commissioning. The design of the base and walls shall have sufficient mass and strength to resist groundwater uplift pressure when the bunker is empty. An example of a waste bunker is shown in Figure 7.6.

The bunker shall be constructed of a robust concrete specification such that impact and abrasion from the crane grabs or tipped waste shall not result in significant damage. The materials of construction will need to be suitably resistant to chemical attack from elements of the waste and waste leachate during its design life. The design will allow complete emptying of waste from all areas of the bunker to ensure that stock can be turned over to avoid decomposition from long periods in the bunker and to empty it prior to plant shutdowns.

The fire detection and protection systems for the waste bunker will comply with the Victorian Government Publication "Management and Storage of Combustible Recyclable and Waste Materials – Guideline", Publication 1667, August 2017, and with the required Australian Fire Protection Authority (FPA) codes and standards applicable.

Good industry practice systems for fire control for waste bunkers shall also be adopted to control the risk of fires in the bunker. These shall at a minimum include the following measures:

- Infrared fire detection matrix system
- Carbon monoxide detectors located around the bunker area
- Remote control operated fire cannons mounted on the bunker walls, which can pivot to cover the entirety of the bunker area, capable of both manual and remote control from the central control room
- Fire hose reels that can be manually operated
- Atomiser mist sprays for dust control to prevent build-up of dust on surfaces in the bunker and tipping hall

Effective waste odour control systems shall be provided to manage odour during normal operations and partial and complete plant shutdown.

The following systems shall be provided to minimise and control waste odour and dust:

- Maintenance of negative pressure above the bunker at all times when one or more combustion line is in operation. The air from the tipping hall should be ducted to the inlet of the primary air fan for the combustion line(s) and combusted in the main furnace

- During an event when no combustion lines are operating (i.e., a short-term boiler outage), suitable systems and procedures will need to be provided to minimise odour generated from waste remaining in the bunker. This will include at a minimum, a shutdown ventilation stack system to maintain negative pressure in the bunker and tipping hall, an inline odour filtration system prior to the discharge point which will be located on the facility roof for good dispersion

The waste bunker shall be separated from the boiler house through a suitably rated fire wall meeting National building fire code requirements.

Figure 7.6: Inside a waste bunker at an EfW plant with waste feeding and mixing crane in operation

7.4.2.6 Waste Feeding Cranes

The waste feeding cranes will comply with the requirements of the design code as set out in AS1418 and shall be of the grab type. They will be used for both mixing waste within the bunker before combustion and to feed the waste into the boiler feeding system.

The cranes shall be suitably rated in terms of grab capacity and travel speed to accommodate all waste types at the maximum feed rates required on a continuous basis, from every part of the waste bunker. Each crane shall be capable of feeding each combustion line waste feed hopper. The cranes shall also be capable of operating for the purposes of mixing waste within the bunker to homogenise the waste fed to each combustion line. Each crane shall also be capable of removing rejected waste from the bunker and discharging it to a rejects area in the tipping hall. The cranes' travel and inertia shall be controlled to prevent collision with bunker walls, tipping bays, vehicles unloading in the tipping bay and fire water cannons.

Each crane shall be capable of remote operation from an operation panel in the central control room. The room will have a clear viewing window allowing sight lines across the length and breadth of the waste bunker and crane travel range. CCTV will also be provided to cover areas which are more difficult to view from the central control room, with images relayed to the crane operation panel viewing screens. The cranes shall be capable of all operational modes typical of modern waste feeding cranes at EfW plants, including:

- Semi-automatic operation with some operator intervention from the central control room to position the grab, following which grab operation and waste hopper feeding is in automatic mode to the selected waste hopper
- Fully automatic operation for bunker feeding and mixing modes, with waste bunker profile sensors and level control algorithms
- Full manual operation from the crane operator panels in the central control room

Each crane shall accurately weigh each grab load of waste fed to the hoppers of each line, for the purposes of plant control and performance logging, with the output signal provided to the distributed control system. A calibration weight shall be provided in the works for regularly calibrating the weighing systems. The cranes will be designed for low noise and minimal vibration during all modes of operation.

7.4.2.7 Waste Feeding Hopper

The waste feeding hopper receives waste from the crane and the bottom of the hopper has a mechanical feeding device that pushes the waste onto the combustion grate in the boiler.

The fuel feeding systems shall comply with all relevant FPA Australia fire protection requirements and specific requirements for stoker fired boilers.

The waste feed hoppers will be designed with a safe and efficient means of emptying in the event of a line shutdown, for maintenance of the feeding system, or to clear waste blockages.

The volume of waste in the hopper shall act as a plug to prevent air ingress to the furnace from the bottom of the hopper. A hydraulically operated isolation gate shall also be provided to automatically cut off waste and air flow to the furnace in the event of low hopper level or other abnormal operating events in the furnace.

Waste feeding from the hopper to the furnace shall be via hydraulically driven ram stokers. The stokers shall feed waste onto the grate at a controlled and uniform rate with even distribution for optimal combustion, automatically controlled by the boiler control system.

The hopper connection to the furnace shall have a water-cooling system which will maintain the hopper bottom at a suitably low temperature to avoid waste combusting in the hopper. The fire detection and protection systems for the waste feed hoppers shall comply with the regulations, codes and standards including Australian and NFPA codes.

Industry good practice systems for fire control for EfW waste feeding chutes shall also be adopted to limit the risk of fire in the hoppers. This shall include:

- Automatic fire detection systems located over the mouths of, and within the hoppers
- Automatic fire water sprays into the top of the hopper
- A remote manual system for fire water sprays allowing operation from the central control room
- Fire hose reels that can be manually operated to fight fires within the hoppers

7.4.3 Moving Combustion Grate

The moving combustion grate is a fundamental element achieving effective and reliable waste burnout. The moving combustion grate is an air cooled and hydraulically driven reciprocating grate. Waste is fed on to the grate via hydraulic ram feeders in the bottom chute of the waste feed hopper. A typical schematic of a mass burn combustion grate is shown in Figure 7.7.

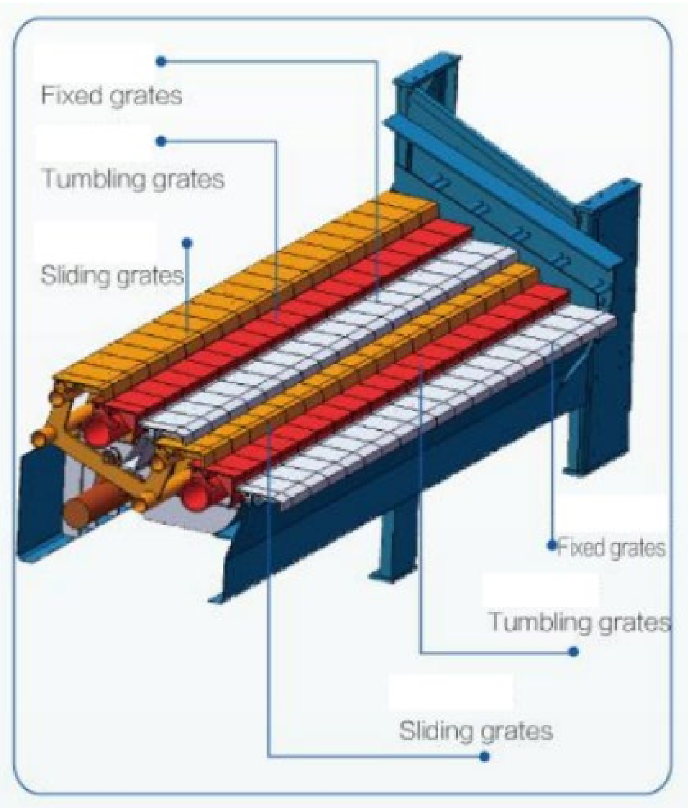
The grate is designed with a sliding and tumbling mechanism. The orange sections shown in Figure 7.7, are the sliding grates, the red sections are the tumbling grates and the grey are the fixed grates. The sliding grates move horizontally, and the tumbling grates move in an upwards and downwards motion. The purpose of the tumbling grates is to:

- Break down the waste mass
- Increase contact with the air to help accelerate the drying process
- Provide a means of controlling the fireball in the furnace

The purpose of the sliding grates is to:

- Move the waste forward
- Help control the thickness of the waste on the grate
- Promote mixing of the wastes
- Control the waste speed on the grate.

Figure 7.7: Proposed mass burn combustion grate courtesy of Everbright



The grate will be designed to maintain an even distribution of waste over the entire grate under varying load and waste quality conditions. The overall movement of the various grate elements agitates the waste and moves it along the grate and down the incline by gravity, through the combustion process. This includes waste drying, gasification, ignition, combustion and ash burnout.

Different suppliers have their own similar, proven and patented technologies, with the most significant difference being the direction of the reciprocating elements' motion. This achieves the same goals of waste mixing, good combustion and progressive transport of the material down the grate incline. Hydraulically driven reciprocating grates are generally well suited for processing municipal waste with the range of MSW and C&I calorific values expected for this Project.

7.4.4 Waste feedstock sources and composition

An important consideration for the Project is the development and enforcement of waste acceptance criteria for the plant, which will align with Victorian waste regulations and reflect the requirements of the grate and combustion. The waste acceptance criteria will be integral to any waste supply contract or agreement with MSW and C&I suppliers to mandate waste specifications and enforce the right to reject waste. Refer to Chapter 8.6 for further details.

It is reasonable to expect that improvements in at-source separation and changing householder habits may occur over the life of the Project. This has the potential to change the quantity and composition of the municipal waste received. The moving grate technology is flexible and will be effective for a wide range of waste composition variations and calorific values.

The plant design will allow safe operation with varying waste compositions within a specified net calorific value firing envelope. The plant should operate satisfactorily within the bounds of the defined envelope in a firing diagram which indicates the safe operational range around the design point without auxiliary burner firing, or thermal or mechanical overload of the treatment process. An indicative net calorific value is set at 9.5 MJ/kg for this concept stage design.

Further waste compositional analysis is required, including physical waste sorts and lab analysis of samples collected from targeted Melbourne waste sources. Desktop modelling of the technology's sensitivity to changing waste composition is also required to assess how changing consumer habits, or different waste collection regimes (e.g. separate food waste collection bins) may impact the Project. As more data becomes available, the waste composition assumptions, including the net calorific value design point, may be adjusted to tailor the plant design for the waste it is likely to receive.

EfW plants of this type are limited in processing capacity by the thermal energy in the waste (calculated by multiplication of waste net calorific value and waste tonnage consumed per unit of time). Hence, the waste firing diagram (or stoker diagram) is useful for assessing possible plant throughput for a facility. The preparation of this diagram, once the intended waste supply is better characterised, will be a key performance requirement for the Project.

The design capacity of the plant is 400,000 tonnes / year of waste. Based on a 95% nominal throughput, which is a realistic assumption for the average thermal load of the plant over a year (assuming waste supply is not a constraint), the plant will need to operate for approximately 7,884 hr/ year to achieve a waste processing throughput of 9.5 MJ/kg net calorific value. This is equivalent to a plant availability of approximately 90%. The grate can also operate on a short term above this design point by circa 5-10%, based on the grate's design heat release rate. This allows capability to sit stably on a set point of 100% MCR on a continuous basis, whilst allowing some headroom for safe load and pressure control of the boiler with varying waste quality.

7.4.5 Furnace and heat recovery boiler

The design of the furnace and the heat recovery boiler is another important aspect of the plant in terms of reliability, efficiency and environmental performance. In particular, the chemical composition of MSW and C&I fuel is such that it has a high potential for boiler tube slagging (ash build up) and corrosion. The chlorine, sulphur and alkali metal content of the waste feed to the boiler are important parameters to consider in the design.

The chlorine content is also a factor in the production of chlorinated pollutants in the flue gases leaving the boiler, which ultimately needs to be controlled. Detailed waste composition analysis has not been undertaken yet and the average chlorine content of the waste is not known. The level of chlorine content is, based on preliminary assessment of publicly available waste data for Victoria, expected to compare similarly with other global MSW EfW projects. For example, chlorine levels for MSW EfW plants in Europe can be up to 1.0 % chlorine, with typical values being between 0.5 and 0.8 %. The limit under the 2010 EC IED for a non-hazardous thermal treatment process is 1%. This Project will not accept waste > 1% chlorine content by weight. The risk of boiler gas side corrosion and the generation of chlorinated pollutants (e.g. HCl) in the flue gases will be capped at levels for which there are proven technologies to control these risks. It is noted that waste composition can change during a project. The boiler and flue gas treatment system will be designed for the maximum permissible levels of chlorine,

The furnace is designed as a fully enclosed membrane, with water-wall tube-cooled chambers. There are a number of boiler passes, with the first pass of the boiler consisting of the water-cooled gas tight welded tube walls of the furnace. Following this pass, the second (and sometimes third) passes will be 'empty' (i.e., no convective tube bank elements), employing radiative heat transfer on the wall surfaces only. The first convective pass (and sometimes the third or fourth pass), will include the first tube bundle elements across the gas flow path, typically the evaporator and high temperature convective superheater elements. The convective passes generally also include a further two stages of low and medium temperature superheater elements. The final pass, which can be either be horizontal or vertical, contains a number of stages of convective feedwater economiser elements.

Various methods are employed to clean the boiler's convective elements, typically including:

- Water soot blowing in the high slagging furnace and empty radiant passes;
- Rapping devices along convective passes if orientated horizontally; and/or
- Steam and gas pulse shock soot blowing if a vertical convective pass is adopted.

Each of these tube cleaning techniques promotes ash to fall off tubes into collection hoppers below. A horizontal convective pass design allows relatively simple removal and replacement of those tube elements. This may be required during the life of the plant when corrosion or erosion reduces tube thickness below safe acceptable margins. A vertical convective pass design is more complex for tube element replacement but allows a smaller overall boiler footprint.

The objective of the empty boiler passes is to cool temperature of the flue gases. Typically, the target is to cool the gases from above 850^{0}C in the upper furnace, to below 650^{0}C before the gases reach the metal tube surfaces of the high temperature superheater elements. This reduces the risk of fouling and corrosion in the superheater tubes. By employing an evaporator screen tube before the first convective superheater, it is possible to allow the gas temperature into the evaporator element to exceed 650^{0}C, as the temperature of the water in this tube is considerably lower than the main steam temperature. This reduces the risk of slagging and corrosion in the evaporator.

The flue gas needs to be maintained at a temperature greater than 850^0 C for more than two seconds with adequate excess oxygen, (>6 vol%), to destroy persistent volatile organic compounds including dioxins and furans and their precursors by oxidation. The gas is then cooled as it passes though the boiler empty passes (with water-cooled tube walls) to less than 650^{0}C, and then through the convective evaporator and superheater passes, including the economiser, to circa 160-190^{0}C. The thermal energy is recovered during the gas cooling to generate steam by heat transfer from the gas path into the boiler water/steam tubes (no direct water contact). This is one of a number of key differences between modern EfW plants and old waste incinerator plants that formerly used water quenching to cool the flue gas with no heat recovery and limited emission control technologies employed.

Dioxins and furans can potentially reform (known as novo synthesis) from their precursors in the convective evaporator and economiser passes of the boiler, (where the temperature zone is between 450^{0}C and 250^{0}C). However, the combustion gases only have residence times of seconds in these passes, so the probability of dioxins reforming here is limited, as many of the precursors have already been destroyed in the furnace through effective combustion control.

The residence time for flue gases and dusts in this 450^{0}C to 250^{0}C region is reduced by the effectiveness of heat transfer to cool the gases rapidly to below 250^{0}C. Residual dusts on these elements will be removed by proven tube cleaning systems, such as mechanical rappers and soot blowing. Ash collected in the bottom of these passes is discharged continuously to the ash handling system, to avoid residence time issues.

Chapter 4 (parts 4.4.14) of the 2019 EC BREF for Waste Incineration[1] confirms these approaches as good practice design that meets the requirements of the 2010 EC IED with respect to dioxin and furans emission control.

Any residual dioxins and furans in the flue gases leaving the economiser are then treated in the flue gas treatment system as described in Chapter 7.4.6 of this document.

The final steam temperature selected for the plant is also an important parameter for mitigating slagging and corrosion risks in EfW plants. This is discussed in Chapter 4.4.5 of the 2019 EC BREF for Waste Incineration. Higher steam temperatures are more energy efficient, but also raise the gas side surface metal temperatures of superheater elements, increasing the slagging and corrosion risk. For this reason, EfW plants typically adopt conservative steam temperatures and pressures. The expectation for the boiler outlet steam conditions for this Project is approximately 440°C and 64 bar(a). These numbers may be refined during the detailed design stage.

It was identified by JSPDI that technology suppliers such as Everbright have constructed a number of plants operating at similar steam conditions. This temperature should allow a good practice level of thermal efficiency and support reasonable superheater life by limiting high temperature corrosion and ash fouling.

The design of the boiler for the Project will adopt a conventional design which has been proven to be effective for combusting MSW. This general type of combustion technology is successfully used at the majority of EfW plants in the world and is not expected to prove problematic in handling the MSW and C&I waste types proposed.

7.4.6 Flue gas emission control systems

7.4.6.1 General

Air emissions from the stack are the most regulated and controlled emissions from an EfW facility. The plant is required to have continuous (24/7) emission monitoring systems (CEMS) for the majority of pollutants to ensure compliance with the air quality requirements. Figure 7.2 provides a summary of the types of emissions found in low concentrations in flue gas (from MSW and C&I feedstock) and the Best Available Techniques (BAT) typically used to control these emissions.

Table 7.2: Flue gas emissions and treatment

Flue gas emissions	BAT Treatment
Oxides of Nitrogen (NOx)	Controlled by combustion control and a selective non-catalytic reduction (SNCR) system with the injection of ammonia or urea into the hot flue gases
Oxides of Sulphur (SOx)	Controlled by the injection of lime (alkaline) reagent into the flue gas to absorb and neutralise the acid gas compounds
Halogens (e.g., HCl, HF)	Controlled by lime (alkaline) reagent injection, neutralisation and adsorption
Particulates	Boiler ash and APC residues are filtered out in the bag filter system
Heavy Metals (e.g., Hg, As, Cd, etc)	Controlled by the injection of activated carbon into the flue gas which is subsequently collected downstream in the bag filter system

[1] Frederik Neuwahl, Gianluca Cusano, Jorge Gómez Benavides, Simon Holbrook, Serge Roudier; Best Available Techniques (BAT) Reference Document for Waste Incineration; EC Joint Research Council Science for Policy Report, 2019; EUR 29971 EN; doi:10.2760/761437

Flue gas emissions	BAT Treatment
Volatile organic compounds including dioxins and furans	Destroyed by high temperature in the furnace. The reformation of these compounds is inhibited by controlling the flue gas cooling and using activated carbon injection and bag filters to absorb and remove any residuals

In Europe, emissions to air from EfW plants are tightly regulated by the 2010 EC IED, which has subsumed the regulations that were formerly known as the Waste Incineration Directive. This legislation sets out stringent emissions levels for the following pollutants and is considered a tougher compliance standard than the regulations applying to non-waste burning, large combustion plants such as coal and biomass power stations. Table 7.3 outlines the main emission limits for waste burning plant under 2010 EC IED.

In December 2019, the EU updated their Best Reference Document for Waste Incineration[1] (2019 EC BREF), which included recommendations to tighten flue gas emission limits for new plant, (also presented in Table 7.3). It is expected that the next revision of the 2010 EC IED will adopt the 2019 EC BREF emission limit recommendations in Europe.

Using the BAT emissions control techniques outlined in Table 7.2, modern EfW plants can comfortably comply with the 2010 EC IED and 2019 EC BREF limits.

Table 7.3: Average Emission Limits for Waste Burning Plant under the 2010 EC IED and 2019 EC BREF for Waste Incineration

Pollutant	Units	2010 EC IED Emission Limit	2019 EC BREF Emission Limit	Averaging & Sampling Period
Total Dust	mg/Nm^3	10	5	Daily, Continuous
Organic substances or VOCs	mg/Nm^3 as TOC	10	10	Daily, Continuous
Hydrogen chloride, HCl	mg/Nm^3	10	6	Daily, Continuous
Hydrogen fluoride, HF	mg/Nm^3	1	1	Daily, Continuous
Carbon Monoxide, CO	mg/Nm^3	50	50	Daily, Continuous
Sulphur dioxide, SO_2	mg/Nm^3	50	30	Daily, Continuous
Nitrogen Monoxide & Dioxide, expressed as NO_2	mg/Nm^3	200	120	Daily, Continuous
Cadmium and Thallium, Cd+Tl	mg/Nm^3	0.05	0.02	Average over sampling period, 30 min to 8 hrs
Mercury, Hg	mg/Nm_3	0.05	0.02	Average over sampling period, 30 min to 8 hrs
Other Trace Metals	mg/Nm_3	0.5	0.3	Average over sampling period, 30 min to 8 hrs
Dioxins and Furans	nano g/Nm_3 I-TEQ	0.1	0.04	Average over sampling period, 6 to 8 hrs

Note: Emission limits are standardised to normal conditions defined as 273°K, 101.3 kPa, dry gas at 11% volume of oxygen.

The 2010 EC IED also includes half-hourly emission limits for total dust, TOC, HCL, HF, SO_2, NO_2 and CO to regulate transient operating conditions.

The Project will comply with all the environmental requirements of the Victoria EPA Energy from Waste Guideline, Publication 1559, December 2013. This guideline has adopted the 2010 EC IED as the requirement for an EfW plant in Victoria. Along with emission level compliance, this Project will also target emission levels below that as specified in the 2019 EC BREF for Waste Incineration. These are applicable under all transient, part load, start up and shut down operating conditions.

The Project will also comply with the requirements of the Victorian Government State Environment Protection Policy (Air Quality Management) no. S 240, December 2001, (SEPP AQM), Schedule E (Stationary Source Emissions – Air Quality Management Regions). This introduces some additional regulated pollutants and more stringent pollutant levels than those required under the 2010 EC IED. The EfW Plant is located in the Port Philip Air Quality Control Region.

There are very few operating reference plants globally that are currently required by regulation to achieve the more stringent 2019 BREF emission limits as, although the 2019 BREF has now been accepted, the IED limits won't be revised until 2023. The flue gas treatment systems to be employed for this project will entail some design enhancements building upon those currently globally practiced which can already achieve the present European IED requirements. The technologies that have been proven to achieve the equivalent levels of emissions as the present IED in numerous operating EfW plants in China will also similarly require these design enhancements to achieve the 2019 BREF limits. Jacobs has obtained reference plant information for six plants in the UK which already apply the technologies that will be employed by this project, and we describe how those plants' flue gas treatment systems will be upgraded to meet the upcoming regulations, with an equivalent approach to be adopted for this project. Refer to Chapter 7.5 for details.

7.4.6.2 Flue gas treatment description

Air emission controls begin with combustion control in the furnace. Secondary combustion air is heated and injected above the grate in order to promote better mixing to maximise the destruction of volatile organic compounds and minimise carbon monoxide in the flue gases. There are typically secondary combustion air nozzles provided on the front and back wall of the furnace, normally offset to promote mixing and turbulence which encourages complete combustion. It also allows for the staging of combustion such that on the grate, the waste is combusting in a reducing environment. This means less air is required for full combustion of the waste, which reduces the production and subsequent emissions of oxides of nitrogen (NO_x).

7.4.6.2.1 Advanced SNCR System

Most EfW plants achieve compliance with the 2010 EC IED NO_x emission limit through the use of an SNCR system. This process injects ammonia or urea solutions through two or more rows of nozzles into the top of the furnace where the temperature is around 800^0C to $1,000^0$ C. The ammonia or urea reacts with NO_x in the combustion gases, reducing it to water and Nitrogen (N_2), which is a major component of air. To avoid overdosing the reagent, ammonia (NH_3) levels are monitored in the flue gas. This SNCR approach has been specified for this Project but in addition, in order to meet the more stringent 2019 BREF NO_x limit an advanced system will be adopted for this project. The advanced SNCR system will employ enhanced temperature sensors (radiation pyrometers) and upgraded control systems that will continuously optimise the injection locations and rates of ammonia or urea into the upper furnace so that the reduction efficiency over a standard SNCR system is improved without compromising on ammonia urea slip. Further description of how these enhancements are being employed in existing UK reference plants employing SNCR NO_x abatement are described in Chapter 7.5.

7.4.6.2.2 Flue Gas Recirculation

Another technique used in EfW plants to increase energy efficiency, further reduce NO_x and help control CO emissions, is the use of a flue gas recirculation (FGR) system. An FGR system recirculates part of the dust free flue gas, typically from downstream of the induced draft fan, and mixes it with fresh secondary air before injecting it back into the furnace. This replaces a part of the fresh combustion air that would have otherwise been required via the secondary air system. It has a dual effect of cooling the furnace flame temperature and limiting the oxygen content for nitrogen oxidation, thus limiting the NO_x generation. It also allows the combustion process to proceed with less excess air, without increasing the CO concentration.

The use of an FGR system is particularly relevant as a means of reducing NO_x formation in the boiler and helping the plant achieve the NO_x emission target. It also helps reduce the ammonia consumption for the SNCR system which is also a benefit. An FGR system in combination with an advanced SNCR system is proposed for this Project to achieve the required NO_x emission limits.

The FGR system usually comprises a flue gas recirculation fan, a damper and duct work to the combustion chamber. The FGR fan is typically designed so that sufficient flue gas flow rates are available over the entire combustion diagram range.

7.4.6.2.3 Dry/Semi Dry Absorbent Reactor System

The flue gas treatment technology proposed for this Project is a dry or semi dry (or a combination of the two) absorbent system. The approach involves the injection of hydrated or slaked lime ($CaOH_2$) into an absorption tower, in addition with the injection of dry activated carbon powder. Reagent recirculation will be employed to recirculate a proportion of the unreacted reagents in the APC residue. Bag filters downstream of this process will be used to capture ashes and spent flue gas reagents from the gas flow.

To accommodate potential changes in waste composition identified during the detailed design phase, an allowance will be made to include an additional flue gas dosing system using dry sodium bicarbonate ($NaHCO_3$) (commonly referred to as 'baking soda'). The Project proposes to use one of the following two flue gas technologies:

a) A Circulating Fluidised Bed (CFB) design with an absorption tower, bag filters and recirculation system. An indicative schematic of the proposed system is shown in Figure 7.8

b) A loop reactor design with reagent recirculation which is a reactor vessel with a downdraft pass to a loop or turning point where reagent is injected and mixed followed by an updraft pass where the flue gases and reagents continue to mix and react. One vendor Luehr filter employs a motorised rotor filled with small balls of heat and wear resistant ceramics to enhance mixing at the bottom of the loop. This general technology type is used globally by technology suppliers such as Luehr Filter and CNIM LAB amongst others. A schematic of the proposed Luehr technology is shown below in Figure 7.9.

In principle, both types of flue gas treatment systems are fairly similar in their functionality and purpose and are very similar to what is offered by other global technology suppliers. Both technologies are described in the following chapter, and both are able to achieve the emission limits set out in Table 7.3 when the enhancements required to achieve the 2019 BREF are employed, which entail:

- Increased consumption of sorbent reagents
- Option to use sodium bicarbonate in lieu of hydrated lime.

Further description of how these enhancements are being employed in existing UK reference plants employing these types of sorbent reactor systems are described in Chapter 7.5.

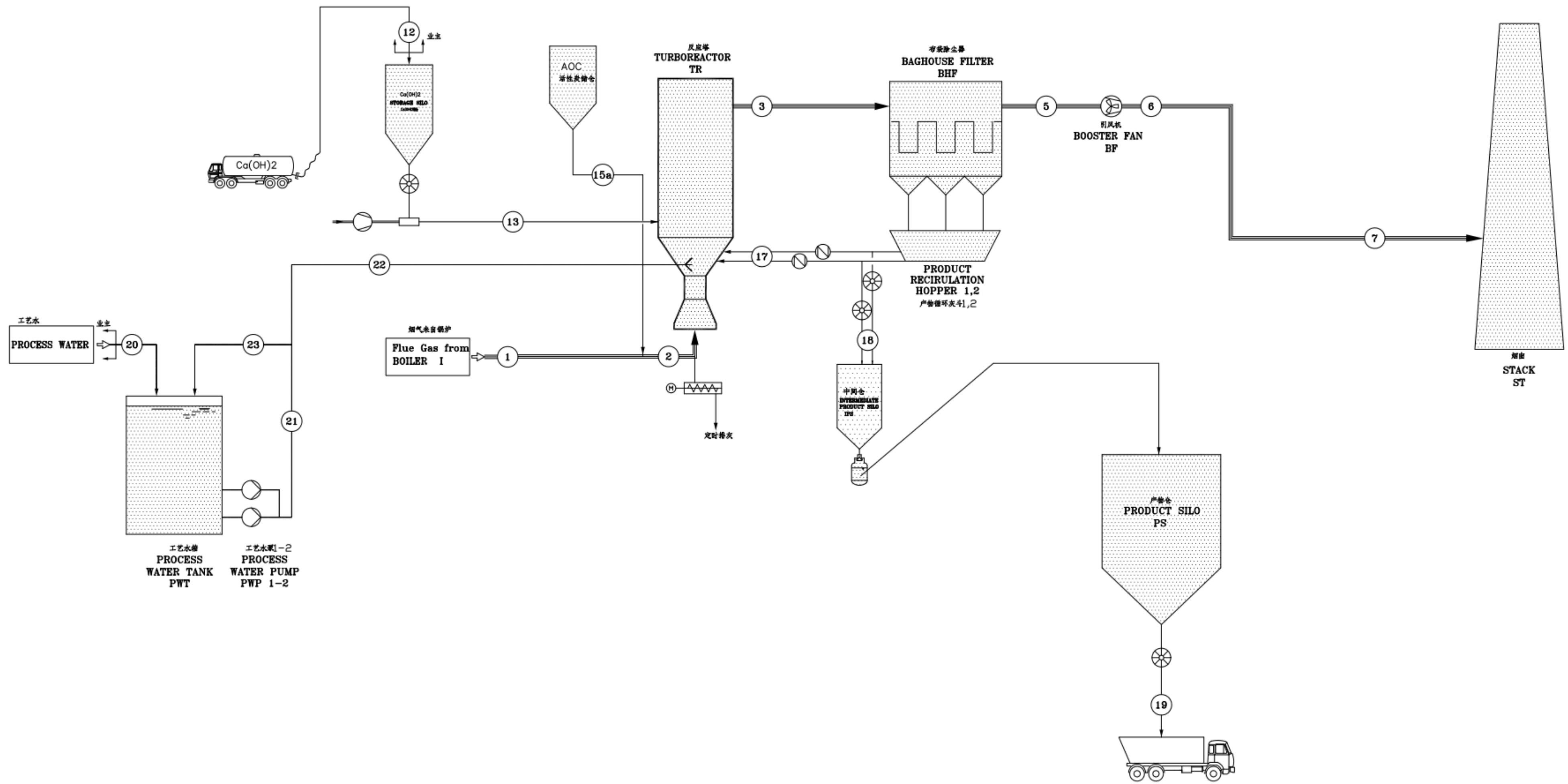
7.4.6.2.4 CFB reactor design

Flue gas leaving the boiler is expected to be around 170°C to190°C. For the CFB reactor technology, it will enter the lower part of the absorption tower which is where the 'fluidised' bed of hydrated lime will be injected. This allows for instantaneous mixing of the flue gas and the hydrated lime. Process water is sprayed via nozzles into the lower part of the absorption tower to increase the humidity of the flue gas and reduce the flue gas temperature, so the reaction temperature is maintained as close as possible to the water dew-point. This improves the desulfurisation efficiency.

The hydrated lime reacts with the acid gases (HCl, HF, SO_2, etc.) in the flue gas and the reaction products are carried by the flue gas from the upper part of the absorption tower to the bag filters downstream. The resulting APC residue is collected in the bag filters and discharged to a hopper for recirculation back to the Circulating Fluidised Bed via an air chute. Some of the APC residue is also transferred to the fly ash silo for storage. The amount of APC residue that is recirculated can be adjusted according to the EfW plant load. The velocity of the flue gas at a venturi is rapidly mixed with the APC residue and moisture in the residue and forms a three-phase flow in the absorption tower.

The activated carbon powder is injected directly into the inlet flue gas duct leading into the fluidized bed reactor. The reaction effect of the activated carbon powder absorbs heavy metals such as Mercury (Hg) from the flue gas, as well as other pollutants such as dioxins and furans. If required, additional dry sodium bicarbonate will be injected directly into the flue gas duct to the bag filter, or into the fluidised bed reactor, to assist with reducing the acidic gas concentrations in the flue gas.

Figure 7.8: Semi-Dry or Dry Lime CFB Flue Gas Treatment system with recirculation (image courtesy of Jiangsu Huaxing East Electric Power Environmental Protection Technologies Co Ltd)

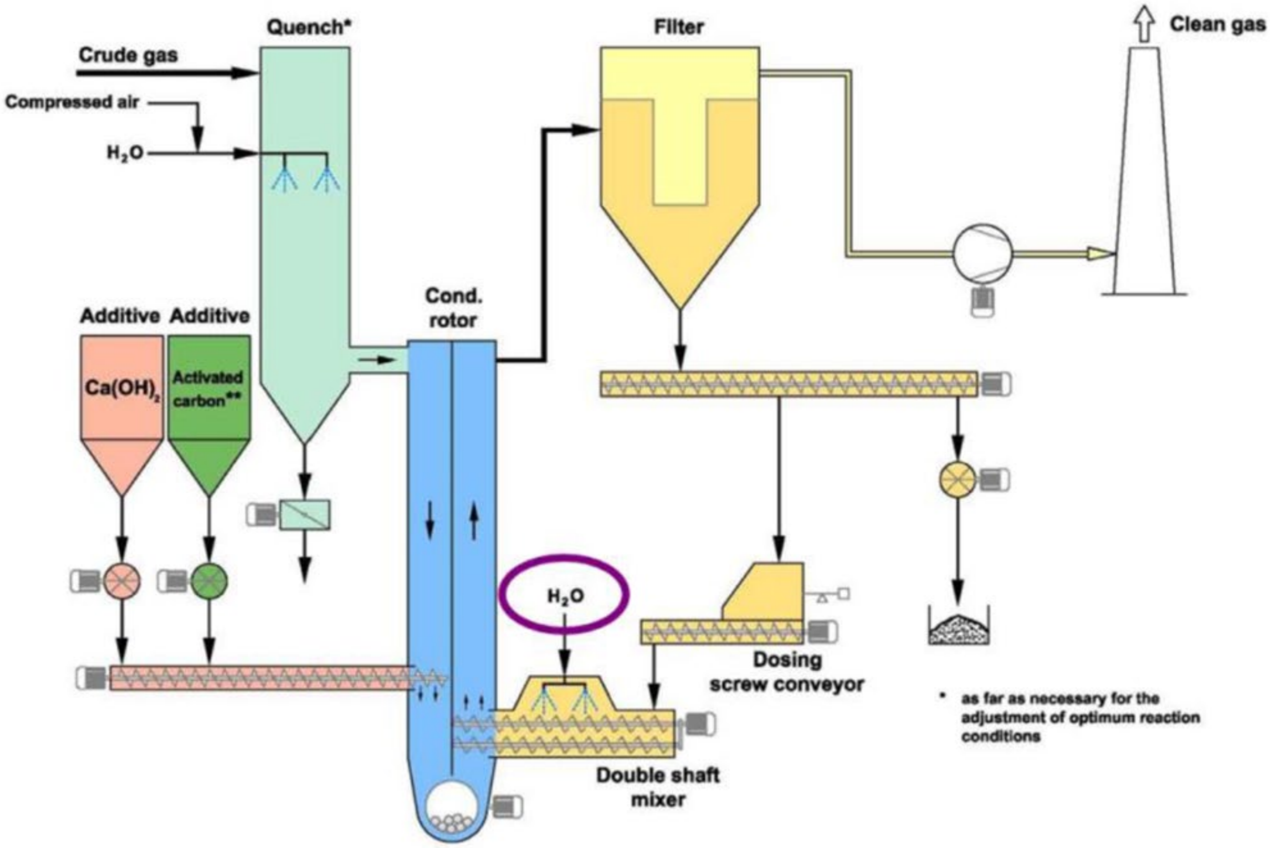


7.4.6.2.5 Loop reactor design with reagent recirculation

The CRD technology injects hydrated lime and activated carbon towards the lower part of the reaction chamber 'elbow', where in this Leuhr filter example is where the conditioning rotor is located. The loop reactor allows for better distribution of the injected reagents and the gas flow. The reagents are injected via a continuous dosing device. The flue gas will enter more towards the top end of the tower after going through a flue gas conditioning tower, which adjusts the flue gas temperature and humidity as required via the injection of water mist. This provides an ideal reaction condition within the loop reactor. Any water that is injected will be fully evaporated. Similar to the CFB technology, additional dry sodium bicarbonate can be injected directly into the flue gas duct or the loop reactor, to assist with reducing the acidic gas concentrations in the flue gas.

Specifically, for the Luehr filter example shown above, the main functions and purpose of the conditioning rotor is to prevent reverse particle flow and achieve a homogenous distribution of particles in the flue gas, even with high particle loads and the disintegration of larger particles. This loop reactor technology also allows for reagent recirculation into the reaction loop via the means of a mechanical screw conveyor. As with the CFB technology, the recycling rate can be adjusted and controlled as required. Some water will be injected into the recirculating system to humidify the recirculating agents and improve the deacidification efficiency. The water quantity required for this process is relatively low compared to other uses within the EfW plant.

Figure 7.9: Semi-dry or Dry Lime Conditioning Rotor Flue Gas Treatment system with recirculation (image of the Luehr Filter technology shown below for reference)



7.4.6.2.6 Bag filters

Once the flue gas leaves either type of absorption tower, it enters the bag filters which aim to capture APCr and fly ash in the flue gas and bring the concentrations below the 2010 EC IED & 2019 EC BREF limits. In the bag filters, the acidic gases in the flue gas continue to react with the hydrated lime, and the activated carbon continues to absorb heavy metals and dioxins and furans. Various particles, including fly ash from the boiler, condensed heavy metals, reaction products, unreacted reagents, and activated carbon, are entrained onto the surface of the bag filters and are blown into the dust hopper by compressed air.

A portion of the collected dust will be recirculated back into either the duct or the absorption tower for re-use. The recirculation of the collected dust residues, which contain some unspent reagent, allows a reduction in the amount of lime used and reduces operating costs. It also allows a significant reduction to the volume of APCr generated, reducing the volume for subsequent treatment and disposal. The recycling of the APCr also prolongs the reaction time. This is a requirement as indicated in the 2019 EC BREF.

The bag filters to be employed for the Project can typically achieve particulate emission levels less than 5-10 mg/Nm^3 which meet the 2010 EC IED requirements and the SEPP AQM criteria. APCr collected in the bag filters will be stored in a silo with dust control filtration, prior to dispatching into suitable enclosed vehicles for safe disposal offsite.

7.4.6.2.7 Choice of treatment reagents

The proposed flue gas treatment equipment function in a similar manner to other similar technologies supplied by the leading global companies. However, there may be some subtle differences around the design of the sorbent absorption tower/reactor and use of water for hydration and gas conditioning. The choice of either a semi-dry or dry system (or a combination of the two), means that any water used will be fully evaporated within the gas duct or reactor, which will operate at a minimum of 130°C. No liquid effluent will be produced from the flue gas treatment system. The choice of burnt lime or already hydrated lime generally comes down to availability and economics of supply. Hydrated lime is generally more expensive per tonne than burnt lime, but would not require an onsite slaking system. The use of hydrated lime injection simplifies the injection and absorption tower system design, as less water is required for hydration in the duct and the reagent reacts more quickly. Either reagent is suitable for the Project and both approaches are well proven and effective in achieving 2010 EC IED and 2019 EC BREF emission limits. The use of sodium bicarbonate in these types of flue gas technologies is also proven to be effective.

The activated carbon injection is an important step to absorb volatile heavy metals (e.g. mercury, lead) and toxic volatile organic species (e.g. dioxins and furans) which are found in trace levels in the waste. The spent carbon dust containing the absorbed pollutants is also collected in the downstream bag filters, capturing the majority of the heavy metals released during the combustion of the waste.

These approaches for the minimising acid gas, dioxin and furans and heavy metals from MSW fuelled EfW plants are considered Best Available Technologies.

7.4.6.2.8 CEMS

A NATA (National Association of Testing Authorities, Australia) and MCERTS (UK gas analyser accreditation scheme) certified CEMS will be provided on each boiler to measure pollutant and duct process condition parameters, as required under the 2010 EC IED and SEPP AQM. It will also monitor ammonia for SNCR dosing control optimisation.

The CEMS will monitor, time average and report emissions in accordance with the 2010 EC IED. The CEMS will provide record the following corrected concentrations of gases in the chimney on a continuous basis:

- Stack gas flow
- Temperature
- Pressure
- Gas moisture content
- Oxygen
- Carbon Dioxide

- Total dust
- Total organic carbon (TOC)
- Hydrogen chloride (HCl)
- Hydrogen fluoride (HF)
- Sulphur dioxide
- Oxides of nitrogen (NOx) as nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Ammonia
- Mercury

A ‘hot’ spare CEMS will also be provided which can be switched into service if the duty CEMS on a combustion line chimney is not operating (e.g. due to maintenance, calibration or instrument faults).

7.4.7 Steam turbine and generator

Whilst the specific steam turbine supplier for the project has not been selected, the following generic description is representative of a typical design for this piece of equipment. It should be noted that the steam conditions and power output described below are not guaranteed values and may change slightly during the detailed design phase of the project.

It is proposed there will be two steam turbines for the plant, one per boiler unit. The steam turbines will be a single casing unit each rated at circa 20,500 kW, linked to either a 2 or 4 pole 23,000 kVA generator via a speed reduction gearbox. The turbine will be rated for approximately 83 ton/hr of steam at 64 bar(a) and 440°C. The steam will discharge to the condenser at approximately 80 mbar(a) after it has passed through a number of turbine stages. The turbine will include an emergency stop valve and control valves, extractions for the feed heating and steam air heater system, a gland steam system and a drain system. It is common for steam turbines of this size to rotate at speeds above the grid frequency of 50Hz, or 3,000 rpm (for a 2-pole generator), and a reduction gearbox be mounted between the steam turbine and the generator.

The steam turbine will also include a control system including instrumentation, vibration monitoring, an automatic start-up system and transfer of the required signals to the plant control system.

The turbine lube oil system is used to support the rotor journals in the bearings and will include a lube oil tank, a lube oil cooler and oil purification system, a main oil pump, auxiliary oil pump and an emergency DC lube oil pump.

The generator will most likely have an air-cooled rotor and water-cooled stator and it is anticipated that it will produce electricity at 11 kV. The generator will also include:

- A brushless excitation device with rotating rectifiers
- Generator protection
- Current and voltage transformers
- Synchronization
- Voltage controller
- Air-water coolers to cool the water that cools the stator

A 100% steam turbine bypass system to the condenser will also be incorporated which allows the boiler to star-up independently of the steam turbine and for it to be operated without the need to exhaust steam to atmosphere. In normal bypass operation the bypass system controls the initial pressure of the main steam of the boiler. The bypass system consists of a HP reduction station that reduces HP steam from ~64 bar(a) to a pressure sufficiently low to be acceptable for the condenser. A water spray (condensate) attemperates the steam so that it is suitable for the condenser. The bypass system allows operation of the boilers at full load without the turbine being on-line, which allows the boilers to continue waste treatment operations if the turbine is out of service.

7.4.8 Condensate and Feedwater Systems

The steam turbine will have various steam extractions, including low to medium pressure extractions for the condensate feedwater heaters, deaerator and steam air preheaters. This arrangement is common for industrial scale steam turbines and does not represent any notable technological or environmental risk.

The feedwater deaerator will operate at a temperature of approximately 130^{0}C or higher, which should adequately deaerate the water to mitigate the risk of pressure parts corrosion, as well as gas side dew-point corrosion in the boiler economiser. The deaerator feedwater storage tank should have at least 30 minutes of water volume between normal operation level and low water level trip, which is typical for a plant of this nature.

A water cooled (shell and tube) condenser will condense the steam exhausting from the turbines and shall conform to the Standards of the Heat Exchange Institute (HEI) Standard for Steam Surface Condensers. Materials used in the construction of the tubes, tube plate and shell will be of industry standard quality and shall be selected to be compatible with the water/steam cycle chemical dosing and control regime. The condenser will be of the divided water box type, which allows cleaning of one side on-line while maintaining a minimum of 50% load. This allows maintenance of heat transfer performance if the condenser scales up during service.

It will be proposed that two,100% duty, constant speed electrically driven condensate extraction pumps will be supplied.

Air extraction pumps will also be provided to remove all non-condensables from the condenser and maintain vacuum conditions. Two,100% duty air extraction systems are proposed and will be designed to HEI standards.

Boiler feed pumps will also be provided within the condensing and feed heating plant. It is proposed use two by 100% electrically driven pumps to provide a level of redundancy suitable for a plant of this type.

The boiler feedwater system will be equipped with a chemical dosing system for pH regulation (alkaline reagent) and a drum anion buffering reagent dosing system (such as phosphate or caustic), to mitigate the risk of boiler corrosion. This is typical for plants of this type. The need for oxygen scavenger injection should also be considered in line with the chemical regime for the boiler water. Hydrazine will not be used if an oxygen scavenger is deemed to be required.

7.4.9 Cooling water system

The cooling tower system will be an induced mechanical draft counter-flow wet cooling tower, with multiple cells, each with a low noise variable speed fan ventilator.

Biocide and anti-scaling dosing systems are proposed which will minimise biological organisms and scale build-up in the cooling water system. The cooling towers shall comply with statutory requirements of the *Victorian Public Health and Wellbeing Act 2008,* Victorian Public Health and Wellbeing Regulations 2019 and the National Construction Code.

A potable water make-up and blowdown system shall be provided as part of the cooling water system. Water will be supplied via a potable water main owned by Barwon Water. Blowdown water discharge will be minimised and recycled where possible for other site processes. Excess blowdown will be discharged to an existing sewer main, again owned by Barwon Water. The blowdown water is essentially clean water with elevated levels of salt due to evaporation in the cooling towers.

The plant will employ cooling water pumps for cooling the condenser from the cooling towers. Auxiliary cooling system pumps will also be provided for the auxiliary plant.

7.4.10 Balance of Plant

A demineralised water system (most likely a combined reverse osmosis / electrodeionisation system) is required for the plant. This will make up water lost from water cycle such as boiler blowdown and steam blowing. A sand filtration system will be used upstream of the demineralised water plant. This type of system is considered typical for a plant of this nature.

Other balance of plant equipment required include:

- A gas supply from an existing AusNet Services gas main (for start-up and flame stability gas supplementary firing)
- Air compressors for the provision of instrument air and service air
- Emergency diesel generators
- Fire pumps (electric and diesel) and a fire pump and hydrant ring main system
- Fire detection, alarming and suppression systems in higher risk areas such as the transformer, the turbine lube oil system, the waste bunker, and the waste feeding systems into the boiler
- An overhead crane in the turbine hall
- Weighbridges for recording waste and other consumable deliveries, and despatched volumes of residues and recyclables
- Mobile plant for waste handling, such as front-end loaders for moving loose waste and bottom ash
- Separated dirty and clean site drain systems, including an oily water separator system
- Clean storm water run-off system directed to an existing stormwater drain operated by the City of Greater Geelong Council

7.5 Reference Plants

The two potential general types of flue gas treatment systems for the Project, (described in 7.4.6.2), are common in EfW plants throughout Europe and years of continuous emissions monitoring has proven the ability of these technologies to achieve the 2010 EC IED emission standards. Publicly available information from three operating plants using HZI CFB technology and three operating plants using CNIM-LAB loop reactor with recirculation technology in the United Kingdom (Reference Plants) has been collated to demonstrate the capability of the flue gas treatment system technologies proposed for the Project to meet the 2010 EC IED emission standards (202 Appendix N). These technology providers are being used for best practice benchmarking purposes. A formal procurement process will be initiated by PHI at the next stage of project development.

As the BREF 2019 guidelines are not due to be adopted in Europe until 2023, the Reference Plants do not yet operate in accordance with the BREF 2019. However, the plants do have the capability to reduce NOx, HCl and SO_2 emissions to consistently achieve compliance with BREF 2019. The approach each Reference Plant will take to achieve the more stringent emission controls is described in Table 7.4 and Table 7.5 below. The approach applicable for the loop reactor type approach with recirculation is applicable

Table 7.4: Reference Plants using HZI CFB technology

	Greatmoor EfW Facility	Newhaven EfW Plant	Riverside EfW Plant
Typical waste composition	Residual MSW	MSW with up to 10% clinical	MSW, C&I mixture
Basic plant capacity information	345 ktpa, Single line 1 x 37.5 ton/hr	226 ktpa, Two lines 2 x 14.5 ton/hr	585 ktpa, Three lines, 3 x 31.8 ton/hr
Commencement of operations	2016	2011	2011
Basic plant boiler & FGT	▪ HZI reciprocating grate ▪ Recirculating flue gas ▪ SNCR ▪ Semi-dry CFB reactor utilising lime & PAC	▪ HZI reciprocating grate ▪ Recirculating flue gas ▪ SNCR ▪ Semi-dry CFB reactor utilising lime & PAC	▪ HZI reciprocating grate ▪ Recirculating flue gas ▪ SNCR utilising aqueous ammonia ▪ Semi-dry CFB reactor utilising lime & PAC
Emissions standard met	IED 2010/75/EU (EC, 2010)		
Design changes required for BREF 2019 emissions	NOx: DyNOR system Acid gases: increased consumption of reagents, option to use sodium bicarbonate in lieu of lime. The acid gas loading of the raw flue gas will need to be assessed to finalise the optimum design.		

Table 7.5: Reference Plants using CNIM-LAB loop reactor with recirculation technology

	Battlefield EfW Plant	Leeds EfW Plant	Staffordshire EfW Plant
Typical waste composition	MSW, small quantity of C&I	MSW, small quantity of C&I	MSW
Basic plant capacity information	102 ktpa, Single line 1 x 12 ton/hr	164 ktpa, Single line 1 x 20.5 ton/hr	340 ktpa, Two lines 2 x 20 ton/hr
Commencement of operations	2015	2016	2014
Basic plant boiler & FGT	▪ CNIM-Martin reverse acting grate ▪ Recirculating flue gas ▪ SNCR utilising urea injection ▪ Dry system, VapoLAB with LABLoop reactor utilising lime & PAC		
Emissions standard met	IED 2010/75/EU (EC, 2010)		
Design changes required for BREF 2019 emissions	NOx: advanced system with improved control system and increased number of reagent injection points. Acid gases: increased consumption of reagents, option to use sodium bicarbonate in lieu of lime. The acid gas loading of the raw flue gas will need to be assessed to finalise the optimum design.		

Each of the six Reference Plants have publicly reported continuously monitored emissions data. Emissions data for the period 2017-2020 is presented in detail in Appendix N. Emission data for 2019 is summarised in Table 7.6 for the four pollutants for which BREF 2019 has the more onerous requirements than IED 2010 (NOx, HCl, SO_2 and particulates). The data shows that all six Reference Plants are comply with current emission limits and with the above stated enhancements will comply with the 2019 BREF requirements.

Table 7.6: Selected emissions data for reference plants (2019)

Pollutant	IED 2010 Emission Limit (mg/Nm^3)	2019 BREF Emission Limit (mg/Nm^3)	HZI CFB Technology 2019 annual average of reported daily emissions (mg/Nm^3)			CNIM-LAB Loop Reactor Technology with residue recirculation 2019 annual average of reported daily emissions (mg/Nm^3)		
			Greatmoor	Newhaven	Riverside	Battlefield	Leeds	Staffordshire
NOx	200	120	180.2	185.7	180.2	172.8	175.5	175.2
HCl	10	6	5.5	3.7	5.5	6.3	5.5	6.8
SOx	50	30	3.5	0.6	3.5	22.8	40.9	37.0
Particulates	10	5	5.1	1.6	5.1	0.3	0.9	0.3

7.6 Energy Efficiency

Modern EfW plants generally recover energy by generating steam in a boiler which can be used for either the generation of electricity via a turbine, for heating purposes, or both. For central heating plants or heat only plants, the energy efficiency is reliant on there being a heat demand available near the EfW site (e.g., industrial or commercial heating demand). However, for this project there is no requirement for a heating plant and only generation of electricity is considered.

European Union's Waste Framework Directive 2008/98/EC 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 or above 0.65. If R1 is below 0.65, proponents are expected to provide a justification as to why this value cannot be reached.

A preliminary estimate has been made of the expected efficiency of the Project, which will be subject to minor revision following the selection of the preferred EPC Contractor's design.

The overall plant efficiency and R1 calculation based on the current estimated waste net calorific heating value (9.5 MJ/kg (LHV)) is presented in Table 7.7. The preliminary calculation shows the plant will meet the European R1 criteria to be deemed a genuine energy recovery facility.

Table 7.7: Preliminary plant efficiency and R1 calculation

Parameter	Value
Gross power	40.7 MWe
Overall thermal efficiency (LHV Gross)	28.8%
R1	0.77

Key assumptions used in the R1 calculation include:

- Figures are preliminary and based on the Thermoflow™ thermal modelling estimates
- Assumes 7,884 operation hours per annum with 95% load factor during this time
- Annual gas usage estimate of 20,350 GJ or approximately 0.54 % (GJgas / GJwaste) of waste throughput. The amount of auxiliary fuel used is an estimate and any reduction in the amount will lead to a slightly improved R1 value
- Half of the annual gas fuel is used for start-up of the boiler (i.e. no steam production) and the other half is used during steam production to maintain combustion stability and furnace temperature during transient instability events (e.g. wet waste)

- Electricity imported is based on a plant auxiliary load of approximately 17% (as per the Technology Supplier recommendation) of the gross output and assumes six starts and stops per year. Each start and stop duration is assumed to be 5 hours long. The plant will not require the full 17% auxiliary load for the entire start up or shut down process, and will only require grid import when the turbine is not synchronised, so this is considered a conservative assumption.
- The soot blowing technology has not been confirmed, however is assumed to be a Gas Pulse Shock Soot Blower. The Technology Supplier has indicated the annual amount of natural gas required is 2,825 m^3. A typical Australian East coast gas quality is assumed to be utilised. If steam soot blowing was implemented, there would be a minor change to the R1 value
- The EfW plant and equipment will be designed and will be capable of reliable and continuous operation at various design conditions as per below,:
  - 1) At the maximum ambient dry bulb air (shade) temperature and a relative humidity (RH) at the higher end of the range that can occur during those summer conditions (typically summer climatic conditions are hot and dry at this site);
  - 2) At the minimum ambient temperature and at maximum relative humidity up to and including 100 per cent; and
  - 3) The plant design performance shall be optimised for the typical annual ambient dry bulb air (shade) temperature of 15°C, derived as the midpoint between monthly mean maximum and minimum temperatures, with a corresponding relative humidity of 65%.Table 16 outlines the preliminary design conditions that were considered during the Concept Design. The "Typical Site Ambient" conditions were used as assumptions in the Thermoflow heat balance model, the output of which was in turn used in the R1 calculation i.e. the efficiency estimate is already based on typical site ambient conditions at Lara.

Table 8 Site climatic design conditions

Parameter	Unit	Typical Site Ambient	Maximum	Minimum
Air Temperature	°C	15	45	-5
Relative Humidity	%	65	14	100
Prevailing wind direction		Westerly		
		Southerly		

- These values may not necessarily correspond to the actual values used during a future detailed feasibility study but provide a reasonable basis for comparison between some different operating conditions
- A summary of the major climate statistics recorded for the Lara region over a period of 26 years have been retrieved from the Australian Government Bureau of Meteorology website (*http://www.bom.gov.au/climate/averages/tables/cw_087113.shtml*). The climatic data is based on the Avalon Airport site 087113 (Latitude 38.03° South, 144.48° East and 11.0 m elevation)."

7.7 Construction

After all approvals have been granted, the EPC Contractor will mobilise to site and initially fence off the construction area. A general civil site scrape will be undertaken to clear rubbish and undulating ground in order to prepare the site for the works. This will be followed by bulk earth works, as well as piling in key process plant areas, and then the installation of buried services. The waste bunker excavation is likely to be the deepest excavation onsite (unless piling is required for the main structures), potentially being 5 m below the surface level. Where possible, any fill generated from cutting and excavation will be used onsite, to avoid unnecessary transport of spoil off site.

The next stage involves laying the concrete foundations, starting from the tipping hall and moving through to the waste bunker, boiler room, flue gas cleaning hall, stack and steam turbine hall. The key infrastructure of the boiler and flue gas treatment equipment would then be erected. The plant housing structure would be erected in a similar sequence to the foundations, with all remaining mechanical and electrical equipment installed. Items will be supplied to site in a modular arrangement as much as practically possible, to simplify onsite construction. The cladding would be installed to finalise the structure.

The other ancillary areas such as the truck weighing station, water treatment building, cooling towers, HV switchroom, fire protection equipment, administration office, switchyard, bottom ash pre-treatment, process and storage hall would be installed in a similar yet staggered sequence to the main plant. Finally, roadways and landscaping would be completed.

During this time, the EPC Contractor will manage safety and environmental issues for the construction and be ultimately responsible for all sub-contracted work undertaken onsite. At commencement of the project, the EPC Contractor will develop detailed project management plans, including Construction Environmental Management Systems and Plans (aligned with ISO 14001), to guide all activities. This would detail, for example, the management of:

- Dust (i.e. by possibly using water trucks)
- Hazardous, non-hazardous and construction wastes
- Noise through practical control solutions (i.e. substitution, isolation, engineering or administration controls)
- Fuels and other chemicals to restrict harmful, dangerous or toxic materials being released into the environment
- Disturbance to flora and fauna

As the waste bunker is predicted to be a relatively deep excavation, (pending the geotechnical report of the site detailing the levels of rock encountered and final detail design), there may be a requirement to use explosive techniques to break any rock encountered during excavations. This will be assessed in more detail as the design and site-specific information becomes clearer. Apart from this, the construction of the EfW plant is expected to be similar to other large industrial projects, with similar levels of environmental risk during construction.

7.8 Commissioning

There are two main phases of commissioning expected for the EfW Project as follows:

- Cold commissioning (before introduction of fuel)
- Hot commissioning

The procedures and timescales for these commissioning periods will be dependent on the selected EPC Contractor's preferred approach and design, which are not available at this stage of the Project. The following technical description is indicative only and is based on plans for similar EfW facilities outside Australia, which use similar moving grate combustion technology.

7.8.1 Cold commissioning

Cold commissioning starts when construction of all major plant, equipment and structures are complete. An EPC Contract milestone, such as a mechanical completion certificate, is often necessary to be issued by the Owner, or an Independent Engineer, who must be satisfied the works are safe to commence commissioning.

Cold commissioning involves a systematic and thorough checking of electrical, safety interlocks, controls, and control loop functions for each system of plant throughout the entire facility. The process starts for individual plant items one by one and works up to plant systems and/or packages that can be effectively tested, without requiring hot commissioning.

Initial energisation of electrical boards and equipment systems supplying power to the plant auxiliary systems is undertaken, without subjecting those systems (e.g. motors) to loads or temperatures (e.g. boiler) typical of normal service. This allows confirmation that equipment power supply systems, including protection systems, have been undertaken correctly (e.g. motors spinning in the correct direction).

Loop checks of control systems are undertaken to establish instrument sensors are working and control actuators are functioning correctly. Control logic and safety interlocks and protection systems within the plant control system are also tested for correct and safe operation.

During cold commissioning some other activities may take place in readiness for the commencement of hot commissioning, to avoid delays once the relevant certificates are issued, such as:

- Cleaning and flushing of equipment internals in readiness for operation, removing mill scale, rust, and similar. This will include the boiler chemical clean which is the most significant item requiring internal cleaning
- Installation of final consumable parts in preparation for hot commissioning (e.g. bag filters)
- Supply to site and filling of tanks and silos for main consumables such as lime, activated carbon, urea, and water treatment chemicals

The overall duration of cold commissioning is typically in the order of four months. During this time, there are expected to be few significant environmental impacts, but there may be some spent cleaning chemicals and residues generated in the internal equipment cleaning processes, which will be contained and appropriately disposed.

All checks are documented and tests are sample audited by the Owner, their representative, or an Independent Engineer. Generally, an EPC contract milestone, such as a Readiness Certificate, or Construction Complete Certificate, needs to be formally issued to the satisfaction of the appropriate representative before hot commissioning can commence, allowing checking of document records and plant condition before sign-off.

7.8.2 Hot commissioning

Commencement of hot commissioning for an EfW plant is associated with the first combustion of fuel, starting with auxiliary fuel (natural gas in the case of PHI), and followed by the introduction of the first waste firing. It also involves operating and testing all other plant and equipment systems, subjecting them to conditions representative of the normal range of operation and testing the plant systems as a whole for functionality and correct operation.

During hot commissioning, deliveries of MSW and C&I waste will commence to the waste bunker in preparation for the first waste firing. Waste will be sourced that is a representative of the feedstock the plant will burn over its operating life. Timing and volumes of deliveries need careful planning to match the commissioning schedule and to ensure sufficient volume without long storage times in the bunker. This detailed schedule will be developed by the EPC contractor during the detailed design and construction phase of the works. Waste bunker and tipping hall fire, dust and odour control systems will be operational before the first delivery of waste.

The following phases are the principal steps in hot commissioning of the plant:

Refractory dry out and boiler boil-out

This is a two-step process run in parallel or in sequence, which involves part capacity firing of the gas burners in the boiler. Refractory is a ceramic material and the process is similar to the firing process for other ceramic products. The refractory dry-out helps ensure the furnace and boiler internal linings (critical for protecting equipment and achieving necessary combustion temperatures) can be cured or set following installation, to remove water content.

The boiler boil-out is a heated washing and draining process undertaken to clean the inside of boiler tubes, piping, headers and vessels, to ensure they are free from contaminants, scale, grease etc. which could cause operational problems, such as corrosion.

The duration of the refractory dry-out and boiler boil-out is expected to be up to two weeks. Emissions to air during this time will be natural gas combustion products only. The CEMS will be operational during this period. Wastewater generated from the boiler boil-out will be directed to the wastewater discharge holding pond onsite. The demineralised water treatment plant will also be in service during this period.

Steam Blowing

Steam blowing is an essential part of hot commissioning to clean the boiler and steam systems including the steam turbine and bypass piping to condenser, of mill scale, corrosion products, foreign bodies and impurities introduced into the piping during fabrication and construction.

The steam blowing must be undertaken at high steam pipe velocities (known as disturbance factors) to ensure appropriate removal of contaminants. For this process, temporary pipework needs to be installed to an outdoor steam vent with a silencer, so that steam can be safely released from the process on an intermittent basis. A target plate system is also installed on the steam outlet to monitor the levels of foreign material removed during the blows. Steam chemical impurity parameters are also monitored. The process is repeated intermittently until satisfactorily low levels of foreign material and impurities are observed impacting the target plate, or in the steam samples.

The duration of the steam blowing is typically two weeks and involves significant intermittent noise emissions which do not occur during normal operation. This noise is minimised as much as possible though the use of the temporary silencer.

Emissions to air during this time will be natural gas combustion products only. The CEMS will be operational during this period. The demineralised water treatment plant will also be in service during this period as considerable volumes of ultrapure water are required for the process.

First waste firing and overall steam system testing

Before waste is introduced to the boiler ready for the hot commissioning stage, all CEMS and flue gas treatment systems will be fully operational. During this phase, waste is gradually introduced on a cyclical and ramping up basis to the first boiler, with several plant start-ups and shut downs expected. As for normal operation, for start-up and shut down, natural gas fuel will be used to ensure the furnace temperature is maintained above 850°C whenever waste is present, and before it is introduced to the combustion chamber.

The amount of waste consumed during this period will ramp up as the plant is proven at greater capacity. Once the first boiler is proven, the commissioning will start on the second boiler, and continue until all boilers are tested running simultaneously at full load.

The steam turbines will commence operational tests when the boilers have been proven to operate stably. When the turbine is first operated up to full speed, it will be synchronised with the grid frequency, and the first electricity will be produced. Electricity production and waste consumption will initially be intermittent and variable in rate, until the later stages of testing.

The duration of this testing period is expected to be around one month. During this time the CEMS and flue gas treatment systems will be in operation, but it is possible that there will be some short-term emissions excursions as the flue gas treatment equipment is ‘tuned’ to operate effectively. All other plant auxiliary equipment will also be tested in operation at this time.

Operability and Throughput Tests

During this period the plant will run at close to full capacity for an extended period of time. Both boilers and the steam turbine will be in operation, although tuning and testing of systems will be ongoing during this period. Generally, a formal operability test is undertaken when the plant operates continuously under the supervision of the EPC contractor for approximately two weeks, at high waste throughput (e.g. > 90% maximum). During this period, statutory and contractual testing requirements that need to be undertaken with AusNet Service in relation to the electrical system, grid connection and power export will be undertaken.

The ongoing testing of the flue gas treatment and CEMS systems to achieve correct operation during this period means that it is possible that there will be some short-term emissions excursions. The completion of the operability and throughput testing is generally an EPC milestone to allow commencement of the main plant performance tests.

The overall period of operability and throughput testing is expected to be around one month, including the formal operability test period.

Trial Operation Testing Period

The trial operation testing period is when the main overall performance and reliability tests occur. The performance tests will include a wide range of tests, including the following from an environmental perspective:

- Third party stack emissions tests for contractual guarantees (i.e. meeting 2010 EC IED emission limits)
- Combustion residence time tests (850°C for two seconds)
- Demonstration that the bottom ash is an inert residue (Total Organic Carbon and Loss-On-Ignition)
- Noise tests
- Waste throughput tests and industrial residue waste testing
- Power and steam output tests demonstrating the plant efficiency and proof that it is a recovery operation under the EU Waste Framework Directive R1 guidance.

The performance tests are expected to take around one week, if successful.

The reliability test is expected to be a month duration, during which time the plant will be required to demonstrate it operates reliably, with a reliability > 90% for the period. Operation will be at a range of loads demonstrating plant flexibility, however overall, will operate at high capacity. The CEMS must be in operation during this period or the plant will not be considered available. The plant must also comply with guarantee levels of emissions during this period, or be deemed to be not available under the test calculations. Some occasional emission exceedances may occur, as final adjustments to plant settings are made.

Once the reliability test has passed, a final plant inspection will be undertaken by the Owner, their representative or an independent engineer, to verify that operation hasn't damaged the mechanical integrity of the plant. Following this inspection, and passing all the above tests, the Taking-over Certificate will be issued, which transfers responsibility for the plant and its operation from the EPC contractor to the Owner. This Taking-Over date is sometimes referred to as the Commercial Operation Date.

The trial operation period will be a minimum of one month, and up to three months if some of the tests need to be repeated.

Availability Test after Taking Over

A final test related to the EPC contact occurs after taking-over, to demonstrate that the plant operates reliably with high availability to process waste and produce energy. There are commercial consequences under the EPC contract if the plant availability does not meet expectations. This test may be up to a year-long, but effectively is considered normal operation from an environmental perspective, with all systems functioning normally and in compliance with licence requirements.

7.9 Operation

The plant will operate on a baseload of 24 hours per day, 7 days a week, with the exception of maintenance outages and is anticipated to operate for approximately 7,884 hours per annum.

The operator's organisation structure has not been considered to date, however is envisaged that the Owner will appoint an O&M contractor to operate the plant. This would require an O&M agreement to be in place and establishes the range of duties and responsibilities of an O&M contractor, including environmental, health and safety obligations. The O&M agreement may also provide a performance-based fee and conversely liquidated damages, for failure to meet required performance targets.

The operation of the plant is expected to employ approx. 50-60 full-time staff throughout the life of the plant. Staff work in shifts to cover the 24-hour operation of the plant.

The approximate number of truck trips expected to the plant each week are as follows:

- 430 trips for municipal solid waste to the plant
- 9-10 deliveries for consumables and chemicals used for the plant
- 60 truck trips for ash and scrap metal removal from site

During annual, major, or unplanned shutdowns, site operations would differ, for example, an increase of maintenance contractors and different equipment used, as well as no MSW disposal trucks entering the site. Indicative shutdown periods are as follows:

- Annual Outage: 21 days per boiler (one boiler will be shut down while the other is in operation)
- Boiler Major Outage: 42 days every four years
- Turbine Overhaul: 21 days four every

The monitoring of emissions on site will be a key task for site O&M contractor. They will use the best available techniques for flue gas and emissions control (i.e., a CEMS). In addition, there would be periodic testing for dioxins and heavy metals conducted by a NATA accredited certifier. In the first couple of years of plant operation, this periodic testing would be conducted every 3-6 months and then be less frequent (i.e. 6-12 months), depending on test results in the future.

8. Waste feedstock

8.1 Feedstock profile

The anticipated waste feedstock is residual MSW (80 per cent by weight) and non-prescribed C&I waste (20 per cent by weight). The total expected amount of waste treated per year is 400,000 tonnes. MSW will be derived from a number of councils in Victoria. The exact councils are unknown at this time, as PHI will enter in to a tender process to secure waste feedstocks for the project after this report is published. Table 8.1outlines the anticipated tonnes of waste streams by source location.

Table 8.1: Anticipated tonnages by location

Source	MSW (ton)	C&I (ton)	Total (ton)
Colac Otway, Surf Coast, Greater Geelong	60,000	40,000	100,000
Western Melbourne	200,000	40,000	240,000
Nearby regional LGAs	40,000	0	40,000
Melbourne LGAs	20,000	0	20,000
Total	**320,000**	**80,000**	**400,000**

8.2 Waste data modelling

Desktop research, including a review of the following documents was undertaken to characterise the expected MSW and C&I composition of the waste feedstock:

- Maryvale Energy from Waste Plant, Australian Paper Works Approval Application (Jacobs, 2018)
- Advanced Waste and Resource Recovery Technologies: Metropolitan Regional Business Case and Procurement Strategy (Metropolitan Waste and Resource Recovery Group [MWRRG], 2018)
- Waste flows in the Victorian commercial and industrial sector (Sustainability Victoria, 2013) – C&I only

Waste data was analysed from the Gippsland, South East Melbourne, and Metropolitan regions, as well as Victoria-wide. It is important to note that the Gippsland and South East Melbourne regions will not be targeted as feedstock suppliers. However, due to limited public data availability, these data sets were included in modelling and may have some parallels with other regional Victorian areas which are under consideration for this Project. The MWRRG have announced they intend on tendering for the residual waste collection and processing of the western MWRRG councils. It is anticipated that the detailed waste audits undertaken by MWRRG will be made available to successful tenderers, which could be used to further confirm waste composition data.

The data provides indicative composition data for MSW and C&I waste streams for the state of Victoria. The datasets have been aggregated in Total expected feedstock as a percentage from each category per annum. Table 8.2.

The waste composition assumptions for the Project will be refined once further datasets are available from the specific councils who are likely to become suppliers for the Project. PHI will also undertake a waste audit of MSW waste that will be targeted by the Project to provide further analytical data of the combustion parameters of the waste material. The audit framework will be designed in accordance with Sustainability Victoria (SV) document 'Guidelines for the auditing of Kerbside Waste in Victoria' and analyse waste over a 12 month period to capture waste seasonality.

Table 8.2: Total expected feedstock as a percentage from each category per annum

Category	MSW %	C&I %	Total %
Earth based, Masonry	0.00%	2.68%	0.54%
E-waste	0.80%	1.51%	0.94%
Glass	6.00%	1.68%	5.14%
Hazardous & Fines	4.40%	5.45%	4.61%
Metals, Ferrous	1.30%	1.40%	1.32%
Metals, Non-Ferrous	0.70%	0.33%	0.63%
Miscellaneous, non-combustibles	0.40%	0.00%	0.32%
Miscellaneous, combustibles	6.20%	0.00%	4.96%
Organics, food	35.70%	36.04%	35.77%
Organics, garden	11.20%	0.37%	9.03%
Organics, timber	0.00%	4.53%	0.91%
Organics, soil & other	3.90%	01.22%	3.36%
Other	1.70%	14.61%	4.28%
Other, inert	2.50%	0.00%	2.00%
Paper & Cardboard	12.10%	16.87%	13.05%
Plastic	13.10%	12.25%	12.93%
Textiles	0.00%	1.06%	0.21%
Total	**100%**	**100%**	**100%**

8.3 Municipal solid waste overview

The document *Advanced Waste and Resource Recovery Technologies: Metropolitan Regional Business Case and Procurement Strategy 2018* (Metropolitan Waste and Resource Recovery Group, 2018) was reviewed to compile the waste composition data presented in Table 8.3. Seasonal variations and changes in policy may affect the input feedstock composition and as such the data presented in Table 8.3 is only indicative.

Table 8.3: Indicative MSW composition

Categories	Total anticipated tonnes per annum
E-waste	2,560
Glass	19,200
Hazardous & Fines	14,080
Metals, Ferrous	4,160
Metals, Non-Ferrous	2,240
Miscellaneous, non-combustibles	1,280
Miscellaneous, combustibles	19,840
Organics, food	114,240
Organics, garden	35,840
Organics, soil & other	12,480
Other	5,440

Categories	Total anticipated tonnes per annum
Other, inert	8,000
Paper & Cardboard	38,720
Plastic	41,920
Total	**320,000**

8.4 Commercial & industrial waste overview

It is anticipated that the primary C&I waste feedstock inputs will be sourced from Colac Otway, Surf Coast, Greater Geelong, and western Melbourne councils. Specific industries will be targeted depending on their suitability. The following data sources were used to estimate the material tonnage:

- Maryvale Energy from Waste Plant, Australian Paper Works Approval Application (Jacobs, 2018)
- Waste flows in the Victorian commercial and industrial sector (Sustainability Victoria, 2013) – C&I only

The data presented in Table 8.4 is indicative of the composition of the C&I waste.

Table 8.4: Indicative C&I composition

Data Source	Maryvale Energy from Waste Plant, Australian Paper Works Approval Application		Waste flows in C&I sector 2013	Average anticipated waste flows in C&I
Regions	**Gippsland**	**South East Melbourne**	**State wide**	
Earth based, Masonry	2,720	2,640	1,069	2,143
E-waste	1,768	1,800	59	1,209
Glass	768	888	2,376	1,344
Hazardous & Fines	6,480	6,600	0	4,360
Metals (not specified)	0	0	0	0
Metals, Ferrous	1,144	1,328	891	1,121
Metals, Non-Ferrous	288	328	178	265
Organics (not specified)	30,600	29,672	0	0*
Organics, food	0	0	34,981	28,835
Organics, garden	0	0	356	294
Organics, timber	0	0	4,395	3,623
Organics, soil & other	0	0	1,188	979
Other	10,976	11,144	0	11,689**
Paper & Cardboard	14,736	14,640	11,106	13,494
Plastic	9,736	10,160	9,503	9,799
Textiles	784	800	950	845
Tyres/Rubber	0	0	416	-
Unknown	0	0	12,532	-
Total	**80,000**	**80,000**	**80,000**	**80,000**

**Organics (not specified) totals for Gippsland and South East Melbourne was separated into the four categories of food, garden, timber and soil & other using the ratios of the State Wide audit*
***The category of 'Other' is inclusive of Tyres/Rubber and Unknown*

8.5 Future feedstock supply

Operation is expected to commence in 2025. The design life of the plant is 25 years, however this may be extended. Future habits in consumption and therefore waste disposal, as well as State and Local waste policies will affect future feedstock supply. The main impacts to future feedstock supply are summarised below:

- Change in collection services (e.g. household food organics and garden organics [FOGO] services)
- Change in population
- Change in consumption and therefore disposal habits
- Policy changes (e.g. Recycling Victoria 10-year policy and action plan for waste and recycling)

The Victorian Government has stated that it plans for every household to have access to a four-bin system by 2030 (Victorian Government, 2020). This will include FOGO services. Organics currently make up 51% of MSW bins. Due to human error and participation rates, not all organics are recovered, however a large portion likely will be. This policy decision will therefore affect a proportion of 51% of the expected MSW feedstock for the Project. The Victorian Government has also pledged to invest $129 million to transform recycling services, which will also affect the composition of the plant feedstock.

The Australian population is projected to increase to between 37.4 and 49.2 million people by 2066 (Australian Bureau of Statistics, 2018b) and the City of Melbourne has been experiencing the highest rates of population growth (Australian Bureau of Statistics, 2020). The more people there are, the more waste they will create. This projected increase in population will increase the amount of MSW feedstock available that could be sourced for the Project.

Seasonal changes occur to MSW and C&I waste streams. During the Christmas/summer holiday season, consumption generally increases, as does residual waste.

8.6 Management of incoming feedstock

The plant is expected to operate 24 hours a day, 7 days a week, 52 weeks a year. The following chapters outline how feedstock will be managed during operation. Waste deliveries are expected to occur multiple times each week during the following times:

- Monday – Friday: 7:00am – 7:00pm
- Saturday: 7:00am – 1:00pm

Feedstock deliveries will be spread evenly throughout the time periods mentioned above. Feedstock deliveries will either be made from waste transfer facilities or directly from nearby councils.

8.6.1 Feedstock delivery protocol

The delivery protocol will involve several measures to assess the quantity and type of waste that is delivered. The assessment measures are as follows:

- There will be two onsite weighbridges used for calculating waste quantities, one at the entrance, and one at the exit. Vehicles arriving onsite will be logged and weighed to determine the amount of feedstock
- Number plate recognition software will be installed to track incoming and outgoing vehicles. The origin of the waste and vehicle will be recorded for auditing purposes
- The feedstock will be visually inspected by staff members to confirm feedstock does not have any obvious contamination. Visual inspections will also be used to determine problems or hazards. If no problems or hazards are found during the visual inspection, the vehicle will move to the tipping hall

- If a problem or hazard is suspected, the vehicle will move to an inspection area where a more detailed analysis of the delivery can be undertaken. If the waste is determined to be safe for unloading for inspection purposes only, the vehicle will move to the tipping hall and unload the waste in a separate demarked bay within the hall so that further inspection can be undertaken. If the waste is found to be unsuitable, but not hazardous (e.g. oversized or non-combustible waste) it will be loaded into a 30m^3 hook bin skip. The skip will be removed from site once full. If the waste is found to be hazardous (e.g. batteries) it will be loaded into a separate 30m^3 segregated hazardous waste hook bin skip.
- Waste will be inspected again as it is tipped into the bunker. Waste that is found to be non-compliant will be removed using a grab crane. Rejected wastes areas will be separated from the rest of the waste, and further separated according to whether it is hazardous or not. All hazardous wastes must be stored correctly whilst onsite
- Periodically, random waste deliveries will be audited via a similar inspection process for quality control
- Once the waste has been unloaded, the delivery vehicle will be weighed and logged before it leaves site

Waste that has been bulked at a transfer station will be in sealed containers, which presents challenges for visual inspections. Therefore, this waste will be inspected and categorised at the transfer station.

8.6.2 Waste acceptance criteria

The plant will accept residual MSW and C&I wastes as described in Chapter 8.1. Waste that is deemed hazardous will not be accepted. The following list of waste types will not be accepted at the plant:

- Radioactive waste
- Non-combustible waste (e.g. construction debris, earth, concrete, stone, sand, building rubble)
- Source-separated fabrics (e.g. synthetic material granules, fine dusts)
- Large quantities of electrical parts and components (such as printed circuit boards, cables, etc.)
- Whole batteries, television sets, computer screens
- Accumulators, cooling equipment, luminescent material tubes
- Flammable and highly flammable substances (flash point under 55°C)
- Self-combustible and explosive substances (including fireworks, ammunition)
- Smouldering refuse
- Poisonous substances
- Acids, caustics, corrosive substances
- Reactive substances
- Liquid and volatile waste (e.g. cleaning fluids, crank case oils, cutting oils, oil sludges, solvents, paints)
- Chemical waste which is unsuitable for incineration
- Drugs
- Biological wastes (e.g. animal carcasses, infectious waste, human waste, waste from hospitals, sludge from neutralisation pits, etc.)
- Solid metallic objects which may endanger the plant (e.g. washing machines, refrigerators, bicycles, motorcycles, metal chairs, wire rope, spring mattresses, tyre rims, large drums or containers, etc.)
- Metal foils, metal dusts or metal shavings, particularly from light metals like aluminium, magnesium and beryllium
- Parts or components from motor vehicles, motor cycles, automobile engines, transmissions, rear ends, springs, fenders or major parts of motor vehicles, trailers, agricultural equipment, marine vessels, or similar items, farm and other large machinery

- Bulky waste exceeding 0.6 m in length or 0.6 m in width or 100 mm in thickness
- Tyres and wood waste that can be recycled
- Carbon fibres
- Insulation materials such as rock wool, asbestos, calcium silicate boards, ceramic fibres, big carpets, etc.
- Polyvinyl chloride (PVC) waste such as PVC pipes, plastic film and upholstery
- Fire retardants
- Chlorinated herbicides, insecticides, and fungicides
- Polychlorinated compounds such as polychlorinated biphenyl (PCB) used in transformers and capacitors
- Light materials such as sawdust, feathers, dust and powders
- Waste from grease interceptors
- Waste that is too large to fit in to the incinerator (such as couches, mattresses etc.)

8.6.3 Waste categorisation

Waste will be categorised using the following methods:

- Weighbridge inspection as the vehicle arrives onsite
- Weighbridge inspection at the waste transfer terminal for bulk vehicles
- Information from the carrier
- Inspection of the carrier's documentation
- Visual inspections either at the waste transfer terminal or at the EFW plant
- The origin of the waste

Documentation of feedstock categorisations and origins will be retained onsite for the life of the plant. Regular reports will be provided to the EPA as required by regulations.

8.6.4 Independent auditing

An independent auditor will be commissioned by PHI for the first three years of the plant's operational life. These audits will be undertaken by a suitably qualified professional, at regular intervals, to ensure the incoming feedstock complies with EPA regulatory requirements.

8.6.5 Screening and homogenising

The calorific value of the feedstock will directly affect the power output and steam production of the facility. Therefore, waste screening and homogenising will be a key driver in the efficiency of the plant. Waste will be screened as detailed previously in this chapter, with unsuitable waste removed prior to combustion. Within the bunker, the waste cranes will mix the waste delivered to homogenise the material prior to being loaded into the boiler feed hoppers. This will aid stable combustion and provide another opportunity to identify any unacceptable waste.

8.6.6 Storage capacity

Deliveries of feedstock will occur Monday-Saturday. However, the plant will operate 7-days a week. It is assumed that to operate at full capacity, the plant will need 26.7 tonnes per hour (tph) of feedstock for each boiler (53.4 tph total). Therefore, the storage capacity must allow for enough feedstock for Sunday. The bunker capacity for the Project is designed for up to five days storage of feedstock or approximately 3,200 tonnes of waste. During unplanned shutdowns a further 5 days of storage is possible by super stacking waste against the rear/side walls of the bunker in a safe manner.

9. Waste outputs

9.1 Construction waste

During construction, earthmoving will be required to prepare the site including excavating areas for building foundations, car parks, road access and water runoff control. It is estimated that the earthmoving activities will generate 178,500 cubic metres (m^3) of excavated material. This will be reused onsite where possible. If there is a need for disposal of spoil offsite, further sampling and analysis will be conducted to determine potential contamination. Any contaminated spoil will be managed in accordance with EPA requirements.

The construction phase will generate typical construction wastes, such as steel, concrete, masonry. There will be some waste generated from onsite staff which will typically be a mix of solid inert waste and putrescible waste. Skip containers will be provided for recycling and general waste options, where contractors will be encouraged to sort waste for recycling.

Waste avoidance measures will be implemented onsite in accordance with the Wastes Hierarchy and the principles of Victoria's State Waste and Resource Recovery Policy. This will include us of waste avoidance targets and sustainable procurement procedures as part of supplier contracts and the Construction Management Plan.

9.2 Operational waste

The three main wastes generated during operation will be:

- Bottom ash, this is the solid residue removed from the combustion chamber after the waste has been thermally treated
- Boiler ash, the part of the fly ash that is removed from the boiler
- APCr (also known as Flue Gas Treatment residues) from the APC equipment

Initial review of similar Australian projects indicates that bottom ash will most likely be categorised as industrial waste, with boiler ash and APCr most likely being categorised as Category A, B, or C PIW, as described in the *Environment Protection (Industrial Waste Resource) Regulations 2009*. Once the plant is operational, the operator will conduct testing on the waste outputs to determine their composition. Until then, the composition of operational wastes can only be assumed to be similar to other EfW plants. It's noted that the current *Environment Protection (Industrial Waste Resource) Regulations 2009* is being reviewed in line with the *Environment Protection Amendment Act 2018*. New legislation will take effect from 1 July 2021, which may affect the waste classifications.

If the APCr or boiler ash are tested and found to exceed the Category A PIW thresholds, PHI will need to seek a specific classification from the EPA, treat the waste prior to disposal, or reuse the waste. Table 9.1 provides an overview of the estimated outputs of the plant.

Table 9.1: Estimated outputs

Waste stream	Categorisation	Approximate generation (tph, dry basis)
Bottom ash	Industrial waste	7.2 tph
APCr and Boiler ash	Category A, B or C PIW	2.7 tph

9.2.1 Bottom ash

Bottom ash is the residue that remains on the grate after combustion. Bottom ash can vary from small rocks, to a granular consistency, or powder. This will be the largest residue the facility produces by weight (15-20% of feedstock weight). Assuming the facility operates for 24 hours a day, 7 days a week, it may produce up to 63,072 tonnes of bottom ash per annum[2].

A major component of bottom ash is aggregate (stone, glass, ceramics) which has engineering properties similar to primary building materials (such as gravel and sand). Bottom ash must be adequately treated or 'matured' before it can be considered suitable for recycling, as heavy metals such as copper, molybdenum and zinc have potential to leach if not in a stable condition. Treatment of bottom ash may allow for it to be re-processed into an aggregate material suitable for use in the construction industry (AEA Technology, 2003). There is also an opportunity to recover metals from the bottom ash subsequent to combustion, using magnetic and eddy current technology (International Solid Waste Association [ISWA], 2006; 2015).

The 2019 EC BREF for waste incineration (European Commission, 2019) recommends in Part 5.1.7 Material Recovery Efficiency the following:

> *"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 hazardous properties of the slags and bottom ashes."*

The 2019 EC BREF goes on to list the following techniques as generally applicable:

- Screening and sieving
- Crushing
- Aeraulic separation
- Recovery of ferrous and non-ferrous metals
- Ageing
- Washing

PHI proposes to preferentially develop an onsite bottom ash treatment system using some of these recommended techniques to recover metal and produce an aggregate product that can be used for construction purposes. An alternate approach is to transport the material offsite to a centralised facility employing a similar treatment and recovery process, likely to be built, owned and operated by a third party that may also treat ashes from other thermal treatment facilities. At present, no such alternate facility exists in Victoria, although facilities of this type are under development in Western Australia. The most common application of the bottom ash aggregate product is in road base applications. Other civil construction applications can include pipe/cable trench backfill material, capping layers for vehicle parking areas, and applications where the aggregate is mixed with cement to form a rigid weight bearing surface or construction element.

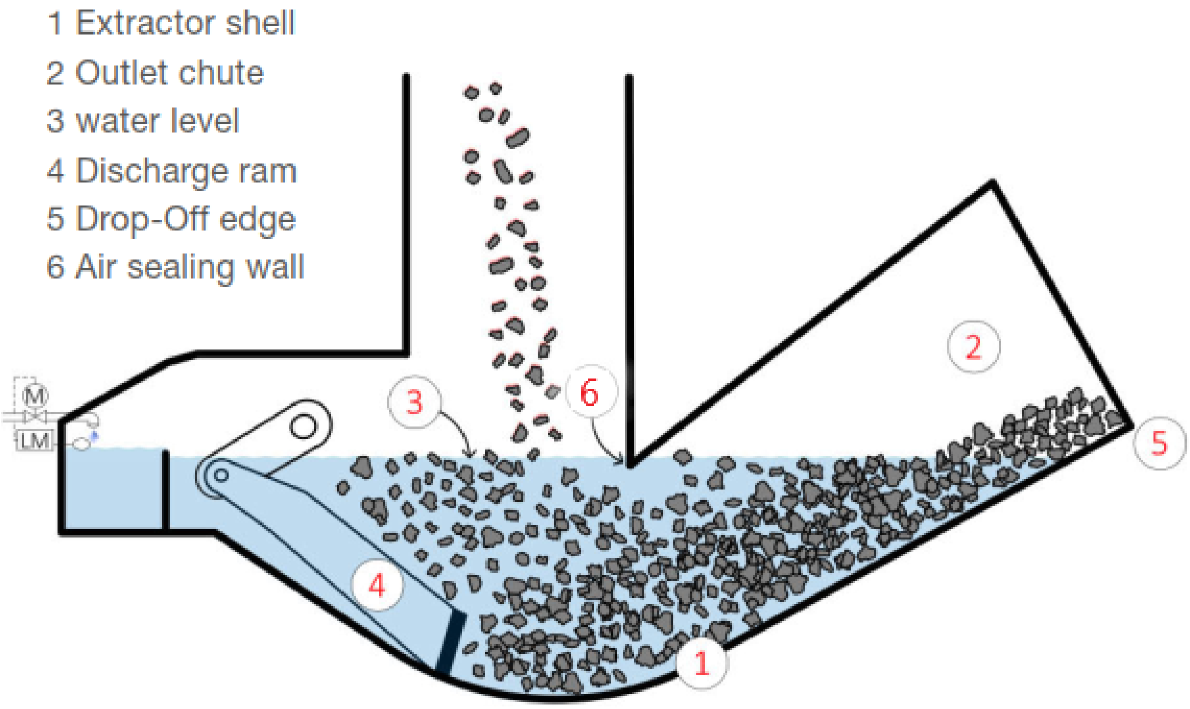
The development of the facility onsite is considered the "base case" of this application as it eliminates some market and commercial risk associated with relying on a third party. The success of this endeavour still relies on the approval of the aggregate material produced at the facility as being suitable for beneficial reuse as a construction product (e.g. road base aggregate) by EPA. It is also reliant on a viable market being established for the beneficial re-use of the aggregate product. In EU countries with high adoption rates of EfW technology, there is also an established practice for bottom ash aggregate production, with the product being accepted by both national environmental regulators and the construction industry.

[2] This figure is based on the amounts in **Table 6-1**, multiplied by the amount of hours in a year.

9.2.1.1 Wet Bottom Ash Extraction System

The Project will adopt a wet boiler bottom ash discharge system, as shown in Figure 9.1. Bottom ash falling off the grate will fall into a water filled slag extractor bath.

Figure 9.1: Wet bottom ash extractor of the hydraulic ram type



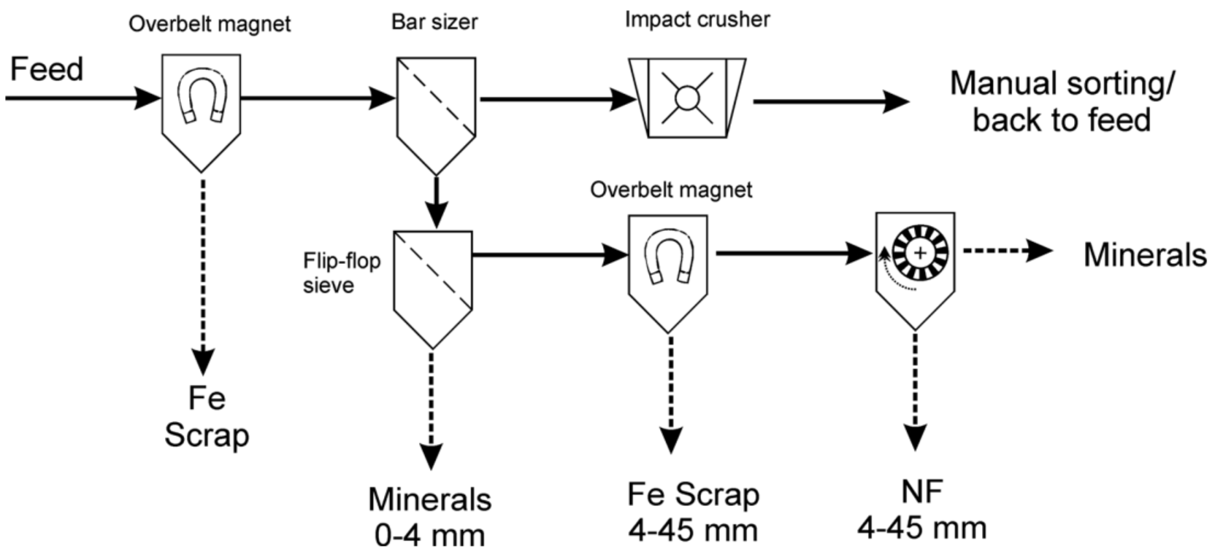
The water system has the advantage of quickly quenching and cooling the ash whilst also mitigating the risks of downstream dust generation in handling and processing systems. A hydraulically driven ram or an alternate type of mechanical conveyer will push the ash up an inclined slope out of the bath. Excess water will run down the incline back into the bath. Some water from the bath will be evaporated into the boiler furnace which operates under negative pressure. The balance of water will be absorbed into the ash, which will typically be around 15-20%. The wet bottom ash system is a net consumer of water due to these losses, so no water will be discharged from this system that requires treatment.

The wetted bottom ash will be dropped from the top of the slag extractor onto a belt conveyer system. A grizzly or vibrating screen system will be employed to remove oversized material into a skip for sorting. Inorganic non-metallic oversize material collected at this point will be sorted from the skip and crushed and returned to the aggregate stream for grading. Material passing through the oversize screen will be conveyed via enclosed belt conveyers and conveyer transfer points, to the bottom ash pre-treatment storage hall within the ash treatment building, where it will be stored for approximately 7 to 10 days for drying and draining. Any water draining off conveyers or the pre-treatment storage area will be routed to a specific dirty drains system and returned back to the ash quench water system as make-up for the evaporation losses. No additional treatment or offsite disposal is required for this wastewater stream.

9.2.1.2 Bottom ash treatment process

The drained and partly dry bottom ash will then be subjected to a dry mechanical bottom ash treatment process to grade the aggregate into useful product size fractions and recover both ferrous and non-ferrous materials. A simplified flow diagram of a dry mechanical treatment system is presented in Figure 9.2.

Figure 9.2: Simplified process flow diagram for bottom ash treatment with metal recovery



In practice, the number of screens, their type and cut sizes selected during detailed design may be optimised from those shown on the diagram, to match the sizing grades of product aggregate that will meet end-user expectations. Additional screens to those shown on the simplified diagram will produce distinct product grades typically between 0- 40 mm, (e.g. 4-10 mm, 10-20 mm, 20-40 mm). Screening into additional size fractions will allow enhanced metal recovery with magnetic and eddy current separators which perform more optimally when treating smaller stream flows of more homogenous product sizes.

In terms of screen types, some equipment vendors prefer trommel screens at the front end of the process, while others recommend ballistic separators to remove the fine fraction (which, if left in the bulk stream can inhibit metal separation by adhering to the surfaces of metal particles). Both approaches have been proven to be effective and a proven vendor technology will be adopted for the project. Oversized inorganic non-metallic material greater than the top useful product size will be crushed down to a useful size fraction, so it can be recovered rather than disposed. A manual picking station will be located on the oversized stream to remove unburnt material and non-processable material prior to the crusher, to avoid equipment damage. Unburnt oversized material will be returned to the waste bunker for re-combustion.

Conveyors prior to the metal separators shall be adequately sized for their load so the material bed depth does not inhibit effective separation. It is common to employ vibrating conveyers prior to the eddy current separators to spread out the material into a thin bed to make it easier to attract the non-ferrous metal particles.

The processing hall will be contained in an enclosed shed with a dust extraction system to maintain a safe working environment. A bag filter system will be present in the discharge point to prevent emissions to the environment. Low noise equipment will be selected to comply with OHS regulation noise levels and maintain site noise emissions below permissible limits.

Water washing of the ash is not expected to be used in the mechanical process, as adequate demobilisation of leachable trace metals can be achieved with sufficient maturation. Any water used for cleaning and washdown of equipment will flow to floor drains within the building and will be directed back to the ash quench bath make-up system, such that the water does not require treatment or offsite discharge.

Ferrous and non-ferrous metal will be collected in skips which will be taken offsite for recycling by appropriately licenced facilities.

The different grades of aggregate product will be transported to their respective piles in the maturation hall, which will be separated from the raw ash by a partition wall to avoid cross contamination. The aggregate stockpiles will be managed by a front end loader vehicle. The maturation hall will be enclosed to mitigate windblown dust, with accessways into the building for front end loader and truck vehicle ingress and egress. Adequate ventilation will be provided to mitigate build-up of any gases emitted from the stockpile during maturation (trace amounts of hydrogen can be emitted from residual aluminium reacting with calcium hydroxide). The material is otherwise inert and fire risk is considered low. Odour is minimal due to low levels of residual organic material.

Storage capacity in the maturation hall sufficient for approximately 12 weeks of storage or approximately 11,300 tonnes will be provided onsite. Product material nearing the end of it's maturation period will be routinely sampled and trace metal and ASLP testing performed as required to demonstrate the material is safe for use. Once satisfactorily stabilised, the material will be loaded by the front-end loader into top loaded bulk trailers for despatch to their end use location. Some water may be used for dust suppression or wetting to enhance stabilisation, but any runoff water will be directed to drains that return the water to the ash quench bath make-up system.

9.2.1.3 Composition of bottom ash

The exact composition of the bottom ash residue will depend on the composition of the feedstock. However, it will contain some aggregates, and some residual metals. To determine an approximate composition of bottom ash, a review of two sources was undertaken:

- Bottom Ash from EfW Plants - Metal Recovery and Utilization, ISWA (2015)
- Maryvale Energy from Waste Plant, Australian Paper Works Approval Application, Jacobs (2018)

Table 9.2 provides an overview of the approximate composition of bottom ash from ISWA (Atrup, T., and Christensen, T. H., 2003; Morf, L. S., Gloor, R., Haag, O., Haupt, M., Skutan, S., Lorenzo, F. D., et al. ,2013).

Table 9.3 provides an overview from bottom ash testing for 18 UK sites, tested every month in 2011. The data has been supplied by UK Environmental Services Association (ESA) and was compiled by Jacobs for the Australian Paper Works Approval Application.

Table 9.2: Approximate composition of bottom ash, in mass concentration

Element	Unit	Range	Average
Silicon (Si)	grams per kilogram (g/kg)	168-274	221
Calcium (Ca)	g/kg	89.1-104	94.9
Iron (Fe)	g/kg	46.7-77.8	65.1
Aluminium (Al)	g/kg	45.0-56.1	50.3
Sodium (Na)	g/kg	33.3-39.2	35.4
Magnesium (Mg)	g/kg	10.5-11.2	10.7
Potassium (K)	g/kg	7.4-8.6	8.1
Copper (Cu)	g/kg	3.4-11.0	5.6
Zinc (Zn)	g/kg	2.0-4.8	3.1
Barium (Ba)	g/kg	1.1-2.4	1.5
Lead (Pb)	g/kg	0.6-2.6	1.4
Silver (Ag)	milligrams per kilogram (mg/kg)	-	19.9
Gold (Au)	mg/kg	-	1.9

Table 9.3: ESA bottom ash processing results

Element / Analysis	Units	Lowest site average	Average of all site averages	Highest site average
pH		10.5	11.7	12.5
Alk Res	g/100 g	0.15	0.78	2.23
Al	mg/kg	13,225	21,625	31,461
Cd	mg/kg	2.8	11.2	26.1
Chromium (Cr)	mg/kg	66	246	812
Cu	mg/kg	1,415	1,900	2,901
Pb	mg/kg	383	820	1,456
Mg	mg/kg	4,344	6,980	9,254
Nickel (Ni)	mg/kg	54	134	296
Phosphorus (P)	mg/kg	1,164	4,838	5,785
K	mg/kg	1,269	3,564	4,590
Zn mg/kg		1,590	2,107	3,044
Total Petroleum Hydrocarbon > C5-C44, mg/kg		9	144	170

This preliminary analysis shows that bottom ash is likely to be categorised as 'Industrial Waste'. As an Industrial Waste, bottom ash would not be subject to the PIW classification process, if a secondary beneficial reuse is permitted.

Once quenched at discharge the bottom ash will also incorporate 15 to 20% water within it, some of this would then evaporate during ash processing leaving a moisture content of around 10 to15%.

Proof of performance tests will confirm the composition of the bottom ash outputs from the EFW plant. It is noted that post proof of performance testing, the outputs will continue to vary slightly in composition and generation rate due to the fluctuating composition of the input feedstock. The 2010 EC IED is the main EU instrument for regulating pollutant emissions from industrial installations and is referred to as best practice in Australian policies. According to 2010 EC IED the composition of bottom ash residues that are produced from incineration must have a TOC and Loss of Ignition (LOI) that is less than 3% and 5% respectively.

The main reuse opportunity for treated bottom ash is as an aggregate in road basecourse construction. This practice is common in Europe where long-term leachability tests have been undertaken for roads using treated bottom ash as an aggregate (Silva et al, 2019). A study of the Tangamenent Road in Spain found that decreased mobility was exhibited in most elements (Izquirdo et al, 2019). The results of this study are presented in Table 9.4**: Cumulative (1-year) releases of hazardous elements**. The measured leachable concentrations are presented against the benchmark of the European Commission waste acceptance criteria (WAC) for inert (WAC-I), non-hazardous (WAC-NH) and hazardous (WAC-H) wastes for landfills. Under the European Commission Landfill WAC the bottom ash aggregate used as road base would be considered inert material for all parameters with the exception of Antimony (Sb), and the ions chloride (Cl), fluoride (F) and sulphate (SO_4) where it would be considered non-hazardous. Furthermore, a synthesis of studies in to comparing the outcomes of landfilled bottom ash, and bottom ash that is used as a construction aggregate, found that when taking into account global warming potential, transportation distances, acidification, and groundwater contamination, reuse as a construction aggregate was preferable (Silva et al, 2019).

Table 9.4: Cumulative (1-year) releases of hazardous elements

Component	Leachate concentrations (mg/kg)	WAC-I (mg/kg)	WAC-NH (mg/kg)	WAC-H (mg/kg)
As	0.04	0.5	2	25
Ba	0.08	20	100	300
Cr	0.09	0.5	10	70
Cu	1	2	50	100
Mo	0.3	0.5	10	30
Ni	0.1	0.4	10	40
Pb	0.02	0.5	10	50
Sb	0.09	0.06	0.7	5
Se	0.05	0.1	0.5	7
Zn	0.3	4	50	200
Cl	1626	800	15000	25,000

9.2.1.4 Changes to bottom ash quantity and composition

As stated, bottom ash quantity and composition will depend on the feedstock input. Changes to feedstock may occur due to the following reasons:

- Seasonal changes, such as holidays, may affect the type and quantity of MSW
- Policy changes, such as DELWP's Recycling Victoria 10-year plan
- Introduction of FOGO bins, which could remove a large quantity of organics from the red-lid bin
- Population growth or decline

The introduction of FOGO bins would increase the bottom ash quantity. Organics typically have a lower ash content and if removed from the residual waste stream, will result in an increase in the ash content and consequently the volume of ash generated. The waste classification work undertaken for the Recovered Energy Australia Works Approval Application calculates that a of 50% adoption of FOGO will result in a 3-5% increase in ash generated.

Once the plant is operational, the exact composition and quantity of bottom ash can be determined, and patterns in seasonal variation of feedstock analysed. Any policy changes should also be closely monitored during the plant's lifecycle.

9.2.2 Boiler ash and APCr

Boiler ash and APCr will be treated together. Assuming this facility operates for 24 hours a day, 7 days a week, it may produce up to 23,652 tpa[3] of combined boiler ash and APCr.

APCr (also known as flue gas treatment residues) are products in fine particulate form that are carried along with the flue gases (fly ashes) and collected in bag filters within the flue gas treatment plant. Prior to collection, the fly ash is mixed with lime and powdered activated carbon flue gas reagents to absorb acid gases, trace heavy metals and hydrocarbons such as dioxins (European Commission, 2006; 2017). In absorbing acid gases (including halogens and oxides of sulphur), some of the lime will react to form halogenated compounds of calcium or sulphates of calcium. This combined mix of fly ash, reagents and reaction products is known as APCr.

[3] This figure is based on the amounts in **Table 6-1**, multiplied by the amount of hours in a year.

Some of the APCr will be recirculated back to the reagent injection point to improve efficiency of reagent use. A proportion of the APCr from the bag filters is not recirculated and will be disposed of to an appropriately licensed prescribed waste landfill. APCr are typically higher in contaminant concentrations when compared to bottom ash (Fruergaard, T. et al, 2010)and may require further treatment before disposing to landfill.

Boiler ash is fly ash that leave the furnace but are removed before the flue gases reach the treatment area. It is likely that these will be treated with the APCr. These outputs can be high in heavy metals and dioxins. A compositional analysis of APCr is outlined below.

Compositional analysis of APCr

As per bottom ash, the composition of APCr will vary depending on the composition of the input feedstock. A desktop review (Bühler, J., Schlumberger, S. 2011) found that generally, the APCr will contain a mixture of:

- Zinc
- Iron
- Lead
- Titan
- Copper
- Antimony
- Tin
- Manganese
- Cadmium
- Chromium
- Nickel
- Silver
- Cobalt
- Mercury

Once the plant is operational, the exact composition and quantity of the APCr can be analysed in a laboratory. This should be undertaken periodically to allow for changes in feedstock input.

Treatment and/or disposal of APCr

The final composition of the APCr will be dependent on the input feedstock, but due to the assumed high content of organic pollutants and heavy metals present in APCr, it is important to manage, treat, and dispose of it correctly. The composition will determine which PIW category the APCr classification falls into. Currently, the feasible option in Victoria is treatment, then disposal to landfill. However, this process will be dependent on the waste classification that is assigned:

- Category A

It is assumed that the APCr may be classified as Category A waste. In this case, it would require treatment prior to disposal to landfill. The current feasible option is mixing the APCr with cement, which would reduce the leachability of the material, but add weight and require further materials. However, this could downgrade the residues to Category B

- Category B & C

Currently, there is only one landfill in Victoria identified that accepts Category B wastes, which is SUEZ Taylors Road, over 100 km from the Project

Another treatment option used in the UK is long term storage in old salt mines (Astrup, T. 2008). This, and other treatment options may be feasible in the longer term but are not available in the short term in Victoria.

9.3 Waste categorisation and sampling

Testing and categorisation of wastes that are transported offsite will be required. A testing program will be developed in accordance with EPA requirements, including ALSP – Australian Standard (AS) Leaching Procedure AS4439.2 and AS4439.3. Documentation of testing will be kept, and results will be supplied to the EPA if required.

Samples will be submitted to a laboratory accredited by the NATA in accordance with the EPA publication IWRG701 'Sampling and Analysis of Waters, Wastewaters, Soils and Wastes'.

9.4 Waste storage and logistics

Bottom ash will be stored in the maturation hall, which will have a capacity of approximately 11,300 tonnes of waste or 12 weeks of storage. It will then be hauled by bulk haul vehicles with covered top filled trailers, or in sealed shipping-style containers. It may be possible to use the input feedstock bulk haul vehicles to remove waste. If bottom ash is categorised as industrial waste, it may be treated, transported, and disposed of at an industrial waste landfill, if it is not suitable for reuse. This may change if reuse opportunities become available during the operational life of the plant.

APCr will be stored in a 455-tonne, dust tight silo. This will accommodate the APCr produced over 7 days of operation. Pneumatic loading is the only option currently available for the removal and disposal of boiler ash and APCr. APCr will be pneumatically loaded from the storage silo into a B-double power tanker. The tanker will transport the waste to the nearest facility accepting PIW, currently identified as the SUEZ Taylors Road facility. The EPA requires that waste is transported by an accredited agent. A waste transport certificate must be completed within 7-days of transportation.

Two 30m^3 hook-bin skips will be provided for unsuitable but not hazardous waste. The skips will be rotated in use and removed from site when full.A further two 30m^3 hook bin skips will also be provided for hazardous waste storage. As per the non-hazardous waste, one bin will be in use and the other on standby. Skips will be emptied when full.

Recovered metals and scrap metal from worn equipment etc. will be collected in ferrous and non-ferrous skips for recycling in the IBA treatment plant.

General waste produced on site in the offices, workshops etc. that meets the waste acceptance criteria of the facility will be transferred to the bunker. Recyclables will be recycled offsite in an appropriate manner.

10. Water use and surface water management

This chapter outlines the proposed water use and discharges for the EfW Plant. Water use for the Project will be associated with the two different phases: construction and operation.

Construction of the Project will include civil, electrical, mechanical and structural activities. During construction there will be a temporary potable water supply available for amenity purposes, most likely sourced from a temporary connection into Barwon Water's potable water main, or by using water trucks. There will also be a temporary domestic sewer discharge for construction purposes, most likely a temporary connection into Barwon Water's existing sewer main.

During normal operation of the EfW Plant at average ambient temperature conditions, the water demand of the EfW Plant is expected to be approximately 2.5 megalitres (ML) of raw water per day. This will vary depending on the load and operating mode of the plant and the meteorological conditions and will increase slightly during higher ambient temperatures. The main uses of water in the EfW operation include:

- Cooling towers and other cooling systems
- Demineralised water system for the generation of steam
- Ash quenching and handling system
- Flue gas treatment system
- Amenities
- Firefighting water systems

When in operation, water will be supplied from a Barwon Water potable water main.

The majority of the incoming water will be recirculated back through the ash handling system, with approximately 0.4 ML/day discharged to sewer during normal operation and average ambient temperature conditions. Waste water will be discharged to the Barwon Water sewer main under the terms of a Trade Waste Agreement. No waste water from the process will be discharged to surface water system.

Temporary and permanent stormwater drainage systems will be established for the construction and operations phases, respectively. Clean stormwater will be segregated from contaminated water and discharged separately from the site as clean runoff into the City of Greater Geelong stormwater drainage system.

It should be noted that the Project is in the feasibility phase. Accordingly, the information in this chapter is preliminary and optimisation of water recycling opportunities and the use of alternative water sources has yet to be completed. The EfW Plant will look to minimise water usage and discharge quantities where possible through recycling and reuse of water through the process. Initial discussions with Barwon Water have confirmed the availability and capacity of the existing water network in the vicinity of the Project site. Further consultation will be required during the detailed design phase, to discuss any upgrades required to the mains network and ways to further optimise water use at the EfW Plant.

10.1.1 EPA requirements

10.1.1.1 State Environment Protection Policy

The State Environment Protection Policy (Waters) 2018 (SEPP Waters) sets the framework for Government agencies, businesses and the community to work together to protect human health and the environment by reducing the harmful effects of pollution and waste, and to contribute to the restoration and protection of the ecological integrity of Victorian waters. The SEPP Waters outlines principles for the protection and management of the State's surface waters. It identifies beneficial uses and environmental quality objectives that, if met, will allow the protection and management of the State's surface waters and actions to avoid pollution. The Project design will be guided by the principles outlined in this SEPP.

10.1.1.2 EPA Licences

An EPA Licence is required for all scheduled premises, unless the premises are exempted in the *Environment Protection (Scheduled Premises) Regulations 2017*. An EPA Licence contains standard conditions that aim to control the operation of the premises so there is no adverse effect on the environment, including from water discharges.

Subject to Works Approval, PHI will apply for an EPA Licence prior to commissioning of the plant.

10.1.1.3 Barwon Water requirements

Wastewater discharged from the Project will only go to the Barwon Water sewer main. The Project will be classified as a Category 3: Trade Waste Agreement Customer and will be required to enter into a Trade Waste Agreement with Barwon Water.

Barwon Water's Trade Waste Acceptance Standards are discussed in Chapter 10.1.1.8.

10.1.1.4 Existing environment

The mean rainfall at the Avalon Airport Bureau of Meteorology weather station, located approximately 9 km from the Project site, is 454.8 mm per annum (Australian Bureau of Meteorology, 2020). The nearest major surface water feature is Hovells Creek, which flows north-south approximately 3 km to the east of the Project Site, near where the creek flows into Corio Bay. Hovells Creek is a small creek which flows through agricultural land immediately to the north of Lara township.

No surface water bodies exist at the Project site. A stormwater drainage swale was observed along the western boundary of the site, running parallel to McManus Road. Water bodies in the vicinity of the Project site are shown in Figure 10.1.

The site is generally flat, except for piles of fill material of varying depths currently observed across the site. The site slopes slightly towards the northwest.

10.1.1.5 Proposed operations

During operations, the EfW Plant will require approximately 2.5 ML/day of water for use in various processes. The key processes requiring water are:

- Cooling Towers and other cooling systems
- Demineralised water system and storage tank(s) for the generation of steam
- Ash quenching and handling system
- Flue gas treatment system
- Municipal potable water systems for the EfW Plant
- Firefighting water systems - this will not require water on a daily basis and will be supplied from an onsite fire water storage tank)

Figure 10.1: Surrounding surface waters

10.1.1.6 Water supply

Water will be supplied from Barwon Water's potable water main. Depending on the load and operating mode of the Project, it will require approximately 2.5 ML/day of raw water (approx. 820 ML per annum based on the plant's expected availability throughout the year). The importance of reducing water consumption for the EfW Plant will be reinforced in the EPC contract with EPC tenderers required to provide a final water balance demonstrating best practice in water management.

Potable water for amenities and ablutions will be supplied to the Project in accordance with relevant Victorian legislation, primarily the *Safe Drinking Water Act of 2003* and *the Safe Drinking Water Regulations 2015*. Potable water supply must also comply with the *Australian Drinking Water Guidelines 2011* (National Health and Medical Research Council, 2011). The Plant shall be equipped with facilities to accept and distribute potable water and all equipment in contact with water for potable uses shall be compliant with the relevant Australian Standards.

Rainwater will also be harvested from roofs as a measure of reducing the water demand from the potable water main.

10.1.1.7 Key Wastewater Sources from the EfW Plant

Wastewater discharges from the EfW Plant will be directed to a wastewater holding pond located in the north of the Project site. The main wastewater source for the EfW plant will be periodic blowdown from the cooling tower. This is expected to contribute the largest volume of water discharged to the holding pond and then to the Barwon Water sewer main. There would not be any discharge of wastewater from the Project to surface water. .

Based on information previously provided by Barwon Water, there is an existing DN150 sewer main running through the road reserve along Production Way to the north of the Project Site. Barwon Water indicate that based on current discharge volumes in the area and the predicted discharge from the EfW Plant, there should be no requirement to upgrade this sewer line. This will need to be confirmed during the detailed design phase and PHI will apply for a Trade Waste Agreement to discharge wastewater into Barwon Water's sewer system.

The size and volume of the wastewater holding pond will be confirmed during the detailed design and will need to satisfy the maximum permitted wastewater temperature for discharges to sewer (35°C), , inflows from the plant, and anticipated Rainfall Events in the area. The estimated size of the wastewater holding pond is indicative only, based on a calculation of approximately 7 times the size of the estimated cooling tower blowdown at typical ambient conditions (and 4 times at the maximum blowdown conditions).

Filter Backwash

The water supply from Barwon Water's reservoirs should be of reasonably high quality, however, water used in the EfW Plant will be treated in a sand filtration system. The chemical composition of backwash from the filtration system should be similar to that of the raw incoming water, as the proposed gravity-type sand filters do not introduce any additional contaminants. The backwash stream will comprise a more concentrated form of the particles inherent in the raw water supply from the reservoir.

The total volume of filter backwash per day will be dependent on the backwash frequency and the quality of the incoming water, which will ultimately be matched to the equipment supplier's operating instructions when available. This will take into account the detailed filter design and the amount of incoming water used per day (which is dependent on the nature of operation). It is estimated that for a typical operating scenario, the amount of filter backwash generated would be in the range of 5% of the total potable water filtered. This water could easily be re-used in the ash handling system for the EfW Plant.

Cooling Tower Blowdown

The cooling tower proposed for this Project will be a semi-closed loop, wet cooled mechanical induced draft system, with multiple cells. Biocide and anti-scaling dosing systems are typically used for these types of cooling towers, which will minimise biological organism growth and scale build-up in the system. The cooling towers will need to comply with statutory requirements of the Victorian *Public Health and Wellbeing Act 2008* and the Victorian Public Health and Wellbeing Regulations 2019 and the National Construction Code (NCC).

A potable water make-up and blowdown system shall be provided as part of this system. Potable water will be supplied via a potable water main owned by Barwon Water. Make-up water is required to replace the water lost through evaporation in the cooling towers. Blowdown water discharge will be minimised with blowdown water recycled where possible for other onsite processes, such as use in the flue gas treatment system. Excess blowdown will be discharged to an existing sewer main owned by Barwon Water. The blowdown water will essentially be clean water with elevated levels of its original salt content (due to evaporation in the cooling towers). Cooling tower blowdown is water drained from the towers to remove mineral build-up (also known as "bleed water").

The plant will employ cooling water pumps for the condenser in the cooling towers. These are not expected to require water make-up during normal operation as they are a closed circuit.

The cooling towers will be dosed with an oxidising biocide to control growth of algae and other biomass that reduce the cooling system effectiveness (through fouling of spray nozzles and surfaces), leading to reduced heat transfer and plant efficiency. Biocide dosing is also required to address the risk of legionella growth in the towers. The most common form of biocide used in the power sector is chlorine, although some power plants use bromine, or a combination of the two.

Blowdown from the cooling towers will contain residuals from the biological (likely to be chlorine) and scale (likely to be sulphate) dosing systems. Chlorine has a short effective lifespan and the residual free chlorine level in the cooling water circuit will dissipate relatively quickly after exposure to biological matter and air, (e.g. during the drop from spray nozzles to the cooling water pond, or within the holding pond).

The cooling towers will have a fibreglass structure and antifouling packing to minimise the potential for biological growth that might be expected for other materials (such as wooden structures). The cooling towers will comply with Victorian Public Health and Wellbeing Regulations 2019 for cooling towers and the use of biocide will be optimised to minimise free chlorine impact on the cooling tower blowdown through good practice design and material selection.

10.1.1.8 Wastewater Discharge Quality

PHI will enter a Trade Waste Agreement (TWA) with Barwon Water to discharge wastewater into the Barwon Water sewer main.

Barwon Water Trade Waste Acceptance Standards provide maximum allowable concentrations for general substances, metals, halogens and halides, phenolic substances, aldehydes and ketones, mononuclear aromatic hydrocarbons, halogenated aliphatic hydrocarbons, esters, and persistent organochlorine pesticides.

The EfW Plant will be designed to comply with the TWA concentration limits, a summary of which is provided in Table 10.1.

Table 10.1: Key Barwon Water trade waste acceptance standards.

Substance	Limit
Temperature	<35°C
pH	6-10
Suspended Solids	500 milligrams per litre (mg/L)
Total Dissolved Solids	The daily load of Total Dissolved Solids must not exceed 200 kg/day, unless otherwise specified in a TWA. The applicable concentration limit will be determined using the allowable maximum daily discharge rate specified in the TWA.
Ammonia	50 mg/L
Colour	The customer must not discharge Trade Waste containing colour which is noticeable after more than 100 dilutions.
Sulfate	1,000 mg/L
Phosphorus	14 mg/L

10.1.1.9 Proposed Water Testing

A water monitoring and testing program would be designed and implemented to satisfy the conditions of the future Trade Waste Agreement and EPA Licence.

10.1.1.10 Proposed Drainage System

The Project will require the design and construction of an onsite water drainage system. There will be small areas of the EfW Plant that could be contaminated by chemicals, namely the bunds around fuel and chemical storages and oil from transformers. Rainfall in these bunded areas will be designated as trade waste and will be transferred to the wastewater discharge holding pond via oil water separators (or equivalent), then discharged to the Barwon Water sewer main in the road reserve along Production Way.

There is a strong emphasis on maximising water efficiency for the Project to reuse as much of the waste water from the EfW plant in other site processes. This will minimise both raw water use and wastewater discharge quantities.

It is estimated that the Project will discharge approximately 0.4 ML/day of water (depending on the load and operating mode of the EfW Plant and ambient temperatures) to the Barwon Water sewer main. This will comprise relatively clean saline water from the cooling towers, the boilers and raw water filter backwash, and demineralisation effluent. The water will be directed to the wastewater holding pond, then discharged into the Barwon Water sewer main under a TWA once it has settled for a sufficient period.

10.1.1.11 Proposed Stormwater Management

The proposed stormwater system will capture run off and control flow from the Project's impermeable surfaces such as roofs, roads, parking areas, clean concrete and hardstand areas.

The stormwater collected from clean areas of the plant will be directed towards the stormwater detention pond, which will most likely be located in the northwest corner of the Project site. The stormwater will then discharge into the City of Greater Geelong's existing stormwater system. The size of the stormwater detention pond in the concept design is indicative only, based on a 1 in 10 year storm event and designed to allow for approximately 1 hour of inflow to buffer the pre-development stormwater discharge for the site. This can also provide some storage capacity for harvesting rainwater for process use. The eventual size and storage volume will be subject to detailed design and will be reviewed in consultation with the City of Greater Geelong.

It is anticipated that some of the stormwater that falls on the EfW Plant could be captured and stored for reuse in the ash treatment systems. This will save water being drawn from the raw water supply.

PHI will apply for an EPA Licence, which would include conditions for water discharges from the site.

11. Energy use and greenhouse gas emissions

This chapter includes assessment and discussion of:

- Commonwealth and State government regulatory frameworks and responses to the management of GHG
- Expected energy and non-energy related GHG emissions from the project, including study boundaries, calculations methodologies and activity data
- Implementation of 'best practice' and eco-efficient practices with respect to GHG emissions and energy consumption

11.1 Policy setting

As a scheduled premise, (deemed under the *Victorian Scheduled Premises and Exemptions Regulations 2017*) the proposed EfW plant will be subject to the *Victorian Climate Change Act 2017*. This requires EPA, when making a works approval decision, to consider the potential impacts on climate change. Clauses 18, 19 and 33 of the SEPP (AQM) 2001 set out the regulatory requirements for the project. The clauses in SEPP (AQM) are supported through the implementation of the Protocol for Environmental Management (PEM) - Greenhouse Gas Emissions and Energy Efficiency in Industry 2002. The PEM is the mechanism by which EPA will assess compliance with the SEPP (AQM) policy principles.

The PEM aims to ensure that Victorian businesses subject to EPA works approvals and licensing system that have an impact on the environment, (in terms of their energy consumption and GHG emissions):

- Take up cost-effective opportunities for GHG mitigation, noting that in many cases they will achieve cost savings through greater energy efficiency
- Integrate consideration of greenhouse and energy issues within existing environmental management procedures and programs

The approach set out in the protocol is intended to support these objectives by promoting integrated environmental management, including energy management. The protocol supports businesses in addressing the greenhouse implications (including energy use) of their activities and assists them to respond in ways that will strengthen their long-term business sustainability.

The protocol also seeks to streamline procedures to minimise duplication of requirements with other programs in which a business may be involved, such as the Energy Smart Business Program of the Sustainable Energy Authority and the Commonwealth's National Greenhouse Gas and Energy Reporting (NGER) system.

Other legislation relevant to the GHG assessment is outlined in Table 11.1.

Table 11.1: Legislation relevant to the GHG assessment

Legislation	Relevance
Climate Change Act 2017	The *Climate Change Act 2017* (Vic) sets out a clear policy framework and a pathway to 2050 that is consistent with the Paris Agreement to keep global temperature rise below two degrees Celsius above pre-industrial levels. It provides a platform for subsequent action by the Victorian Government, community and businesses and the long-term perspective and policy stability to drive innovation and investment. In summary, the *Climate Change Act 2017* (Vic) includes a long-term carbon reduction target of net zero emissions by 2050, a requirement to set five-yearly targets and strategies, frequent reporting and mitigation measures that support climate change adaptation. This project has the potential to assist Victoria in meeting this target. This chapter identifies a significant annual reduction in emissions as a result of the project from the avoidance of ongoing landfill of waste, and energy generated from non-renewable sources.

Legislation	Relevance
	Section 17 of the *Climate Change Act 2017* (Vic) states that "Decision makers must have regard to climate change" and sub sections 17(2), (3) and (4) require decision makers to have regard to GHG emissions and climate change impacts.
Environment Protection Act 2017	Clause 25(1) – General environmental duty - a person engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.
Environment Protection Act 1970	The EP Act provides a legal framework to protect the environment in the State of Victoria. It applies to emissions to the air, water and land environments in Victoria as well as noise emissions. Under the EP Act, SEPP AQM is subordinate legislation made to provide more detailed requirements for the application of the EP Act. Specifically, relevant to GHG emissions, the SEPP (AQM) includes: ▪ Clause 18 – General Requirements – including a definition of the management of emissions, generators of emissions and requirements to comply with the policy. This clause compels generators of emissions to manage activities and emissions in accordance with the principles and intent of SEPP (AQM) and to pursue continuous improvement in environmental management practices. ▪ Clause 19 – Requirements for the management of new sources of emissions. This clause compels generators of new sources of emissions to apply best practice to the management of emissions. ▪ Clause 33 – Requirements to implement the Protocol for Environmental Management (PEM) for GHGs. This clause specifies that GHGs must be managed in accordance with clauses 18 and 19
Environmental Effects Act 1978	Under the *Environmental Effects Act 1978*, the Minister in administering the Act may decide that an EES should be prepared where there is a likelihood of regionally or State significant adverse effects on the environment. One of the criteria for an EES referral relates to emissions of GHGs, with the specific trigger being: "*potential greenhouse gas emissions exceeding 200,000 tonnes of carbon dioxide equivalent per annum, directly attributable to the operation of the facility.*" This assessment quantifies the direct emissions attributable to the facility, which (as can be seen within the following chapters) does not exceed the EES criteria threshold and as such, an EES referral has not been made. Additionally, there will be significant avoided GHG emissions from landfill through the implementation of the Project, which is discussed further in Chapter 11.4.2. The net emissions would bring the project significantly further under the EES referral trigger level for potential GHG emissions.

11.2 Methodology

11.2.1 Scope and boundary

The scope of this study includes a GHG assessment of the construction and operation of the Project, considering the material sources of emissions. The assessment compares the proposed future operation with a current baseline of operation, where waste is sent to landfill instead of to the EFW plant. The boundary of this study scope therefore includes all material sources (and sinks) of emissions within the construction and operation (over approximately 25 years) of the proposed Project.

11.2.2 Source of emissions

The GHG inventory has been prepared in accordance with:

- The Greenhouse Gas Protocol (GHG Protocol) issued by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI)
- ISO 14064-1:2006 Greenhouse gases - Part 1: Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removals.

The GHGs associated with the project include:

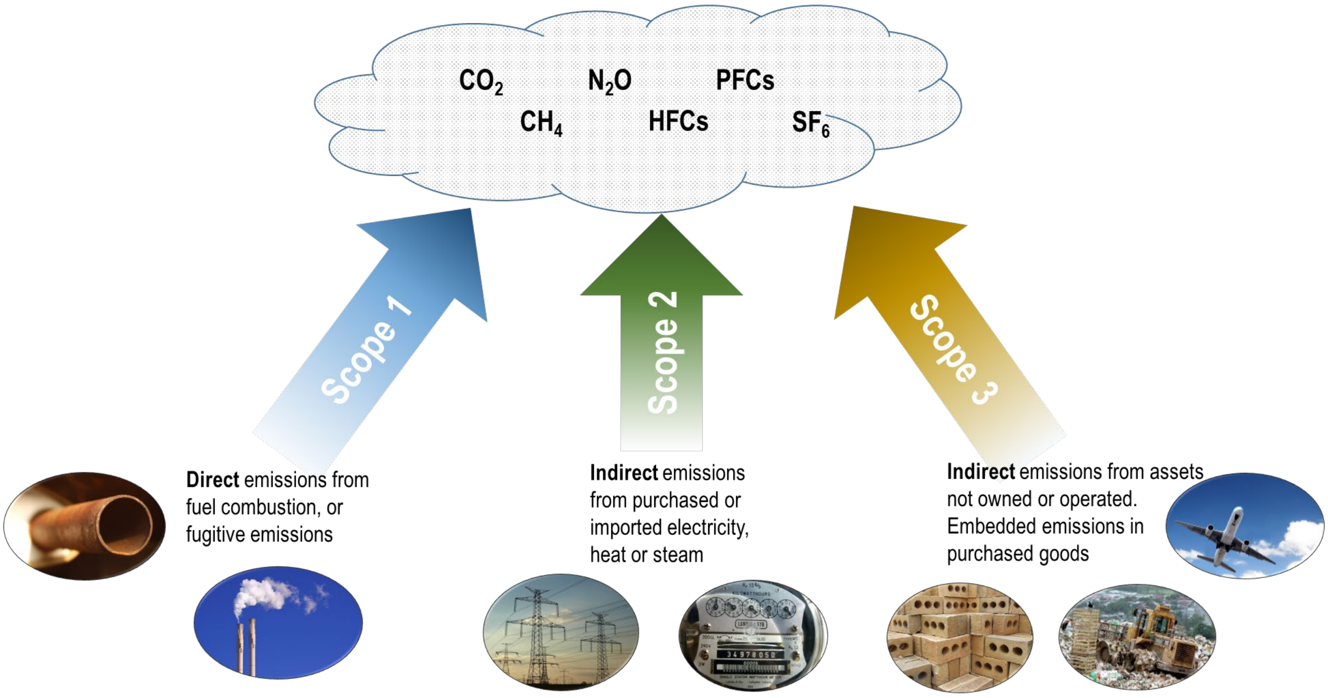
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

The GHG emissions sources are categorised into three different scopes in the GHG Protocol as follows (Figure 11.1):

- Scope 1 – Direct emissions from sources that are owned or operated by a reporting organisation (examples – combustion of fuel used in on-site power generation equipment)
- Scope 2 – Indirect emissions associated with the import of energy from another source (examples – purchases of electricity)
- Scope 3 – Other indirect emissions (other than Scope 2 energy imports) which are a direct result of the operations of the organisation but from sources not owned or operated by them (examples include embedded emissions in raw materials, business travel by air/rail and product usage)

In the PEM, GHG emissions are categorised into energy and non-energy related GHG expressed in CO_2 equivalent terms (CO_2e). Energy related GHG emissions include emissions from the use of fuels or consumption of electricity. Non-energy related GHG emissions include process emissions (e.g. emissions from chemical reactions or direct releases of GHG from activities such as land clearing) and incidental emissions (e.g. use of products).

Figure 11.1: Sources of greenhouse gases



11.2.2.1 Construction sources

The sources of emissions from the construction of the EfW plant are provided in Table 11.2Table 11.2.

Table 11.2: Sources of emissions – construction

Source	Greenhouse gases	Included	Scope		
			1	2	3
Energy related emissions					
Construction fuel – excavation of material and haulage	CO_2, CH_4, N_2O	✓			●
Construction fuel – earthworks and civil works	CO_2, CH_4, N_2O	✓	●		●
Material deliveries	CO_2, CH_4, N_2O	✓			●
Construction materials – embedded emissions*	CO_2, CH_4, N_2O	✓			●
Non-energy related emissions					
Loss of carbon stored in vegetation	CO_2	x No vegetation will be cleared	●		

* Construction materials – embedded emissions will contain a mixture of fugitive process and energy related emissions. However, it is not possible to separate these due to the emissions factors used, which do not separate the individual GHGs or provide a breakdown of the process steps which give rise to these gases (and whether they are energy related or not)

11.2.2.2 Operation sources

The sources of emissions for operation of the EfW plant are provided in Table 11.3.

Table 11.3: Sources of emissions – operation

Source	Greenhouse gases	Included	Scope		
			1	2	3
Energy related emissions					
Emissions from the combustion of waste – fossil sources	CO_2, CH_4, N_2O	✓	●		
Emissions from the combustion of waste – biogenic sources	CH_4, N_2O	✓	●		
Emissions from natural gas combustion	CO_2, CH_4, N_2O	✓	●		●
Emissions from onsite diesel generators used for start up and during shutdowns, and for generation only (note emergency use has not been included, as it is not material)	CO_2, CH_4, N_2O	✓	●		●
Emissions associated with fuel used in operation of on-site waste handling equipment	CO_2, CH_4, N_2O	x Waste will be tipped into facility by truck – no waste handling equipment will be used.	●		●
Emissions from use of grid electricity during operation	CO_2, CH_4, N_2O	x Only used during shutdowns. Not considered material		●	
Emissions associated with transport of waste from point of generation to waste transfer point	CO_2, CH_4, N_2O	x Outside scope, all waste assumed to be transported from source to transfer site.			●
Emissions associated with transport of waste from point of generation to site	CO_2, CH_4, N_2O	✓			●
Emissions associated with transport of residues from site to landfill	CO_2, CH_4, N_2O	✓			●
Avoided emissions resulting from displaced grid electricity	CO_2, CH_4, N_2O	✓		●	
Non-energy related emissions					
Avoided emissions resulting from landfill of waste	CH_4	✓			●
Emissions associated with landfilling of rejected loads of waste	CH_4	x Not considered material			●
Emissions associated with landfilling ash residues	CH_4	x Inert waste – not expected to be material			●

11.2.3 Emissions factors

Emissions factors are used to determine emissions of GHG from processes or activities, where it is impractical to directly measure (or model) emissions. Standard factors are published by numerous sources for a range of common emission-generating activities, and it is appropriate to use them in the calculation of GHG footprints where direct measurement is not possible or practical.

To determine the appropriate emissions factors for a project, EPA Victoria Publication 1658 *Works approval application guideline* (June 2017) refers proponents to the National Greenhouse Accounts (NGA) Factors published by the Commonwealth Department of the Environment and Energy. For this GHG assessment, process emissions from EfW are a focus, and hence emissions of CO_2 from fossil sources have been modelled, as has the equivalent baseline of waste sent to landfill (for CH_4).

There are aspects of the Project which are not covered by process emission modelling. These include the combustion of fuel in construction plant and equipment and delivery vehicles, the embedded emissions in construction materials (i.e. the emissions generated during their extraction, processing and manufacture) and emissions associated with use of natural gas and diesel as a fuel. The emissions factors for all activities are presented in Table 11.4.

Table 11.4: Emissions factors summary with references

Activity	Emissions Factor	Reference
Process emissions (EfW)	Scope 1 Modelled for CO_2 only (from fossil sources). See Appendix C	Methodology derived from various Emissions Reduction Fund (ERF) methods.
Process emissions (EfW)	Scope 1 0.0002 $kgCH_4$ / t waste incinerated 0.056 kgN_2O / t waste incinerated	Intergovernmental Panel on Climate Change 2006 (IPCC 2006) (highest non-fluidised bed factor taken for N_2O)
Landfill (baseline)	Scope 3 Modelled for CH_4 only – see Appendix C	Based on Alternate Waste Treatment (AWT) methodology (Commonwealth of Australia, 2015)
Natural gas consumption	Scope 1 CO_2 - 51.4 $kgCO_2e$ / gigajoule (GJ) CH_4 - 0.1 $kgCO_2e$ / GJ N_2O - 0.03 $kgCO_2e$ / GJ Scope 3 3.9 $kgCO_2e$ / GJ	National Greenhouse Accounts Factors – August 2019 (NGA 2019) (Department of the Environment and Energy, 2019)
Gasoline use (transport)	Scope 1 CO_2 – 2.305 $kgCO_2e$ / kL CH_4 – 0.017 $kgCO_2e$ / kL N_2O - 0.062 $kgCO_2e$ / kL Scope 3 3.6 $kgCO_2e$ / kL	NGA 2019
Diesel use (transport)	Scope 1 CO_2 – 2.698 $kgCO_2e$ / kL CH_4 - 0.004 $kgCO_2e$ / kL N_2O - 0.019 $kgCO_2e$ / kL Scope 3 3.6 kg CO_2e / kL	NGA 2019

Activity	Emissions Factor	Reference
Diesel use (stationary)	Scope 1 CO_2 – 2.698 kgCO_2e / kL CH_4 - 0.004 kgCO_2e / kL N_2O - 0.008 kgCO_2e / kL Scope 3 3.6 kgCO_2e / kL	NGA 2019
Electricity (offset)	Scope 2 0.82 kgCO_2e / kilowatt hour (kWh)	NGA 2019 – Table 6 (as used in ERF offset methodologies)
Articulated truck (>33t) 0% Laden	Scope 3 CO_2 - 0.64869 kgCO_2e / km CH_4 - 0.00013 kgCO_2e / km N_2O - 0.01378 kgCO_2e / km	Department for Business, Energy & Industrial Strategy (DBEIS 2019)
Articulated truck (>33t) 100% Laden	Scope 3 CO_2 - 0.0593 kgCO_2e / t.km CH_4 - 0.00001 kgCO_2e / t.km N_2O - 0.00076 kgCO_2e / t.km	DBEIS 2019
Articulated truck (>33t) Average Loading	Scope 3 CO_2 - 0.08020 kgCO_2e / t.km CH_4 - 0.00001 kgCO_2e / t.km N_2O - 0.00120 kgCO_2e / t.km	DBEIS 2019
Rail (Freight train)	Scope 3 CO_2 - 0.03299 kgCO_2e / t.km CH_4 - 0.00003 kgCO_2e / t.km N_2O - 0.00031 kgCO_2e / t.km	DBEIS 2019
General Cargo Ship (Average)	Scope 3 CO_2 - 0.01305 kgCO_2e / t.km CH_4 - 0.000004 kgCO_2e / t.km N_2O - 0.000178 kgCO_2e / t.km	DBEIS 2019
Material use - Steel	2.324 tCO_2e / t	Infrastructure Sustainability Council of Australia (ISCA) Materials Calculator – Worldsteel data, global Plate, C2G, GLO S & Welding, arc, steel/RER U/AusSD U (ISCA 2020)
Material use - Concrete	0.2 tCO_2e / t	ISCA Materials Calculator – 40MPA concrete 0%SCM
Material use - Aggregate	0.006 tCO_2e / t	ISCA Materials Calculator – Aggregate – referenced to 'Gravel, crushed, at mine/CH U/AusSD U'

It should be noted that some of the factors referenced are expected to change over the modelled (25 year) life of the EfW plant. These include:

- Changes to the composition of waste over time. Various factors will influence the composition of waste coming into the plant, which will have a 'knock-on effect' on other aspects of the calculation, such as the quantity of waste combusted, the fossil content and the amount of heat and electricity produced. This variation has not been modelled as part of this assessment. It would be expected that the calorific value of the waste would need to remain relatively constant, and whilst there will be programs to improve the recycling rate of waste pre-EfW treatment, that this would affect both biogenic and non-biogenic fractions (and high and low calorific value materials).
- Changes to the grid factor for electricity. Victoria's electricity grid will most likely become less carbon intensive over the lifetime of the proposal, meaning that whilst the quantity of electricity offset will remain steady, the emissions offset will decrease. The factor used for electricity in this assessment is taken from NGA Factors and represents the offsetting of future energy generation. It is used within ERF methodologies to represent emissions offset from the National Electricity Market. It may be that the Victorian grid will be lower than this value later in the life of the EfW plant, but given the uncertainty of this, the chosen factor is deemed appropriate for determining the emissions profile for this assessment over its lifetime, and for other emissions generation sources it may displace. The results are also presented using the current Victoria electricity emissions GHG factor to demonstrate the magnitude of the offset at year 1 of operation, as well as an indication of what the factor may be towards the end of the intended life of the plant.

The operational emissions for the initial year have been multiplied by 25 to determine the emissions over the 25-year life of the plant.

11.3 Step 1 – energy related greenhouse gas emissions

11.3.1 Construction

Construction will require excavation of material to prepare the groundworks for the plant, as well as the formation of foundations. Construction is estimated to last for 36 months. Assumptions made to inform the greenhouse estimate include:

- 6,100 tonnes steel, 23,100 tonnes concrete and 7,050 tonnes aggregate will be used during construction
- 69,610 tonnes of earth will be extracted during the construction works
- Average distance between the site and potential earth stockpiling or disposal destinations is approximately 25 km

A breakdown of the results by GHG source is presented in Table 11.5. The table shows that the construction energy-related emissions profile is dominated by the embedded emissions in construction materials. Given that much of the plant will be manufactured off-site and transported to the site, this is expected. Following materials, the fuel used during construction is the next largest source. Fuel used, during spoil and waste haulage as well as material transport, do not contribute significantly to the emissions profile.

Table 11.5: Construction energy-related emissions summary – by source

	Source	Total quantity	Energy consumption (GJ)	Scope 1 GHG emissions carbon	Scope 1 GHG emissions methane (tCO_2e)	Scope 1 GHG emission nitrous oxide (tCO_2e)	Scope 1 GHG emissions (tCO_2e)	Scope 3 GHG emissions (tCO_2e)	GHG emissions – all scopes (tCO_2e)
Construction plant and equipment	Construction Fuel Transport Diesel	4,240,254 t.km	NA					345	345
	Construction Fuel Transport Petrol	73.8 kL	2,524	170	1	5	176	9	185
	Construction Fuel Stationary Diesel	1,849 kL	71,375	4,989	7	14	5,011	229	5,240
	Construction Materials (embedded emissions)	36,250 t	NA	-	-	-	-	18,829	18,829
	Construction Material transport	Sea – 58,664,127 t.km Land – 2,724,000 t.km	NA	-	-	-	-	940	940
Total			**73,899**	**5,159**	**8**	**19**	**5,186**	**20,352**	**25,538**

A breakdown of the results by GHG 'scope' is presented in Table 11.6 The table shows that the majority of the emissions are Scope 3 – i.e. indirect emissions not under the direct control of the proponent. These largely relate to the embedded emissions in purchased materials. The Scope 1 emissions are the direct emissions on site under the direct control of the construction contractor and relate to combustion of fuel in construction plant and equipment.

Table 11.6: Construction energy-related emissions summary – by scope

Scope	Emissions (tCO_2e)
Scope 1	5,186
Scope 2	-
Scope 3	20,352
Total Emissions (all Scopes)	**25,538**

During operation, waste will be transported to the site by road from a number of LGAs along the west coast of Port Phillip Bay, including the Metro Melbourne, Western Melbourne and Greater Geelong LGAs.

After arrival at the site, the waste will be deposited in the tipping hall, where it will be mixed before being combusted in the EfW plant. The plant will require the use of natural gas on occasions at start-up or when the waste fuel feedstock is of lower calorific value, but this is expected to represent (at worst case) 1% of the energy input. The plant will be powered with the electricity it generates; with surplus (i.e. the majority of generated energy) exported to the national grid.

The site will also house a diesel generator with the capacity to produce approximately 3–3.5 MWh. The primary function of this generator is to produce power for the EfW plant during outages and emergency situations.

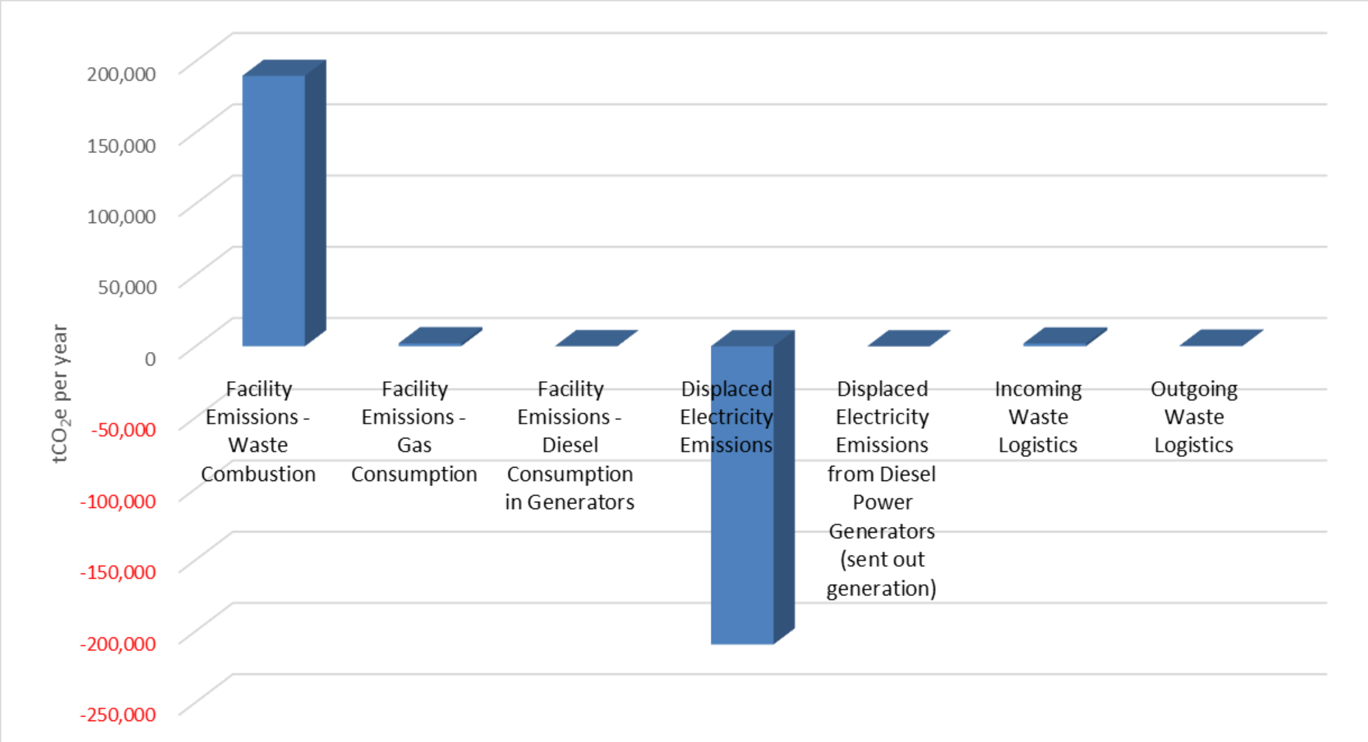
The solid wastes from the EfW plant are the bottom ash from the combustion process and residues from the APC system. These will be stored on site (with the APCr in a silo) and will be delivered by truck to the Suez Dandenong South Landfill (bottom ash) and Taylor's Road landfill (for APCr) for disposal. This is the worst case, as it is expected that some this waste may be diverted to a Secondary Beneficial Reuse, subject to industrial waste categorisation and the requirements of the Environment Protection Act.

A breakdown of the results by GHG source is presented in Table 11.7 and Figure 11.2.

Table 11.7: Annual operation energy-related emissions summary – by source

	Source	Total quantity	Energy consumption (GJ)	Scope 1 GHG emissions carbon dioxide (tCO_2e)	Scope 1 GHG emissions methane (tCO_2e)	Scope 1 GHG emission nitrous oxide (tCO_2e)	Scope 1 GHG emissions (tCO_2e)	Scope 2 GHG emissions (tCO2e)	Scope 3 GHG emissions (tCO_2e)	GHG emissions - all scopes (tCO2e)
Facility Emissions	Facility Emissions - Waste Combustion	400,000 t	3,800,000 GJ	184,260	2	5,602	189,865	-	-	189,865
	Facility Emissions - Gas Consumption	38,000 GJ (lower heating value [LHV])	38,000 GJ (LHV)	1,953	4	1	1,958	-	148	2,106
	Facility Emissions - Diesel Consumption in Generators	311 GJ	311 GJ	60	0	0	60	-	3	63
Displaced Energy	Displaced Electricity Emissions	-255,229 Megawatt hours (MWh)	918,823 GJ	-	-	-	-	-209,288	-	-209,288
	Displaced Electricity Emissions from Diesel Power Generators (sent out generation)	-86 MWh	311 GJ	-	-	-	-	-71	-	-71
Waste Logistics	Incoming Waste Logistics	24,000,000 t.km truck	NA	-	-	-	-	-	2,004	2,004
	Outgoing Waste Logistics	6,031,545 t.km truck	NA	-	-	-	-		496	496
Total			-	**186,273**	**6**	**5,604**	**191,883**	**-209,358**	**2,651**	**-14,824**

Figure 11.2: Operation energy-related energy emissions summary – by source



A breakdown of the results by GHG 'scope' is presented in Table 11.8. The figures show, as expected, that the emissions associated with operation are dominated by those associated with waste combustion. These emissions relate to the fossil-derived carbon in the waste only. Positive emissions associated with other sources are not material. Displaced electricity emissions provide a significant offset in emissions that the plant achieves. These are allocated as Scope 2 in this assessment.

Table 11.8: Operation energy-related emissions summary – by scope

Scope	Annual Emissions (tCO_2e)	Total Emissions (25 years – tCO_2e)
Scope 1	191,883	4,797,072
Scope 2	-209,358	-5,233,960
Scope 3	2,651	66,285
Total Emissions (all Scopes)	-14,824	-370,604

11.4 Non-energy related greenhouse gas emissions

Based on the activities identified as being within the scope of this assessment, this chapter provides details of the activities that give rise to the emission of non-energy related GHG, and the resulting calculation of the emissions relative to the Project.

11.4.1 Construction

As no vegetation is being cleared as a part of the construction of the EfW plant, there are no non- energy GHG emissions associated with this stage of the Project.

11.4.2 Operation

In addition to the energy-related emissions sources modelled, the diversion of waste to the EfW plant will avoid landfill. The emissions attributable to this avoided landfill are calculated and a breakdown of the results by GHG source is presented in Table 11.9.

Table 11.9: Operation non-energy related emissions summary – by source

	Source	Total quantity	Energy consumption (GJ)	Scope 3 GHG emissions (tCO_2e)	GHG Emissions – all scopes (tCO_2e)
Offset Landfill Emissions	Offset Landfill Emissions	-400,000 t	NA	-300,051	-300,051
Total			-	**-300,051**	**-300,051**

The only non-energy related emission associated with operations is expected to be offset emissions associated with avoided landfill, and account for a significant overall emissions reduction. These are the emissions that would have been expected to occur should the waste have been sent to landfill. These emissions are classified as a Scope 3 source (given that they would have occurred at a site not owned or operated by the proponent).

A breakdown of the results by GHG 'scope' is presented in **Table 11.10**.

Table 11.10: Operation non-energy related emissions summary – by scope

Scope	Annual Emissions (tCO_2e)	Total Emissions (25 years - tCO_2e)
Scope 1	0	0
Scope 2	0	0
Scope 3	-300,051	-7,501,278
Total Emissions (all Scopes)	**-300,051**	**-7,501,278**

Table 11.10: Operation non-energy related emissions summary – by scope shows that the Project is expected to avoid landfill emissions of approximately 7.5 $MtCO_2e$ over 25 years of operation, in addition to savings associated with electricity generation.

11.4.3 Cumulative emissions profile

The cumulative emissions over the lifetime of the Project are presented in Table 11.11 and Figure 11.3.

Table 11.11: Cumulative emissions summary

	Construction emissions (tCO_2e)	Operation Energy-related emissions (tCO_2e)	Operation Non-energy related emissions (tCO_2e)	Total emissions (tCO_2e)
Construction	25,538	-	-	25,538
Years 1-25 (annual)	-	-14,824	-300,051	-314,875
Total (25 years)	**25,538**	**-370,604**	**-7,501,278**	**-7,846,344**

Figure 11.3: Cumulative emissions summary

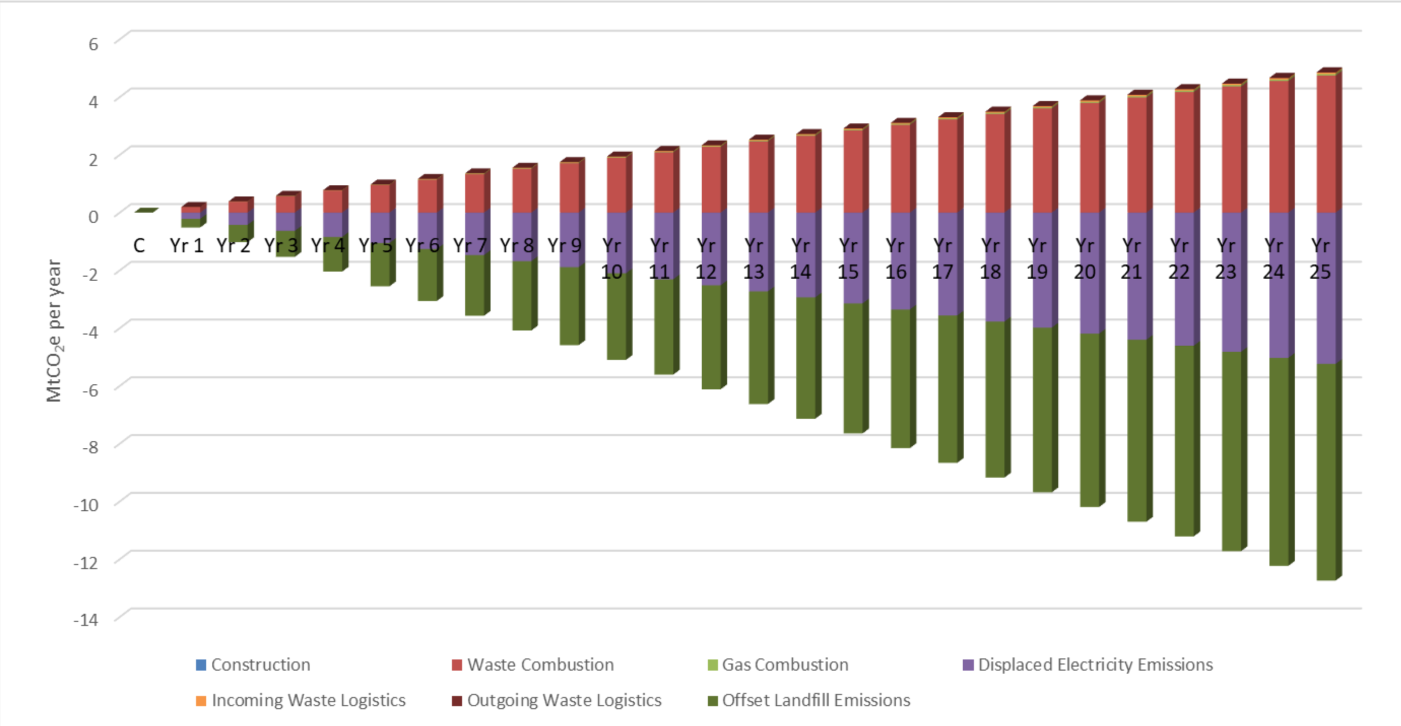


Figure 11.3 gives the cumulative GHG emissions over an assumed 25-year life of the EfW plant. This shows the cumulative emissions of the plant are expected to be approximately 5 $MtCO_2e$ over this period, whilst the cumulative avoided emissions are expected to be approximately 13 $MtCO_2e$. This results in a net GHG benefit associated with the project of approximately 8 $MtCO_2e$. Of the benefits, the avoided landfill emissions are the greatest benefit, followed by the displaced electricity emissions.

11.5 Best practice energy and greenhouse gas management

As the Project will use greater than 500 GJ (and emit greater than 100 tCO_2e), identification and implementation of best practice energy consumption is required in accordance with the PEM. The best practice assessment for energy use and GHG management has included the application of the wastes hierarchy and the integration of economic, social and environmental considerations. This project is committed to use best practice in the selection and operation of the EfW plant and equipment, and to deliver the emissions savings identified in this chapter.

11.5.1 Construction

The proponent will seek opportunities to reduce the energy and greenhouse impact of the construction process. This may include the following:

- Detailed modelling to ensure that cut and fill balances are managed to minimise unnecessary movements of material
- Review opportunities to specify biofuel use in construction plant and equipment based onsite for extended periods
- Review opportunities to use alternative materials in construction, such as fly ash as a supplementary cementitious material (to replace traditional Portland cement) and reclaimed aggregate
- Specify high recycled content in steel use (where technically possible and cost effective)

11.5.2 Operation

This assessment presents a waste management solution for a large proportion of waste in Victoria and as such has been considered in terms of best practice.

The results of this energy and GHG assessment show that although the project will have direct emissions of approximately 192 $ktCO_2e$ per year, the net benefit of the project (including emissions avoided or offset) is approximately 209 $ktCO_2e$ per year. By comparison, landfill of the waste would result in emissions of 300 $ktCO_2e$ per year. This will be a measurable impact on Victoria's (and Australia's) emissions profile.

The emissions profiles of Victoria and Australia (and the proportion reduction that this Project would represent) are (for 2018 – latest dataset available):

- Australia – 537,446 ktCO2e / year – 0.06% reduction
- Victoria – 102,189 ktCO2e / year – 0.31% reduction

The above figures are calculated on the basis of the EfW plant offsetting electricity at a rate which is lower in emissions intensity than the current Victorian grid factor (i.e. using a factor of 0.82 tCO_2e / MWh as opposed to 1.02 tCO_2e / MWh). Using the current Victorian grid emissions intensity factor, the project will result in a net benefit of approximately 260 $ktCO_2e$. As the Victorian grid switches to lower carbon forms of generation (such as this project), this offset value will decrease in quantity. For example, at a grid rate of 0.6 tCO_2e / MWh the total offset for the project is closer to 153 $ktCO_2e$. The rate chosen for this Project is consistent with the methodologies used in the ERF and representative of the likely change in the magnitude of the offset over the life of the plant.

Victoria is aiming to become carbon neutral by the year 2050. Diversion of material from landfill, and the recovery of energy from residual waste will make a contribution to Victoria in achieving this, alongside generating electricity from renewable sources.

The carbon intensity of the electrical energy generation of the EfW plant has been calculated. Based on the gross emissions from the plant operation only (including emissions from the fossil content of waste combustion and emissions from gas combustion); the resulting carbon intensity factor for electricity from the plant is 0.75 tCO_2e/MWh.

The thermal efficiency of the EfW plant must meet the criteria as defined in the Victorian EPA's Energy from Waste Guideline (EPA, 2017). This states that:

> *"For dedicated EfW plants, the proponent should demonstrate the thermal efficiency of the proposed technology using the R1 Efficiency Indicator as defined in the European Union's Waste Framework Directive 2008/98/EC (WID). For a plant to be considered a genuine energy recovery facility, R1 will be expected to be*

equal or above 0.65. Alternatively, if R1 is below 0.65, proponents will be expected to provide a justification as to why this value cannot be reached."

The R1 figure for the proposed EfW plant is 0.76, which comfortably exceeds this value, and represents the fact that both electrical and steam outputs are being utilised in line with best practice.

Figure 11.4 presents a comparison of the emissions intensity of electricity production of the proposed EfW plant (0.75 tCO_2e / MWh) alongside a range of comparative emissions intensity factors, including generators at Loy Yang Power Station (PS) and Mine, Loy Yang B and Yallourn. It also presents figures for a range of other renewable and non-renewable generators, as well as state and national averages. The data were derived for the 2018/19 financial year from information reported to the Clean Energy Regulator and include both Scope 1 and Scope 2 emissions.

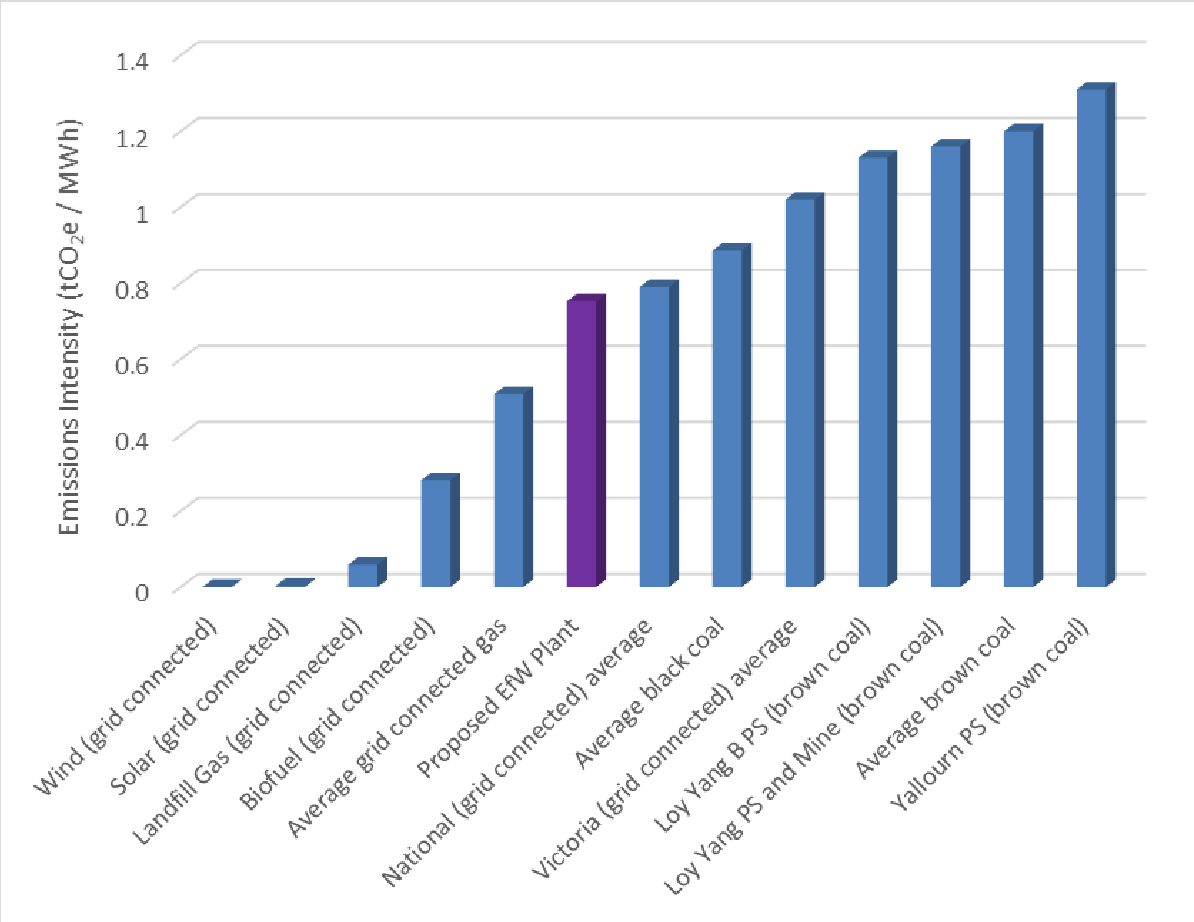


Figure 11.4: Electricity generation – GHG comparison

Figure 11.4 shows that the proposed EfW plant's emissions intensity is higher than that for grid connected gas fired power stations, and notably lower than that for black and brown coal fired stations. Wind and solar are much lower intensity forms of energy generation but are not as significant contributors to energy generation in Victoria, and do not form baseload generation.

It is difficult to compare the derived figure with others for EfW plants internationally, due to differences in waste stock, and difficulties in obtaining comparable numbers – for instance, determining what emissions were and were not included in the assessment boundary. However, the figure presented of 0.75 tCO_2e / MWh is comparable (but higher) than that presented for the UK Cory Riverside Energy Plant (0.62 tCO_2e / MWh) (ICE, 2017).

Within this assessment it has been assumed that the solid waste from the EfW plant will be sent to landfill in Melbourne, and the appropriate haulage distances have been calculated based on the tonnage expected. It is the proponent's intention to seek beneficial reuse of the residues as markets allow. This includes:

- Bottom Ash – this is used widely in Europe as a substitute aggregate. The material undergoes a process of conditioning and final metals screening before being used as (for example) road base. Use of this material in Victoria would offset virgin aggregate manufacture and provide a sustainable alternative.
- APCr – the proponent is investigating the opportunity to process this material to bind the contaminants it contains into a concrete like mixture, and then use within concrete, or as a screed. Use of this material would also offset virgin material manufacture. Further, some APCr treatment processes (such as the carbon8 process – see https://oco.co.uk/ Technology, 2020]) use liquefied carbon dioxide (from power generation operations) within the process – resulting in a carbon negative product.

11.5.3 Greenhouse gas emissions reporting

With gross emissions in excess of 50 ktCO_2e per year the EFW plant will need to report GHG emissions to the Clean Energy Regulator each year in its own right, or as part of the PHI annual reporting process.

11.5.4 Eligibility for Renewable Energy Large Scale Generation Certificates

Renewable electricity generated by power stations, whether they are off grid or connected to an electricity grid, may be eligible for the creation of large-scale generation certificates. According to Section 17 (subsection 1q) of the *Renewable Energy (Electricity) Act 2000* the biomass components of MSW are eligible to generate large-scale generation certificates (LGCs).

The net electrical output of the EfW plant will be 255,229 MWh per year. Of this, approximately 1% could be generated by gas used (when waste feedstock calorific value dips below the required level). Of the remainder, the assessment shows that approximately 57% of the incoming waste is of biogenic origin, and then potentially eligible to generate LGCs. This would equal approximately 148,033 LGCs (as one certificate is generated for every eligible MWh). LGCs are sold to liable entities (electricity retailers) which are required to surrender a certain amount of LGCs each year to the Clean Energy Regulator in order to assist in meeting the Renewable Energy Target (RET).

11.6 Summary

The construction phase emissions have been calculated as 25,538 tCO_2-e. Table 11.12 shows the calculated GHG emissions for the operational phase of the EfW Plant. Taking into account the GHG emissions saved by the displacement of landfill GHG emissions, the Project will have a net saving of 314,875 tCO_2e per annum. Over the 25-year life of the Project, the GHG emissions savings are expected to be 7,846,344 tCO_2e.

Table 11.12: Operational phase emissions summary (per annum)

	EfW Plant	Transport and logistics	Offset from displaced electricity and steam	Offset from avoided landfill emissions	Total GHG Emissions (tCO2e) per annum
Operational phase Emissions	192,034	2,500	-209,359	-300,051	**-314,876**

12. Air Quality

12.1 Study area

The air quality impact assessment study considered an area within an approximately 10 km radius of the proposed site. Within this area, the nearest sensitive receptors are shown in Figure 12.1 and described in Table 12.1.

Table 12.1: Nearest sensitive receptors

Map label	Receptors
Minyip	Minyip Road (closest residence to the Project site)
CN	Corio North
FMP	Flinders Memorial Park
SR	Stulle Reserve
EPGC	Elcho Park Golf Course
MC	Macgregor Court
RS	Rennie Street
BP	Beckley Park
MW	Minyip West
AD	Apollo Drive
FR	Frys Road