Appendix C to Attachment 1 to Item 4.5.2.

Appendix C – Tech Memo 2

Date of meeting: 12 March 2024
Location: Council Chambers
Time: 6:30 p.m.

Member of the Surbana Jurong Group

Technical Memorandum

Memo No.	02	**Date of Issue**	18 May 2023
Subject	Resource Recovery	**Discipline**	Waste and Resource Recovery
Project Title	Hawkesbury Landfill management strategy beyond 2026	**Project No.**	30019111
Document No.	Tech Memo – 02 - Resource recovery	**Revision**	05
Author	Linda Nordin, Gopika Venugopal		
Reviewed by	Robert Nutt	**Approved by**	Matt Fraser
Prepared for	Hawkesbury City Council	**Attention to**	Samuel Swain
Attachments	N/A		

Purpose and Approach

The purpose of this Technical Memorandum (Memo) is to present a summary of works and findings for the assessment conducted on the current resource recovery performance and waste disposal data for the Hawkesbury Waste Management Facility (the Site), and the potential for reducing waste sent to landfill. Furthermore, this Memo assesses required future landfill diversion and resource recovery options to achieve strategic diversion targets. It also identifies suitable resource recovery options that could be established on available land at the Site (located at 1 The Driftway, South Windsor). More precisely we will look to provide further information to help Hawkesbury Shire Council (HCC) address the following:

- The potential for increased recovery at the Site and implications of this in terms of future life of the landfill, economic viability of activities and ability to expand the customer base to other LGAs.
- Is there scope to recover additional materials at a net saving? Are there efficiencies in recovery?
- Would the Site benefit from permitting access to users from other LGAs?
- What options are there for the use of the Site post landfill closure?
- What efficiencies and benefits can be gained by establishing a transfer station at the current site?

Documents reviewed

The following documents have been reviewed, in addition to external information obtained through desktop research and recent presentations and conversations at the Waste Coffs Harbour Conference 2023.

- Weighbridge data for 2022
- General information (data) supplied by HCC
- Hawkesbury City Council (HCC) Waste Strategy “Waste and Resource Recovery Strategy 2032”
- Western Sydney Region: Waste and Sustainable Materials Strategy 2022-2027
- Site visit to Waste Management Facility at Hawkesbury

1. Summary of findings

The initial review of the current resource recovery performance and type of opportunities that may exist for HCC has been summarised below.

1.1 Key drivers

Below is a list of local and regional targets that HCC has committed to achieve and are most relevant to this study. The local and regional targets are influenced by actions provided in the Federal Government's *National Waste Policy Action Plan 2019* which was realised to guide Australia's investment and national efforts to 2030, [1]and the NSW State government strategy *NSW Waste and Sustainable Materials strategy 2041*[2] that aims to transition NSW to a circular economy and focuses on achieving reduction in waste and emission, implement innovation and reduce harm to the environment. In the Western Sydney Regional Waste and Sustainable Material Strategy there are four regional themes:

1. **Avoid and reduce waste**, driving regional circular economy transformation
2. **Recover Resources:** meeting waste infrastructure needs to 2030 and beyond, transitioning to food waste collection by 2030, updating waste planning controls
3. **Protect the region from waste pollution:** Building Resilience to Climate Change Impacts on Waste Services, Managing Problem Waste, Preventing Illegal Dumping and Littering
4. **Strategic Collaboration,** knowledge share and support strategic collaboration across western Sydney.

Below in Table 1, SMEC has listed the key local and regional strategic targets, considered to be most relevant to this study (please note that this is not an exhaustive list):

Table 1: Key strategic drivers

Strategic driver	Local target	Regional target
Introduce FOGO or FO service by 2030.	x	x
Work towards diverting 50% of organics by 2030	x	x
Achieve 80% diversion by 2030	x	x
Increase opportunities for waste avoidance and reduction in the region by 2027. Reduce its waste stream by 10%	x	x
Achieve net zero emissions by 2030	x	
Transition to a circular economy, Protect region from waste pollution	x	x
Recover materials at their highest value, including reuse and repair	x	x
Develop appropriate waste infrastructure locally and in the region		x
Increase opportunities for the responsible disposal of household problem waste across the region by 2027		x
Collaborate with regional councils with joint procurement and cost-efficiency for services and waste contracts		x
Meet infrastructure needs by 2030 and beyond		x

Combined, these strategies create a foundation for HCC to make further decisions on how and what type of services, reprocessing and infrastructure to invest in.

[1]National Waste Policy Action Plan, accessed 12 May 2023, https://www.dcceew.gov.au/environment/protection/waste/publications/national-waste-policy-action-plan
[2]Strategic Direction for Waste in NSW, accessed 12 May 2023, https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/strategic-direction-for-waste-in-nsw

1.2 Growth

The average growth rate for Hawkesbury is considered to be 1.28% p.a. Below is a list of projected housing and population growth over the next years.

Table 2: Projected growth in HCC (this is also relevant for Collection services)

Year	Population	Housing	Growth Housing	Growth Pop
2021	71,000	26,150	Baseline	Baseline
2026	74,800	27850	7%	5%
2031	79400	29700	7%	6%
2036	85050	32000	8%	7%

1.3 Current and surrounding infrastructure

Below is a list of the closest waste and resource recovery facilities to the Site. It should be noted that there are more facilities in the greater Sydney region. Glass reprocessing, paper mills and Organic FOGO facilities has been excluded from the list. The location of these facilities dictates the distances that HCC currently need to transfer its material and helps to inform what options are more or less suitable for HCC to consider. Distances provided in the table below are from the Site.

Table 3: Facilities that Hawkesbury can transport its waste to.

Facility	Type of Waste streams	Location	Distance
Smithfield Materials Recovery Facility	Co-mingled recyclables	6 Herbert Place, Smithfield, NSW, 2164 Australia, used for HCC's material today, JJR collects and dispose material there	36km
Eastern Creek Organics Resource Recovery Facility	Garden Organics	Used for HCC's material today, JJR collects and dispose material there	24.5km
Blacktown Waste Services	Bulky Waste (kerbside)	Mardsen park (Veolia)	11.1km
Blaxland Waste management facility	Landfill	28-30 Attunga Rd, Blaxland NSW 2774	28.3km
Energy from waste facility (future)	Residual wastes	**West Lithgow Precinct** (closest EfW precinct)	84km
		Parkes Activation Precinct	270-300km
		Goulburn precinct	196 km
		Richmond Valley	727km

Soft Landing Mattress Recycling	Mattresses	29 Chifley Street, Smithfield New South Wales 2164	33.7km
SoilCo	Organics (FOGO)	3/132 W Dapto Road, Kembla Grange NSW 2526	125km
Bettergrow	Organics, clean wood and plaster board	21-25 Dunheved Cct, St Marys NSW 2760	16.8km
Glass Recycling, VISY	Glass	126 Andrews Road, Penrith, NSW	16.9km
Glass Recycling NSW	Glass	Unit 5/1 Swaffham Rd, Minto	54,3km
Sircel	E-waste	Sydney (location TBC)	TBC
Scipher (Albury Recycling Center)	Solar panels (potentially also E-waste)	565 Mudge Street, Lavington NSW 2641	553km
MIcroFactorie	Plastic, glass, textiles and mattresses	10 Victa Way, Nowra New South Wales 2541	189km
ABC Tissue Pty Ltd	Recycled Paper	34 Redfern Street, Wetherill Park New South Wales 2164	32.4km
Enviro Paper and Cardboard Recycling	Paper, cardboard	11 Ingleburn Rd, Ingleburn NSW 2565	49.9km
Repeta Pty Ltd	Plastic HDPE/PET (non-CRS)	46-50 Melbourne Road, Riverstone, NSW 2765	14.5km

2. Resource recovery and its impact on landfill space

The following table indicates the Diversion Rates achieved in recent years and the 2030 (target). As 80% may be difficult target to achieve without adding EfW facility, a lower diversion rate of 65% has been included for comparison. It should be noted that the 65% is not a current target, for reference it has been included as most Councils, based on SMECs industry experience, introduce a full and dedicated FOGO program often area able to achieve between 60% and 70% in diversion rates.

The table also provides quantities for various waste categories that need to be recovered or recycled for HCC to achieve a 65% or 80% Diversion Rate. It should be noted that the reduction-target, if achieved, basically counteracts the growth, leaving the total waste stream to landfill at the same level as today. The table includes an average growth factor of 1.28% per annum.

Table 4: Tonnes per annum per category to divert to achieve strategic targets.

Waste Category (incl strategic target)	2020-21	2021-22	2030 (target)	Comments
Diversion Rate	34%	36%	80% (65%)	Target of 80% recycling rate may not be realistic, 65% has been included for comparison.
Dry Recycling (tpa)	5,127	5,185	12,958 (10,529)	All dry recyclables excl Organics
Organics - Green and Food waste (tpa)	5,380	6,090	14,385 (11,688)	14 ktpa (80%) may not be realistic diversion, 65% diversion represents ~ 60% update of FOGO.
General Waste if strategic targets are achieved (tpa)	19,975	20,420	6,836 (11,963)	Includes growth, excludes reduction target of 10 %
Total waste incl growth (tpa)	30,482	31,695	34,179	Applied 1.28% average growth.
Reduction (tpa)	3,048	3,170	3,418	10% reduction in waste (Local, Regional and National Strategic Target)
Tonnes to divert to achieve strategic targets (tpa)	N/A	N/A	13584 (8457)	Total amount to be diverted from landfill to achieve 80% (65%)

3. Hawkesbury Waste Management's current operation

Hawkesbury Waste Management Facility (the Site) provides resource recovery services to both residential and a limited number of commercial customers that operate within Hawkesbury LGA only. The resource recovery area is an open flat area and is located just after the weighbridge and Scrap metals, building and construction materials, bricks and concrete are placed on the ground with other materials placed in designated receptacles. The facility including landfill is manned and operated by 3 staff members and the weighbridge is operated by 2 staff members as well. Accepted waste and recyclable items are listed in the tables below.

Table 5: Materials accepted free of charge

Items (free)	Comments
Co-mingled recycling (Domestic kerbside recyclable materials)	Approximately 30 yellow top wheelie bins (240L) are positioned at the recycling area.
Cardboard (Paper and unwaxed cardboard)	Collected in cages
Scrap steel (excluding fridges, Freezers and Air Conditioning Units)	On the ground
Sump oil and Motor oils	To be poured into designated holding tank
Car Batteries (lead acid) and household batteries	At dedicated areas and wheelie bins
Problem household waste (paint, globes and tubes, smoke detectors)	At dedicated and labelled areas/containers
Gas bottles and Fire extinguishers	Mixed in a cage
e-Waste (computer and televisions)	At dedicated and labelled areas/containers
Good quality, clean clothing donations	At dedicated charity bins
Reusable items (books, furniture, household goods)	At the reuse shed

Table 6: Materials accepted at a cost.

Material accepted at a cost	Comments
General domestic waste	RORO bins for landfill disposal
Building and Demolition waste	On the ground
Bricks and Concrete	On the ground
Mattresses	At dedicated and labelled area
Tyres – motorbike/passenger car or smaller (max 5 per load)	At the ground
Fridges, Freezers and Air Conditioning Units ($25 each)	On the ground
Green waste	On a pad. Contamination removal by staff.
Other opportunities	Ongoing as HCC directs

Figure 1: Picture taken of Operation at Hawkesbury Waste Management Facility.

3.1 Top 10 priority streams

Below is a list of the top 10 recovery streams for Hawkesbury. If diverted, these streams could help HCC achieve their strategic targets. Many of the recyclable waste streams are hidden in household's general waste bins and can be captured through HCC offering kerbside collection services that provides additional diversion and increased opportunity to separate at the source, such as moving from a Green Organics (GO) to a Food Organics, Green Organics (FOGO) bin service.

However, other waste/recycling streams could benefit from local facilities at the Site to encourage a circular economy that promotes local reprocessing, reuse and repair of items such as clothing, e-waste, tools, furniture and other bulky items that can be saved from entering the recovery and/or landfill stream.

For HCC to achieve its resource recovery targets and to transfer to a circular economy, the most suitable and feasible options for resource recovery at their current waste transfer station have been assessed and identified as the following. It should be noted that all waste that currently go to landfill, is charged with a portion of this cost being returned to the sate through the Waste Levy.

Table 7: List of top 13 categories and current approximate cost for disposal (based on disposal costs provided by HCC)

Waste stream	Operation	Current source separated feedstock (tpa)	Available to recover from landfill (tpa)	Cost/Revenue per annum to recycle
Co-mingled recycling	Collected by JJR, improve through improved service operation	4836	2,285	Paid per lift to Waste collecting contractor, plus gate fee for disposal
Cardboard (including above)	Received at WRC and another 1000tpa left in kerbside bin	293	1,074	$29,300
Green Organics WRC incl untreated timber	Self-hauled green waste, mulched at WRC	761	261	$98,000
Kerbside FOGO available in general waste (incl untreated timber)	Collected GO and future FOGO to be processed at Circular economy hub	5272	7886	Paid per lift to Waste collecting contractor (plus future gate fee at FOGO processing facility)
Clothing/Textiles	Repair, reuse or EfW	6	978	Assume collected for free through charity bins
Soft plastics (kerbside)	Send to larger facility	0	403	Landfill cost today (future cost TBC)
Solar panels	Regional facility could be feasible (landfill ban?)	TBC	TBC	Landfill cost today (future cost TBC)
Mattresses (cost per mattress)	Dismantle/shredding	54 (~1,500 mattresses)[1]	TBC	$36 per mattress, 1500 mattresses, equals $54,000
Reuse bins (items returned to tip shop)	Free to put into reuse shed	19	2267	Labour cost to operate the shed (no cost provided)
E waste including other E-waste appliances	Placed in cages for collection (no repair or reuse)	N/A	331	$600 (cost is paid per E-waste cage)
C&D (bricks, concrete, wood, tyres, plasterboard etc)	Open air (dump on the ground)	100	522	HCC to pay for crushing, shredding (no cost breakdown provided)
Treated, contaminated timber	Collected by facility nearby that accepts treated timber	157	351	$35,400
Scrap metal	Placed in on the ground, no further sorting of metals	1578	261	$275,000

[1]Assuming that one mattress weighs in average 35kg.

4. Auxiliary facilities at HCC's Waste Transfer Station

In this section SMEC have researched how to recover or reprocess the top 10 priority streams listed in Table 5 above. The process or facilities could be located at a Waste Transfer Station (WTS) to improve HCC's strategy targets for achieving:

- higher resource recovery by increased diversion from landfill
- increased lifespan of their landfill
- regional collaboration
- reduced greenhouse gas emission
- transition towards a circular economy (CE).

It should be noted that HCC is committed to work in collaboration with surrounding councils to establish a Circular Economy Hub for the region. It should be noted that a number of the identified facilities may be more suitable to be situated at a regional CE hub

4.1 Options

The most suitable resource recovery infrastructure options are described below and are summarised in Section 4.2.It should be noted that it may also be possible for HCC to establish these facilities at other Council owned available land parcels.

Figure 2: ***Picture above of an enclosed organics facility (left), Solar Farm on closed landfill (middle) and tiles i.e., end products from a MicroFactorie.***

MicroFactorie[3]

MicroFactorie is a relatively new and emerging resource recovery processing option. These modules are ideally suited for waste transfer stations and are designed to process problematic waste such as textiles, plastics and E-waste.

The MicroFactorie concept was developed by the SMART Centre in Sydney, with a focus to find solutions for problematic waste streams and to promote sustainable technologies for rural communities. The MicroFactorie is a small-scale manufacturing facility that can be easily transported and set up in rural (or regional) areas, The MicroFactorie concept is intended to provide regional communities with greater access to essential products and services, while also promoting circular economy, entrepreneurship and innovation.

Smart Centre has developed bespoke models tailored for individual councils, based upon their individual circumstances. They use a variety of thermal transformation techniques to reprocess problematic waste streams. In the module, the waste undergoes a thermal transformation process, to be reformed into industrial grade ceramics and plastic filaments which can be used for 3D printing, tiles or other engineering stone products (splash backs and coffee tables etc).

Modules are constructed for low CAPEX approximately $1,000,000 per unit/module with as little as 200 m^2 space requirement (depending on tonnage throughput). Each solution is unique and has been developed to create end products that can make the process profitable.

A facility has been established in Shoalhaven City Council Resource Recovery Precinct, where they have implemented a module which processes waste glass and textile into tiles and benchtops. Advice was given by their Waste operation and Project manager, Peter Windley, during an interview at Coffs Harbour Waste Conference 2023, that up to 1000 tpa can be processed in these facilities and different modules servicing different streams can be constructed. The area used at this site is approximately 2500 m^2 .

Recommendation: Each MicroFactorie can be tailored to suit each location and the type and tonnage of problematic waste streams available at that specific site. As such, a MicroFactorie module, that processes either e-waste, textiles and/or glass is considered suitable for the site at HCC. It is recommended that HCC discuss further with the provider on what size and module would be suitable for HCC.

4.1.1 Solar Panel Farm

In New South Wales, solar farms on closed landfills are part of the State Government's Renewable Energy Action Plan, which aims to increase the use of renewable energy. These solar farms provide a sustainable use for closed landfill sites while contributing to the state's renewable energy targets, with a goal of sourcing 50% of its electricity from renewable sources by 2030.

[3] MicroFactorie technologies, https://www.smart.unsw.edu.au/technologies-products/microfactorie-technologies

Solar farms on closed landfills in New South Wales, Australia, work by installing photovoltaic (PV) panels on top of landfill site. The suitability of a closed landfill for a solar farm is assessed based on factors such as its location, size, accessibility, and potential for solar exposure. Solar panels are installed on top of the landfill site, typically mounted on a framework above the ground or on top of a low-height building. The panels are connected together in an array and to inverters that convert the DC electricity generated by the panels to AC electricity.

The solar farm is connected to the electricity grid through an interconnection agreement with the local utility company. The electricity generated can then be used to power nearby homes, businesses, or fed into the electricity grid. Any excess electricity generated by the solar farm can be fed back into the grid and sold to the utility company.

While there are many benefits to establishing solar panel farms on closed landfills, there are also some risks and challenges that need to be considered.

Key risks for solar panel systems at landfills include:

- Soil instability: Closed landfills may have unstable soil, which can cause the ground to shift and affect the stability of the solar panels. This can lead to structural damage or even collapse of the panels.
- Methane gas emissions: Closed landfills may continue to emit methane gas, which is a potent greenhouse gas, and the presence of methane gas can pose a safety risk and may require special precautions.
- Toxic waste: Some closed landfills may contain toxic waste materials that can pose a risk to workers during the installation process or if the waste is disturbed by natural events like heavy rainfall or flooding.
- Environmental Regulations or Land use conflicts: There may be conflicts with other potential uses for the landfill site, such as recreational or residential development. Environmental regulations can also be challenging. This can create challenges in obtaining necessary permits and approvals for the solar panel farm.
- Environmental and Decommissioning challenges: When the solar panel farm reaches the end of its useful life, decommissioning and removing the panels may pose challenges due to the presence of buried waste materials and the potential for soil contamination.[4]

To mitigate the above risks, it is important to conduct thorough site assessments, develop appropriate safety protocols, implement safety in design practices, and work closely with local regulators and community stakeholders to address concerns and ensure the safe and sustainable use of closed landfill sites.

The size of a solar farm on a closed landfill can vary depending on several factors, such as the available space on the landfill site, the amount of sunlight the site receives, the capacity of the solar panels used, the access roads and infrastructure needed for the project, and any requirements for buffer zones or setbacks from nearby properties or sensitive areas.

In Australia, the size of solar farms on closed landfills ranges from a few hundred kilowatts to a few megawatts and can be built on as little as 1 ha to 10 ha closed landfill. In general, solar farms on closed landfills tend to be smaller than other utility-scale solar projects, as they are built on sites that may have more limited space and may also have some limitations due to the nature of the underlying landfill.

[4] Solar information, accessed 15th of May, https://www.cleanenergycouncil.org.au/resources/technologies/solar-energy

Figure 3: ***Albury Solar Farm.***

Below are just a few examples of the many solar and renewable energy projects underway in New South Wales

- Albury Waste Management Centre has a solar farm that is a 1.1MW (AC) PV power station consisting of 4,000 solar panels. The project was developed as a partnership between Albury City, LMS Energy and Joule Energy. LMS owns and operate the system.[5] The Albury system is part of the Albury Renewable Energy Hub, which also hosts a landfill gas-to-energy facility. The two plants will generate an estimated 11,200 MWh of electricity each year, combined which is enough to supply the electricity needs of the equivalent of more than 1,900 homes. As a bonus the greenhouse gas abatement is estimated to be at 54,000 tonnes (CO^2 equivalent) annually.
- Situated in Melbourne's northern fringe, Hanson's Wollert Renewable Energy Landfill has provided households and commercial, industrial and demolition businesses with a facility to safely dispose waste since 2000. In 2016 it converted the capped portion of the site into a solar farm by installing more than 380 solar panels. This solar farm has the ability to generate up to 100 KW per annum. The energy can provide power to over 5000 homes.[6]

Other Councils in Australia are considering turning their old landfills in to solar farms for example South Fremantle, who announced its plans during 2022. [7]

It should be noted that Feasibility Study Report on a Pilot Landfill Solar Project on the Wollert Landfill (2020) summary stated that while solar was technically feasible that "landfill solar system [are] unlikely to be financially feasible until significant equipment, installation and grid interconnection cost savings are realised." [8]

Given the available space available at the HCC landfill at closure and current solar technology and efficiencies a system with a capacity of 750 kW to 1 MW could be installed. This would require between 2 to 3 ha of suitable land space.

Recommendation: These projects demonstrate the potential for closed landfill sites to be repurposed for renewable energy generation, and the role that solar farms can play in providing sustainable solutions for energy production. In general, solar farms on closed landfills tend to be smaller than other utility-scale solar projects, but they can still produce significant amounts of renewable energy and provide an innovative way to reuse previously unusable land. Depending on where the expansion of the current landfill is developed, and how much space is available, a solar farm may be a suitable alternative.

4.1.2 Solar panels

Australia's rooftop solar installations are amongst the highest in the world (per capita basis). Approximately 50 million (18.5 GW) have been installed so far. Most solar panel manufacturers guarantee a 20-year lifetime; however, panels

[5] https://www.solarquotes.com.au/blog/albury-landfill-solar-mb1194/
[6] Creating Habitat and Powering Homes with Green Energy | Hanson Australia, https://www.hanson.com.au/news-media/creating-habitat-and-powering-homes-with-green-energy/
[7] https://mysay.fremantle.wa.gov.au/south-fremantle-solar-farm
[8] Pilot landfill solar report, feasibility study, prepared by Joule Energy for ARENA, 2019

are often replaced earlier, between 10 to 12 years. Panel decommissions is increasing exponentially and it is estimated that more than 100,000 tonnes of solar panels will enter Australia's waste stream by 2035. End products from solar panel recycling include glass, plastic, aluminium, metals (e.g., silver, copper) and silicon. These materials can be repurposed and used in road construction and within batteries. [9]

Prior to recycling, the panels should be stacked in a stackable rack (preferably sideways) to avoid any leakage of hazardous materials. It is important to consider the repair of solar panels before they are recycled and there are two primary pathways to recovery solar panels:

- Downstream separation technologies: The recycling techniques involved are primarily crushing and shredding to recover materials that may be suitable for lower value applications (e.g., road bases). At present most down cycle recyclers only recycle and reclaim up to 17% of a panel by weight, usually a solar panel's aluminium frame and junction box.
- Delamination: The process of delamination for resource recovery involves separating the different layers of the panel, including the encapsulant, solar cells, back sheet, and other components. This is done through a combination of mechanical and chemical processes, such as shredding and chemical treatment and can recover materials such as glass, plastic, copper, aluminium and silicon. The material recovery rate of this process is considered to be 90% or higher. [10]

The footprint required for solar panel recycling will vary depending on size but is considered to be approximately 2,500 m2 (undercover). Keeping solar panels out of landfills will reduce operational cost of the landfill and its risk profile as the material is toxic and influences leachate quality. Recycling solar panels will have a minor impact on landfill air space, increasing the landfill lifespan.

The closest dedicated PV solar panel recycling facility is opening at the end of 2023, it will be located in Albury and operated by Scipher. It will be use global processing technology and advanced downstream separation technology.

Recommendation:

The CEO for Scipher, Chris Sayer, advised that the facility in Albury will serve both Melbourne and the Sydney area, however HCC could gauge and access interest from surrounding councils. There may be appetite for more solar panel facilities. HCC can consider offering a space for a solar panel facility at its waste management facility as long as it is not also considered for the regional Circular Economy Hub.

Another option is stockpiling the solar panels at waste recycling area and setting up an agreement with a solar panel recycling facility for collection. By charging for the disposal of solar panels at its WTS, HCC can then use this to off-set the cost of establish the recycling facility.

4.1.3 Landfill gas capture

Landfill gas capture is an important component of waste management in Australia, particularly as it provides a renewable source of energy. It was discussed that HCC has previously undertaken an assessment to identify that it was not viable to extract landfill gas from their landfill.

HCC is currently undertaking active landfill gas extraction at its landfill; however, the gas is only flared. There may be opportunities for HCC to look in to converting the gas into electricity, biogas introduced to the grid and/or Hydrogen.

As an example, there is a Landfill Gas Capture System in Wodonga, in Victoria, that captures landfill gas from a landfill site that receives around 24,000 tonnes of waste per year. The captured gas is used to generate electricity, with a capacity of 550 kW.

Recommendation: It is recommended that HCC revisit generating renewable energy from the gas captures at the landfill in the future. The landfill gas system could be used to generate renewable electricity and biogas to the grid. This gas could potentially be turned in to Hydrogen in the future (5 to 10 years), but this is not considered a cost-efficient solution today.

[9] Solar information, accessed 15th of May, https://www.cleanenergycouncil.org.au/resources/technologies/solar-energy
[10] Solar Recovery Operation, accessed 15 May, https://www.srcorp.com.au/

4.1.4 Organics

Feedstock for an organic processing facility could include future Food Organic Green Organic (FOGO) material collected from kerbside, self-haul green waste dropped off at Council's waste transfer stations and commercial organic waste, especially generated from agriculture and food processing industries.

There are different types of organics processing from low-cost mulching which could include pasteurising processing, enclosed FOGO facilities including IVC, Dry Anaerobic Digestion (AD) or wet AD.

Recommendation: Although this is the largest waste stream for HCC to divert from landfill, this is not going to be discussed further in this study. It is not recommended that HCC continue to review this concept as it is understood that a regional FOGO facility that will service HCC is to be established at CE Hub. Until a FOGO facility is established, HCC can continue to mulch its self-hauled green waste on site.

4.1.5 E-waste

E-waste recycling in Australia has become increasingly important in recent years, as electronic waste has become one of the fastest-growing waste streams in the country. E-waste includes a wide range of electronic devices, such as computers, televisions, mobile phones, and other electronic equipment, that have reached the end of their useful life. Recycling e-waste is important for several reasons, including the recovery of valuable materials, such as metals and plastics, which can be used to make new products, as well as reducing the amount of electronic waste that ends up in landfill.

E-waste is considered a hazardous waste due to the presence of potentially harmful substances such as lead, mercury, and cadmium, which can be harmful to human health and the environment if not handled and disposed of properly.

In Australia, e-waste recycling is regulated by the federal government, which has established a national e-waste recycling scheme to ensure that electronic waste is managed in an environmentally responsible manner.

The National Television and Computer Recycling Scheme is an important step towards reducing the environmental impact of e-waste in Australia and is part of the government's broader strategy to promote the sustainable management of waste and resources.

Under the NTCRS, manufacturers and importers of televisions and computers are required to take responsibility for the end-of-life disposal of their products. This means they must either establish their own collection and recycling systems or join a government-approved recycling program. The scheme is funded through industry contributions and government grants and aims to recover as much E-waste as possible[11]

Several e-waste recycling companies are operating in NSW that specialize in the collection and processing of electronic waste. Some examples include:

1. **Sims Limited**: Sims is a global leader in the recycling of electronic waste, with operations in over 20 countries. In NSW, Sims operates a large e-waste recycling facility in Villawood.[12]
2. **TES-AMM Australia** is a specialist e-waste recycling company that operates across Australia and Asia. In NSW, TES-AMM operates a processing facility in 1 Marple Avenue, Villawood, NSW.[13]
3. **MRI E-Cycling** is a family-owned e-waste recycling company that operates across NSW.[14]

The size of e-waste recyclers in NSW can vary, depending on the scale of their operations. Larger recyclers, such as Sims Limited, have facilities capable of processing tens of thousands of tonnes of e-waste per year, while smaller operators, such as MRI E-Cycling, may have facilities capable of processing a few thousand tonnes per year.

Recommendation: E-waste is the type of waste stream that could be co-processed with solar panels and/or a MicroFactorie. It is also the type of waste stream that may be suitable to send to a repair centre.

[11] EPA Victoria, 2021. Managing e-waste. Web page, CleanUp.org.au, Sywasterecycle.com accessed 15 May 2023
[12] Sims Limited - About Us (simsltd.com), accessed 17 May 2023, https://www.simslifecycle.com/locations/sydney-nsw-au/
13E-waste, accessed 17 May 2023, https://www.tes-amm.com/it-services/e-waste-recycling/#!/
[14] About Recycle – MRI technologies, accessed 17 May 2023, https://mritechnologies.com.au/about/

4.1.6 Co-mingled recycling

All Co-mingled recycling is collected by JJ Richards and taken to Smithfield Materials Recovery Facility that is operated by VISY, this means that the MRF separated waste streams from the yellow lid bin service will never enter HCC's Waste Management Facility.

The individual streams for glass, plastics, paper packaging, steel and metal, are not considered to be of significant amount at HCC transfer station to provide an opportunity for future auxiliary processing activities.

The largest Co-mingled stream at HCC is Paper and Cardboard. This is currently collected as a dedicated stream at the HCC Waste Facility. In addition to the current offtake this product could be developed into a paper mould reprocessing concept and be established in the future to produce moulds like, coffee, drink, egg trays etc. These items could be sold into the local area and contribute towards a local circular economy concept. [15]

Recommendation: Consider if there is a need/interest in a recycling manufacturing facility such as the production of paper products. Subject to the level of interest and financial viability, a paper mould facility could be established at the Site for a relatively low investment, small footprint, however, the quantity of input material may need to be higher to achieve viability and return on investment, and the end market need to be confirmed for the initiative to be feasible. This type of facility may be more suitable for the regional CE Hub.

4.1.7 Construction & Demolition (C&D)

In Brisbane and overseas, robotic systems have been established to process C&D waste, where incoming waste is sorted, shredded and screened into different piles, ready for dispatch. This is more suitable for larger feedstock then HCC currently are accepting to their waste and transfer station.

The simplest and traditional approach is to accept C&D in separate piles and then utilise open aired crushing, grinding and screening of the incoming material to create end products that could be reused in construction. For this type of facility, either equipment at site or hire/leased equipment can be used during days/weeks of the year. For example, this equipment could be but are not limited to front loader, backhoe, crusher, screens and excavator.

Recommendation
Open air processing is commonly used at transfer stations throughout Australia, and this is the type of processing that would be most suitable for HCC to use for its incoming C&D material.

4.1.8 General waste – additional streams and pre capture

To divert more waste from the general waste stream that is currently sent to landfill one of the following systems could be considered.

- HCC could introduce an L bin system and/or a Push pit prior to landfill and/or a Waste Transfer Station (see further information in the section below).
- More bays for new material streams such as polystyrene, plasterboard, hard plastics and or treated timber to allow for contractors to collect and take to closest reprocessing facilities.
- Construct a Circular economy community hub, a building that looks after and captures item for reuse and repair. This could also include a library that could be for specific items such as clothes, furniture and tools.

4.1.9 Waste Transfer Station for bulk haulage

If and when the landfill needs to close, HCC could construct a Waste Transfer Station to bulk haul the general waste into compactors and transport these on a road train to nearest landfill and/or EfW facility (If that has been constructed).

The different sizes of Waste Transfer Station facilities that could be considered is considered to be as per below are:

1) **Minimum** is the alternative where HCC is managing its waste so well that it is achieving strategic recycling targets of 60% per annum, including its minimisation targets
2) **Medium** is the in between scenario where either HCC has not achieved as high diversion rate as hoped for and/or is allowing general waste from surrounding councils, and.

[15] Beston Group Pty Ltd, www.bestongroup.com, information provided by Joshua Sun, May 2023

3) **Maximum** is where HCC is working with several of the surrounding councils and accepting general waste to its Waste Transfer station from multiple of these regions.

Table 8: Approximate number for different sizes of waste transfer station facilities at Hawkesbury Waste Management station, excluding transport and operational costs.

Size	Min	Medium	Max
Tonnes per annum	10,000	20,000	30,000
Footprint	250m^2	400m^2	1000m^2
CAPEX (equipment incl compaction bin)	$230,000	$1.4M	$2M
CAPEX (machinery wheel loader, hook lift truck)	$850,000	$850,000	$850,000
Civil works/ construction for a building	Not required, only land preparation	400m2, 6m high $380,000	1000,2, 6m high $850,000

The costs above are for a flat site to create an upper and lower level and no further resource recovery (i.e., no Dirty MRF). The work required to prepare the land for construction has not been included above.

4.1.9.1 Push pit

A push pit can be established prior a Waste Transfer Station to improve resource recovery from self-haul prior to sending it to landfill. A shallow push pit is designed with an elevated tipping floor, where incoming customers unload their waste. A loader or similar is used to push waste to the open end. Open top trailers or compactors are underneath the open end to temporary store waste before the waste is transfer to landfill. A shallow push pit can also cope with larger quantities and the advantage is that recoverable material can be salvaged by staff prior to it being pushed into the open top trailer or compactor. Push pits offer opportunities to increase compaction.

Figure 4: ***Shallow push pit floor to the left and backdrop into the compactors to the right at Molendinar (City of Gold Coast).***

Figure 4 includes a picture of a shallow push pit, where it is possible to recover recyclable items prior to it being pushed into the compactor. A deep push pit has a deep tipping floor and is suitable for a large site with high volume of over 100,000 tpa waste, which is not relevant for HCC.[16]

4.1.9.2 LBIN and direct floor system

L shape bins are separated by barriers. Customers unload waste into LBINs, directly from their cars and trailers. The material is then reviewed by staff and recoverable items and hazardous waste are easy to be identified and separated or isolated from landfill waste. When the LBIN is full it is tipped to release waste to back of house plant operating area, where waste is (compacted if a compactor is in use on site) picked up and reloaded to waste trailers or trucks. The back of house area can be designed as flat floor. LBINs provide customers a friendly waste unloading system and halve the customer vehicle dwelling time. [17]This system has been in use by several NSW councils for example Byron Bay and the system was presented at Coffs Harbour 2023.

[16] Waste transfer stations, accessed May 15, 2023, https://wasteadvantagemag.com/types-of-transfer-stations/

[17] Positive outcomes at Waste 2017 Conference, Contained Waste Solutions, 2017. Available from, https://www.containedwaste.com/category/contained-waste-transfer-station/

The system works well at smaller transfer stations for example Byron Bay under 10,000 tpa and/or around 5,000 customers per month and on sites that have a number of staff on site to help recover the material and empty the LBIN to the back of house when they are full. The system is usually complemented with an elevated saw tooth drop off area.

Some key benefits with the LBIN system are that it eliminates major high-risk activities, reduces the client time spent on site (one drop of instead of multiple) and could reduce waiting time in comparison to a sawtooth model, improves resource recovery transfer station and usually provides high customer service and operator satisfaction

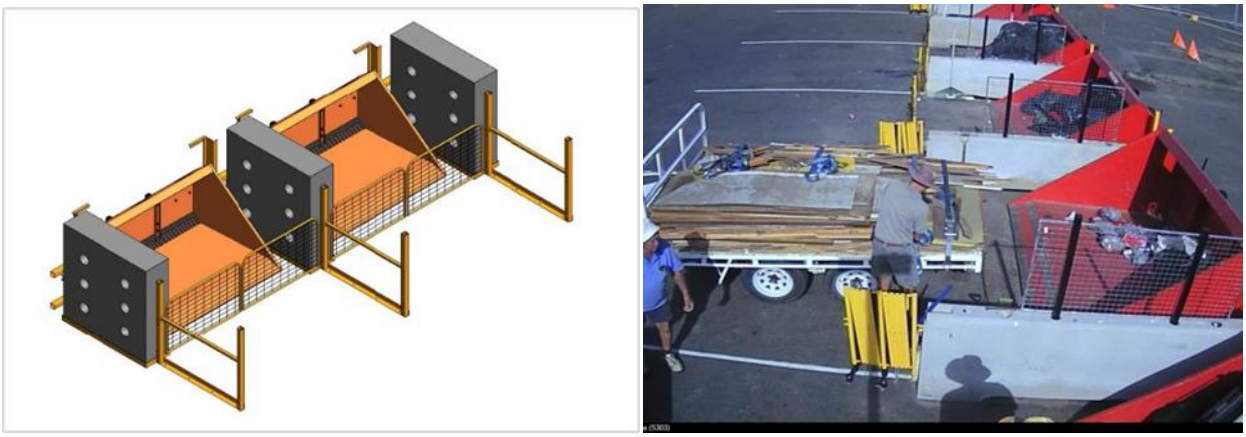

Figure 5: ***L Bin system concept.***

Recommendation (L-bin and Push pit): If a transfer station is required in the future and/or as an initial step to separate more materials from landfill waste stream, both the push pit concept and/or the L-bin system could be considered. The L-bin system is cheaper and more flexible than establishing a push-pit system.

4.1.9.3 Dirty MRF

A dirty MRF provides further extraction of recyclable materials from the landfill stream, prior to the waste entering into the Waste transfer station/landfill.

The cost for a Dirty MRF system sized for HCC current landfill quantities; including shredder, incline conveyor belt, eddy current, trommels; is approximately $2M. If plastic needs to be separated out, an optical sorter of $0.5M will be required. Additionally, HCC will need to allocate an area of approximately 2000 to 3000m^2 and build a shed (which has not been included in the costs above). Operational cost including maintenance is likely to range between $300,000 – $900,000 p.a.

The key waste streams that could be further extracted through a Dirty MRF include plastics, scrap metal and steel/aluminium. Based on the current waste audit of the kerbside general waste, and assuming approximately 10% of the self-hauled landfill stream contains scrap metal, then the total tonnage available is estimated at 1,500 tpa out of the current 22,000 tpa.

- Steel/Aluminium: 800 tpa, approximate commodity price excluding transport average varies greatly between $200 to $2000 cost per tonne for non-CDS material (CDS material is likely to have a higher commodity price)
- Recyclable plastics: 500 tpa, approximate commodity price excluding transport average $100-$1000 cost per tonne for non-CDS material (CDS material is likely to have a higher commodity price)
- Scrap metal, approximately 250 tpa (commodity price is between $50-$200 per tonne)

This type of facility could, prior transport, create a new revenue stream significant revenue stream.

All the streams recovered through the Dirty MRF system will avoid the landfill charge, which is a saving for Council.

Recommendation: Further review into the feasibility of this option is required to identify if there are sufficient feedstocks for this to be a viable operation.

4.2 Summary

Below is a summary of all the auxiliary facilities, based on the information provided in the previous section. SMEC has used a traffic high light system indicating if this system could be suitable for HCC to consider. These facilities have also been discussed with HCC at a workshop and the feedback from Council staff has been included in the recommendations below.

Table 9: Legend

Green light	Yellow light	Red light
Suitable	May be suitable	Not suitable

Table 10: Summary indicating suitability of each type of facility for Hawkesbury.

Type of facility	Footprint	Indicative cost	Comments (Council)	Recommendation
Solar farm 1MW	~ 2-3.5 ha for a 1 MW Farm	Min $1 M	Yes, this could be of interest.	Worth further consideration. Size and approach are pending where the landfill expansion will occur.
Waste Transfer station for residual waste	~ 2-5 ha	$1M - $3M excluding land preparation costs	Look at expanding the landfill first, a transfer station is only if/when landfill closes. There may be opportunities to collaborate with surrounding councils.	It is likely to be of interest when the landfill closes (price and cost will depend on type/size of transfer station and earthwork required)
C&D reprocessing – open air	~ 2-3 ha	$0.2M – $1M (will vary depending on what HCC wants to do)	Low volumes, can promote local circular economy, HCC - interested if it can be done cost-efficiently	Stockpile material for shredding/ crushing of concrete, tyres, timber, wood. Products can be used to create a local Circular Economy for Road & Building infrastructure
Cardboard and paper (paper mould)	~ 1000m^2	$0.2M -$0.5M (only for equipment, additional shed and infrastructure will be required)	Maybe, HCC prefer to provide an area at the Site where industry could hire space at the WTS	Can produce caddies for FOGO service or other paper trays, depends on feedstock volume
FOGO facility (20k tpa)	~ 4-10ha	$10-$40M[1]	Not of interest, this will be situated in the CE Hub	No, a FOGO facility will be established at the regional CE hub
Repair and reuse center	~ 200 - 500 m^2	$0.5M-$2M (includes cost for shed not for labour)	Interested, Encourages circular economy and community initiatives for reuse, repair, and social enterprises	Consider construct new building to use in combination, to the current resource area for local community
Further Scrap metal sorting	~ 200m^2	Labour cost to extract the metals	Can be included in a Repair/ Reuse center, collaborate with social enterprises.	This operation could be included in Included in repair and reuse center
Micro facility	~ 300-2500m^2	$1M plus earth works and cost of shed (cost will depend on number of modules)	Interested in this concept and could consider taking waste from surrounding councils for input to this facility.	This small-scale concept will help create a circular economy for problematic waste streams, and can be tailor made for HCC, plus there may be possibility to get funding
Landfill gas	Add on to existing area 100-200m^2	Cost neutral or minor revenue	Could be converted to renewable electricity	Assessment was done and said landfill gas production is not feasible at HCC, however the site is larger now and it may be worth revisiting

Type of facility	Footprint	Indicative cost	Comments (Council)	Recommendation
L-bin or Push pit	100-200m^2	Depends on the system and size $0.5-$2M	No comments	This could be a good way to divert more materials/recyclables from landfill
Dirty MRF	2000-3000m^2	Between $2M – $4M for equipment (excludes shed and earthwork)	Council said they may be interested in this type of processing	Will require significant space and processing at site, may be more cost-effective to position a centralized Dirty MRF for the region instead

[1] Capex/Opex will differ depending on if the Organic processing applied and the size of the facility, this interval is considering enclosed facility without and with AD.

The costs provided in the table above are preliminary and only indicative. For more detailed costing, more discussion on size and scope of each of the types of facilities needs to be undertaken. In addition, depending on exact location the required amount and cost for earthworks, road infrastructure and construction of buildings needs to be further assessed and considered.