10. Waste

10.1 Overview

This chapter outlines the waste assessment components of the construction and operation of the Project, addressing the specific requirements of:

- EPA's EfW Guidance (Publication 1559, 2013)
- Schedule 1 and Schedule 2 of the Environment Protection (Industrial Waste Resource) Regulations 2009
- Industrial Waste and Resource Guidelines: Solid Industrial Waste Hazard Categorisation and Management (Publication IWRG 631, 2009).

Detail is provided on the input feedstocks and the waste residues generated by the EfW Plant, along with Australian Paper's proposed approach for handling and managing these waste types. Particular attention has been given to the categorisation of the different waste streams that would be handled by the plant during the operational phase of the project, given that the amount and composition of each can have impacts on the design of the facility, waste acceptance and handling protocols, plant operational efficiency and waste transportation and disposal requirements.

Detailed assessment of the input feedstock available to the EfW facility, the resultant characteristics of combustion, and resultant range of waste outputs has been undertaken using information available at the time of reporting and assuming feedstock only from certain regional areas will be available. This has provided indicative and supporting information on the amount of feedstock tonnages available to the facility, and the likely range of compositions possible for the ash residues. From this, Australian Paper has determined facility performance needs and best practice environmental management of the waste outputs. Additionally, Proof of Performance testing of the EfW Plant, once constructed, will be required to demonstrate the actual compositions of the resultant ash residues in order to determine (in conjunction with the EPA) the required treatment and disposal method(s).

10.2 Background

10.2.1 Existing situation

Australian Paper proposes to seek the majority of its input feedstock (source separated non-hazardous residual waste) from councils represented by the Gippsland Waste and Resource Recovery Group (GWRRG) and Metropolitan Waste and Resource Recovery Group (MWRRG). Population growth in these regions is anticipated to be considerable over the next 30 years. For example, a 20% increase of the current population in Gippsland is expected by 2031 which means an additional 62,145 people will be residing in the area[32]. This population growth will drive an increase in the amount of residual waste that needs to be managed by these regions. Sustainability Victoria has projected that by 2043, Victoria's annual waste generation will increase by 60% on 2015-16 figures exceeding 20 million tonnes. The Metropolitan region accounts for about 80% of Victoria's waste.

The Gippsland region has reported that in 2013-14 the region was generating approximately 450,000 tonnes[33] of waste and recycling per year, while the Metropolitan region has reported that in 2014-15 the region was generating above 10.4 million tonnes[34] of waste and recycling per year. Both regions are achieving recovery rates that are higher than the State average of 67%[35], with overall average resource recovery rates of 70% for the Gippsland region and 73% for the Metropolitan region across the Municipal Solid Waste (MSW), Commercial and Industrial (C&I) and Construction and Demolition (C&D) sectors.

[32] Gippsland Waste and Resource Recovery Group (GWRRG), Gippsland Waste and Resource Recovery Strategy 2017
[33] Reported by GWRRG, page 37
[34] Metropolitan Waste and Resource Recovery Group (MWRRG), Metropolitan Waste and Resource Recovery Implementation Plan 2016, page 75
[35] Sustainability Victoria, Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP) 2017-2046

However, this means that 30% and 27% respectively of residual waste generated in these regions is being disposed of to landfill. A breakdown of performance by sector shows that resource recovery rates for MSW are closer to 63% for the Gippsland region and 48% for the Metropolitan region which means that an average of 37% and 52% respectively of residual waste generated by households in these regions is disposed of to landfill. MSW also represents nearly half (46%) of all material disposed in Metropolitan landfills each year. Recovery of energy from this residual waste will help these regions achieve higher overall rates of resource recovery while also reducing reliance on existing and new landfills.

Gippsland is currently serviced by 14 landfills, of which nine are council-owned and accept putrescible waste. The remaining five landfills are privately-owned – three of these landfills are operated by power generation companies, the other two are operated by Australian Paper and Gippsland Water. These privately operated landfills are primarily used for the disposal of wastes generated on-site (e.g. ash from the combustion of brown coal or the disposal of asbestos waste and synthetic mineral fibre). Several council-owned landfills will require works approval applications should they wish to extend their current operations to use the planned capacity of the sites (Latrobe City Council and Wellington Shire Council) and several other landfills are calculated to reach current approved capacity within 15 years.

At the same time, landfills in the south east of Melbourne are reaching full capacity and are closing. Of the 11 landfills that receive putrescible waste, one landfill closed in 2016[36], and three are likely to close by 2018[37] with an additional landfill due to close by 2020[38]. All landfills in the Kingston Closed Landfill Precinct (part of the Clayton South hub) and the Rye landfill will close within the next three years and both council and privately owned and managed landfills within this precinct have ceased accepting new waste. This will leave two landfills (SUEZ Hallam and SUEZ Lyndhurst) operating beyond 10 years. SUEZ Lyndhurst has approval to accept prescribed industrial waste (PIW) and municipal waste, and has an additional municipal solid waste cell currently being planned. SUEZ Hallam is scheduled to close in 2040 but may fill faster than expected if alternative recovery options are not available[39]. As landfills close, an increase in resource recovery capacity will be pivotal to reducing reliance on existing landfills and new landfill development. Both the GWRRG and the MWRRG have indicated that they will re-evaluate the need for future landfill airspace capacity as new initiatives are presented.

10.2.2 Waste terminology

The *Environment Protection Act 1970* (EP Act) and associated guideline documents define the different types of waste.

Industrial waste is defined in the EP Act as:

> *"any waste arising from commercial, industrial or trade activities or from laboratories; or any waste containing substances or materials which are potentially harmful to human beings or equipment"*

Municipal waste is defined under the EP Act as:

> *"any waste arising from municipal or residential activities, and includes waste collected by, or on behalf of, a municipal council, but does not include any industrial waste"*

EPA Publication Industrial Waste Resource Guideline IWRG600.2 (Waste Categorisation) states that Prescribed Industrial Wastes (PIWs):

> *"have the potential to adversely impact human health and the environment. They may either be from a manufacturing source or be contaminated soils"*

[36] http://www.heraldsun.com.au/leader/inner-south/clayton-south-landfill-site-has-closed-its-gates-to-rubbish-forever/news-story/a7c9718220605407a50a76504465c54e
[37] https://www.cleanaway.com.au/wp-content/uploads/2017/01/Cleanaway-Clayton-Update.pdf, http://mpnews.com.au/2015/09/21/rye-tip-to-close-in-three-years/
[38] Metropolitan Waste and Resource Recovery Implementation Plan 2016
[39] Metropolitan Waste and Resource Recovery Implementation Plan 2016

The nomenclature commonly used by the Australian waste industry differs slightly from the definitions of wastes in the EP Act and associated guidelines. The Australian waste industry description of wastes refers to "municipal waste" as "municipal solid waste (MSW)" and "industrial waste" described in terms of "Commercial and Industrial (C&I) waste", "Construction and Demolition (C&D) waste" and "Prescribed Industrial Waste (PIW)".

It is AP's intention to source primarily MSW (80%) and the remainder C&I waste (20%) subject to acceptance criteria (see Section 10.5.2.1). AP will not source PIW, C&D waste, solid inert waste or fill material for the EfW Plant. Because AP is in discussions with many parties in the waste sector, the terminology used most commonly within the industry are generally preferred.

This Works Approval Application uses the terms:

- "municipal waste" interchangeably with "municipal solid waste" or MSW
- "industrial waste" interchangeably with "commercial and industrial waste" or (C&I), where C&I waste is taken to exclude PIW

10.2.3 Application of the waste hierarchy and best practice option for waste management

The waste hierarchy (Figure 10.1 below) is one of eleven principles of environment protection contained in the *Environment Protection Act 1970*. The application of the waste hierarchy has been an active part of project decision-making processes as outlined below and described in the context of Best Practice in Chapter 5.

Recovery of energy from waste is a higher order waste management option than landfill (disposal), addressing the economic issue of waste being a lost resource. Landfills also have the potential to impact the environment and communities long after they have stopped receiving waste (e.g. odour; groundwater pollution; surface water pollution; gaseous emissions). As such, the period of aftercare management (from when the site is closed) can be up to 30 years for licensed sites and buffer distances are required to remain during the post-closure period to address potential risks[40]. There are 120 closed landfills in a state of rehabilitation or aftercare across the Gippsland region[41]. EfW facilities reduce the volume of waste by up to 90% (or around 95% in the case that bottom ash is reused by the construction industry), minimising dependencies on new and expanded landfills and ensuring that existing landfill airspace capacity is retained for contingencies and unrecoverable materials into the future.

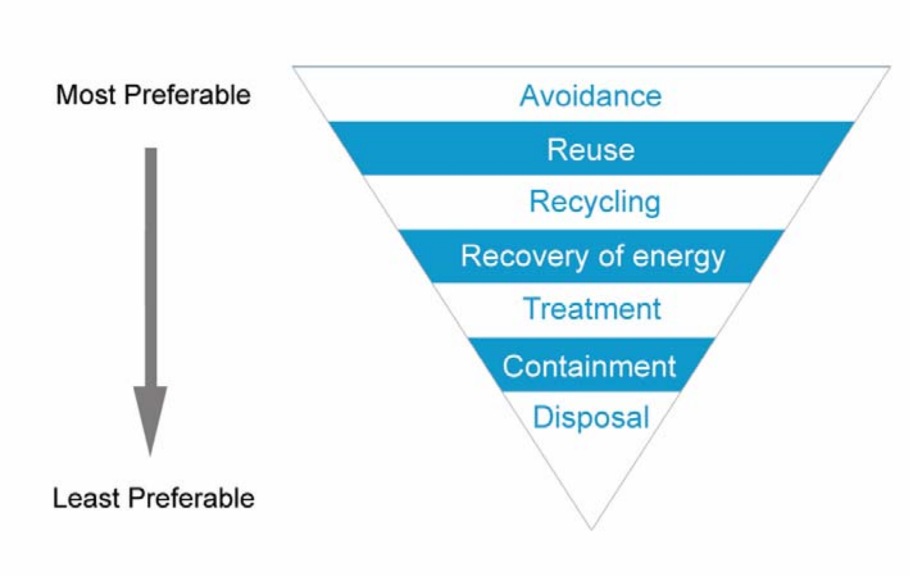

Figure 10.1 : EPA Victoria waste hierarchy

[40] Metropolitan Waste and Resource Recovery Implementation Plan 2016
[41] Gippsland Waste and Resource Recovery Strategy 2017

The EfW feedstock would comprise primarily of residual MSW which represents a relatively predictable baseload feedstock having relatively consistent compositions. MSW materials would be supplemented with other residual waste sourced from the commercial and industrial (C&I) sector, but only from those businesses generating waste appropriate for treatment by the EfW facility – for example, wastes will not include prescribed industrial wastes such as asbestos, dangerous goods and clinical waste. The majority of these residual waste materials are currently collected by councils and private contractors for disposal at landfill. The benefits of EfW are realised when waste materials used as input feedstocks cannot be viably recovered for reuse and recycling. The project is seeking to target waste feedstocks which have limited potential for reuse or recycling and can be aggregated and transported along major transport routes.

Any ferrous metal present in input feedstocks 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 as a clean stream. Reuse of other waste residues generated by the plant have been investigated to determine if further diversion of waste from landfill is possible. It is noted that reuse of waste residues, specifically bottom ash, is currently undertaken across Europe (including in the UK) with bottom ash being used, for example, in place of or to supplement aggregates. Similar avenues are being investigated by Australian Paper and the wider waste industry in Australia.

In addition, Australian Paper is undertaking a comprehensive modelling study to review historic trends in waste and recycling generation rates, and to better understand the impacts that future potential changes to these input feedstocks (e.g. changes to waste collection schemes or waste legislation) may have on the project over its lifetime. This will help to ensure appropriate measures to secure required tonnages are made through the life of the project. This modelling will also ensure that the EfW facility can manage residual wastes where greater sorting of recyclable materials occurs at source (i.e. by councils, residents and businesses). It is acknowledged that scenario modelling and investigations for reuse of waste residues and waste logistics are still ongoing. To allow for this, a range of conservative assumptions have been used throughout this report.

The EfW Plant would reduce dependencies on landfills for disposal of source separated non-hazardous residual (red top bin) wastes, allow aggregation of residual waste for improved logistics, recover metals for recycling and recover energy for industrial use by Australia Paper.

10.2.4 Alignment with State and Regional Groups of Councils waste strategies

Sustainability Victoria's Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP) 2017-2046[42] provides an overview of Victoria's infrastructure needs to manage solid wastes entering the waste and resource recovery system over the next 30 years. It states that by 2043, Victoria's annual waste generation is projected to exceed 20 million tonnes; which is an increase of 60% on 2015-16 figures.

While landfill is recognised as a critical component of managing residual waste, the EPA's Waste Management Policy (Siting, Design and Management of Landfills) seeks to limit the use and development of landfills and promote higher order waste management alternatives. Goal 1 of the SWRRIP also places a limit on landfills for 'receiving and treating waste streams from which all materials that can be viably recovered have been extracted' and notes that the only acceptable method to manage residual waste in Victoria is to dispose of materials to landfill. Recovery of energy from waste is recognised as an alternative waste management option that could divert 45 to 50%[43] of waste currently going to landfill, in alignment with the goals and objectives of the SWRRIP.

Sustainability Victoria's *Sustainable Together, We Can Do More 2020* Strategic Plan[44] establishes four goals for waste and resource recovery. These goals seek to reduce reliance on landfills, encourage resource recovery and recycling through consolidation and aggregation of waste, improve the performance of waste and resource recovery facilities, and improve the evidence base for decision making at all levels of government, industry and the community. Complementary work being undertaken to support a fully integrated waste and resource recovery system in Victoria includes facilitating investment in new waste and resource recovery infrastructure

[42] Originally released in 2015 and currently available in its amended form as a consultation draft
[43] SWRRIP (Amended Consultation Draft 2017), page 38
[44] Sustainability Victoria Strategic Plan 2015 - 2020

and stimulating markets for products made from recovered resources. Sustainability Victoria also states that it will support better land-use planning for waste and resource recovery infrastructure, support increased recovery of key products and materials like e-waste and organics, and introduce ways to turn waste into energy.

The Gippsland and Metropolitan Regional Groups have recently published their 10-year Regional Waste and Resource Recovery Implementation Plans[45] identifying how the recycling and waste management needs of each region will be met over the next 10 years. These plans also include the Gippsland and Metropolitan Regional Groups' support for the use of EfW technology as a method of resource recovery. The Gippsland Waste and Resource Recovery Strategy (2017) highlights that Gippsland has extensive transmission and energy generation infrastructure and there is private sector interest in establishing EfW facilities in the region. The Plan further notes that EfW options are well supported through appropriately zoned and serviced industrial areas located within the Latrobe Valley. Rising landfill disposal costs in Gippsland and closure of Hazelwood power station provides added pressure for the establishment of additional EfW facilities in Gippsland to partially replace the capacity of this major electricity generator.

Ongoing dialogue with both the GWRRG and MWRRG has occurred over the development life of this project. Input has been sought from both of these groups for the preparation of this Works Approval Application. The formal responses are included in Appendix D.

The Metropolitan Waste and Resource Recovery Implementation Plan (2016) looks to create opportunities to increase EfW infrastructure under the key implementation actions in the SWRRIP. It further notes that the amount of landfill space is decreasing and many landfills in the south east of Melbourne will close over the next few years. In light of this, and with a government focus on higher order waste options, the Metropolitan's regional strategy is to reduce reliance on landfills by building alternative technology facilities. Strategic Objective 1 of the Plan also includes an action which states that by 2026, 25% of all municipal residual waste collected through facilitated group procurement will be recovered either through recycling or thermal treatment for energy recovery.

10.2.5 Main input feedstock types

The main input feedstock types to be targeted for combustion at the EfW Plant are:

- Residual waste materials disposed of into general waste bins (i.e. "red top bins") by householders, collected directly from the kerbside by or on behalf of councils, which would otherwise be disposed of to landfill
- Residual waste materials and other waste types disposed of by commercial businesses which would otherwise be disposed of to landfill and does not include prescribed industrial wastes – wastes similar to MSW will be targeted (e.g. from shopping centres, office blocks)
- Selected non-prescribed industrial wastes collected from specific industries, including plastic waste from Australian Paper's paper recycling process generated at Maryvale Mill that has limited realistic potential for recycling
- Residual waste collected from waste transfer stations operated by or on behalf of councils
- Residual waste generated from Material Recovery Facilities that cannot be recycled.

10.2.6 Waste types not accepted as input feedstock

Waste streams not being targeted for the purposes of recovery by thermal processes include:

- Bulky / drop off household wastes and other municipal wastes such as street sweepings
- Commercial and industrial waste types that are not considered to be appropriate feedstocks, such as medical wastes
- Source separated household, commercial and industrial recycling streams

[45] Metropolitan Waste and Resource Recovery Implementation (2016), Gippsland Waste and Resource Recovery Strategy (2017)

- Construction and demolition waste
- Prescribed industrial wastes (e.g. special wastes, medical wastes).

Only business waste streams that comply with the EfW facility's acceptance criteria will be targeted as an input feedstock. PIW such as asbestos, PVC, treated wood waste, dangerous goods and clinical waste will not be sought as a procurement option, nor will material streams with high proportions of materials that could realistically and viably be recycled.

10.2.7 Quality assurance processes to reduce contamination and the presence of recyclable materials

Wastes which do not meet with the EfW facility acceptance criteria (outlined in Section 10.5.2.1), and the presence of contamination and recyclable materials within the input waste feedstock, will be minimised through the following measures:

- Sampling of input feedstock waste types to support planning and approvals processes (taken to be representative of the final waste composition to be processed by the EfW facility) to determine characteristics and potential contamination levels present in the waste outputs
- Segregation of recyclable materials and hazardous wastes by the householder and by commercial businesses for separate processing so that these materials do not end up in the general waste bin (i.e. "red top bins")
- Targeting of commercial waste contracts for residual wastes that would otherwise be disposed of to landfill, and other waste types which meet with the EfW acceptance criteria
- Targeting of industrial waste contracts for specific waste types which meet with the EfW acceptance criteria and have limited realistic potential for recycling
- Clauses in commercial and industrial waste contracts which clearly state the EfW acceptance criteria and penalties / disincentives for those businesses which do not meet with this criteria (including that the facility will not accept such wastes)
- Inspection / visual assessment of waste materials received at transfer stations prior to aggregation and/or at the facility to check for PIWs / wastes which do not meet with the EfW facility acceptance criteria, with rejection of waste loads which do not comply
- Inspection / visual assessment of waste materials dumped into the EfW facility bunker prior to combustion to remove obvious contamination
- Sampling and monitoring of wastes during the operational phase (taken to be representative of the final waste composition to be processed by the EfW Plant) to determine characteristics and potential contamination levels present in the waste
- Continuous, real-time monitoring of process parameters and air quality emissions to identify and manage higher levels of pollutants to comply with licence limits
- Sampling and monitoring of waste outputs during the operational phase to determine characteristics of these wastes and therefore, the handling and management requirements for these wastes.

It is in AP's interests to reduce contamination levels present in input waste feedstocks to achieve optimal operating conditions at the EfW Plant and to reduce the potentially hazardous characteristics of waste outputs generated by the combustion process, should reuse and recycling markets for these waste outputs emerge in the future, similar to markets established in Europe.

10.3 EPA Requirements

This section presents the regulatory requirements against which the Victorian EPA assesses the compliance of works approval applications with waste policy and legislation. It has been developed in reference to the *Environment Protection Act 1970*, the EPA *Energy from Waste Guideline* (Publication 1559.1) and the EPA

Works Approval Application Guideline (Publication 1307.10), with a focus on Section 12 (Waste)[46] and subsections 12.1, 12.2 and 12.3 which specifically relate to licensing regarding industrial waste (IW) and prescribed industrial waste (PIW) generation (these waste types are described in Section 10.3.4) and waste handling and treatment premises.

10.3.1 Environment Protection Act 1970

The primary instrument for the regulation of waste in Victoria is the *Environment Protection Act 1970* (EP Act). 'Waste' is defined by the Environment Protection Act 1970 as:

- Any matter whether solid, liquid, gaseous or radio-active which is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment
- Any greenhouse gas substance emitted or discharged into the environment
- Any discarded, rejected, unwanted, surplus or abandoned matter
- Any otherwise discarded, rejected, abandoned, unwanted or surplus matter intended for:
  - Recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter
  - Sale
  - Any matter prescribed to be waste.

'Municipal Solid Waste' is defined as

- Any waste arising from municipal or residential activities, and includes waste collected by, or on behalf of, a municipal council, but does not include any industrial waste.

'Industrial Waste' is defined as:

- Any waste arising from commercial, industrial or trade activities or from laboratories;
- Any waste containing substances or materials which are potentially harmful to human beings or equipment.

Discharge of waste onto land under the EP Act:

- Shall at all times be in accordance with declared State environment protection policy or waste management policy specifying acceptable standards and conditions therefore
- Shall comply with any standards applicable under [the EP Act].

10.3.2 EPA Energy from Waste Guideline

The EPA's *Energy from Waste Guideline* provides high-level guidance on the EPA's expectations and requirements for the siting, design, construction and operation of EfW facilities.

The EPA states that recovery of energy from waste is resource recovery, as opposed to waste disposal, but that it should not compete with avoidance, reuse or recycling. The EPA encourages EfW options where energy recovery provides the best practicable environmental outcome for the management of waste, and where it represents the most feasible option for treatment of residual waste (i.e. waste that cannot be avoided or recovered for productive purposes through reuse and recycling). The Guidelines state that this 'generally means that the environmental or economic costs of further separating and cleaning the waste are greater than any potential benefit of doing so'.

The EPA requires that the Works Approval Assessment provide a full description of the proposed EfW process including the waste acceptance and preparation process and the disposal of by-products, and that consideration is given to the impact of future waste collection services on the composition of the residual waste stream over

[46] EPA, 2015. Works Approval Application (Guideline), Environment Protection Authority (EPA) Publication 1307.10.

the life of the proposal. All EfW residues and by-products must be categorised and managed according to the *Environment Protection (Industrial Waste Resource) Regulations 2009*. Where possible, and in accordance with the IWR Regulations, reuse and recycling options for residues should be explored.

10.3.3 EPA Works Approval Assessment considerations

The proposed EfW Plant will be categorised as a Scheduled Premise (under the Victorian *Scheduled Premises and Exemptions Regulations 2007*) as follows:

- Category A08 applies to premises which recover energy from waste at a rated capacity of at least 3 megawatts of thermal capacity or at least 1 megawatt of electrical power.

In addition, the proposed operation of the EfW facility is anticipated to generate Industrial Waste at a rate of greater than 1,000 tonnes per year, therefore details are required on the waste types likely to be generated and proposed management measures in accordance with the waste hierarchy.

Table 10.1 outlines the EPA considerations of direct relevance to the waste assessment.

Table 10.1 : EPA WAA considerations

EPA Considerations	Relevant Guidelines / Requirements	Chapter Section/s
Waste handling and treatment premises (A01, A02, A07, A08, A09 and glass reprocessors (H05))		
Types and waste hazard categorisation	Comply with EPA publications IWRG621 (Soil Hazard Categorisation), IWRG631 (Solid Industrial Waste Hazard Categorisation and Management) and and/or IWRG822 (Waste Codes).	Section 10.4.1, Section 10.5.2.2, Section10.6.1,Section 10.6.2,
Best practice for selected processes and technology	Demonstrating best practice in accordance with EPA publication 1517. In accordance with EPA publication 1559.1, subsection 12.1.2.2 demonstrate that waste generated will be managed in accordance with the waste hierarchy. Additionally, as per subsection 12.3.3 of the WAA Guidelines, indicate how you determined best practice for waste treatment: • Compare the available processes and technologies for each type of waste to be treated at the site • Provide the reasons for your selected process	Chapter 5 Section 10.2.3 and Section 10.7
Storage and handling: • Placarding • Separation to buildings and boundaries • Segregation of incompatible chemicals • Spill containment or bunding ventilation • Exclusion of ignition sources • Fire protection • Emergency planning • House-keeping • Correct racking and stacking	Design of storage in accordance with EPA publication 347. Meet WorkSafe requirements for Dangerous Goods and Occupational Health and Safety: for example, AS1940 Storage and Handling of Dangerous Goods AS 3833 Storage and Handling of Mixed Classes of Dangerous Goods. In accordance with EPA publication 1559.1, subsection 12.3.2.2, provide the following: • Explanation of how industrial waste or prescribed industrial waste (PIW) will be	Refer to Chapter 4 Engineering processes Section 10.5, Section 10.7

EPA Considerations	Relevant Guidelines / Requirements	Chapter Section/s
	loaded and unloaded • Design and drawing of loading area	
Measures proposed to control fugitive emissions (odour or chemical substances) from waste storage or treatment buildings	Information should be provided with reference to Section 8 of Part B (Air Emissions) and assessed against criteria outlined in 8.1.4.	Chapter 6
Treatment requirements are: control air, odour and noise impacts prevent contamination of water, land and groundwater	Comply with EU requirements for incineration/thermal degradation where required.	Section 10.5.2
Transport and disposal requirements	Comply with Waste Transport Certificate publication IWRG811. Comply with Parts 3 and 4 of the IWR Regulations that relate to transport and management of waste, as well as prescribed industrial waste (PIW) (transport certificates and permits).	Section 10.5.1, Section 10.6.6

10.3.4 Environmental Protection (Industrial Waste Resource) Regulations 2009 and Guidelines

The main legislative instrument governing industrial waste resource management is the *Environment Protection (Industrial Waste Resource) Regulations 2009*[47] (IWRR, these are the Principal Regulations and amendments are available as the Amendment Regulation 2016).

The IWRR includes provisions for the:

- Categorisation of Industrial Waste and PIW
- Transport and management of waste
- Specific requirements for PIW
- Exemptions to the regulations for secondary beneficial reuse applicable to PIW.

In accordance with the EPA's Energy from Waste Guidelines, all EfW feedstock, residues and by-products must be characterised and managed in accordance with the Regulations.

10.3.4.1 Categorisation of industrial waste and PIW

Industrial Waste and PIW are described in Schedule 1 and 2 of the Regulations. Industrial waste is any waste arising from commercial, industrial, or trade activities including waste arising from building and demolition activities. PIW is any waste which has the potential to adversely impact human health and the environment. The majority of PIWs are of industrial origin or may arise from trade or commercial activity.

The Schedule 1 wastes receive an automatic exemption from being categorised PIW, and include:

- Biosolids managed in accordance with specifications acceptable to the Authority
- Bitumen or asphalt
- Brick
- Cardboard
- Commercial food waste

[47] Authorised Version incorporating amendments as at 18 July 2017

- Concrete
- Formed metal components
- Glass
- Green waste
- Industrial waste water managed in accordance with specifications acceptable to the Authority
- Paper
- Plastic
- Textiles
- Timber
- Tyres.

Schedule 2 deals with PIW. PIW is described as any industrial waste or mixture containing industrial waste other than industrial waste (as defined above) or a mixture containing industrial waste that:

- Is a Schedule 1 industrial waste; or
- Has a direct beneficial reuse and has been consigned for use; or
- Is exempt material; or
- Is not Category A waste, Category B waste or Category C waste;

It should be noted that none of the main waste outputs (bottom ash, boiler ash and air pollution control residues including fly ash) of the EfW facility could be described by the Schedule 1 definitions, and therefore would not receive an automatic exemption from being categorised PIW.

EPA Publication 631 (IWRG631) *Solid Industrial Waste Hazard Categorisation and Management*[48] defines ‘specific hazard characteristics’ and ‘solid industrial waste hazard categorisation thresholds’ for categorisation of PIW. Wastes are categorised on the basis of their chemical composition or physical attributes. There are four waste categories of PIW: ‘Category A’, ‘Category B’, ‘Category C’ and Industrial Waste. Category A is the highest hazard category. Less hazardous wastes, that are not categorised as PIW, will be categorised and managed as Industrial Waste.

According to IWRG631, if any waste displays specific hazard characteristics (as outlined in Table 1 of the publication) it will automatically be categorised as a Category A PIW. These specific hazard characteristics are associated with Dangerous Goods (i.e. wastes that are explosive, flammable, toxic etc.). If solid industrial wastes do not display these specific hazard characteristics, they must be assessed against three total concentration thresholds (TC0, TC1 and TC2) and three leachable concentration thresholds (ASLP0, ASLP1 and ASLP2) to determine which of the four waste categories it falls into[49]. The thresholds for each contaminant (inorganic species, anions, organics species and pesticides) are specified in Appendix B of the IWRR.

The hazard categorisation framework[50] categorises wastes as follows:

- Solid industrial wastes that display any specific hazard characteristics are **Category A** PIW. PIWs with any contaminant level above the TC2 or ALSP2 thresholds are categorised as **Category A**
- Note: Specific hazard characteristics include waste that can be classified as ‘Dangerous Goods’ (i.e. Explosive, Flammable solid, spontaneously combustible, Dangerous when wet, Oxidising, Organic peroxide, Toxic, Infectious, Corrosive, generate gases that can be classified as Toxic Gas, yield another material possessing any of the Dangerous Goods characteristics) as per the Dangerous Goods Act 1985

[48] EPA Victoria (2009) Publication IWRG631 Solid Industrial Waste Hazard Categorisation and Management
[49] TC = Total Concentration, ASLP = Australian Standard Leaching Procedure
[50] EPA Victoria (2009) Publication IWRG631 Solid Industrial Waste Hazard Categorisation and Management, Figure 1 of the IWRG and Appendix A of IWRR

- PIW with any contaminant level greater than TC1 but below TC2, or greater than ASLP1 but below ASLP2 are categorised as **Category B**
- Wastes with any contaminant level greater than ASLP0 but below the TC1 and ALSP1 thresholds are categorised as **Category C**
- Solid industrial wastes with all contaminant levels below both the TC0 and ASLP0 thresholds are categorised as **Industrial Waste**
- If a component of the waste is, in its pure form, poisonous (acute), toxic (delayed or chronic) and/or ecotoxic and is not listed in Appendix B of the IWRR, or if, after containment the waste is capable (by any means) of yielding another material, for example leachate, which is poisonous (acute), toxic (delayed or chronic) and/or ecotoxic and is not listed in Appendix B of the IWRR, the waste generator must apply to EPA for a determination of hazard category
- Assessment must be for all chemical substances known and reasonably expected to be present in the waste. The EPA is to be contacted for further guidance on contaminants not listed in Appendix B of the IWRR.

Alternatively, PIW generators can submit a classification application to the EPA if it can be demonstrated that a different category may apply for a particular contaminant or group of contaminants (e.g. when an immobile contaminant may display a low hazard despite a high concentration).

This hazard categorisation framework is illustrated in Figure 1 of IWRG631. It should be noted that that none of the main waste outputs of the EfW facility would be classified as 'Dangerous Goods'. Waste categorisations are provided for the input feedstock in Section 10.4.1, and in Section 10.6.1 and 10.6.2 for the facility's construction and operational waste outputs.

10.3.4.2 Sampling and analysis

The waste categorisation process will involve identification of likely contaminants present in the waste, and sampling and analysis for each contaminant. Solid wastes from processes with variable inputs will require more regular testing than waste streams where the inputs and processes are consistent and repeatable results can be demonstrated. Each study must, therefore, be tailored specifically for the waste that is to be categorised.

For sampling and analysis of the wastes, the IWRG631 states the following procedures must be used to sample and analyse the waste stream:

- Wastes must be sampled, collected, preserved and analysed as specified in *IWRG Sampling and Analysis of Waters, Wastewater, Soils and Waste*
- Sampling must be representative of the waste and account for variability in the waste composition (see IWRG Waste Sampling for Solid Prescribed Industrial Waste)
- Samples must be submitted to an analytical laboratory accredited by the National Association of Testing Authorities (NATA) to undertake the analyses.

Two buffer solutions must be used to determine leachate concentrations for waste (as outlined in Australian Standards AS 4439.2 and AS 4439.9 using Class 3B leaching fluids). It is recommended that a two-step analytical process be followed when determining the hazard category of waste.

- Initially total concentrations should be determined and if, and only if, the total concentration (TC) is less than twenty times the ASLP1 value, leachable testing is not necessary for Category C (this is due to the twenty times dilution factor involved in the ASLP leaching test method). In all other situations ASLP must be determined.
- Leachability testing is required to determine if the waste is Industrial Waste.

The EPA Publication 621 (IWRG621) Soil Hazard Categorisation and Management Guideline notes that any material to be categorised as "clean fill" (e.g. excavated soils generated during the construction phase of the project) will require an assessment of the soil, including site history, to determine if the material has been potentially contaminated. Soil may be classified as "clean fill" when an assessment demonstrates that the material is not contaminated, or contaminant levels are below those specified in IWRG631, or any elevated level of metals or other constituents can be demonstrated to be of natural origin.

AP will undertake sampling and analysis of input feedstock and EfW facility waste outputs on a routine basis, and as required by the EPA, to confirm waste categorisations and appropriate methods of handling and treatment or disposal.

10.3.4.3 Licensed transport and management of waste

Based on the assigned hazard category there is an associated management option as demonstrated in Table 10.2.

Table 10.2 : Management options for PIW hazard categories[51]

Category	Management Option
A	Prescribed industrial wastes which require a very high level of control and ongoing management to protect human health and the environment. Wastes in this category cannot be accepted at a disposal facility without prior treatment to reduce or control the hazard.
B	Prescribed industrial wastes which require a high level of control and ongoing management to protect human health and the environment. Solid prescribed industrial wastes in this category can be accepted at a facility licensed by EPA to receive this category of waste.
C	Prescribed industrial wastes which pose a low hazard, but require control and/or ongoing management to protect human health and the environment. Solid prescribed industrial wastes in this category are able to be accepted at best practice municipal landfills licensed by EPA to accept such waste.
Industrial Waste	Industrial wastes are not regulated as prescribed industrial wastes, but when disposed of to landfill, continue to be controlled by EPA. These wastes can be accepted at solid inert landfills (non-putrescible) or municipal solid waste landfills (putrescible) licensed by EPA to accept this type of waste.

The transport of any industrial waste must meet with relevant vehicle requirements. Contractors transporting any PIW (more than 50 kilograms)[52] must carry relevant permits complying with Section 53F of the EP Act. PIW must not be transported or permitted to be transported from any premise to another premises unless the receiving premises is licensed under the Act to receive that category of prescribed industrial waste, or the receiving premises is exempt from requiring a licence to treat or dispose of PIW at the premises, or transport has been otherwise approved by the EPA.

Transport requirements for 'Industrial Wastes' and 'PIW Category B or C' will likely need to be complied with for facility waste ash outputs. Additional transport requirements may apply should proof of performance testing determine a higher risk level waste categorisation (i.e. 'PIW Category A') is applicable.

10.3.4.4 Specific requirements for PIW

A PIW producer must complete a transport certificate for each consignment of PIW transported from the premises reporting on information as outlined in Part A of Schedule 3 of the Amendment Regulation 2016 (e.g. consignment authorisation number, description of the waste, waste form and code, hazard category, amount of waste, contact details, address of waste receiver etc). Alternatively, an accredited agent can carry out reporting requiring on behalf of the waste producer.

The waste transporter must also complete a transport certificate for each consignment of PIW providing information on the waste producer before the waste is transported from the premises, and provide the information to the waste receiver at the time of delivery of the waste as outlined in Part B of Schedule 2 of the Amendment Regulation 2016 (e.g. vehicle registration number, date of transport etc).

[51] EPA Victoria (2009) Table 3 - Publication IWRG631 Solid Industrial Waste Hazard Categorisation and Management
[52] Part 3, Clause 13 and Clause 28 of the Regulations.

The waste receiver is required to report to the waste transporter (at the time of receipt of the waste), and to the appropriate authority (within 7 days) as specified in Part C of Schedule 3 of the Amendment Regulation 2016 (e.g. date of receipt, amount of waste, type of treatment etc).

Records must be retained for 24 months from the date on which the waste was transported.

These special requirements will only apply to the EfW facility in the case that the facility generates waste ash outputs that are categorised as PIW (Category A, B or C). Waste categorisations of ash outputs will be determined during proof of performance testing.

10.3.4.5 Exemptions to the regulations for secondary beneficial reuse applicable to PIW

Beneficial reuse is defined by the Amendment Regulation 2016 as ‘a substitute for an input or raw material in a commercial, industrial, trade or laboratory activity where the substitute (a) has one or more similar hazard properties to the input or raw material; and (b) would not require any environmental risk management controls other than the controls required for the input or raw material.

The two types of beneficial reuse are direct and secondary relate to whether or not the beneficial reuse requires prior treatment or reprocessing of the input or raw material before reuse. If treatment or reprocessing is required, this is known as secondary beneficial reuse. Part 4 of the Regulations details the process and conditions for establishing a secondary beneficial reuse.

It should be noted that Australian Paper is investigating options for beneficial reuse of ash residues that will be generated by the facility. It is Australian Paper’s preference for ash residues to be diverted from landfill and reused, for example, as an aggregate supplement or replacement. There are aggregate producers in Europe that reuse EfW ash residues for road base and concrete applications however there are no such applications in Victoria.

Australian Paper is currently investigating the reuse of ash residues in the Australian aggregates market. As this will be a new market, there will be a period of time before the proposed reuse of ash residues is implemented. Accordingly, for the purposes of this Works Approval Assessment, it has been assumed that all ash residues will be disposed to landfill.

10.3.4.6 Waste classification

PIW in Victoria is *classified* by the EPA to assist in directing its appropriate management. Note that this term ‘*classification’* differs to the term categorisation of waste, which is otherwise used in this chapter.

PIW is classified for either reuse (i.e. a market exists for this material and it must be reused rather than landfilled) or disposal (with guidelines on how to dispose, and in some cases ‘downgrading’ of the PIW category based on meeting these guidelines). The waste classifications apply to either material streams which may be industry wide or to specific material streams from a specific industry.

The specific classifications which exist for material reuse (which ban the material from landfill) include:

- Unprocessed used cooking fats and oils
- Classification for end-of-life industrial transformers containing PCB-free oil
- Classification for grease interceptor trap waste
- Classification for used oil filters
- Classification for large containers.

The classifications for contaminated soil include those which contain:

- Monocyclic aromatic hydrocarbons
- Total petroleum hydrocarbons

- Polycyclic aromatic hydrocarbons
- Organochlorine compounds.

The classifications for disposal or temporary storage (which may be used by anyone wanting to dispose of these types of waste, provided they meet the conditions of the classification) include:

- Drilling mud
- Firefighting dry chemical powders
- Ceramic-based fibres
- Absorbent materials
- Packaging wastes
- Arsenic and arsenic compounds contained in sand, rock and mine tailings from the City of Greater Bendigo municipality
- Specific classifications – at present limited to the temporary storage of non-friable asbestos by public utilities.

Where wastes are categorised as 'Industrial Waste' (i.e. non PIW), these wastes may not immediately be subject to (or benefit from) the above (e.g. the EPA is unlikely to classify bottom ash for reuse (essentially banning it from landfill) and given its anticipated waste categorisation, it does not need assistance in being downgraded from a PIW).

However, where wastes are categorised as 'PIW', development of a different waste classification can be sought to assist with the cost-effective disposal of this material (e.g. if a waste is categorised PIW Category A, then a waste classification may assist this waste type by downgrading it from a Category A to a Category B or C). The EPA has in its power the authority to approve such classifications where it can be deemed that the material does not post an unacceptable risk to the environment. In these cases, as long as a set of management instructions are adhered to, the material is classified for a maximum three-year period as a lower Category PIW. This reduces the processing costs for the material and allows it to be disposed of to landfill.

10.3.4.7 Waste codes

Waste codes (outlined in EPA publication IWRG 822) are used by the EPA to refer to particular types of PIWs and to ensure that anyone handling, transporting, recovering or disposing of such wastes holds the appropriate licence.

Waste codes that may be applicable to EfW facility waste output residues are:

- Fly ash – Waste code N150; and/or
- Residues from pollution control operations, not otherwise specified in this item (including activated carbon, baghouse dust, residues from industrial waste disposal operations and leachate) – Waste code N210.

In addition to definition of the wastes, there is a requirement to identify what hazard category the waste falls under (A, B or C as identified in Section 10.3.4.1), a requirement to identify the specific contaminants, and a requirement to identify the origin of the waste. For this latter categorisation, it is possible that the following waste code would apply:

- Waste treatment and disposal services – Waste origin code 2921

Finally, there is a requirement for the receiver of the waste to define the waste disposal / treatment option. Waste codes that may be applicable are:

- As a Category C PIW– Waste code D1 (Landfill disposal of Category C PIW); or
- As a Category B PIW – Waste code D5 (Landfill disposal of Category B PIW).

It should be noted that landfill disposal of wastes categorised as Category A PIW is not permitted in Victoria. Alternatively, there is the option for treatment of the waste (for secondary use or for pre-treatment prior to landfill). Appropriate codes for this may be:

- D9A (Treatment and immobilisation or immobilisation only)
- D9B (Chemical treatment and/or solidification)
- D9C (Physical treatment not otherwise specified)
- D12 (Permanent Storage)
- R17 (Bioremediation).

Only waste management facilities that are licensed to accept the designated waste code, and undertake the required disposal or treatment process can be used.

10.3.4.8 Other regulations

There is a range of other regulations applicable to the transport, recycling and disposal of Industrial Waste, which is not covered in detail in this section. This includes the following:

- Transport of waste – transporters of waste and raw materials have specific requirements under the *Road Transport (Dangerous Goods) Act 1995*, and for PIW have specific requirements for licensing under the IWRR. Vehicle guidance for non-tanker vehicles / trailers and tanker / tanker trailers is provided within EPA publications IWRG814.1 and IWRG816.1.
- Receiving and processing (recycling) of waste – sites need to be appropriately licensed to receive / store / process materials and are likely to require a works approval (if they do not already have one). Specific licences are required to handle PIW.
- Disposal of waste off site – landfill facilities must be appropriately licensed for the category of waste that they receive (i.e. Industrial Waste or Category B or C PIW). Type 1 landfills can accept PIW for containment, Type 2 landfills can accept putrescible, inert waste, fill and Category C (low-hazard) PIW. Type 3 landfills can accept inert waste and fill.

Australian Paper will comply with these other regulations as applicable to the EfW facility and EPA requirements.

10.4 Input feedstock profile

This section provides an overview of the waste streams proposed to be utilised as input feedstocks for the EfW facility, with information provided on the sources, the anticipated amounts and the composition. These factors are important considerations for the design and operation of the EfW facility, as well as to satisfy the associated EPA requirements outlined within this Works Approval Application.

10.4.1 Overview of type, source and quantity of input feedstock

The proposed EfW Plant is expected to treat 650,000 tonnes (+/- 10%) of waste per year, consisting of approximately 80% household residual waste and the remainder being made up of commercial and industrial waste (specific sectors only).

The feedstock will comprise:

- residual waste from MSW kerbside collections and transfer stations operated by or on behalf of councils forming a part of the GWRRG and MWRRG
- C&I waste, the majority of which is anticipated to be derived from the largest five waste producing sectors within the C&I sector, which are Manufacturing, Retail Trade, Wholesale Trade, Education and Training, and Healthcare (non-biohazard) and Social Assistance (which does not include PIW).

The anticipated amounts of each waste stream are outlined in Table 10.3, along with their categorisations in accordance with Schedule 1 and Schedule 2 of Environment Protection (Industrial Waste Resource) Regulations 2009 and EPA Publication IWRG 631.

Table 10.3 : Feedstock overview

Waste Stream	Source	Categorisation[53]	Weight (tonnes; +/- 10%)[54]	Proportion
Municipal Solid Waste (General Waste only)	Kerbside collections from households in council areas forming part of GWRRG and MWRRG	Municipal Waste (mix of solid inert and putrescible waste)	520,000	80%
Commercial & Industrial Waste	5 sectors: Manufacturing, Retail Trade, Wholesale Trade, Education and Training, and Healthcare and Social Assistance	Industrial Waste (mix of solid inert and putrescible waste)	130,000	20%

10.4.2 Waste streams not accepted

Waste streams <u>not being targeted</u> for the purposes of energy recovery by combustion include:

- Bulky / drop off household waste and other municipal wastes such as street sweepings
- Commercial and industrial waste types that are not considered to be appropriate feedstocks, such as medical wastes
- Source separated household, commercial and industrial recycling streams
- Construction and demolition (C&D) waste
- Prescribed industrial wastes (e.g. special wastes, medical wastes).

These 'non-targeted' waste streams identified have either capacity for additional reuse or recycling, limited data available on which to yield Calorific Value (CV) information or presents challenges for processing in an EfW facility given waste acceptance criteria requirements. For example, bulky wastes such as mattresses cannot be accepted at the plant given size constraints.

EfW facilities operating to a temperature of 850°C must also meet with feedstock criteria which states that halogenated organic substances, expressed as chlorine, should comprise of no more than 1% of the feedstock, and PIW can often contain high levels of chlorine (or other hazardous substances in elevated concentrations).

10.4.3 Breakdown of anticipated waste tonnes by source location

Waste feedstock generated in the Gippsland region, the south and east part of Melbourne (within the Metropolitan region) has been the focal point of feedstock investigations given the geographical proximity of these areas to the proposed project location and the benefits of minimising feedstock transport distances.

Gippsland comprises many small communities with more than 40% of its residents living in towns of less than 1000 people[55] and connected by the Princes Highway, the primary transport corridor. Much of the region is sparsely populated. However, Gippsland's western portion is also subject to some of Victoria's highest population growth, and its tourist centres attract substantial temporary population increases at peak times. The

[53] http://www.epa.vic.gov.au/~/media/Publications/IWRG600%202.pdf
[54] The tonnage spilt is based on estimated total input tonnes of 650,000 tpa
[55] GWRRG (2017) Gippsland Waste and Resource Recovery Implementation Plan, June 2017

Metropolitan region is a city of 4.4 million people[56] with population projected to increase to 7.8 million people[57] by 2051. The region includes 31 metropolitan Melbourne municipalities.

The breakdown of anticipated waste tonnes by source location is provided in Table 10.4.

Table 10.4 : Approximate breakdown of waste input feedstock tonnes by location

Feedstock Source	MSW (tpa, +/- 10%)	C&I (tpa, +/- 10%)	Total (tpa, +/- 10%)	Percentages
South East Melbourne	465,000	100,000	565,000	87%
Gippsland	55,000	30,000	85,000	13%
Total	**520,000**	**130,000**	**650,000**	**100%**

Further detail of the MSW and C&I waste streams is presented in Section 10.4.2 and Section 10.4.3 of this chapter.

10.4.4 Waste data modelling

The 'naus' waste intelligence tool (waste data modelling software) has been used to establish baseline waste data models for individual councils so that aggregation and modelling of different mass flows of waste in varying proportions from each council could be undertaken. Councils have been selected based on proximity to transport routes (and to the facility) but are only indicative at this stage, given that a procurement process for these wastes will need to be undertaken. The naus tool provides a standardised methodology for modelling waste inputs and flows at a local government area (LGA) level. Within naus, it is possible to establish a relational database of linked individual council models so that population, waste tonnage, composition, service factors and mass flows (facilities and transport) can be manipulated to test a multitude of possible scenarios. In addition, compositional data can be exported at any facility used in a model or scenario, in any year.

Baseline waste data models have been set up for the selected individual councils and aggregated to provide outputs for the MSW proportion of the input feedstock. C&I sector waste tonnages and compositions have also been input into naus to build an overall EfW input feedstock baseline model. This baseline model has been used to support Net Calorific Value (NCV) calculations, to undertake waste growth projections and to model input feedstock availability in 2020-21 (currently expected to be the year that the EfW facility will be ready for commercial operation) and up to 2045-46 (a 25-year time horizon adopted for future input feedstock availability modelling).

10.4.5 Municipal waste overview

Assessment of available feedstock

Data is provided for MSW tonnages from Sustainability Victoria[58] (for kerbside collections), and from the Victorian Local Government Annual Waste Services Report (VLGAWSR) for the year 2014/15[59]. The VLGAWSR also projects future tonnages of waste. Work is on-going to determine which councils may eventually supply waste to the EfW Plant through a range of other technical studies and considerations, including which councils will engage in a joint procurement process and best methods for consolidating / aggregating input feedstock materials.

Councils that have been initially been assumed to provide input feedstock are outlined in Appendix D, Table I.1 (as example only – no dialogue has occurred with these councils and they are used for feasibility purposes only). These councils have been selected based on their geographical proximity to the project site and locations which make the most sense in terms of transport of waste to the EfW Plant. The councils initially selected from

[56] MWRRG (2016) Metropolitan Waste and Resource Recovery Implementation Plan
[57] Victoria in Future DELWP 2015
[58] http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Interactive-waste-data-mapping/Kerbside-waste-data# for 2014/15 and 2015/16
[59] Victorian Local Government Annual Waste Services Report (2014/15)

the Metropolitan Melbourne region are referred to as the South East Melbourne councils in this report. The GWRRG and MWRRG councils go to tender for residual waste processing / disposal contracts in mid-2018. The project will be bidding as part of this procurement process to secure required tonnages for the EfW Plant. Using data made available from VLGAWSR, municipal residual waste tonnages generated by the councils listed in Appendix D, Table I.1 have been projected out to 2030-31. The input feedstock available to the facility at opening is estimated to comprise of 465,000 tonnes per annum for the South East Melbourne councils and 55,000 tonnes per annum for Gippsland councils, a total of 520,000 tonnes.

Waste composition

Significant work and a comprehensive review of available data has been undertaken to understand the waste composition of the input feedstock.

A review of the following documents and data has been undertaken to determine the composition of the input feedstock:

- The Guidelines for Auditing Kerbside Waste in Victoria[60]
- Waste composition data for individual councils in the GWRRG and MWRRG regions
- Sustainability Victoria's 'Victorian Statewide Garbage Bin Audits: Food, Household Chemicals and Recyclables 2013 (published 2014)'[61].

Given the limitations of the most recent Victorian datasets (explained in Appendix D), and to establish confidence in the percentage ranges of each waste material type, a comparative review of waste compositional data available from other studies was undertaken.

Compositional data considered included:

- Kerbside audit data available for groups of councils in New South Wales (kerbside audits of nine Western Sydney councils in 2011)[62]
- Waste composition reports submitted to Australian Paper by HRL in July 2017 and December 2017[63]
- Kerbside audit data available for New Zealand.

Further details of this review are provided in Appendix D. Following review of all data sources, a composition table for the Gippsland and South East Metropolitan councils MSW residual waste stream was created as an input for the naus model. The final composition assumed for the aggregated municipal residual waste stream for the year 2020-21 is shown in Table 10.5.

Table 10.5 : Composition input summary table for municipal residual waste, Gippsland and South East Melbourne (Year 2020-21)

Primary Category	Secondary Categories	MSW (%)	
		Gippsland	South East Melbourne
Paper	Newspaper, Magazines/Brochures plus 11 more.	13.92	14.69
Plastic	PET #1, HDPE #2 plus 11 more.	12.65	12.63
Glass	Glass Packaging / Containers Clear, Glass Packaging / Containers Green plus 4 more.	4.62	2.82

[60] Guidelines for Auditing Kerbside Waste in Victoria, Leading practice for measuring kerbside waste, recycling and green organics, Sustainability Victoria, 2009.
[61] EC Sustainable Environment Consultants for Sustainability Victoria (2014) Victorian Statewide Garbage Bin Audits: Food, Household Chemicals and Recyclables 2013 (Sustainability Victoria, 2013)
[62] Western Sydney Regional Waste Avoidance and Resource Recovery Strategy 2014-2017. Summary waste audit data for 2011 for The Hills, Blacktown, Blue Mountain, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta and Penrith Councils (publicly available / online).
[63] Confidential reports

Primary Category	Secondary Categories	MSW (%)	
		Gippsland	South East Melbourne
Ferrous	Composite (mostly ferrous), Steel Packaging Food and Pet Cans plus 5 more.	2.18	1.54
Non-Ferrous	Aluminium (food cans), Aluminium beverage cans plus 5 more.	0.64	0.56
Organic (Compostables)	Food/Kitchen, Garden/Vegetation plus 2 more.	46.30	48.08
Other Organic	Textile/Rags/Carpet (Organic), Leather plus 4 more.	2.25	2.42
Earth Based	Cat Litter, Soil plus 4 more.	3.20	3.67
Miscellaneous	Miscellaneous Combustible, Miscellaneous Non-Combustible plus 1 more.	6.43	6.04
Waste Electronic	Electrical Items: Large, TV's & Monitors plus 4 more.	1.27	0.93
Hazardous	Asbestos / Building Materials, Paint plus 8 more.	2.02	1.96
Liquid	Liquid	0.00	0.00
Fines	Fines < 10mm (break out)	4.54	4.66

Councils within the Gippsland and Metropolitan regions published municipal solid waste recovery rates of 63%[64] and 48%[65] respectively, and it is noted that the average resource recovery rate for the municipal sector in 2014-15 in Victoria was 53%[66]. Source separation of recyclables and hazardous wastes (e.g. e-waste and asbestos) at the household will be relied upon as the main method of segregating these materials from the residual waste stream prior to treatment for energy recovery.

Both GWRRG and MWRRG are implementing the Victorian Waste Education Strategy and other initiatives and programs designed to educate residents on recycling at home. Project waste data modelling will determine how improvements in household recycling rates in the Gippsland and Metropolitan regions will impact the waste input feedstock over time.

A recent (2016) commitment by the State Government to ban e-waste from landfill will significantly change how this material is managed. Methods of achieving this aim are under consideration and will require planning and consultative activities. E-waste is currently collected at all transfer stations in Gippsland[67] and both the GWRRG and MWRRG have made a commitment to adhere to the e-waste landfill ban. It is currently unknown how the ban will affect recycling in Victoria until after mid-2018[68] when the preferred e-waste policy approach will begin to be implemented. It is therefore anticipated that amounts of e-waste received to the EfW facility will be minimal and will decrease over time.

[67] GWRRG, Gippsland Waste and Resource Recovery Implementation Plan, June 2017
[68] https://www.environment.vic.gov.au/sustainability/e-waste-in-victoria

10.4.6 Commercial & industrial waste overview

Assessment of available feedstock

C&I sources of waste were determined using regional economic data and information regarding the top five waste producing sectors. These include Manufacturing, Retail Trade, Wholesale Trade, Education and Training, and Healthcare and Social Assistance which produce an estimated 55% of the C&I waste across the Gippsland region and South East Melbourne.

C&I waste tonnages were determined from waste generation data applicable to the regions and applied to local areas based on workforce / census data. The following data sources were used for C&I material tonnage generation:

- www.economicprofile.com.au (REMPLAN, Compelling Economics Pty Ltd) and http://economy.id.com.au/ - websites which provide gross regional product (GRP) information and links to economic and community profile information at the Regional Group and LGA level
- Waste flows in the Victorian commercial and industrial sector: Final report, prepared for Sustainability Victoria by Sustainable Resource Use Pty Ltd (Sustainable Resource), June 2013 – a report identifying sources of Victorian C&I sector waste by quantifying waste and recycling through targeted industry division and material composition for each industry type
- C&I South East Melbourne Disposal Market Analysis, A submission to Australian Paper, MRA Consulting Group (MRA), August 2017 – a report providing high level market research into C&I waste in South East Melbourne to identify potential waste feedstock for the EfW project.

The Australian and New Zealand Standard Industrial Classification (ANZSIC) system provides a framework for organising data about businesses. To identify appropriate waste generation sources, a survey of C&I waste generation in South East Melbourne and Gippsland was performed sorting by ANZSIC class (i.e. business / industry division type) and size (measured through equivalent full time employees (EFTE)). Research was also carried out into C&I landfill waste composition and trends in C&I waste generation and disposal. Direct engagement was undertaken with C&I collection contractors, Metropolitan Melbourne Materials Recovery Facility (MRF) operators and reprocessors, and private transfer station operators.

The survey focussed on waste service providers collecting waste from medium-sized organisations and large wholesale/retail trade organisations. The five most prominent industry divisions in South East Melbourne and Gippsland with residual waste streams having desirable material compositions[69] were identified as Manufacturing, Retail Trade, Wholesale Trade, Education and Training, and Healthcare and Social Assistance. These sectors are characterised by a large typical organisation size, a large EFTE (which is aligned to waste generation) and high calorific compositions for recovery of energy at an EfW facility.

To understand the total amount of waste generated by these five industries, the waste generation rates per EFTE for each sector (provided by Sustainability Victoria in units, kg per EFTE) were multiplied by the percentage of EFTE for individual LGAs (available via census economic information published online) and used to estimate the total waste disposed to landfill per annum. A C&I waste disposal market profile was developed and it was identified that more than 250,000 tonnes of C&I waste was available from the five industries identified, including businesses which indicated they would be willing to establish alternate disposal arrangements with an EfW service provider.

Despite a relatively large percentage of EFTE, the Accommodation and Food Services industry was deemed inappropriate given the high organic material present in waste generated by this industry type. The high organic material content is likely to be targeted by competing alternate treatment options for the processing of food waste (such as anaerobic digestion or composting) and has a significantly lower CV than other C&I waste.

This high level study was based on data available at the time of reporting. It provides a snapshot of the indicative C&I waste tonnages generated in the South East Melbourne and Gippsland regions, that have similar characteristics to MSW residual waste, to determine the potential scale of waste feedstock available to the EfW facility. While a range of waste streams are generated by the industry divisions reviewed as part of this study, only residual waste appropriate for combustion will be targeted. For example, C&I waste streams comprising a high food organic content or PIW such as clinical waste, and Accommodation and Food Services will not targeted; C&I waste will be procured specifically for the EfW Plant according to strict criteria (outlined in Section 10.5.2.1). Additionally, there will be other sources of C&I residual waste available outside the South East Melbourne and Gippsland regions and from other industry divisions (not included in the top 5 industries).

Waste composition

The composition of the C&I waste stream will differ slightly for each council and region due to the difference in commercial and industrial activity. Further, it is noted that the composition of waste generated in each region may not necessarily be disposed in each region. A compositional table has been created for each council for C&I for naus modelling purposes, which is shown in Table 10.6. Groupings of waste types provided by Sustainability Victoria have been sorted into primary and secondary categories to the extent possible given the available data.

Table 10.6 : Composition naus input summary table for C&I for Gippsland and South East Melbourne

Primary Category	Secondary Categories	C&I (%)	
		Gippsland	South East Melbourne
Paper	Newspaper, Magazines/Brochures plus 11 more.	18.42	18.30
Plastic	PET #1, HDPE #2 plus 11 more.	12.17	12.70
Glass	Glass Packaging / Containers Clear, Glass Packaging / Containers Green plus 4 more.	0.96	1.11
Ferrous	Composite (mostly ferrous), Steel Packaging Food and Pet Cans plus 5 more.	1.43	1.66
Non-Ferrous	Aluminium (food cans), Aluminium beverage cans plus 5 more.	0.36	0.41
Organic (Compostables)	Food/Kitchen, Garden/Vegetation plus 2 more.	38.25	37.09
Other Organic	Textile/Rags/Carpet (Organic), Leather plus 4 more.	0.98	1.00
Earth Based	Cat Litter, Soil plus 4 more.	3.40	3.30
Miscellaneous	Miscellaneous Combustible, Miscellaneous Non-Combustible plus 1 more.	13.72	13.93
Waste Electronic	Electrical Items: Large, TV's & Monitors plus 4 more.	2.21	2.25
Hazardous	Asbestos / Building Materials, Paint plus 8 more.	0.85	0.87
Liquid	Liquid	0.00	0.00
Fines	Fines < 10mm (break out)	7.25	7.38

According to the Sustainability Victoria report, the five industries targeted have recycling rates of 24% (Education and Training), 48% (Wholesale Trade), 60% (Retail Trade), 69% (Manufacturing) and 78% (Health Care and Social Assistance)[70]. The average resource recovery rate for C&I waste in 2014-15 for Victoria was 72%.

[70] Waste flows in the Victorian commercial and industrial sector: Final report, prepared for Sustainability Victoria by Sustainable Resource Use Pty Ltd (Sustainable Resource), June 2013 (page 39)

Only business waste streams that comply with the EfW Plant's acceptance criteria will be targeted as an input feedstock. PIW such as asbestos, PVC, treated wood waste, dangerous goods and clinical waste will not be sought as a procurement option, nor will material streams with high proportions of materials that could realistically be recycled. Once contracts have been procured, source separation of recyclables and hazardous wastes (e.g. e-waste and asbestos) by businesses will be relied upon as the main method for separating these materials from the residual waste stream prior to treatment for energy recovery. Wastes supplied will need to meet with a range of contract criteria to be accepted by the EfW facility and be subject to the Standard Operating Procedures described in the following section.

10.4.7 Final combined input feedstock composition and net calorific value

While modern EfW facilities can accept a variety of different residual waste and operate under a fairly broad range of feedstock NCVs, the composition and NCV of the feedstock are important in designing an appropriate system (designing for waste tonnage throughput as well as export of electricity and steam in the appropriate quantities). Steam energy and electrical power output (key project revenue streams) are directly proportionate to the waste fed into the boiler and the calorific value of that waste.

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)[71] requires R1 to be equal or above 0.65 for a plant to be considered a genuine energy recovery facility[72]. Technology choice for a facility therefore strongly influences options for feedstocks. In turn, choices about feedstocks and how they are pre-sorted or processed will determine the operational efficiency of the plant and the nature of its outputs[73].

A project baseline (aggregating MSW and C&I waste tonnages to give a final waste amount and waste composition) has been developed in naus for each of the LGAs listed in Appendix D, Table I.1 using the estimated tonnages and composition for MSW and C&I waste. The waste tonnages and compositional data form the basis of the 6 Gippsland and 14 South East Melbourne councils' models. Waste growth projections over the lifetime of the project have been generated based on the established baseline data with mapping to population growth projections made available by the Victorian Department of Environment, Land, Water and Planning[74].

A 'Mass Flow' element in naus allows for the blending of MSW and C&I waste from different (individual Council) models in varying proportions, whilst aggregating the constituent materials from each of the different service waste compositions. An input feedstock comprising 80% MSW and 20% C&I waste has been used to provide a breakdown of the final feedstock composition and NCV (see Table 10.7).

Table 10.7 : Anticipated combined MSW and C&I feedstock composition (Year 2020-21)

Baseline Feedstock	Composition		Combined Composition (%)
	Gippsland	South East Melbourne	
Paper	14.78%	15.45%	15.37%
Plastic	12.56%	12.64%	12.63%
Glass	3.92%	2.46%	2.64%
Ferrous	2.03%	1.57%	1.36%
Non-Ferrous	0.58%	0.53%	0.53%
Organic (Compostables)	44.75%	45.78%	45.65%
Other Organic	2.01%	2.13%	2.11%
Earth Based	3.24%	3.59%	3.55%

[71] European Union's Waste Framework Directive 2008/98/EC (WID)
[72] http://www.epa.vic.gov.au/~/media/Publications/1559.pdf
[73] https://engage.vic.gov.au/application/files/9415/0897/9363/Turning_waste_into_energy_-_Final.pdf
[74] Victorian Department of Environment, Land, Water and Planning, Victoria in Future 2016 (VIF2016) https://www.planning.vic.gov.au/land-use-and-population-research/victoria-in-future-2016/victoria-in-future-data-tables

Baseline Feedstock	Composition		Combined Composition (%)
	Gippsland	South East Melbourne	
Miscellaneous	7.83%	7.70%	7.71%
Waste Electronic	1.45%	1.20%	1.23%
Hazardous	1.79%	1.73%	1.73%
Liquid	0.00%	0.00%	0.00%
Fines	5.06%	5.23%	5.21%
Estimated Tonnes	**85,000**	**565,000**	**650,000**

It will be part of the EfW Plant's Standard Operating Procedure (SOP) to continually monitor waste feedstock so that optimal operating conditions can be achieved by the facility. SOP will include:

- Categorisation of waste loads, and monitoring of the source and amounts of waste received to the site
- Inspection, tipping procedures and rejection of waste loads at transfer stations prior to bulking, or at the facility
- Inspection and contamination removal during mixing within the facility's bunker
- Mixing of wastes within the bunker to homogenise the waste and achieve a consistent CV with minimised levels of contaminants.

Refer to Section 10.5.2 for more information on input feedstock delivery protocols.

It should be noted that metals in residual waste streams received by the facility will be recovered at the end of the grate. The bottom ash facility output will be passed over magnets and eddy current separators to remove ferrous and non-ferrous metals. Ferrous metals can be recycled as steel scrap for electric arc blast furnaces. Non-ferrous metals can be melted down for reuse.

A range of studies were available on which to determine the NCVs of common waste materials, including the following sources:

- C&I South East Melbourne Disposal Market Analysis, A submission to Australian Paper, MRA Consulting Group (MRA), August 2017
- UK studies completed by Jacobs (including the Entec Study 2009)[75]
- The Australian Clean Energy Regulator (2001 Guideline for Determining the Renewable Components in Waste for Electricity Generation)
- HRL studies completed for Australian Paper (based on 'manufactured' waste)
- A 2015 CSIRO study based on waste auditing undertaken in Brisbane, QLD[76].

Comparison was made to a range of MSW CVs. As NCVs are very closely linked to waste composition, taking analogies from other countries or geographies needs to be undertaken carefully. Based on this review, it was determined that the facility would operate at an indicative NCV of 9.4 MJ/kg.

The required operational range for the proposed EfW facility is 7.0 to 13.0 MJ/kg (see Figure 10.1). The plant design will allow safe operation with varying waste composition within the technology's proposed calorific value (CV) firing envelope.

[75] Entec, Wiltshire Waste Partnership - Residual Waste Composition Analysis, Final Report, June 2009
[76] CSIRO, Characterisation of chemical composition and energy content of green waste and municipal solid waste from Greater Brisbane, Australia, San Shwe Hla, Daniel Roberts, March 2015

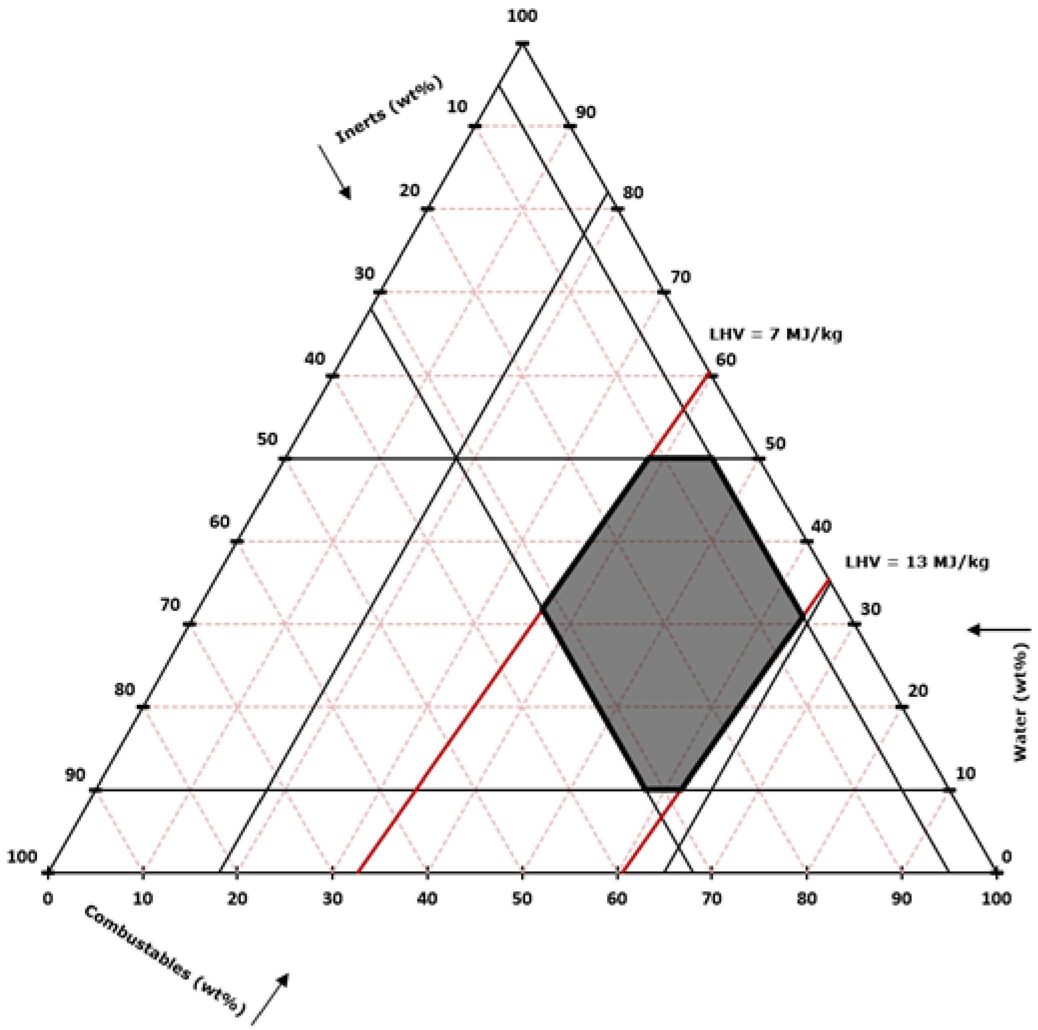

Figure 10.2 : Design waste analysis range for the EfW Plant

10.4.8 Future feedstock availability

Waste composition and the amount of waste generated is influenced by many factors (including population, growth, consumption patterns, collection contracts, etc.). The waste input feedstock available for recovery via thermal processes is therefore likely to evolve over the life of the plant.

To better understand the potential impact that changes to the input feedstock may have on the plant's operational efficiency and waste outputs over a 25-year time horizon, a comprehensive waste data modelling assessment (using naus software) is being undertaken. This involves review of a number of theoretical scenarios, with each scenario established based on factors which may affect the tonnage or composition of the available municipal solid waste and commercial and industrial waste over time.

The core potential changes being assessed are summarised below:

- Changes to projected waste tonnes given variations in population growth and consumption habits
- Changes to collection systems
- Changes to mass flow due to different waste service compositions and varying proportions of waste provided by individual councils.

Expected outcomes of such changes have been (and continue to be) reviewed. For example, should population growth be lower or higher than estimated, this is likely to have a proportionate impact on the feedstock tonnage.

In the case that kerbside organics collections (including food and garden organics) are introduced across all council areas, there will likely be a reduction in overall tonnages but also a potentially greater NCV outcome given a reduction of low NCV materials. The introduction of a container deposit scheme and improvements to recycling may also reduce the overall tonnage and impact the CV.

Changes to relevant legislation and council services will be closely monitored, and these potential impacts planned for as part of contingency arrangements through sourcing of additional compliant input feedstock to re-establish the required waste tonnage and composition to meet with the facility design.

Although compositional studies are ongoing, based on the markets being targeted and an 80% to 20%, MSW to C&I split by weight, it is expected that waste tonnages will continue to increase. This anticipated increase is supported by Sustainability Victoria waste model projections for the State of Victoria up to 2045-46[77] which indicate that future waste generation will remain at the current per capita level, but increase in line with population growth. It is also anticipated that as MSW volumes grow with population growth from councils expected to take part in the EfW project, that these tonnages will displace C&I over time.

10.5 Management of incoming feedstock

An outline of the proposed arrangements for input feedstock handling and management are addressed in this section.

10.5.1 Feedstock Logistics

The project aims to use a range of logistics options to receive input feedstocks to the EfW Plant, including both rail and road transport to deliver waste from the Gippsland and Metropolitan regions.

Waste containment on rail will generally comprise of purpose built sealed containers, typically based on 40-foot shipping container standards, commonly 9 foot or 9 foot 6 inches high. Use of these containers gives flexibility across transport modes as they can be carried on trains and on trucks. For example, Veolia's Banksmeadow and Clyde sites transport waste to their Woodlawn MBF facility in NSW using this approach, carrying 2 x 40 foot containers per rail wagon and 1 x 40 foot container on quad axle semitrailers.

Road transport will comprise of direct delivery by side-loading kerbside contractor roadside collection vehicles (RCVs – which have between 6 and 10 tonnes capacity averaging 7.5 tonnes per truck with compaction equipment) and bulking of waste for loading onto purpose designed semi-trailers for bulk waste line haul transport to site. Semi-trailers will have a capacity of 22 to 25 tonnes per trailer depending on compaction. Skel semi-trailers / multi-trailer combinations will also be used to carry containerised waste to site and are capable of carrying 2 x 40 foot containers. Example transport types are illustrated in Figure 10.3.

[77] Available from Sustainability Victoria via their online waste data portal (http://www.sustainability.vic.gov.au/services-and-advice/business/investment-facilitation-service/waste-data-portal/waste-projection-model) and Sustainability Victoria Waste Resource and Recovery Projection Model v1.1, 2013.

Figure 10.3 : Example transport types – a-double and semitrailer bulk linehaul truck, and waste contractor collection vehicle[78]

For rail transport, waste will be contained in 2 x 40 foot sealed containers on 80 foot skel wagons in a similar configuration to existing Australian Paper trains. Given the range of benefits afforded by rail transport of input feedstocks, rail transport of feedstock in containers is the preferred option for waste materials being transported further distances[79].

Australian Paper has a private rail siding at the existing Maryvale Mill site, with three tracks, which is currently used for the despatch of export and domestic output, and which will be designed to allow for future rail transport of input feedstock to the facility. Upgrades to the existing hardstand areas for waste containers, and to the train loading and unloading pad would be needed. Containers will be loaded in Melbourne for transport to Maryvale.

Rail transport is the preferred logistics option for waste from South East Melbourne, however a number of factors need to be determined before the volume of rail-transported waste is known. These factors (e.g. contracts with councils; location of rail hub; etc) are currently being investigated but will not be finalised prior to the submission of the works approval application. Accordingly, for the purposes of this Works Approval Assessment it has been assumed that waste from this region will arrive on site by road (in purpose-designed semitrailers via line haul) to represent a 'worst case' scenario, however both rail and road options have been assessed for waste delivery to the Site.

[78] https://www.cleanaway.com.au/media-centre/media-releases/a-new-era-in-melbournes-south-east-as-cleanaway-opens-semts/
[79] Australian Paper EfW Logistics Study (Jacobs 2018)

Waste from the Gippsland region will be trucked from source, primarily by RCVs (direct) or bulked at a transfer station for transport to the site.

Logistics assessed for each waste source quantity are outlined below:

- South East Melbourne – Bulking of waste into containers for bulk line haul with containers transferred by a reach stacker to the ground, and then from the ground to a site tip truck for unloading / emptying at the tipping hall.[80]
- Gippsland – Direct delivery via road by waste collection trucks (with compaction) or bulk line haul which will unload direct to the tipping hall.

It is expected that the local collection vehicle deliveries of waste will be concentrated in afternoon times between 14:00 to 15:00 following local waste collection rounds in Gippsland, with a late morning peak between 10:00 to 12:00 also sometimes observed for transfer station and C&I waste deliveries. Local deliveries are expected to average 30 local waste collection vehicle rounds per day, with a further 30 deliveries of C&I and transfer station waste per day. Deliveries are expected to occur 5 days per week as per collection schedules. Site shuttles of 40 foot containers of waste from road haul / train deliveries will be concentrated around the time of arrival of the transport types. Should rail transport be used, unloading full containers and transfer of empty containers back on to the train will be prioritised to enable expeditious turnaround of the train.

10.5.2 Feedstock delivery protocol

The proposed facility will provide two bi-directional calibrated road vehicle weighbridges on site that will be used to provide waste quantity data.

For road transport of the input feedstock, wastes will be inspected at a number of checkpoints:

- Vehicles arriving to the site will be required to travel via a security gatehouse over the weighbridge on arrival for time logging, waste categorisation and weighing. Once the weighbridge transaction data is stored, visual inspection of loads will be undertaken where possible. Inspections of wastes to be transported to the site in sealed containers will be undertaken at the transfer station / rail terminal during filling and prior to receiving sealed containers on site. At the weighbridge, information from the transporter will be checked to confirm the source of the waste:
  - If the visual inspection determines that there is no problem or hazard, the vehicle will move to the tipping hall for delivery into the waste bunker
  - If a problem is suspected, the weighbridge operator will be consulted and the nature of the hazard identified. The driver will be directed to a quarantine area where a more detailed assessment will be completed
  - Periodically waste deliveries will be directed to the quarantine area for routine auditing
  - Regular housekeeping and plant inspections.
- Vehicles directed to the quarantine area will assess if the materials are safe to unload or not.
  - If the detailed assessment determines that the materials are safe to unload, vehicles will be sent to a demarked area of the tipping area floor for unloading, where another inspection will be completed and the material type(s) assessed. A reject waste load out area shall be provided within the tipping hall building. Non-hazardous waste (e.g. oversized waste or non-combustible waste) that does not meet with acceptance criteria will be loaded into a waste skip and the skip removed once full. Hazardous wastes (e.g. batteries, gas cylinders) will be loaded into a hazardous waste storage container and the container removed at appropriate time
  - Other vehicle loads deemed safe to unload and appropriate for acceptance to the facility will be directed to the waste reception area for tipping into the bunker

[80] This table is based on an 80% MSW feed rate.

   - If the load is declared to be non-compliant with acceptance criteria or potentially harmful, the source of the load will be notified and a resolution identified.

- Waste will be inspected again in the bunker from a viewing window located above the bunker, and contaminants removed using an overhead waste feeding / grab crane for discharge at the rejects area of the tipping hall
- Prior to leaving the site, vehicles will log their departure and re-weigh at the weighbridge.

Waste bulked and transported via road (or rail) line haul will be stored in sealed trailers and/or containers which will offer limited ability to visually inspect waste loads. Therefore, inspection and waste categorisation of waste loads to be bulked for transport will be undertaken at the transfer station (or rail terminal site in the case of rail transport) prior to loading and compacting into containers. Should containers be transported via rail, on arrival to the rail siding these containers will be transferred by a reach stacker onto a tipping skel trailer (see Figure 10.4). The tipping trailer will then travel across the weighbridge for arrival time logging, waste categorisation and weighing.

The reject waste load out area within the facility will have separate areas as appropriate for the segregation of untreatable waste (large objects, rubble, soil, plasterboard etc), and skips and containers to hold segregated hazardous materials (e.g. asbestos, paint and solvents, waste oils, gas cylinders, batteries (in plastic storage containers), fluorescent tubes, chemicals). The load out area will be designed to suit the types of wastes that could be rejected from the input feedstock. The load out area will be used if it is ever necessary to load waste from the waste bunker into articulated trailers by means of the bunker overhead cranes. Sufficient space with containment facilities and suitable bunding will be provided for a waste audit pad that allows up to 10 tonnes of waste to be spread and inspected.

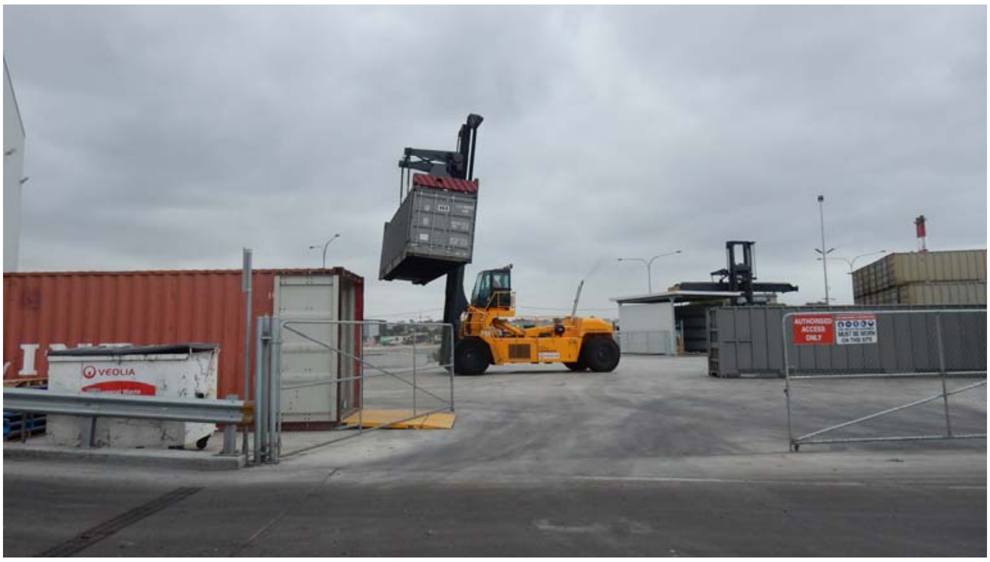

Figure 10.4 : Container transfer by Reach Stacker[81]

10.5.2.1 Waste acceptance criteria

This section outlines the solid waste fuel acceptability criteria[82] typical for a grate combustion plant operating at 850°C combustion temperature.

The EfW facility <u>will accept</u> residual non-hazardous MSW and C&I waste collected from metropolitan and rural regions of Victoria via the following means:

[81] Veolia Banksmeadow waste receival and containerisation plant in Sydney
[82] Singapore National Environmental Agency, Singapore Environmental Public Health (General Waste Collection) Regulations, UK studies completed by Jacobs (including the Entec UK Study 2009)

- MSW (residual waste) disposed of into general waste bins (i.e. “red top bins”) by householders, collected directly from the kerbside by or on behalf of councils and excluding source segregated recycling collections
- C&I waste (residual waste) collected by or on behalf of councils
- residual MSW or C&I waste collected from waste transfer stations operated by or on behalf of councils
- selected C&I waste collected by privately operated waste management companies with similar composition elements or properties to council generated residual MSW, which may include waste directly collected or routed via waste transfer stations operated by the privately owned councils.
- selected non-PIW collected from specific industries, including plastic waste from Australian Paper’s paper recycling process generated at Maryvale Mill
- MSW-like residual waste generated from Material Recovery Facilities that could not be recycled.

The following list of waste types will not be accepted by the facility:

- Asbestos
- 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-flammable 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 sludge’s, 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 shaving particularly from light metals like aluminium, magnesium, 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 PCB used in transformers and capacitors
- Light materials such as sawdust, feathers, dust and powders
- Waste from grease interceptors.

This list is considered to be comprehensive and to cover most types of material which an EfW operator needs to exclude. In the future additional materials may be added to this specification if required.

10.5.2.2 Waste categorisation

The categorisation of wastes received as input feedstock in accordance with the EPA's compliance requirements will be undertaken at the weighbridge (if transported by truck) or prior to bulking at the rail terminal site (if transported by rail). Waste categorisation will be based on its origin, advice from the carrier, inspection of the carrier's documentation and verification of this information by visual inspection / delivery protocol arrangements. For mixed waste streams, the most conservative categorisation will be applied. Records of input feedstock tonnes and categorisations will be retained on-site for the life of the facility, and regular reports provided to the EPA as required by licensing compliance requirements.

10.5.2.3 Independent auditing

Australian Paper will commission a suitably qualified independent auditor[83] to conduct audits on a regular basis during the first 3 years of operations to ensure that waste streams sent to the facility comply with the EfW acceptance criteria and EPA waste categorisation requirements. Beyond this period AP will consider establishing internal auditing protocols following sufficient knowledge transfer or continue with independent auditing.

Non-conformities and corrective actions issued by the auditor will be addressed according to established timeframes and confirmed through re-audit of the action area.

10.5.3 Screening and Homogenising

Pre-treatment of waste input feedstocks is not required for efficient operation of the moving grate technology. However, steam production rate and power output (key project revenue streams) will be directly proportional to the waste fed into the boiler. To meet the varying combustion characteristics of residual municipal waste, the wastes present in the bunker will be mixed and homogenised before transferring waste into the feed hopper to achieve a more efficient combustion process, and the desired NCV and power generation outcome.

Oversized or inappropriate fractions of waste (e.g. mattresses, bicycles, engine parts) will be removed by the grab crane in the bunker for discharge to the rejects area of the tipping hall.

Waste tipped in to the bunker has to be picked up by the grab crane in order to keep the delivery area free and allow for other waste deliveries. Between deliveries, or during periods of a low delivery frequency, the crane operator will turn and thoroughly mix the waste by picking it up and dropping it in a different place of the bunker. In Europe, some facilities have developed automated mixing operations which will be a future consideration for the Project. The grab crane will also need to pick up the waste so that it can be introduced through the hopper into the open end of the grate. From here, the moving grate will convey waste continuously into the furnace in a controlled manner.

The crane will weigh each grab load of waste fed to the hoppers of each boiler line for the purposes of plant control and performance logging. The shape of the hoppers will allow free flow of waste to the hopper bottom without bridging or blockages.

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[83] An auditor having the relevant knowledge, skills and experience. The auditor must be RABQSA Certified Environmental Auditor and a minimum of 3 years of experience in the waste management sector or 'Scope of Waste Management' included in their certification.

10.5.4 Storage capacity

The bunker will be designed to hold approximately 5 days of feedstock below the height of the tipping hall floor. While the facility will be operating 24 hours a day, Monday to Sunday, deliveries to site are likely to only occur from Monday to Friday. Scheduling of deliveries will be largely driven by kerbside waste collections which are primarily undertaken 5 days a week typically between 0630 and 1400. Collections on the weekend and on public holidays are unlikely due to penalty rate implications, however there may be some exceptions to this across individual council collection schemes. As such, the waste bunker will need to store enough feedstock in the bunker to last over the weekend as a contingency measure.

Only one line and one boiler are typically taken off-line for maintenance at any one time. In this situation, waste could be super-stacked against the wall separating the bunker and the boiler house to above the tipping floor level increasing the storage capacity of the bunker to approximately 10 days. So long as one boiler is operational, the tipping hall will still be controlled under negative pressure.

If equipment which is common to all lines requires maintenance (this event is considered unlikely given maintenance protocols), shutdown of all lines and boilers would occur. In this case, negative pressure systems would not be operational. To prevent odour escaping from the tipping hall, the operator would run down the waste stored in the bunker and spread out deliveries so that the tipping hall is closed during the shutdown period. A deodorising system could also be used, where an industrial deodorant is sprayed into the tipping hall and bunker areas.

In the event that plant maintenance or an unexpected event requires a shutdown period of longer than 10 days, Australian Paper will ensure alternative arrangements are made, and are part of waste agreements with collection contractors, so that waste loads are diverted from the facility during this time.

10.6 Generated waste outputs

This section provides an overview of the waste types likely to be generated during the construction and operation of the proposed project.

10.6.1 Construction waste

The site preparation phase of the project will generate large amounts of excavated material as the facility will be built into the side of a hill. A material cut and fill balance was derived from 3-dimensional site modelling. The net amount of excavated material / spoil is estimated to be 42,500m^3.

It is AP's intention that all spoil generated by the Project during the construction phase is to be reused on the EfW Plant site or within the broader Mill site. If there is a need for disposal of clean or contaminated spoil offsite from the EfW Plant or the Mill, further sampling and analysis will be conducted to determine potential contamination. Any contaminated spoil will be managed in accordance with EPA requirements and disposed of or managed accordingly.

During earthworks, approximately 5 hectares of trees will be removed from the site. These are plantation trees used within the paper mill when they reach maturity for the production of paper. These trees will likely be retained on-site for processing by the paper mill.

The construction phase of the project will generate wastes typical of an industrial building development (e.g. concrete, steel, etc). Staff compound waste will comprise primarily of industrial waste (a mix of solid inert waste and putrescible waste) generated from site office and staff compound areas. Amounts of waste generated onsite are expected to be minimal and will be recycled where possible. Waste avoidance and resource recovery measures will be implemented to divert resources from landfill in accordance with the waste hierarchy and the principles of Victoria's State Waste and Resource Recovery Policy *Getting Full Value,* where practicable.

Refer to Section 10.7 for construction waste management details.

10.6.2 Operational waste

The EfW facility will generate a number of residues as part of routine operation. The residues generated will fall within three broad categories:

- Bottom ash (also known as grate ash), this is the solid residue removed from the combustion chamber after the waste has been combusted
- Boiler ash, the part of the fly ash that is removed from the boiler
- Air Pollution Control (APC) residues (also known as Flue Gas Treatment (FGT) residues) from the APC equipment, the term "fly ash" usually includes APC residues.

Initial assessment and review of international literature show that bottom ash will likely be categorised as 'Industrial Waste', while boiler ash and APC residues will likely be categorised as either 'Category B PIW' or 'Category C PIW', with the potential for some of the heavy metal species to exceed thresholds for Category A.

These wastes do not automatically fall into any of the Dangerous Goods Classes outlined in Table 1 of the EPA Publication IWRG631 (see Section 10.3.4.1). Until the plant is operational, actual results for the composition of bottom ash and APC residues can only be inferred from similar plants internationally. As such the operator will conduct (on an ongoing basis) total contaminant level (TCL) and leachability testing on the bottom ash and APC residues to determine the appropriate waste categorisation.

If any Category A PIW thresholds are exceeded (for APC residues) then this material must either receive a specific classification from the EPA (where, for example, it can be shown that exceedances for total concentration do not pose an issue from a leachability perspective when safely disposed) or will require pre-treatment prior to disposal. As a contingency measure, Australian Paper is investigating innovative solutions to treat prior to disposal or reuse APC residues.

Table 10.8 provides an overview of the facility waste streams that will be generated with their anticipated waste categorisations.

Table 10.8 : Operational residues generated by the facility

Waste Stream	Categorisation	Approximate generation (tpa)	Proportion (of input feedstock)
Bottom ash (including ferrous and non-ferrous residues)	Industrial Waste	130,000 to 165,000	20 to 25%
APC residues	Prescribed Industrial Waste (Class B or C or potentially A)	22,750	3.5%
Boiler ash	As per APC residues	6,500	1%

Section 10.7 outlines waste management measures for each broad waste stream generated during the operation of the project. A description of operational waste residues generated by combustion of input feedstock is provided in the following sections. As boiler ash will be captured in the same system as the APC residues and comprises 1% of the waste outputs generated, it has not been discussed separately of the APC residues.

10.6.3 Bottom ash

Bottom ash is the output collected at the end of the moving grate following combustion and the largest residue by weight from an EfW facility. While the exact composition of bottom ash is dependent on the input feedstock materials, the ash is expected to have a coarse and granular ash consistency that will vary from compacted small rocks up to 150 to 200 mm, to granular and powdery material.

Bottom ash will comprise between 20 to 25% of the weight of the input material, and less than 10% by volume. For the proposed facility receiving 650,000 tonnes per year of input feedstock, the amount of bottom ash output generated will be in the range of 130,000 to 165,000 tonnes per year.

A major component of the bottom ash is aggregate (stone, glass, ceramics) which has engineering properties similar to primary building materials (such as gravel and sand). The total quantity of bottom ash will include ferrous and non-ferrous metals (the quantity of metals will depend on the amount present in the input feedstock) which pass through the grate and will be recovered and separated for further metals recycling. It is expected that ferrous and non-ferrous materials will comprise between 2.0% and 3.0% by weight of the incoming waste.

Ferrous and non-ferrous metals will exist as discrete items within the bottom ash and will be extracted and recovered to the largest extent possible. Ferrous metals can be recycled as steel scrap for electric arc blast furnaces. Non-ferrous metals can be melted down for reuse. Removal of metals allows the remaining ash to be re-processed into an aggregate material suitable for use in the construction industry should this be an option.

The bottom ash will be extracted using a wet discharge system. Once the inert ash reaches the end of the moving grate, the ash will fall into a water bath to extinguish any burning lumps, cool the ash and reduce the potential for dust issues. The height of the water within the quench will be used to form an air tight seal between the boiler and its surroundings. A discharge ram will be used to discharge the ash from the quench for transportation, via conveyor, to the bottom ash bunker. An example sketch of a wet discharge system is shown in Figure 10.5.

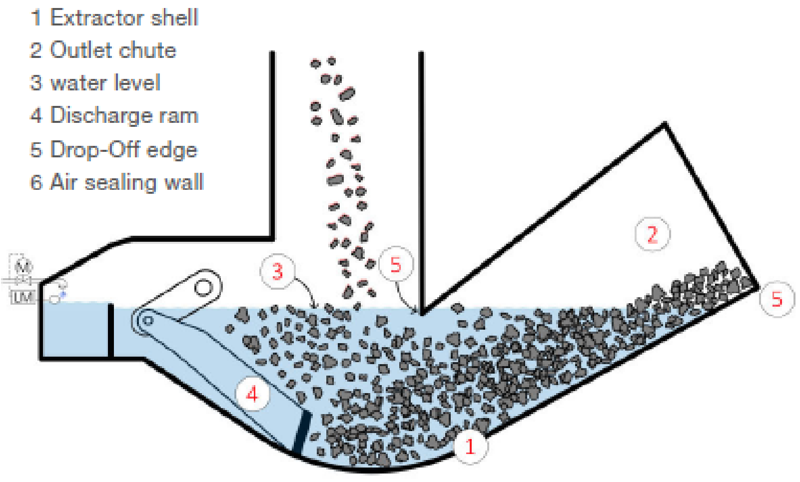

Figure 10.5 : Sketch of a wet bottom ash discharge system[84]

Various parameters such as the ram control or the water height can be amended to have an effect on the quenched moisture content of the ash. The wet discharge system approach is currently the most commonly installed approach adopted by the EfW industry. Section 10.6.3.1 provides an overview of the metals recovery process.

A bottom ash extraction system will be located below the end of the grate at the bottom of each combustion line. The bottom ash will be conveyed using a conveyer appropriately designed for EfW bottom ash, via an oversize screen and passed through ferrous and non-ferrous metal recovery separators, before being discharged to a bottom ash storage bunker. The ash storage bunker will accommodate 7 days of storage of the bottom ash. An automated ash vehicle loading system (e.g. ash conveyor system) will be provided which is capable of loading open topped ash road vehicles or skips of a range of dimensions and heights. The loading system will weigh the mass of the bottom ash loaded into vehicles or containers.

[84] ISWA, 2015, Bottom Ash from WTE Plants Metal Recovery and Utilisation

10.6.3.1 Metals extraction from bottom ash

Metals (e.g. steel, gold and copper) will be extracted from the quenched wet bottom ash stream before it enters the bottom ash bunker. The ferrous fraction will be removed as it leaves the extractor by overband and end roller magnetic separators, and can be recycled after separation of impurities (e.g. dust) as steel scrap for electric arc blast furnaces. The non-ferrous metals will be removed after ferrous metal segregation, particle size reduction and screening, using eddy current separation. It will then be processed externally for further separation into metal type and (most commonly) melted down for reuse. This process enables metals larger than 10 to 15mm to be recovered for recycling.

Metal quality is commensurate with material that has been subject to high temperature combustion with the possibility of some bottom ash adherence to surfaces. This material is readily acceptable to the metals recycling industry, and often contains less contamination adhering to the material than metals pre-combustion. As well as revenue from recycled metal sales, the separation of metals is a necessary step to support recycling of the various ash compounds (if this option becomes available).

The magnetic separator installations and the eddy current separator will be supplied with a separate chute and/or conveying arrangement for the discharge of recycled metal into a skip and/or dedicated non-ferrous metal bay.

10.6.3.2 Compositional analysis of bottom ash

The composition of bottom ash will vary depending on the input feedstock but is expected to contain glass, brick, rubble, sand, grit, metal, stone, concrete, ceramics and fused clinker as well as combusted products such as ash and slag[85]. Within the bottom ash, the majority of the elements will occur in their oxidised form following the combustion process. There will also be a variety of metals present in the ash which will include precious metals contained within items placed in the waste feedstock such gold from consumer electronics.

Example compositions taken from various sources are provided in Table 10.9 to Table 10.11 and have been compared to the predicted composition of bottom ash generated by the EfW facility for the assumed available input feedstock.

Table 10.9 provides an elemental composition of bottom ash presented by ISWA[86] which was determined from a large number of different sources. This dataset includes samples from a number of different EfW technologies and will include variability within the ash management from the combustion process.

Table 10.9 : Approximate elemental composition of bottom ash

Element	Unit	Range	Average
Silicon	g/kg	168-274	221
Calcium	g/kg	89.1-104	94.9
Iron	g/kg	46.7-77.8	65.1
Aluminium	g/kg	45.0-56.1	50.3
Sodium	g/kg	33.3-39.2	35.4
Magnesium	g/kg	10.5-11.2	10.7
Potassium	g/kg	7.4-8.6	8.1
Copper	g/kg	3.4-11.0	5.6
Zinc	g/kg	2.0-4.8	3.1

[85] http://www.esauk.org/energy_recovery/iba_-_incinerator_bottom_ash/ - Accessed December 2017

[86] ISWA. (2006). Management of Bottom Ash from WTE Plants & ISWA. (2015) Bottom Ash from WTE Plants – Metal Recovery and Utilisation
Astrup, T., & Christensen, T. H. (2003). Slagge fra affaldsbehandling – Status og udviklingsmuligheder år 2003. Miljø & Ressourcer DTU.
Morf, L. S., Gloor, R., Haag, O., Haupt, M.,Skutan, S., Lorenzo, F. D., et al. (2013). Precious metals and rare earth elements in municipal solid waste – Sources. Waste Management 33, 634-644.

Element	Unit	Range	Average
Barium	g/kg	1.1-2.4	1.5
Lead	g/kg	0.6-2.6	1.4
Silver	mg/kg	Not reported	19.9*
Gold	mg/kg	Not reported	1.9*

*Silver and gold values estimated by ISWA from available information

Another study[87] extracted from the Journal of Hazardous Materials reported the composition given in Table 10.10. This was based on an EfW facility in France which includes the ash being quenched with metals separation, which is comparable to the proposed wet discharge system proposed for the EfW facility. It is noted that the samples were taken after a few days of weathering.

Table 10.10 : Chemical composition in MSW Samples

Element	Weight (%)
SiO_2	49.3
CaO	16.3
Al_2O_3	7.5
Fe_2O_3	7.6
MnO	0.1
MgO	2.6
Na_2O	6.0
K_2O	1.1
TiO_2	0.6
P_2O_5	1.2
TOC	1.5
S	tot 0.3
Cl	0.4

The UK Environmental Services Association (UK ESA – a UK waste and resources professional services member organisation) has made available results from bottom ash testing (for selective trace elements, including total hydrocarbons and heavy metals) for 18 UK sites that process bottom ash (2011 data)[88], and monthly results were taken for each of the sites. The average, maximum and 95th percentile for each site are provided. Table 10.11 presents the average of all sites as well as the lowest and highest average values for each of the determinants for the 18 sites.

Table 10.11 : ESA bottom ash processing results

Element / Analysis	Lowest site average	Average of all site averages	Highest site average
pH	10.5	11.7	12.5
Alk Resg/100g	0.15	0.78	2.23
Al, mg/kg	13,225	21,625	31,461
Cd, mg/kg	2.8	11.2	26.1
Cr, mg/kg	66	246	812

[87] E. Rendek et al. 2006, Carbon dioxide sequestration in municipal solid waste incinerator (MSWI) bottom ash Journal of Hazardous Materials B128 (2006) 73–79
[88] http://www.esauk.org/esa_reports/3_IBA_-_ESA_2012_IBA_dataset_-_WRc_Report_11_04_13.pdf

Element / Analysis	Lowest site average	Average of all site averages	Highest site average
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
Ni, mg/kg	54	134	296
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
TPH > C5-C44, mg/kg	9	144	170

The compositional data provided in Table 10.9 to Table 10.11 has been compared against the predicted compositional outcome for the proposed EfW Plant as a sense check to ensure it falls within the expected parameters. The prediction of the raw bottom ash discharged from the proposed facility has been made based on HRL laboratory analysis[89] performed in 2017 of potential incoming MSW wastes and use of the Jacobs' spreadsheet tool[90] for estimation of ash quality and composition.

The results of the HRL laboratory analysis were used as an interim method for the classification of the bottom ash according to EPA regulations, as the determinants and testing methods align with the EPA regulations. The results identified that the bottom ash would likely be categorised as 'Industrial Waste' (i.e. it would not trip thresholds for Category C, B or A prescribed industrial waste). It is noted that HRL is conducting MSW sampling from both the Melbourne Metropolitan and Gippsland regions. It is expected that further work being undertaken by HRL will result in additional MSW samples being tested to confirm the classification as 'Industrial Waste'.

The EfW facility process and ash production has been modelled using Jacobs' spreadsheet tool based on the anticipated input feedstock available for combustion (as outlined in Section 10.4). Modelling is currently ongoing. While the model is not exhaustive with regard to the potential elemental composition of the ash residue, it does provide indicative output which can be used to steer decision making process on the classification of raw and treated ash residue output for achieving classifications and specifications suitable for disposal or reuse.

The model works by applying the individual moisture and ash contents from previous studies and applies these to the individual components of the composition and then summates these. The model also has the capacity to do this for selected elements within the feedstock. These elements are: carbon (biogenic and fossil), hydrogen, nitrogen, oxygen, sulphur and chlorine. It does not estimate the proportion of these elements within the ash or the presence of any heavy metals within the ash. Sampling and testing, including that provided by HRL, is therefore considered to provide a more robust estimation.

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 outlined in Section 10.3.4.6, if a secondary beneficial reuse (SBR) 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 facility. 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.

[89] HRL 2017 Confidential Report
[90] Jacobs In-house Spreadsheet Tool

10.6.3.3 Changes to bottom ash quantity and composition

Given the quantity of bottom ash likely to be generated, qualitative changes in the bottom ash outputs under a range of potential waste scenarios has been undertaken. The scenario modelling is outlined in Section 10.4.8 and makes allowances for changes to waste growth, reduced number of sources of feedstock, and the introduction of different waste services and legislative changes.

The widespread introduction of kerbside organics collections (including food and garden organics) would result in an increase in the estimated ash proportion of the residual waste as these organics have a lower ash content than the average for the MSW stream. The ban on e-waste to landfill would be expected to reduce the quantities of this contaminant in the input feedstock while also reduce the recovery of metals, such as gold, incorporated into e-waste items.

Changes to relevant legislation and council services will be closely monitored, and these potential impacts on bottom ash outputs planned for as part of contingency arrangements.

10.6.3.4 Treatment for reuse and/or disposal of bottom ash

The coarse, granular consistency and high mineral content of the bottom ash makes it potentially suitable for use as a secondary building and road or other construction material, reducing the need for production of new substrates. Specifications for the bottom ash to be considered suitable for recycling include total metals content, with the most problematic metals from the point of leachability being copper, molybdenum and zinc. Treatment of bottom ash is required prior to use as a secondary material.

A range of wet and dry treatment systems are available in UK/Europe to screen ash into different fractions which are then processed to separate ferrous and non-ferrous metals. Wet treatment systems (also known as ‘treatment using aging') involve quenching of the bottom ash, screening of the ash into several fractions (0 to 2 mm, 2 to 6 mm, 6 to 20 mm and 20 to 40 mm) for metals recovery and then maturation of the bottom ash in stockpiles. The stockpiles are wetted and turned regularly to reduce the leachability of metals and cause the stabilisation of the bottom ash. The aging period is carried out for between 4 and 20 weeks before utilisation as a construction material.

Dry treatment systems cool the bottom ash using air rather than water, and aim to produce a dry aggregate material with a controlled grain size (larger than 10 to 15 mm) through sieving and crushing in combination with metals recovery. The fine fraction is not treated and as such separation performance is relatively poor for the finer particles. Some dry processes include a maturation stage dependent on the specification for achieving the aggregate and local markets for recycling and treatment. In dry discharge systems the ash is discharged without the use of water which means that the metals are not quenched or introduced to the alkaline environment that exists within the quench, which has impacts the quality of the metals within the ash. The dry discharge approach was the predominant approach up until the 1990s, where they were replaced by wet discharge systems to mitigate dust issues.

A combination of dry and wet treatment systems may also be used to recover metals from particles less than 10mm in size.

A number of processes for the treatment of bottom ash for recovery purposes are commercially available within the UK/Europe and are likely to be transposable to the Australian market. Assuming that a suitable market can be found and approved by the EPA (the UK and European experience demonstrates this is likely) it is anticipated that the wet processes would provide broadly similar ‘recovery’ performance of 90%. It should be noted that some facilities in Europe return the rejected and oversize material from the wet process for it to be added to the feed waste of the EfW. This approach can result in diversion of all bottom ash from landfill. Material which is not able to be used beneficially (approximately 10% of total bottom ash generated) would need to be sent to landfill. AP will also investigate BA as a potential replacement for landfill cover.

While Australian Paper is investigating opportunities for recovery, it is assumed that landfilling of the bottom ash (following extraction of metals) over the operational period of the EfW facility will be required for the purposes of this Works Approvals Assessment. As such, no further treatment of the bottom ash (i.e. maturation and aging) is assumed to be required. Where landfilling of the bottom ash is required a suitable landfill site will be engaged.

10.6.4 Boiler ash and APC residues

The quantity of boiler ash will be less than 1% by weight of the input feedstock, which equates to approximately 6,500 tonnes per year. As boiler ash and APC residues will be captured in a combined system, boiler ash will be conservatively treated the same as the APC residues. APC residues typically represent 3.5% of the input feedstock and will be generated in the range of 22,750 tonnes per year.

APC residues (also known as flue gas treatment residues) are products in particulate form that are produced either as a result of the chemical decomposition of combustible materials or are unburned (or partially burned) materials drawn upward by thermal air currents in the incinerator and trapped in air pollution control equipment. The flue gases require treatment in order to meet air quality standards and air pollution legislation.

It is not possible to give a definitive specification for APC residue as the composition will vary depending on the composition of the input feedstock, and the amount of lime and activated carbon utilised. However, the APC residues will contain a mixture of calcium and/or sodium salts, mainly chlorides and sulphites/sulphates, as well as some fluorides, unreacted reagent chemicals (e.g. lime or sodium carbonate), and activated carbon. The APC residues are expected to consist of the spent reagents, incorporating the pollutants that they have captured and the boiler ash that is collected in the bag filters. This mixture includes some boiler ash (fly ash) entrained from the combustion process.

Common constituents can include:

- Boiler ash/fly ash
- Excess lime
- Reaction products (salts)
- Dioxin sorbents
- Sludge
- Gypsum
- Chloride salts.

The proposed EfW facility will employ a SNCR (Selective Non Catalytic Reduction) system to reduce the levels of nitrogen oxides in the flue gas. Urea is sprayed into a reaction chamber to reduce nitrogen oxides into nitrogen and water. EfW facilities in the UK are generally using SNCR systems as these provide a sufficient level of gas clean up. The SNCR treatment system will then be followed by either a semi wet or a wet process to allow for the removal of dust, clean up of acid gases and removal of dioxins and heavy metals / a dry process involving the injection of lime and activated carbon and the capture of particulates within a bag filter.

A dry APC residue handing system will be provided for each combustion line with a short conveying route to the APC residue storage silo(s). APC residues collected from the baghouse will be pneumatically transported to APC residue storage silo(s). The silo(s) will be capable of storing 7 days of APC residues. The pneumatic transport system will comprise a number of branches each collecting ash from several hoppers. The silo(s) will be fitted with a level sensor to provide measurement of the silos contents, over the full range 0 to 100 % capacity. Alternatively, the silo(s) will be mounted on load cells. In addition, the silo(s) will be fitted with level sensor probes to provide Full, 75% and 50% reports.

Conditioned APC residue shall be produced using waste water to condition the ash with approximately 15% moisture, and to suppress any fugitive dust emissions. A CCTV system will be provided at the bottom ash and APC residue silo truck loading areas to provide a clear picture of the loading area operations.

10.6.4.1 Compositional analysis of APC residues

Typical ranges of elements present within the APC residues are shown in Table 10.12. The ranges provided for each element represent the collated results from EfW facilities in the UK.

Table 10.12 : Elemental composition of APC residues

Element	UK EfW Facilities[91] (mg/kg)	Total Concentration Criteria[92] (mg/kg)
Aluminium	0.9-2.9 Average 1.5	N/A
Arsenic	12-38 Average 25	C>500, B>500, A>2000
Barium	316-452 Average 365	C>6,250, B>6,250, A>25,000
Calcium	22.4-32 Average 26	N/A
Cadmium	26-190 Average 128	C>100 B>100 A>400
Chlorine	7-22 Average 17	TBC
Chromium	58-110 Average 83	C>500 B>500 A>2,000 for Cr(VI)
Copper	320-580 Average 462	C>5,000 B>5,000 A>20,000
Iron	0.6-2.1 Average 0.87	N/A
Mercury	-	C>75 B>75 A>300
Potassium	0.92-3.5 Average 2.8	N/A
Magnesium	0.52-0.84 Average 0.62	N/A
Manganese	270-760 Average 520	N/A
Molybenum	4.8-15 Average 9.8	C>1,000 B>1,000 A>4,000
Sodium	1.2-3.5 Average 2.2	N/A
Nickel	21-59 Average 39	C>3,000 B>3,000 a>12,000
Lead	0.05-0.2 (% by weight) Average 0.16	C>1,500 B>1,500 A>6,000
Sulphur	1-2 Average 1.4	N/A
Antimony	170-510 Average 380	C>75 B>75 A>300
Silicon	0.4-0.92 Average 0.3	N/A
Vanadium	12-36	N/A

[91] Bogush *et al*. 2015, Element composition and mineralogical characterisation of air pollution control residue from UK energy-from-waste facilities, Waste Management Volume 36 page 119-129, http://www.sciencedirect.com/science/article/pii/S0956053X14005674
[92] EPA, IWRG631

Element	UK EfW Facilities[91] (mg/kg)	Total Concentration Criteria[92] (mg/kg)
	Average 19	
Zinc	0.26-0.73 Average 0.59	C>35,000, B>35,000, A>140,000

As can be seen from Table 10.12, a number of the total concentration thresholds presented in Appendix A of the IWRG631 publication could be exceeded by the APC residue material. Elements such as lead (Pb) and antimony (Sb) have the potential to exceed the threshold for Category A PIW. Many of the other elements such as arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr) and zinc (Zn) are also likely to be present, and therefore leachability testing for these elements is likely to be required. As such, the waste categorisation for APC residues (combined with the boiler ash) is likely to be either Category B or C PIW depending on the leachability results. APC residues may also exceed a number of Category A PIW thresholds for concentration or leachability. However, it should be noted that some of the figures presented in Table 10.12 represent a large range. Studies are ongoing to determine the likely output concentrations of contaminants for this proposed plant.

Proof of performance tests will confirm the composition of the APC residue outputs from the EfW facility. 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. APC residues will be sampled and analysed on an ongoing basis to ensure the categorisation of this material is correctly applied throughout the life of the EfW facility.

10.6.4.2 Treatment and/or disposal of APC residues

The leachability of contaminants is an important parameter to consider if disposing of the material to landfill. It is intended to draw on experience from Europe to manage APC residues. Within the UK, the main approaches to the management of APC residues are:

- Neutralisation (Augean treatment process) – Mixes APC residues with aqueous liquid wastes such as site water, landfill leachate and imported liquid wastes to generate a cohesive mix suitable for deposit in landfill. This appears feasible for the Project
- Landfill – disposal to suitably licensed landfill facilities. This appears feasible for the Project as there is a suitably licensed landfill in Victoria for disposal (SUEZ Taylors Rd)
- Long term storage (e.g. back filling old salt mines such as the Minosus facility in Cheshire, UK) – APC residues are transferred into bags and then transferred underground to a designated storage area within the mine. Not suitable for wastes producing gas so testing is required. This is not a current practice in Victoria and does not appear viable. Monitoring of interstate development of geological repositories will continue as this may provide a viable alternative in the long term[93]
- Accelerated Carbonation Technology (e.g. the Carbon8 process) – This is a controlled, accelerated version of the naturally occurring carbonation process which results in an improvement in the chemical and physical properties of the treated material. It produces an aggregate that can be incorporated into blocks or used unbound (e.g. in pipe bedding). The aggregate leaving Carbon8 plants in the UK has achieved End of Waste status. This appears feasible in Victoria but not in the short term. This would be subject to a proponent offering this technology in Victoria and appropriate EPA approvals
- Plasma Vitrification – APC residues are “fluxed” to encourage the formation of a “rock-like” product. The process causes release of gas, which then requires combustion and treatment. The technology is currently at pilot scale stage. This does not appear feasible in the near term in Victoria.

The fundamental difference between landfill and long term storage is that there may be the option to remove the APC residues from storage if appropriate technologies for treatment or recovery become available. APC residues can be hazardous and therefore may exceed the waste acceptance criteria for landfills (i.e. if the

[93] For example: http://www.tellusholdings.com/services_waste_resource_storage_solutions.html

material is determined to be Category A PIW). Therefore, neutralisation is usually undertaken prior to landfilling. In the UK, due to lack of alternative markets for APC residues, the Environment Agency allowed a derogation of the waste acceptance criteria so that the material could be landfilled. The material is normally disposed of to landfill as a hazardous waste, often in large bags.

As a PIW, APC residues may seek an EPA waste classification to be developed (as outlined in Section 10.3.4.6) to assist with the cost-effective disposal of this material. The APC residues would also be subject to use of waste codes (as outlined in Section 10.3.4.7) and PIW regulations (see Section 10.3.4.4) for transport and processing / disposal. The EPA may approve a downgrade in categorisations (for example, from Category A to B) where it is deemed that the material does not pose and unacceptable risk to the environment. In these cases, as long as a set of management instructions are adhered to, the material is classified for a maximum three-year period as a lower Category PIW which allows it to be disposed of in landfill.

For the purposes of this Works Approval Assessment, it has been assumed that the destination of the APC residues will be landfill. In Victoria, the only landfill facility that is licensed to accept PIW materials for disposal is the SUEZ-operated Taylors Road Landfill. This landfill has a 60,000 tonnes per annum contaminated soil treatment facility designed to reprocess soils and downgrade their PIW category to facilitate lower cost disposal. It uses a combination of volatilisation and stabilisation processes (depending on the contaminants present) to achieve this.

Australian Paper is investigating opportunities to recover the APC residues to allow for avoidance of waste to landfill, as well as opportunities to treat the APC residues should the material be determined as Category A PIW. Treatment through a stabilisation process (or other metals removal process) would assist to achieve either contaminant concentrations below both Total Concentration and Leachability Limits or allow for the APC residue material to be given a “classification” by the EPA so that it can be disposed as a Category B or C PIW (or potentially even as an Industrial Waste).

10.6.5 Waste categorisation and sampling

Australian Paper will be required to test and categorise wastes that are transported directly from their premises for disposal. If wastes are treated off-site, they will need to be categorised by the waste treater prior to disposal. Waste treaters will require information from Australian Paper on the nature of the waste, so that it can be treated appropriately. Waste characterisation will involve identification of contaminants likely to be present in the waste, as well as sampling and analysis for each of the contaminants. Documented evidence to support the categorisation must include the results of a sampling and analysis program.

The nature of the waste characterisation study will vary, depending on factors such as the process that generated the waste. For example, solid wastes from processes with variable inputs will require more regular testing than waste streams where the inputs and processes are consistent and repeatable results can be demonstrated. Each study must, therefore, be tailored specifically for the waste that is to be characterised.

The testing required by the Victorian EPA is based on the total concentration and the leaching potential (ALSP – Australian Standard Leaching Procedure AS4439.2 and AS4439.3). Section 10.3.4.1 provides further information. In categorising soils during the construction phase and waste residues during the operational phase, testing for total contaminant concentration must be undertaken first and if all values are 20 times less than the limit for Category C PIW then the leachability tests are not required.

Given the anticipated concentrations of contaminants in the waste residues generated, it would be expected that leachability testing would be required. The sampling program for both bottom ash and APC residues will be developed and agreed with the EPA.

Samples of materials must be submitted to an analytical laboratory accredited by the National Association of Testing Authorities (NATA) for the analyses as outlined in the EPA publication IWRG701 “Sampling and Analysis of Waters, Wastewaters, Soils and Wastes”.

10.6.6 Waste logistics

Bottom ash will be loaded into open topped tip trucks (A-double, truck and dog or B-double dry bulk tipper) from overhead hoppers, covered in mesh to prevent escape of material during transit and emptied by rear or side tipping. Alternatively, bottom ash will be transported in shipping style containers by A-double or semitrailer skel trucks. Options for backhaul of bottom ash in empty inwards input feedstock shipping containers are also being investigated to make approximately 20% of otherwise empty backhaul movements productive.

Assuming bottom ash is categorised as an Industrial Waste, trucks will transport bottom ash to an appropriate landfill with sufficient capacity. Alternatively, should a feasible recovery opportunity become available, the bottom ash will be transported to a suitably licensed facility for treatment and reuse. The capacity to which the transport truck is filled for backhaul will be dependent on road vehicle mass limits (as the bottom ash output will have a greater density than the input feedstock received).

Pneumatic or gravity loading of APC residues will occur from the APC residue storage silo(s) into a pneumatic B-double power tanker for transport. At the receiving treatment or disposal facility end, the ash will be pneumatically discharged. There is no viable alternative to pneumatic tankers for this task and these vehicles are typically engaged on one way movements from production to user with empty return as washout for different products can be challenging. As such, it is assumed that this will be a one-way haul movement with empty return. The closest landfill accepting (and treating) prescribed industrial wastes is the SUEZ Lyndhurst Landfill located at 890 Taylors Road in Dandenong South (SUEZ Taylors Road Landfill).

10.7 Summary of generated waste output management measures

Proposed waste management measures for the main constriction and operational waste streams have been summarised and assessed against the waste hierarchy in Table 10.13.

Table 10.13 : Summary of proposed waste management measures – Construction and operational phase solid waste outputs

Waste Stream	Expected Waste Categorisation	Waste Management	Waste Hierarchy	Expected Site for Processing / Disposal
Construction Phase				
Fill material	Clean Fill	Reused on site or within the broader Maryvale Pulp and Paper Mill site. Exported offsite for reuse on other construction projects or disposal to landfill. If the soil is contaminated, it will be appropriately categorised, contained and disposed of to a suitably licensed landfill.	Reuse Disposal at landfill	Onsite Road transport to a suitably licensed landfill facility
Other materials	Industrial Waste (Solid Inert Waste)	Source separated into designated skips according to material types that can be reused, materials that can be recycled, and residual waste materials. Materials for reuse and recycling will be transported off-site by a private contractor to an appropriately licensed recycling facility. Residual waste will be disposed at a suitably licensed landfill.	Reuse and recycling and Disposal to landfill (residual wastes only)	Road transport to a suitably licensed recycling facility. Road transport to a suitably licensed landfill facility
Staff compound waste	Industrial Waste (Mixed Putrescible and Solid Inert Waste)	Recyclable materials will be transported off-site by a private contractor to an appropriately licensed recycling facility. Residual waste will be disposed at a suitably licensed landfill.	Recycling and Disposal to landfill (residual wastes only)	Road transport to a suitably licensed recycling facility.
Operational Phase				
Bottom Ash[94]	Industrial Waste	Metals capture will occur through inclusion of an over-band bottom ash magnet and eddy current separator for coarse removal of ferrous and non-ferrous metals from the wet bottom ash stream prior to discharge to bunker. Remaining residues are discharged to bunker and then transported off-site for disposal to landfill initially. Overall aim is to develop a market for bottom ash to be reused as road base or similar material, avoiding landfill.	Metal reuse / recycling off-site at a suitably licensed facility and Disposal at landfill (remaining residues) or Reuse of remaining residues in the construction industry (either as an aggregate in concrete, as a fill material, for use in drainage and landfill engineering, or for use in bituminous materials)	Road transport to a suitably licensed metal recycling facility. Road transport to an appropriate landfill.

[94] Typically contains glass, brick, rubble, sand, grit, metal, stone, concrete, ceramics and fused clinker as well as combusted products such as ash and slag

Waste Stream	Expected Waste Categorisation	Waste Management	Waste Hierarchy	Expected Site for Processing / Disposal
Boiler Ash	Prescribed Industrial Waste (as per APC residues below)	As a conservative measure, boiler ash will be treated the same as the APC residue (see below).	Disposal to landfill (Innovative treatment solutions could allow for reuse of the residues following treatment)	Road transport in a pneumatic truck to SUEZ Taylors Road (Lyndhurst) Landfill.
APC Residues[95]	Prescribed Industrial Waste	Containment for transport. Disposal offsite to appropriately licensed landfill by a licensed waste contractor either directly or following treatment.	Disposal to landfill (Innovative treatment solutions could allow for reuse of the residues following treatment)	Road transport in a pneumatic truck to SUEZ Taylors Road (Lyndhurst) Landfill.
Worn process equipment (e.g. filter bags)	Industrial Waste / Prescribed Industrial Waste	Worn process equipment will be contained and either recycled by a specialist provider or disposed at a licensed landfill. Future studies to combust used filter bags in the EfW plant (as occurs in some European facilities) will be undertaken	Disposal to landfill Potential for energy recovery,	Road transport to SUEZ Taylors Road Landfill.
Staff waste	Industrial Waste (Mixed Putrescible and Solid Inert Waste)	Source separated into recyclables and residual waste. Recyclables such as drink containers collected and transported off-site by private contractor to an appropriately licensed recycling facility. Residual waste collected by building caretakers, weighed and sent to the EfW facility for treatment. Waste paper transported to Maryvales' on-site waste paper recycling facilities	Recycling and recovery of energy from residual wastes that would otherwise be disposed of at landfill	Road transport to a suitably licensed recycling facility. Energy recovery via the proposed EfW facility.

95 Typically consists of boiler ash/fly, excess lime, reaction products (salts), dioxin sorbents, sludge, gypsum and chloride salts