RMCG

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Feasibility study of a regional plastic recycling facility for the Whitsunday Region

Final

Whitsunday Regional Council

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Table of Contents

ACKNOWLEDGEMENT OF COUNTRY

We acknowledge the Traditional Owners of the Country that we work on throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present, and we acknowledge emerging leaders. Moreover, we express gratitude for the knowledge and insight that Traditional Owners and other Aboriginal and Torres Strait Islander people contribute to our shared work in Australia.

We pay respects to all Aboriginal and Torres Strait Islander communities. We recognise that Australia was founded on the genocide and dispossession of First Nations people and acknowledge that sovereignty was not ceded in this country. We embrace the spirit of reconciliation, working towards self-determination, equity of outcomes, and an equal voice for Australia's First People.

1 Introduction

1.1 THIS PROJECT

Plastic recovery in the Whitsunday Regional Council (WRC) and the greater Whitsunday region is limited, with no existing local processors, significant transportation costs and limited markets. For the purpose of this project the greater Whitsunday regions include the area covered by seven councils: Whitsunday, Burdekin, Rockhampton, Isaac, Townsville, Mackay and Charters Towers.

Much of the agricultural, aquaculture and mining plastic is stockpiled, burnt or buried. Municipal and commercial collected recyclable plastic is sorted in Mackay and Townsville, but there are significant plastic volumes going to landfill. With the landfill waste levy, the Plastic Export Ban and national targets of 80% recovery by 2030, the need for a regional solution to plastic recovery is of particular urgency.

This feasibility study assessed the viability of establishing plastic recycling processing within the greater Whitsunday region and offered solutions for improved recovery. The objective of this work was to quantify and describe attributes that would be required by investors to consider.

This report presents

- Insights from stakeholders (section 2)
- Plastic quantification (section 3)
- Feasibility assessment (section 4)
- Discussion and recommendations (section 5)
- Conclusion (section 6).

1.2 DRIVERS FOR CHANGE

There is strong policy and strategic support for the improvement of local infrastructure in regional areas to manage waste. Previously, large amounts of unprocessed waste plastics, tyres, glass and paper were exported overseas to China – which took 1.25 million tonnes of waste in 2016–2017 – as well as Indonesia, Vietnam and several other countries.[1] The waste management landscape shifted dramatically in 2017 with China introducing stringent bans on waste imports, which was followed by increased import restrictions in India, Taiwan, Malaysia and Thailand.

National commitment to recycling our own waste and improving sustainability came in 2020 with the Recycling and Waste Reduction Act. The Act bans the export of most waste glass, plastic, tyres and paper, and represents a shift in focus towards building industry capacity, infrastructure and markets for resource recovery locally within Australia.[2] Specifically, the Export – Waste Plastic Rules 2021 stipulate that waste plastics must be sorted into single resin or polymer and further processes (flaked, pelletise, processes engineered fuels) before being exported.

At the national level, the National Waste Policy (2018) was developed to provide an overarching, coordinated framework to reduce waste and transition towards a circular economy model across all states.[3] It sets a national direction on waste through the establishment of five key principles and has a strong focus on improving resource recovery through alignment across national, state and local government priorities.

1 Pickin, J and Trinh, J 2019, Data on exports of Australian wastes 2018-19, Blue Environment Pty Ltd.
2 Department of Climate Change, Energy, the Environment and Water 2022, Waste Exports, Australian Government, https://www.dcceew.gov.au/environment/protection/waste/exports.
3 Commonwealth of Australia 2018, National Waste Policy: Less Waste, More Resources, Australian Government.

The five key principles of the National Waste Policy are:

1. **Avoid waste** through more efficient use, reuse and repair, and better design
2. **Improve resource recovery** by enhancing recycling and collection systems and the quality of recycled materials
3. **Increase the use of recycled material** by building demand and markets for it
4. **Better management of material flows**, for human health, the environment and economy
5. **Improve information** to support innovation, investment and decisions.

The National Waste Policy Action Plan (2019) aims to guide the transition to a circular economy through the implementation of discrete actions and targets.[4] Target three (3) aims to achieve an 80% national average recovery rate across all waste streams by 2030, in line with the waste hierarchy. Action 3.15 under this target is the development of shared infrastructure and processes for managing packaging waste in remote and regional areas. The Australian Packaging Covenant Organisation (APCO) leads this action. The National Plastics Plan (2021) further supports reducing and recycling plastics through regulation and working with industry.[5] It identifies regional solutions as a key action, specifically encouraging assessments of the feasibility of reprocessing packaging waste in regional areas.

In the Queensland setting, the Waste and Resource Recovery Strategy and Action Plan (2018) aims to transition Queensland toward a circular economy and build economic opportunity regarding resource recovery.[6]

The following actions are relevant to this project:

- Funding for the development of resource recovery industries through the Resource Recovery Industry Development Program, which encourages waste infrastructure investment and regional market development and job opportunities. Ongoing funding is committed to industry development through the Waste Levy.
- Development of the resource recovery market through industry attraction programs, investigation of opportunities for value-added recycled products, coordination of supply chains, and specific regional support.
- Promotion of international best-practice technologies and processes and co-investment in projects that utilise recycled materials.

Further, support may be available under the Queensland New Industry Development Strategy (2023), which targets regional areas including Greater Whitsunday for the development of regional economic opportunities in line with a low-emissions future.[7] The circular economy and resource recovery are priority areas for economic growth identified in this Strategy. The new strategy commits to deploying new funding streams for regional economic transformation, developing collaborative Regional Transformation Plans, accelerating infrastructure planning programs and facilitating supply chain development.

The Recycling Modernisation Fund – Plastic Technology Steam was available in July 2023, with outcomes of successful projects yet to be publicised.[8]

4 Commonwealth of Australia 2019, National Waste Policy Action Plan, Australian Government, <https://www.dcceew.gov.au/sites/default/files/documents/national-waste-policy-action-plan-2019.pdf>.

5 Department of Agriculture, Water and the Environment 2021, *National Plastics Plan*, Australian Government, https://www.agriculture.gov.au/sites/default/files/documents/national-plastics-plan-2021.pdf.

6 Queensland State Government 2018, Waste Management and Resource Recovery Strategy, <https://www.qld.gov.au/__data/assets/pdf_file/0028/103798/qld-waste-management-resource-recovery-strategy.pdf>.

7 Queensland State Government 2023, *Queensland new-industry development strategy*, <https://www.statedevelopment.qld.gov.au/__data/assets/pdf_file/0027/80766/queensland-new-industry-development-strategy.pdf>.

8 Queensland Government 2023, 'Recycling Modernisation Fund - Plastics Technology stream – Queensland approach' <https://www.statedevelopment.qld.gov.au/industry/critical-industry-support/resource-recovery/recycling-modernisation-fund-plastics-technology-stream-queensland-approach>.

2 Stakeholder engagement and background research

2.1 APPROACH

We interviewed a range of stakeholders to seek input on the volumes and types of waste generated and stockpiled. The approach included introductory emails, phone call or teams meeting and at times follow up emails and conversations. Details about volumes of waste data was limited but location and qualitative information was reasonable.

The 25 stakeholders interviewed included:

- 6 local councils (Whitsunday, Burdekin, Rockhampton, Isaac, Townsville, Mackay)
- Tyre Stewardship Australia (TSA)
- Mining businesses (Navarre, Glencore, Qcoal, Bravus, BMP, Ravenswood)
- Waste industry (JJ Richard's, Amdett Services and Plastic Recycling, Re-Group, RTD technologies, WMRR, Entyr, Enviroplas Recycling)
- Agriculture industry (Bowen Gumlu Growers Association, Tassal, GFB fisheries)
- Government /related projects (Regional Economic Development – Department of State Development, Infrastructure, Local government and Planning, Pit to Port project team lead by Coreo, Resources Centre of Excellence, BHP/BMP)

2.2 SECTORS AND STAKEHOLDER INSIGHTS

2.2.1 LOCAL GOVERNMENT

Consultation with regional Councils generated a wealth of information, with both quantitative and qualitative data being valuable. Council representatives provided information on where waste was managed, what management systems are in place, how well they thought the system was functioning and their opinions on gaps to be addressed. Data on the amount of waste landfilled and recycled and the plastic proportions of these streams were incomprehensive but helped to sense check and support the modelled approach (see Section 3.1.1).

All councils but Charters Towers offer a two-bin kerbside service. Recycling is sent to Mackay and Townsville to be sorted but all materials are sent to Brisbane or other markets for processing. A significant amount of plastic is landfilled throughout the region's sites. Some of the key information provided was:

- What other waste management organisations or private companies were active. For example, Containers for Change is operated by Anything Environmental, data recording and database management at transfer stations and landfills operated by Mandalay. Also, businesses and some council direct to and use the private recycling operators Amdett Services and Plastic Recycling.
- Work has previously been done to investigate a proposal for an Off-the-Road (OTR) tyre recycling facility in Nebo, but it stalled. However, Isaac Council expressed continuing interest in an OTR tyre recycling facility.
- Isaac Council were interested in conducting a waste compositional analysis to further understand waste composition, especially in the C&I stream.
- Few Council representatives were aware of agricultural stockpiles.

- Councils reported that the Regional Organisation of Councils groups were active in waste analysis and planning, often more so than individual Councils. For example, North Queensland ROC has been developing a new NQROC Regional Waste Management Plan, based on 12 months of regional waste data. A public version of this document was not available at the time of conducting this project.

Challenges identified by some Council representatives were:

- Difficulty in accessing OTR tyres for recycling because of the practice of burying them on mine sites.
- Failure of a past agricultural plastics recycling scheme in the region.
- Sense of frustration and setback experiences following the collapse of the REDCycle soft plastics recycling program.
- Long distances and dispersed infrastructure for managing waste led to inefficiencies, for example WRC reported that only one transfer station had capacity for baling of waste, but this wasn't done.
- One Council reported that a lot of waste data is 'invisible to Councils'.
- There are likely to be more poorly managed sources of plastic waste that pose environmental problems, for example the dam liner from mine tailings dams which is periodically replaced and stockpiled.

2.2.2 AGRICULTURE AND FISHERIES

RMCG supported by AgriFutures, has undertaken extensive investigation into agricultural plastics – exploring their use, quantities, current fate, and options for recovery or replacement with non-plastic materials.[9] Baseline data on waste from agriculture, fisheries and forestry have been collated, and a resource recovery roadmap produced.

Two programs, drumMUSTER and bagMUSTER, currently exist in the Whitsunday region for dealing with chemical containers and plastic bags respectively. The participation rate is impacted by drop-off locations proximity to users and ease of use.

Research has highlighted the rapid growth in interest and production of alternatives to current plastic products. This include the use of certified biodegradable material for composting (e.g., biodegradable mulch) and single-and-high value plastic polymers that are attractive for recycling (e.g., pp irrigation pipe). Ultimately, if avoidance of agricultural plastics is possible in the region, there may be a reduction of long-term feedstock of agricultural plastics. This result aligns with the principles of the waste hierarchy.

Horticulture dominates the greater Whitsunday region's agriculture with intensive vegetable and orchard production. Sugarcane is the other major agricultural commodity. Plastic mulch film and drip tape are commonly stockpiled on private farms or at one of two aggregated stockpile locations (see section 3.3.2). Some larger operations send irrigation pipe to Brisbane for recycling. Other plastics used include drums, netting, twine, bags and aquaculture material such as feed bags, floats, tanks and paddlewheels. There is very limited recycling available and whilst some is collected/deposited at landfill, but most enterprises have on-site stockpiles or unofficial pits. Bowen Gumlu Growers Association are working with farmers to reduce mulch use by trialing compostable films. They are also collaborating with Brisbane recyclers to facilitate better recovery of on-farm plastics.

Taking this background into account for this feasibility study, it is apparent that multiple industries in the region suffer similar challenges in terms of recycling their plastics, yet one solution may not fit for all industries. Considering the complex and diverse nature of plastic materials used across agriculture, fisheries, mining and municipal waste streams, a plastics recycling facility would likely need to have specialised equipment to deal with multiple types of composite wastes.

[9] Boland, A, Muller, C, Lucas, D, Axio, I, Tee, E and McNulty, S 2022, *Agriculture, Fisheries and Forestry National Waste and Resource Recovery Roadmap*, Agrifutures, <https://agrifutures.com.au/wp-content/uploads/2023/04/Agriculture-Fisheries-Forestry-Waste-Roadmap.pdf>.

2.2.3 OFF-THE-ROAD (OTR) TYRES

Off-the-road (OTR) tyres are a resource used extensively across mining and agriculture in the north Queensland region, yet they have persistently low recovery rates. Queensland generated an estimated 46,330 tonnes of used OTR tyres in 2021-2022, which was 34% of the national total.[10] The Bowen Basin has been identified by Tyre Stewardship Australia (TSA) as a OTR tyre hotspot, which may be capable of supporting viable tyre recovery infrastructure due to its high density of mining operations.[11] Tyre Stewardship Australia (TSA) estimates OTR tyre generation in the Bowen Basin at 9,390 tonnes/year from mining and 780 tonnes/year from agriculture. Considering the size of the OTR waste stream in the area, and the relatively high connectivity of mining operations by road and rail, there may be potential to incorporate OTR tyres into the proposed feedstock for a Plastics Recycling Plant in the Whitsunday region.

TSA has developed a regional business case for a circular economy for used tyres specifically for Northern Queensland.[12] Current management of used tyres suffers from several inefficiencies and has detrimental environmental impacts (i.e., they are either transported long distances, stockpiled, sent to landfill, or disposed of in the surrounding landscape or mining pits). The report provides strong evidence for the benefits of a regional recovery solution for used tyres, including improved environmental outcomes, investment and employment in the region, economic diversification, and economic advantages from both reduced costs in transport and the value of the used tyres themselves. Two key challenges to implementing local tyre recycling are the lack of regulatory pressure to recover used OTR tyres, and the associated costs. Currently, used mining tyres are permitted to be buried on site at low to no-cost, thus tyre recovery services are currently unable to offer a competitive advantage.

Stakeholder engagement for this study suggest that OTR tyres in mines are often legally buried or when mines are closing stockpiled and/or landfilled. The TSA have collaborated with mines across Australia and found that the appetite for recovering tyres varies. As current regulations allow for on-site burial, there is no financial or practical push to instigate a collection and processing service. At the same time many mining operations recognize that there is an increasing pressure on environmental performance of mining operations and the benefit of a scheme to drive the feasibility of recovery.

The recovery of OTR tyres is complicated by collection logistics and recycling complexities. Tyres are bulky and mines are located far away from markets, so transport is incredibly inefficient. OTR tyres are composed of a range of materials including steal, natural and synthetic rubber and fabric so the separation of each material is complex. Entyr tyre recyclers in Brisbane explained that whilst recycling technologies exist, and there are a couple of Queensland processors, there is none currently targeting OTR tyres in the region. Further, most existing operations in Queensland and Australia more broadly are either shredding operations producing a processed engineers fuel or crumbing operation producing char for asphalts. Both products are only used once after processing and not continually recyclable.

2.2.4 MINING

In addition to tyres, mines tend to generate HDPE and PVC poly pipes, IBCs, hydraulic oil drums and smaller amounts of pallets and shrink wrap. HDPE and PVC pipes are generally used until mines are decommissioned. Private service providers collect skips where most plastics are mixed and thus landfilled.

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[10] Tyre Stewardship Australia 2023, *Tipping the balance: the business case for a circular economy for Australia's off-the-road tyres, conveyors and tracks*, https://www.tyrestewardship.org.au/wp-content/uploads/2023/06/TSA0003%20-%20L8%20-%20OTR%20-%2040pp%20Business%20Plan%20-%20A4.pdf.

[11] The 'Bowen basin' area is different to the 7 identified councils for this research.

[12] Toovey, N and Malin, N 2022, *Queensland Regional Business Case for a Circular Economy for Used Tyres*, Tyre Stewardship Australia, https://www.tyrestewardship.org.au/wp-content/uploads/2022/08/TSA-NQROCFNQROC-Business-Case-Full-Report.pdf.

There is a current regional project, 'Pit to Port', that is exploring circular opportunities for the Queensland Resources Sector. The project partners[13] are seeking to conduct both qualitative and quantitative analysis to explore opportunities for circularity in BHP/BMA operation in connection with the Queensland regional area's other industries (such as MSW, Agriculture, aquaculture).

2.2.5 WASTE INDUSTRY

JJ Richards is currently the major collector of both MSW and C&I residual and recycling waste. They service the skips in mines and expressed that there is an opportunity for plastic recovery of shrink wraps, IBC plastics, plastic drums, hard hats and plastic bottles from these operations.

The regional material recycling facilities in Mackay and Townsville are managed and operated by Re-Group. They sort material and bale plastic into PET, HDPE and mixed plastics. Material is sent to Brisbane or other Australian markets for processing. There is interest in increasing the material sorted and baled in the region to include, for example, agricultural and other industrial plastics.

Theoretically a mobile baler could service on-site size reduction and collection and use existing MRF for aggregation and distribution to processing markets. However, previous experience of operating a mobile baler in the region came to an end when the export restrictions increased the processing price. Then, there was no willingness to pay for the service from farmers, so the practice became un-viable and ceased.

Recycling operators in the region expressed that regional processing beyond 'sorting and baling' is unlikely to be viable. A washed and flaked product would still need a market, likely to be in Brisbane or further south, making it more realistic to locate processing capabilities there. The difference between transporting a 'sorted and baled' product versus a 'washed and flaked' product is not great enough to warrant regional processing infrastructure. Unless there was a resilient and thriving market for the product in the region.

[13] BHP/BMA, Resources Centre of Excellence, Coreo, Metabolic

3 Plastic quantification

3.1 ANNUAL GENERATION OF PLASTIC

3.1.1 MODELLING APPROACH

Plastic generation for each sector was quantified using different approaches.Figure 3-1 describes how plastic generation was modelled and outlines the data metric references, extrapolation data, output and key assumptions.

In summary, raw data from the desktop research and consultation was used to model:

- **Agricultural plastic:** This created a regional profile based on existing model data that used ABS agricultural production data by sector and plastic generation factors.[14]
- **Aquaculture plastics**: This used data as reported by key stakeholders consulted.
- **MSW and C&I plastic:** First, this approach combined medium projections for SA4 population and state-published waste generation data for landfill and recovery. Of the 6 Councils engaged, some were able to provide specific landfill data, but as it was ad hoc, the state-published figures were used.[15] Data on total volume landfilled and recycled was combined with key assumptions on the plastic composition - estimated at 13.2% for MSW and 13.0% for C&I waste, based on a state-wide waste audit report for NSW and on the National Waste Report 2022.[16,17] Townsville City Council was the only council able to provide regional audit results. This was used as a sense check for the assumptions, but the state-wide figures were used.[18]
- **Off-the-road tyres:** This was estimated using the nominal OTR tyre generation factor of 49 tonnes per million tonnes of production combined with published production data sets of mines in the region.[19]
- **Duration**: 10 years of future plastic generation for the regions with assumptions for production/population increases.

[14] Based on AgriFutures 2023, Pre-farm gate waste management – baseline waste data for the agricultural, fisheries and forestry sectors, https://agrifutures.com.au/wp-content/uploads/2023/05/23-006.pdf.

[15] Where Councils provided tonnes of waste landfilled or recovered for MSW and C&I streams, the model estimates were checked directly against these figures to ensure the model was as accurate as possible. For example, Rockhampton reported that 28,308 tonnes of MSW were disposed of to landfill in the 2022/2023 financial year. The modelled figure was 28,462 tonnes, showing an error of 0.5%.

[16] Rawtec 2020, *Analysis of NSW Kerbside Red Lid Bin Audit Data Report.*

[17] Blue Environment 2022, *National Waste Report 2022*, The Department of Climate Change, Energy, the Environment and Water, Australian Government.

[18] Townsville figures for plastic in MSW were 11.5% and for C&I 16.18%. This is a slight variation from the state-wide figures but broadly supports the assumptions.

[19] Tyre Stewardship Australia 2023, Tipping the balance: the business case for a circular economy for Australia's off-the-road tyres, conveyors and tracks. Page 100, retrieved from, https://www.tyrestewardship.org.au/wp-content/uploads/2023/07/TSA0003%20-%20L20%20-%20OTR%20-%20200pp%20Business%20Case%20Master%20-%20A4%20-%20WR.pdf.

	Model approach		10 year projection assumptions	Model output
Agricultural plastic	**Plastic use - tonnes of plastic / type of plastic type / production** (AgriFutures, 2022 Pre-farm gate waste management - Guidelines for waste data collection)	**Production data - tonnes or number** (2020-21 Agricultural Census)	10% Production increase	Plastic waste generation / agricultural sector / plastic group / local government area
Aquaculture plastic	**Total plastic reported - tonnes of plastic / type of plastic** (Interview data)		300% increase for Tassal production in acordance with planned expansions	Plastic waste generation total for interviewed entities
MSW and C&I landfilled and recycled plastic	**Plastic use / capita / landfill and recycling (Tonnes landfilled and recycles / population * % plastic)** Total tonnes landfilled and recycled (2021-22 Recycling and waste in Queensland report) Population (ABS 2022 Region Summary: Mackay - Isaac - Whitsunday) MSW % plastic in landfill and recycling (Analysis of NSW kerbside Red Lid Bin Audit report 2011-2019) C&I % plastic in landfill and recycling (National Waste Report 2022)	**Population** (Queensland Government population projections, 2023 edition; Australian Bureau of Statistics, Regional population, 2021)	13.2% plastic in MSW landfill and recycling 13.0% plastic in C&I landfill and recycling Population growth (medium scenario)	Plastic waste to landfill / local government area / MSW and C&I Plastic waste to recycling / local government area / MSW
Tyres	**Tyre use factor - tonnes of tyres / production** (Tyre Stewardship Australia, 2023 Tipping the balance)	**Production data - Million tonnes** (Queensland Government Coal Industry Review - Production by Individual Mines)	no growth, static generation	Tyre waste generation / local government area

Figure 3-1: Model approach for each plastic generation sector.

3.1.2 OVERALL ANNUAL GENERATION RESULTS

According to the model, a total of 49,249 tonnes of plastic was generated in the region in 2022.

The majority (95%) of this plastic comes from kerbside collections from municipal (MSW) and commercial (C&I) sources (Figure 3-2Figure 3-1). This results in Townsville, with the greatest population, also having the highest volume of plastics with total generation being directly linked to population (Figure 3-3, Figure 3-4).

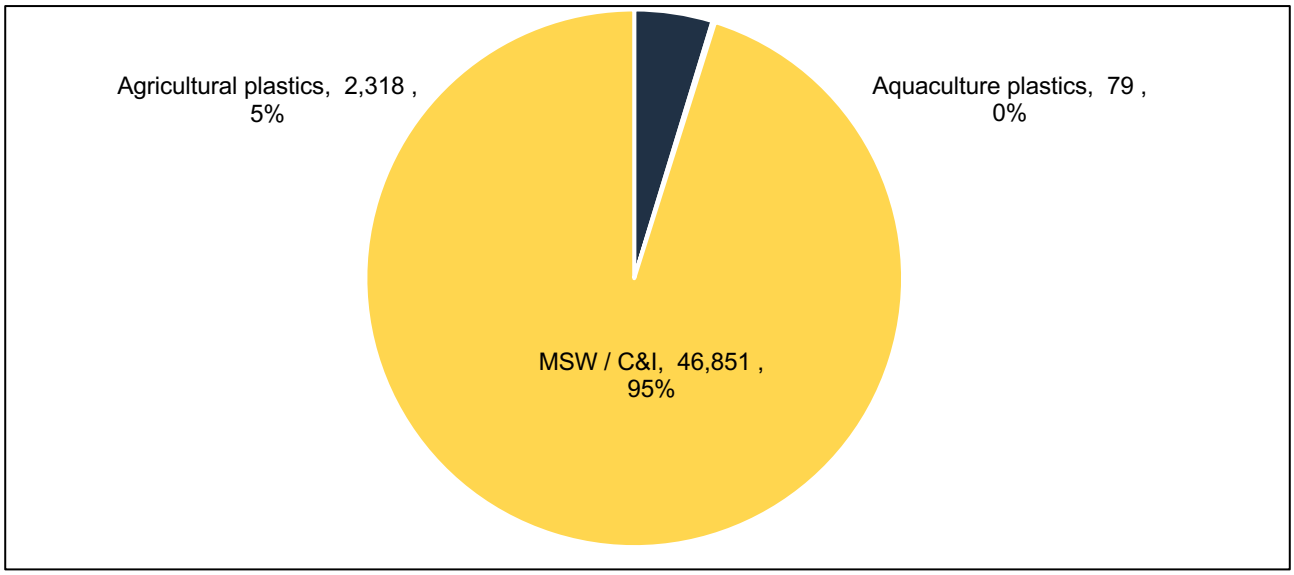


Figure 3-2: Plastic generation by sector, proportion (%) and total volumes (tonnes).

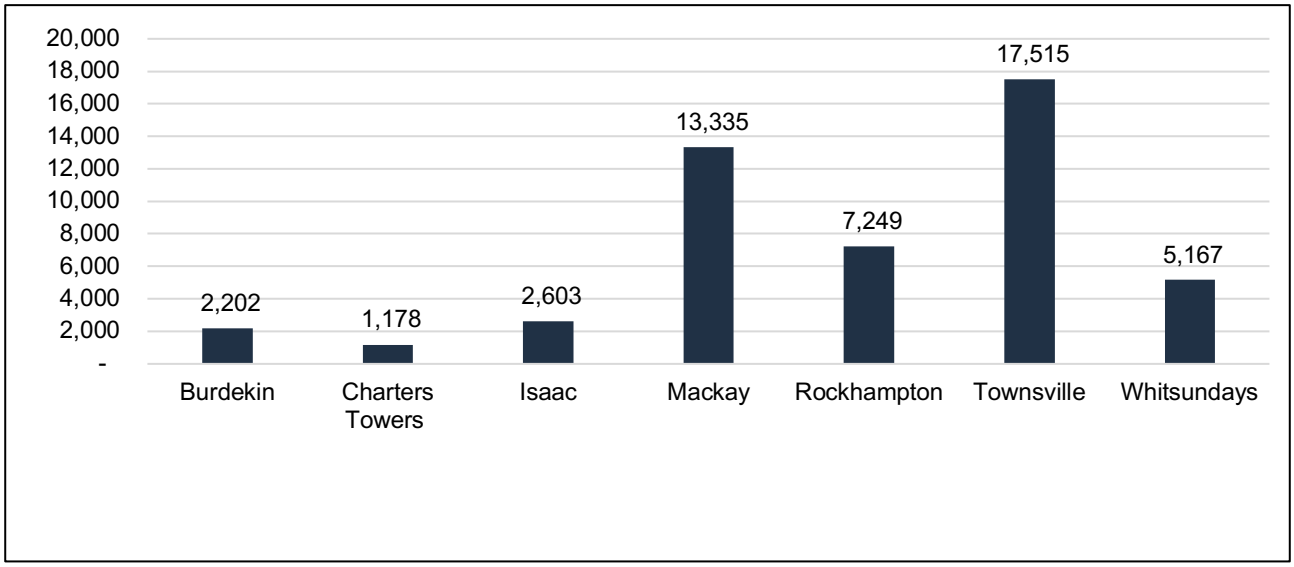


Figure 3-3: Plastic generation by local council area, total volumes (tonnes)

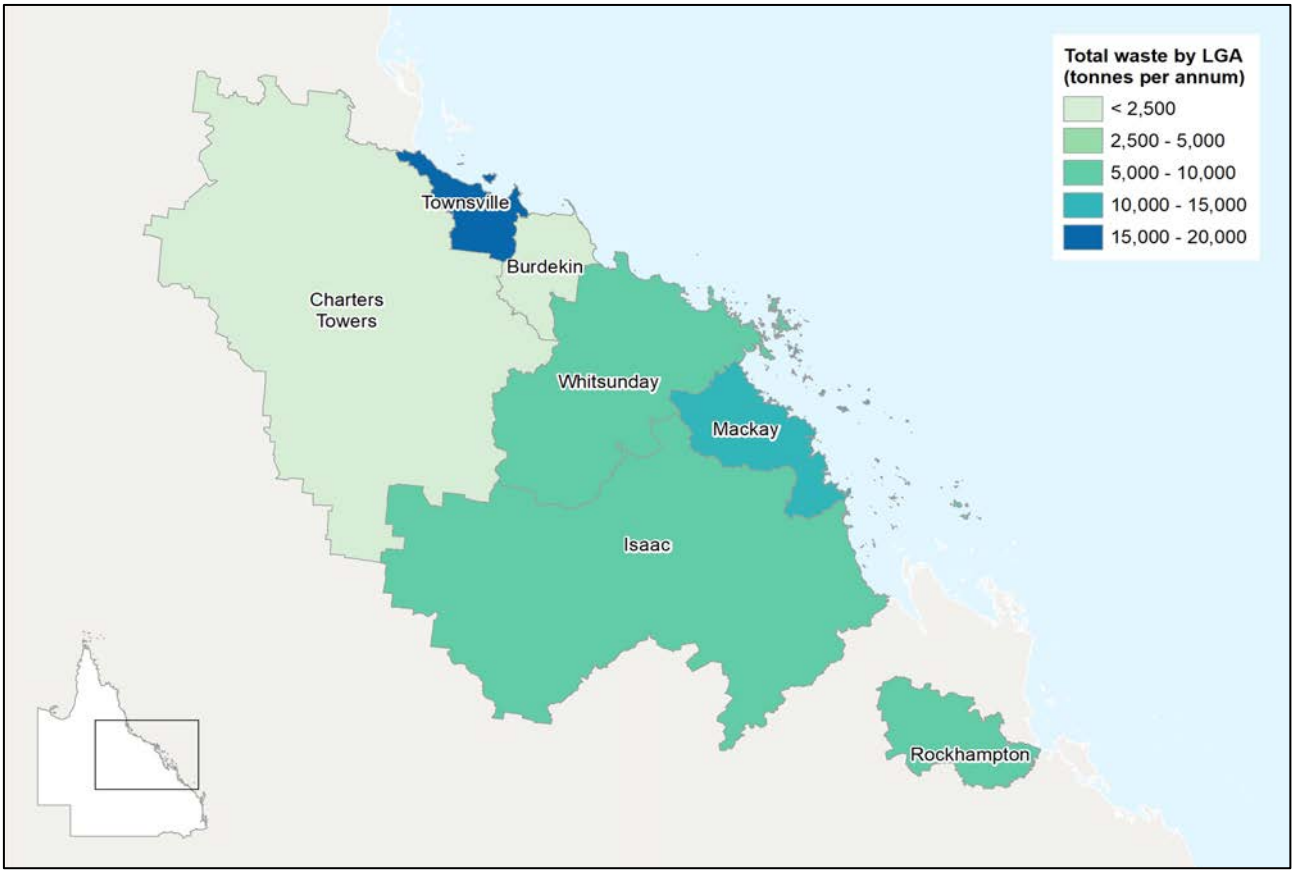


Figure 3-4: Map of plastic generation by local council area.

3.1.3 SECTOR SPECIFIC ANNUAL GENERATION

The total volume generated (tonnes) by sector in local council areas in 2022, according to the model, is described in Table 3-1.

Table 3-1: Total plastic generated by sector and local council area (tonnes per annum)

Sector	Burdekin	Charters Towers	Isaac	Mackay	Rockhampton	Townsville	Whitsunday	Total
Agricultural plastics	723	127	192	83	68	119	1,005	2,318
Aquaculture plastics	-	-	-	-	-	3	77	79
MSW landfill	750	533	1,135	6,237	3,757	8,813	1,923	23,147
MSW recycled	56	40	65	355	319	660	109	1,603
C&I landfilled	674	479	1,212	6,660	3,105	7,920	2,053	22,101
Total	**2,202**	**1,178**	**2,603**	**13,335**	**7,249**	**17,515**	**5,167**	**49,249**

3.1.4 SECTOR SPECIFIC PLASTIC TYPE COMPOSITION INSIGHTS

A summary table of plastic types, compositions and characteristics is included in Appendix A - Plastic type characteristics descriptionsAppendix A - Plastic type characteristics descriptions

Agriculture and aquaculture: There are an estimated 2,318 tonnes of agricultural waste generated in the region, with the majority located in Whitsundays (43%) and Burdekin (31%). Most aquaculture plastics identified are generated within the Whitsundays, with a small proportion in Townsville.

Plastic generation by plastic type is described in Table 3-2. The modelling shows that most plastics are ‘containers, pots and labels’, followed by ‘protective films’. There are also significant volumes of ‘piping, irrigation and drainage’, ‘net and mesh’ and ‘protective films’. Whitsundays and Burdekin are dominated by intensive horticulture, so it can be assumed that the plastic types are chemical and fertiliser containers, fruit crop nets, irrigation poly pipe, irrigation trickle tape and plastic soil mulch. In addition, significant sugarcane producers are present, adding to the containers used for inputs.

Table 3-2: Agricultural plastic generation by plastic type.

Agricultural plastic type	Generation (tonnes per annum)
Bags, twine and ropes	70
Containers, pots and labels	787
Nets and mesh	419
Piping, irrigation and drainage	442
Protective films	601
Total agricultural plastics for region	**2,318**

MSW: There are an estimated 24,750 tonnes of plastic from MSW collection. Plastic includes a small proportion currently being recycled (6%) whilst all other amounts are being landfilled. There are many types of plastic in residual streams and landfill, including packaging that is typically recyclable in co-mingled services

such as HDPE and PET bottles and boxes. It will also include a range of soft (film, bags), semi-ridged (ESP, PS, LDPE) and composite plastic that are currently not recyclable in the co-mingled stream.[20]

Townsville City Council conducted a compositional waste audit of MSW residual waste and recycling bins in 2022. The audit found that the residual waste stream typically contains 4.56% recyclable plastic and an additional 6.94% non-recyclable plastic, giving a total plastic proportion of 11.50%. The recycling stream typically contains 12.20% recyclable plastic and an additional 3.98% non-recyclable plastic, giving a total plastic proportion of 16.18%. These proportions are given as a percentage of overall landfill weight. Using the compositional breakdown from this audit Table 3-3 presents the estimated types of plastic in in the MSW stream.

Table 3-3: Estimated plastic types in MSW stream.

Plastic type	MSW plastics in landfill		MSW plastics recovery	
	% of plastic[21]	plastic (tonnes)	% of plastic[22]	plastic (tonnes)
Recyclable plastic	4.56%	9,178	12.20%	1,209
Non-recyclable plastic	6.94%	13,969	3.98%	394
Total	**11.50%**	**23,147**	**16.18%**	**1,603**

C&I: There are an estimated 22,101 tonnes of plastics from C&I collections. C&I typically includes material from private collections and material deposited directly to waste transfer stations or landfills. It includes trades, retail, shopping centres and various small to medium businesses. The type of plastic can be wide ranging and includes recyclables. Townsville City Council conducted a compositional waste audit where five groups of plastics were assessed. On average 11.23% of C&I loads were found to be plastic. Using the compositional breakdown from this audit Table 3-4 presents the estimated percent and volumes of different types of plastic in the C&I stream.

Table 3-4: Estimated plastic type in C&I stream.

Plastic type	% of plastic[23]	Plastic (tonnes)
Mixed plastics	6.39%	12,580
Black plastic	1.47%	2,902
Polystyrene	2.88%	5,672
Polypropylene bag	0.40%	787
PVC	0.08%	159
Total	**11.23%**	**22,101**

[20] The assumption used for plastic in residual kerbside includes a list of 21 plastic types but does not split out proportions of each plastic. What can be considered recyclable also depends on what is accepted in the LGA, what the MRF can sort and ever-changing markets. See page 28 in report for definition of plastics in residual stream: Rawtec 2020, 'Analysis of NSW Kerbside red lid bin audit data report', <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/fogo/red-bin-audit-2011-19.pdf?la=en&hash=92CF60F4DF80D48AD1910B7891041C38DB683B66%20and%20C&I%20from%20https://www.dcceew.gov.au/sites/default/files/documents/national-waste-report-2022.pdf>.

[21] The proposition of plastic was weighted and applied to the total plastic generation. For example, 4.56% of 11.5% is 39.65%.

[22] As per footnote 20.

[23] As per footnote 20.

3.2 10-YEAR GENERATION OF PLASTIC

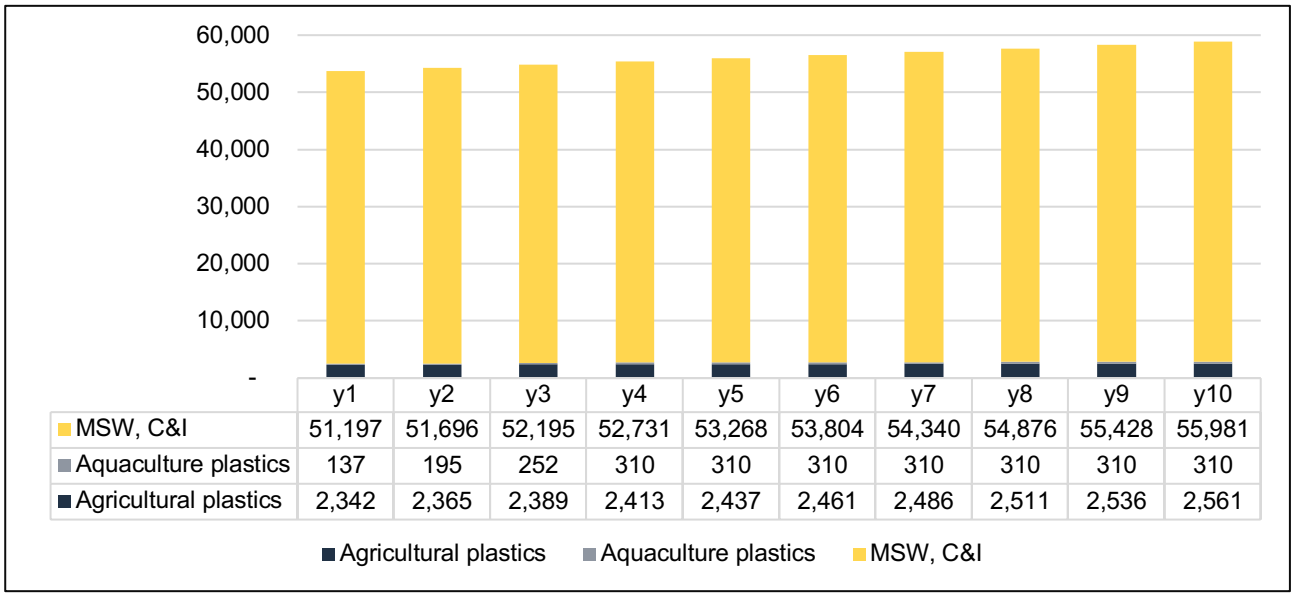
3.2.1 MODELLING APPROACH

The 10-year analysis considered high-level assumptions for waste generation changes, namely:

- **MSW and C&I generation**: Medium population increase by local government area.[24]
- **Agricultural**: Production and plastic use increase (10% over 10 years).
- **Aquaculture**: Production increase based on approved and planned expansion of 300% over 4 years. [25]

3.2.2 10-YEAR PLASTIC GENERATION RESULTS

In summary a total of 535,516 tonnes of plastic could be used and generated in the region over the 10-year period with Figure 3-5 showing the change over time and annual generation per stream.



	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10
MSW, C&I	51,197	51,696	52,195	52,731	53,268	53,804	54,340	54,876	55,428	55,981
Aquaculture plastics	137	195	252	310	310	310	310	310	310	310
Agricultural plastics	2,342	2,365	2,389	2,413	2,437	2,461	2,486	2,511	2,536	2,561

Figure 3-5: Plastic generation (tonnes) in the greater Whitsunday region over 10-years.

[24] Queensland Government 2023, 'Projected population, by local government area, Queensland, 2021 to 2046', <https://www.qgso.qld.gov.au/statistics/theme/population/population-projections/regions#current-release-qld-population-projections-regions-tables>.

[25] Information provided by WRC to RMCG based on planned expansions, https://statements.qld.gov.au/statements/90271>.

3.3 OTHER PLASTIC QUANTIFIED

3.3.1 OFF-THE-ROAD TYRES

There are an estimated 6,581 tonnes of tyres in the region associated with mining operations. Mining operations in Whitsundays generate some tyres (12%, 794 tonnes), but most tyres are located in Isaac (85%, 5,586 tonnes).

3.3.2 STOCKPILES OF PLASTICS

Aggregated stockpiles: There are two known official mixed stockpiles of agricultural plastic in the region. One is located at S.S.A.A.[26] Bowen Branch Inc and is estimated to hold 5,000 tonnes of mixed agricultural plastics, mostly plastic mulch and irrigation tape. The material appears to be covered with earth and is used as a mound for practice shooting. The second stockpile is located within Amdett Services and Plastic Recycling alongside the Bruce Highway. It is understood that this official site collects, sorts and bales agricultural plastics and distributes these to markets in Brisbane. However, significant piles reside on the property, estimated at 3,000 tonnes and believed to include woven bags, IBCs, tanks and plastic mulch.

Business specific stockpiles: There are two known land-based aquaculture businesses in the region that provided details during consultation about stockpiles of bulky hard-to-recycle plastics, including paddlewheel floats, paddles, covers, feed pipes, hatchery tanks, HDPE pipe, pond liners and one large stockpile of baled woven feedbags. The total amount is estimated at approximately 50 tonnes. The plastics are sorted and stockpiled in a flat clear area.

Unofficial farm stockpiles: There are known stockpiles at most agricultural and horticultural farms in the region. The Gumlu Growers Association estimates between 250–500 kg for approximately 80 farms. A non-comprehensive spatial analysis randomly identified 6 farms in the Bowen region and estimated that over 7,000m^2 are covered in plastic stockpiles with 6,000 tonnes of plastic. The spectral imagery and photos from the area suggest that piles are a mix of mulch and irrigation pipe but not overgrown. For privacy reasons, the specific locations will not be revealed.

[26] Sporting Shooters Association of Australia.

3.4 PLASTIC CAPTURE SCENARIOS

3.4.1 MODELLING APPROACH

The generation of plastics describes how much plastic is used and disposed. However, assuming that all the material could be captured for recycling is unrealistic. To change the current practices of individuals and businesses takes time and effort. Further, not all plastic types are attractive for all recycling process technologies. This section presents high-level scenarios for likely captured amounts for recycling with key assumptions outlined in Table 3-5.

Table 3-5: Assumptions for low and high scenarios of capture rates.

Agricultural plastic type	Generation amounts	Capture rate (Low)	Capture rate (High)	Assumptions
Bags, twine and ropes	70	10%	20%	Only one stewardship scheme currently operates for bulk bags (FIBCs) and represents less than 30% of the FIBCs sold. No scheme for twine or rope – often contaminated with vegetable matter.
Containers, pots and labels	787	10%	50%	DrumMuster is available in the region but does not include all containers used. National PP pot collection scheme exists, but no regional drop-off is set up.[27]
Nets and mesh	419	0%	0%	Not currently recyclable in Australia
Piping, irrigation and drainage	442	30%	60%	Poly pipe has markets in Brisbane. Must be baled on-site to ensure freight efficiency. Amounts would include plastic pipe and tape that is less likely to be recovered from farms and recycled.
Protective films	601	0%	0%	Majority of films used in the region are mulch films, which are not currently recyclable in Australia.
Aquaculture PPE	47	0%	0%	Niche recycling required.
Aquaculture feedbags	30	50%	100%	Two major aquaculture producers in the region currently use feedbags which they sort and bale on-site. They commented that accessing markets was not straight forward.
Aquaculture HDPE pipe	2	50%	100%	Attractive plastic type from source separated operations.
MSW and C&I plastic in landfill	46,851	10%	30%	Less than half of landfilled MSW plastics is typically considered recyclable (see Table 3-3). Just over half of C&I could be recyclable (see Table 3-4). Both streams would require significant collection system and behaviour changes. Mixed plastic waste could be processed with Advanced Recycling – but not done at scale yet in Australia.

[27] Garden City Plastic n.d. 'PP5 Recycling initiative', <https://www.gardencityplastics.com/pp5-bin-locations>.

3.4.2 PLASTICS CAPTURED RESULTS

Estimated plastic types captured. Using the above assumptions, the 'low capture' scenario would result in 4,759 tonnes per annum of plastic requiring collection and processing in the region while the high scenario would capture 14,429 tonnes per annum. Details are presented in Table 3-6.

Plastic captured by sector and LGA. The types of plastic generated within each local council area varies. A breakdown of the plastic type for each LGA and the two scenarios is presented in Table 3-7 and Table 3-8.

Table 3-6: Annual total plastic captured (tonnes) in high and low scenarios, by plastic type.

Agricultural plastic type	Capture rate (Low)		Capture rate (High)	
	Capture rate (%)	Generation amounts (tonnes)	Capture rate (%)	Generation amounts (tonnes)
Bags, twine and ropes	10%	7	20%	14
Containers, pots and labels	10%	79	50%	393
Nets and mesh	0%	-	0%	-
Piping, irrigation and drainage	30%	133	60%	265
Protective films	0%	-	0%	-
Aquaculture PPE	0%	0	0%	-
Aquaculture feedbags	50%	15	100%	30
Aquaculture HDPE pipe	50%	1	100%	2
MSW and C&I plastic in landfill	10%	4,525	30%	13,574
Total annual plastics		**4,759**		**14,279**

Table 3-7: Low capture scenario annual plastic volumes (tonnes), by plastic type and LGA.

	Burdekin	Charters Towers	Isaac	Mackay	Rockhampton	Townsville	Whitsunday	Grand Total
Volumes captured (2022 Low)								
Agricultural plastics	70	9	19	10	6	11	93	218
Aquaculture plastics	-	-	-	-	-	1	15	16
MSW / C&I	142	101	235	1,290	686	1,673	398	4,525
Total (excludes tyres)	**212**	**110**	**254**	**1,300**	**692**	**1,686**	**506**	**4,759**

Table 3-8: High capture scenario annual plastic volumes (tonnes), by plastic type and LGA.

	Burdekin	Charters Towers	Isaac	Mackay	Rockhampton	Townsville	Whitsunday	Grand Total
Volumes captured (2022 high)								
Agricultural plastics	220	27	47	26	18	35	299	672
Aquaculture plastics	-	-	-	-	-	3	30	32
MSW / C&I	427	303	704	3,869	2,059	5,020	1,193	13,574
Total (excludes tyres)	**647**	**331**	**751**	**3,895**	**2,077**	**5,058**	**1,522**	**14,279**

4 Feasibility assessment

4.1 ASSESSMENT OF MANAGEMENT COSTS

4.1.1 APPROACH AND ASSUMPTIONS

This section provides a high-level cost assessment comparing the difference in cost between landfilling and recycling of the quantified volumes from the three scenarios described in Section 3:

1. **Overall generation of plastics**: this assessment compares the cost of all plastic generated (see section 3.2.2) being landfilled against being recycled.
2. **Low capture of plastic**: this assessment compares the cost of the low captured volumes (see section 0) being landfilled against being recycled.
3. **High capture of plastics**: this assessment compares the cost of the high captured volumes (see section 0) being landfilled against being recycled.

The assessment assumes that the current practice of plastic management is landfilling, and that the desired future management is recycling. Using a 10-year period the assessment estimates the cost of current and future management, the comparative cost and the discounted net present value (NPV) of the comparative cost.

A set of assumptions were developed for the cost assessment model, as shown in Table 4-1.

Table 4-1: Economic model assumptions

Assumption	Value	Description
Landfill gate fee	$280	This landfill gate fee includes the regional levy ($91/tonne) and represents a weighted average of the 7 regional councils published 2023/24 charge for C&I landfilled mixed waste.
Discount rate	8%	The selection of an 8% discount for this project is grounded in economic theory and practical considerations. The discount rate reflects the rate of interest that is used to discount future cash flow of an investment (i.e., the opportunity cost of investing in the recycling option compared to investing public funds). In the context of local government decision-making, an 8% discount rate is often chosen as it aligns with prevailing market interest rates and represents a reasonable approximation of the rate at which the government could alternatively invest these funds.
Recycling gate fee	$150	Implementing a $150 gate fee for a recycling facility gate fee is justified due to its role in covering essential start-up and operational costs. These upfront expenses are necessary for a facility's operational functionality. The fee helps offset the financial impact of processing contaminated plastics. The fee value was tested with waste industry and agricultural producers for this project.[28]
Net present value - benefit calculation		The benefit of the economic model is calculated as the saved cost available for investment in a new facility, minus recycling gate fees. This represents the financial advantage gained from efficient recycling processing. This benefit is calculated over the 10-years and presented as a Net Present Value (NPV).

[28] The regions current recycling operators and grower association were asked about current recycling cost, the expected future cost and wiliness to pay for a future service. A cost fee range of $100-$150 was discussed. Growers indicated that current and preferred future cost of recycling was in the range of $100-$120. Recycling operators indicated that processing cost ranged between $100-$150 depending on the type and cleanliness of plastic.

4.1.2 RESULTS OF COST ASSESSMENT

The cost to landfill or recycle plastic material for different scenarios is provided in Table 4-2. The cost difference describes the amount saved by recycling instead of landfilling. The NPV is calculated on the cost difference over the 10-year timeframe with an 8% discount rate.

NPV can be considered as a price cap for investing in recycling processing technologies. The benefit, in this case, is defined as the funds available for a new facility after accounting for likely gate fees.

The NPV (benefit) of 'Overall generation' is by far the highest followed by the 'High capture' scenario. This shows that the more plastic that is diverted, the greater the benefit. However, as described in section 0, achieving increased recovery is complex and dependant on behavioural change, contamination and plastic type. Therefore, the benefit of the 'Low capture' and 'High capture' scenarios presents more realistic figures for considering recycling processing technology investment.

Table 4-2: Cost assessment of landfilling vs. recycling of total generation, low and high scenarios (million dollars) and resulting benefit.

	Overall generation ($million)	Low capture ($million)	High capture ($million)
Cost of landfilling captured material	$153	$15	$25
Cost of recycling captured material	$82	$8	$46
Cost difference (landfill- recycling)	$71	$7	$21
Benefit: NPV of future cost	**$47**	**$5**	**$14**

4.2 RECYCLING TECHNOLOGIES OPTION ANALYSIS

4.2.1 CHALLENGES AND OPPORTUNITIES

There are a range of challenges and opportunities for processing plastics that are specific to regional areas (Table 4-3).

Table 4-3: Challenges and opportunities to regional plastics and tyre recovery.

Sector	Challenges	Opportunities
MSW/C&I	▪ Difficulty developing/retaining local capacity to operate and maintain complex plant and equipment. ▪ Small waste volumes and consequently high cost per tonne of collecting waste. ▪ Barriers to reverse logistics ▪ Lack of incentives to end stockpiling ▪ Regulatory gaps in collection and tracking of waste ▪ Insufficient monitoring/enforcement of illegal dumping	▪ Growing interest and collaboration in regional solutions ▪ Government funding support towards regional circular economy outcomes ▪ Government commitments to support regional waste solutions through market development and technology promotion.
Tyres	▪ Complex collection and shredding required. Not compatible with other recycling sorting, washing or shredding processing. ▪ Limited drive for mining operations to transition from burying tyres ▪ Incomplete vision/commitment on the use of tyre-derived materials	▪ The region currently lacks a facility for tyre recovery, while other parts of QLD have reached saturation ▪ Volume of tyres should be ample to support specialised tyre recovery facilities and competition based on avoided transport costs is possible
Agriculture	▪ Contamination of plastics with dirt, vegetative matter etc. is common and significant, and can complicate processing as well as increase transport costs. ▪ Limited transport or pick-up options. ▪ Logistical challenges with aggregating and collecting waste, especially for regional areas.	▪ Emerging alternatives, e.g., certified soil biodegradable mulch ▪ Positive international precedents, e.g., creation of recycled plastic films, closed-loop recycling of greenhouse coverings, etc. ▪ Increasing willingness/pressure to improve disposal practices.

4.2.2 PLASTIC RECYCLING PROCESSING OPTION ANALYSIS

When considering a circular economy, two principal approaches can be defined for plastic recovery technologies:

- **Closed-loop recycling/recovery**: This is where the inherent properties of a recycled plastic are not significantly changed, and the recyclate (the recycled material produced) can be used in the same application as the primary material, for example, bottle-to-bottle recycling.
- **Open-loop recycling/recovery.** This is where the inherent properties of the recycled plastic are changed, and the recyclate cannot be used for the same application again. It can, however, be used for the manufacture of other plastic products, such as bottle-to-fibre recycling.

In the case of mechanical recycling, the completion of multiple recycling loops without change in the plastics' properties (closed-loop) is only possible for a few cycles before deterioration of the molecular structure of the polymers occurs.[29] This is caused by shearing during extrusion at high temperatures and pressures. The umbrella term for this reduction of material quality after recycling is known as 'downcycling'.

Advanced, or chemical, recycling converts plastic waste polymers into their original monomers[30], oligomers[31], hydrocarbons, or other valuable chemicals, such as energy and fuels, which can be reused as raw materials for new plastics. Where the original monomers and oligomers are retained, the process is closed-loop.

[29] Composites Part C: Open access, <https://www.sciencedirect.com/journal/composites-part-c-open-access>.
[30] Monomers are atoms or small molecules that bond together to form more complex structures such as polymers.
[31] An oligomer is a molecule that consists of a few similar or identical repeating units.

Plastic recycling processing includes a range of different processes and technology options. To ensure quality products, the Australian Government have strict specification for what processes are approved.[32]

A high-level summary of technological processing options for plastic waste is provided in Table 4-4, along with the strengths, opportunities, weaknesses and threats specific to the Whitsundays region.

4.2.3 TYRE RECYCLING PROCESSING OPTION ANALYSIS

Passenger, truck, and off-the-road (OTR) tyres can theoretically be recycled through the same process. What differs is the handling of the heavy and bulky OTR tyres for aggregation and collection as well as pre-processing requirements/technology to separate the rubber tyre from the frame (de-beading) and shredding the large tyres.[33]

OTR tyres are a greater issue than passenger tyres with poor recovery. For comparison, 85% of passenger tyres are exported, whilst only 10% of OTR tyres are exported. It is estimated that 81% of OTR tyres are disposed of on-site via burying and stockpiling (mining and agriculture). Interestingly, truck and OTR tyres tend to have higher concentrations of natural rubber making them a more attractive material for crumbing.

The following tyre recycling options are summarised form Tyre Stewardship Australia (TSA).[34]

Tyre derived fuel: The operation separates non rubber and plastic portions to develop a 'tyre derived fuel' (TDF), which is essentially chipped/shredded tyres. TDF is a material intended for overseas markets where it is burnt for energy in kilns, boilers and furnaces. It is assumed that most, if not all, passenger tyres and OTR tyres exported are used as TDF.

Tyre crumbing: In Australia the tyre recycling process of 'crumbing' has increased in recent years. This is because the practice of integrating crumbed rubber into some asphalt has increased. It should be noted that adding crumbed rubber to asphalt has limitations and it cannot be applied to all asphalt surfaces. In addition, asphalt blended with crumbed rubber cannot be recycled (whereas normal asphalt can). This form of recycling (or downcycling) is the dominant fate for tyres intended for the Australian market.

Pyrolysis and gasification: Thermal heating processes that decompose a separate tyre into various organic components including char, oil, syngas and steel.

Thermal desorption:[35] This is a tyre recycling process that uses controlled heat (low temperatures) to produce a 'recovered black carbon' product. This can be used as a binder in asphalt, whilst also allowing the asphalt to be recycled in the future. This process also produces gas (condenser fuel oil) which can be used to replace diesel for burning and heating in asphalt production.

OTR tyres are a valuable resource with high natural rubber content. The main obstacle for recovery is the size of the tyre and the steel component. A de-beading technology is required to remove the OTR tyre steel component. There is a thermal desorption plant in Brisbane (see section 4.3.3).

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[32] Department of Climate Change, Energy, the Environment and Water 2023, 'Plastic specifications and documents', <https://www.dcceew.gov.au/environment/protection/waste/exports/specifications-and-documents/plastic-specifications#specifications>.

[33] Tyre Stewardship Australia 2023, *Tipping the balance: the business case for a circular economy for Australia's off-the-road tyres, conveyors and tracks*, <https://www.tyrestewardship.org.au/wp-content/uploads/2023/06/TSA0003%20-%20L8%20-%20OTR%20-%2040pp%20Business%20Plan%20-%20A4.pdf>.

[34] Tyre Stewardship Australia 2020, 'Used tyres supply chain and fate analysis'.

[35] Personal communications, Entyr < https://entyr.com.au>.

Table 4-4: High-level assessment of recycling processing technologies.

Type of technology - solutions	Required processing quantities (tpa throughput)	Feedstock characteristics	Output products	Market	Strengths & opportunities	Weaknesses & threats
Sorting and size reduction For transport only – either via baling or shredding. This can be mobile or fixed.	Min 1,000 tonne pa for fixed infrastructure	Any plastic, single source segregated. Less than 10% dirt content preferrable	Baled or shredded material (in 1 tonne bulk bags) for further on-shore processing	All Australian mechanical or advanced recyclers.	Will suit smaller volumes. Can be used for other materials. Low process cost – designed to minimise freight. Some polymers will generate a positive gate fee. Sorting and baling capabilities exist in the region with the capacity to increase processing. Fixed equipment can be coupled with mobile balers, using the logistical network of a central location (e.g., MRFs)	Low value-add for the material. Most unprocessed plastics will not generate positive gate fees. No/low increased processing, employment or other associated economic benefits for the region. Strict control of contamination of incoming feedstocks.
Flaking/shredding Size reduced polymers are put through a hot washing process to remove contaminants. (a cold wash process is considered pre-processing)	Min 3,000 tonne pa	Single source, segregated polymers. Up to 50% dirt contamination by weight is acceptable	A hot washed shredded single polymer flake (cold wash flake product is not approved for export)	Selected polymers suitable are HDPE, PET, PP & PS. Primarily an export market.	Compared to mechanical and chemical recycling this has lower processing cost, capital cost and power usage. A cold wash process has lower capital and operational costs. Viability increases if there is a local resilient market for the product.	Specific licensing required with 3-year renewal. Specific format and flake size requirements. Films are unlikely to fit these criteria. Market may still be Brisbane and southern operators so the freight would be similar to simply ‘Size reduction’
Mechanical Recycling Mechanical processes that purify, shred and reconstitute polymers, without altering their current polymer form. With a wash plant to remove contaminants.	Min 5,000 tonne pa	Single source, segregated polymers. Up to 50% dirt contamination by weight is acceptable	Pellets, garbage bags, lumber, furniture etc	Plastics manufacturers (local & overseas).	Can recycle most mildly contaminated agricultural & mining plastics as well as C&I. Large potential feedstock. Can process some segregated MRF plastics currently going to landfill. Mechanical recycling is a mature and well-established technology, with a proven track record and a well understood list of limitations and constraints. Despite its limitations, mechanical recycling is an excellent way to recycle high-quality, clean, post-industrial waste and cleaned post-consumer waste to ensure that materials are retained in the economy.	Wash plant incurs higher processing cost. Would need recovery subsidy (gate fee) on harder to recycle materials. Materials must be segregated by polymer type

Type of technology - solutions	Required processing quantities (tpa throughput)	Feedstock characteristics	Output products	Market	Strengths & opportunities	Weaknesses & threats
Mechanical Recycling No wash plant	Min 5,000 tonne pa	Single source, segregated polymers. <5% contamination	Pellets for manufacturing (only if feedstock is clean), otherwise material downcycled into lumber, furniture etc	Plastics manufacturers (local & over-seas), but usually operated by an in-line manufacturer making plastic lumber, furniture etc	Low processing cost. Ideal set up for a downcycled plastics lumber manufacturer.	Materials must be segregated by polymer type. Smaller material feedstock. Most agricultural plastics are not suitable. More appropriate when there is a lot of clean post-industrial waste. Material produced usually cannot be recycled again.
Processed engineered fuel (PEF)	Min 30,000 tonne pa	plastic waste that is processed with other waste material ready for direct use as a fuel. 50% contamination acceptable.	PEF briquettes	high energy intensity facilities such as cement kilns	No plastics sorting required. Mixed plastics OK. Contamination OK (especially organic). Plastics can be mixed with other materials	Low value usage (calorific value only). Gate fees charged. Does not replace virgin. Limited facilities with the scale to require PEF.
Advanced Recycling **Pyrolysis** Thermal degradation of materials in the absence of oxygen. Small-scale only in Australia	From 1,000 tonnes pa	Mixed polymers, <10% contamination	Syngas, synfuel (diesel), char. Process breaks down plastics back into hydrocarbons that can be a feedstock for new plastic production	Fuel market but also as feedstock hydrocarbon for cracking back into Naptha/polymers (Qenos only polymer manufacturer in Australia & is developing its own AR project with Cleanaway)	Mixed polymers with heavy ink content can be processed (ideal for packaging plastics). When the Naptha produced from pyrolysis is converted via steam cracking to resin it can replace virgin resin in performance. A mature and well-known technology.	Higher processing cost. Circular economy usage (back into plastics) is expensive. Technology is still at an early stage in Australia – no large-scale commercial operation yet. Material needs to have relatively low contamination otherwise yield is affected.
Advanced Recycling **Hydrothermal** – Use of high-pressure water as a reaction medium to crack polymer bonds and produce hydrocarbon products. Small-scale only in Australia – pilot plant only (Licella)	From 5,000 tonnes pa	Mixed polymers, <10% contamination	Syngas, oil ("plasticrude"). Process breaks down plastics back into hydrocarbons using water	Fuel market and as a feedstock hydrocarbon for cracking back into Naptha/polymers	Mixed polymers with heavy ink content can be processed (ideal for packaging plastics). Circular economy usage - it can replace virgin resin after processing.	Higher processing cost. Technology is at a small-scale and no large-scale commercial operation after 15 years. Material needs to have relatively low contamination otherwise yield is affected.
Note: Other Advanced Recycling technologies are deployed overseas but not currently in Australia. These include Gasification, Purification & Depolymerisation						

4.3 CURRENT AND PROJECTED MARKET ASSESSMENT

4.3.1 EXISTING REGIONAL RECYCLING SERVICES

High-level consultation with regional councils, along with investigations into the current state of resource recovery have identified two key recycling service providers. These providers sort, bale and distribute material to an Australian market for processing.

- **Amdett Services and Plastic Recycling.** A local family-owned business that advertises online that they take drip tape, fluming, poly pipe, drums and fertiliser bags. It is understood they service some of the region's farms using 4 tonne trucks that collect Bulka Bags, drip tape, drumMUSTER containers and mulch. Drip tape and containers are understood to be sent to Sunlight recyclers in Brisbane for processing. Bulka bags are currently being stockpiled without an available processor market.
- **Re-Group in Mackay and Townsville**. These two regional material recycling facilities (MRF) sort kerbside municipal recycling and commercial recycling. Their operation sorts and bales plastic into PET, HDPE and mixed plastics. The Townsville MRF is new and has better capacity to sort. Baled sorted products are sold to markets across Australia, typically Brisbane or Victoria.

Amdett Services and Plastic Recycling and Re-Group's MRFs are currently not at capacity and may have the potential to increase capacity. Current limitations are more likely related to available processor markets, willingness to pay for recycling services and contamination of plastic streams.

As such, new additional businesses would be competing for the same feedstock to be processed.

4.3.2 EXISTING STEWARDSHIPS SCHEMES

There are a range of existing stewardship schemes that operate across Australia, including the greater Whitsunday region. The capture rate of these schemes in the region has not been investigated in detail.

- **drumMUSTER** has several collection points for HDPE chemical containers in the region at multiple transfer stations and landfills. The scheme is still reliant on finding facilities to take and process the material. Nation-wide this scheme has a capture rate of approximately 50% of eligible containers.
- **bagMUSTER** is currently in pilot program stage and aims to operate in a similar model to drumMUSTER, by collecting plastic bags used for transporting and storing seed, pesticide, etc.
- **Big Bag Recovery** is an operational stewardship scheme for PP feed and Bulka bags. The scheme has a planned processing facility in Toowoomba (see details below).
- **Tyres and off-the-road tyres stewardship scheme**. Tyre Stewardship Australia has existed as a stewardship scheme since 2014, mainly concerned with car tyres. In 2023, a report on stewardship of the 'off-the-road' (OTR) tyre was released proposing an approach for including the OTR tyre in the scheme. This work and the proposed approach have been developed in close collaboration with parts of the mining sector. Currently, the capture rate of OTR tyres is estimated to be below 10% across all sectors. Notably, the recovery rate is less than 1% for mining and agriculture. The scheme has reported that reverse logistics for the capture and transport of mining OTR tyres to a major centre is the most likely pathway to increase recovery. However, for agricultural sector OTR tyres (which have not been quantified in this report), a regional aggregation and pre-processing point is suggested, prior to connecting with a major centre processor.
- **Australian Packaging Covenant Organisation (APCO)**. This voluntary stewardship scheme has an agreement between commonwealth, state/territory and businesses to share responsibilities for managing plastic packaging with the aim of supporting resource recovery. The scheme aims to improve the design and recyclability of MSW, and C&I plastics and in turn increase recovery and decrease contamination. It could also have the impact of reducing plastic generated by switching packaging to compostable non-plastic material.

- **ReCoil by Netafim.** This is a business-led extended producer scheme where Netafim sell PP irrigation pipe but also offer the service to take-back, recycle and re-manufacture the pipes. It is understood that the consumption of this product in the greater Whitsunday region is not large enough to warrant participation.

The main aim of these schemes is to facilitate collection processes and infrastructure, and thus they are not a hinderance to regional processing but rather act as enablers. The schemes are not effectively capturing material so there is an opportunity to collaborate and improve collection. In addition, there are potential new schemes that may aid additional capture of other streams, for example:

- **National Australian Plastic Stewardship Scheme.** The research component to create an implementation plan for this Scheme was completed in May 2023.[36] This Scheme has not become operational however the Product Stewardship Centre of Excellence is working on setting up an Establishment Working Group with industry.

4.3.3 CURRENT AND PLANNED QUEENSLAND RECYCLING PROCESSORS

There are currently 4 known plastic processors in Queensland. Notably, it is understood that the GREATER WHITSUNDAY MRF operators also may access processor markets in NSW and/or VIC.

- **Resitech Group, Brisbane**. They focus on HDPE, PP, L/LL DPE from industrial generators including agricultural drip tape and poly pipe. Their capacity is 12,000 tonnes per annum. They have a wash plant and extruders.
- **Sunlight Plastics, Brisbane**. They focus on HDPE, PP and LDPE from agriculture and industrial sources. Their approximate capacity is 4,000 tonnes per annum. They offer collection and have a mobile baler as well as processing through washing, shredding and pelletising.
- **Recycling Solutions AUSTRALIA, Brisbane**. They take a wide range of plastic including PET, HDPE, PVC, LDPE, PP and ESP from a range of sources including PP, Bulka bags and HDPE drums. They operate a mechanical processing line with an annual capacity of 6,000 tonnes. This is scheduled to be expanded in 2024 to also process films.
- **Plastic Pirates**. This is a small-scale pyrolysis plant with a planned capacity of 240 tonnes per annum.

There are two known planned facilities in Queensland. Also, there are five Victorian, one New South Wales, one South Australian and two Western Australian proposed plastic processors.

- **Enviroplas recycling Holdings, Mareeba.** This project was awarded a Queensland Recycling Modernisation fund grant of $1.1 million.[37] The target waste plastic includes banana bags, other woven bags, ESP, twine, and other agricultural plastic, but also other commercial sources. The process will shred, wash and pelletise plastic in three streams. The estimated capacity is 3,500-4,000 tonnes per annum.[38]
- **Genuine Recycling Group Pty Ltd, Brisbane**. In addition to other recyclables, the plastic focus is on LDPE and PET. Capacity of 2,500 tonnes per annum of LDPE and 2,000 tonnes per annum of PET. They will sort and bale material.
- **Circular Communities Australia, Toowoomba**. This facility is a collaboration with Big Bag Recovery and will thus process Bulka-bags only. They will process the plastic and manufacture sound abetment/structural panels, school chairs and evaporation/odour suppression floating covers.

As highlighted above, MRF operators access national markets across state boundaries.

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[36] RMCG 2023, 'National Agricultural Stewardship scheme – update', < https://mcusercontent.com/166f825683dac6076c85fab74/files/d8409160-888d-485f-cde7-b06e7b0a5249/DAWE_NPSIF_ag_plastic_waste_update_20230526_lr.01.pdf>.

[37] RDA Tropical North 2023, Mareeba recycling centre to transform banana plastic waste, https://www.rdatropicalnorth.org.au/10818-2/>.

[38] Marc Jackson, Pers Comms Oct 2023.

Investing in plastic recycling infrastructure is a significant commitment. Whilst Australia generates large volumes of plastics, the ones that are most attractive for recovery (source separated, free from contamination, single polymer, valuable polymers) are not as readily available. The ban on exporting plastics (see below) has driven a rapid investment in local processing options, most of which are yet to commence operations. The market is not saturated as such, but investors and processors are looking for the most attractive value proposition and key aspects for consideration are access to feedstock, access to markets and the resilience or diversity of both. These considerations tend to favour investment in areas with a high population and many industries. For Queensland, this is the South-eastern corner.

4.3.4 MARKET DRIVERS AND RESTRAINTS

Ban on exports of waste plastics. The Recycling and Waste Reduction Act 2020 and associated Rules 2021 (Export - Waste Plastic) stipulates that waste plastics must be sorted into a single resin/polymer type and be further processed prior to being exported as a product. Minimum processing would involve washing and flaking. Prior to this, most of Australia's recycling was exported either as sorted or mixed plastic, these rules now enforce on-shore processing. However, the infrastructure shortfall to perform this processing is significant.

Regional development and strategic priorities. A key action identified in the Queensland Resource Recovery Industry 10-year Roadmap and supported by industry was to develop a strategic approach to industrial precincts to achieve economies of scale, provide opportunities to access markets for recyclates and enhance sustainability outcomes. The Recycling Enterprise Precinct Location Strategy highlights Townsville and Mackay as the region's potential hubs.[39] The mapping of waste material types and recovery, as well as existing infrastructure (or lack thereof), suggest a state strategic approach for what locations should 'prepare' (i.e., pre-process) and what locations should 'transform' (i.e., process) what type of material (e.g., glass, organics, plastics, tyres etc.). This state strategic mapping suggests that Queensland needs two key plastic transformation locations and that the suitable locations are Brisbane and Townsville. The same approach suggests that Mackay is a suitable location for the transformation of tyres. It should be noted that the waste generation data that has informed this study is unlikely to consider agricultural plastic, as the nature of how it is managed (i.e., stockpiled, buried/burnt on site) means it is rarely recorded through official processes of landfills and MRFs.

Energy from Waste (EfW). There are no planned Queensland EfW projects targeting residual waste. However, following the approval and construction of the Western Australia Kwinana Waste to Energy facility, it is likely that other projects will find it easier to demonstrate benefit and progress to establishment. Whilst, Queensland has an EfW Policy, it does not advocate for EfW activities but rather has established the regulatory landscape, as articulated in the purpose statement: "This policy does not incentivise or promote EfW, rather it provides a framework that aims to provide certainty to EfW proponents around the requirements…".[40]

Markets, freight and ports. Regardless of the level to which plastics are processed (i.e., baled, flaked or pelletised) in the region the final processed material will need to be transported to locations outside the region for remanufacturing into new plastic products.

Most plastics products sold in Australia are manufactured overseas. Therefore, the market for most plastic recyclate will be an export market. The few domestic plastic manufacturers are clustered mainly in Melbourne, with a smaller number in Brisbane, Sydney and Adelaide. The economics for the creation of a larger domestic plastic manufacturing industry are not currently feasible.

The container port in Townsville would appear to make this city an advantageous location. Townsville has a less frequent number of container ships and usually smaller vessels. This results in considerably higher

[39] Queensland Government 2022, 'Recycling Enterprise Precinct Location Strategy', Department of State Development, Infrastructure, Local Government and Planning.

[40] Queensland Government 2021, Energy from Waste policy. Page 1.

shipping costs per container than the major Australian ports. For example, container export costs out of Townsville are approximately 40% higher than Port Brisbane.[41] For example, $5,000 – $5,500 per 40-foot container is a standard cost for shipment to Malaysia.

Its worth noting that a master plan the coal Port of Abbot Point identifies a range of expanded uses and associated land parcels for development. This could be an opportunity for local processing and distribution.

With established collection and sorting in the region, there is nothing stopping future development of processing in the region. For example, should Port of Abbot Point and the industrial hub be developed this could pose an attractive location for processing.[42]

Road freight from Townsville or Bowen to Brisbane (Carole Park) for a similar load weight (approx. 23 tonnes) in 1-tonne bulk bags (the most common format for shipping flake or pellets) would be $3,300.[43] This represents an approximate 20% discount on freight in the opposite direction, as most bulk freight comes from Brisbane up to Townsville, so back freight load rates apply (larger discounts may be achievable for spot rates). Similar or greater load rates would be achieved with baled unprocessed plastics because the uniform dimensions of baled materials make them more efficient for load stacking. However, at least 15% of the load weight would be contaminants (soil, organic matter), possibly making the load yields similar.

Logistics analysis would suggest that it would be more advantageous to ship plastic processed locally from Townsville Port, rather than road freight to Brisbane and ship from there.

4.4 KEY FEASIBILITY FEATURES

A description of the greater Whitsunday region with key features discussed in this report is provided in Figure 4-1. The map presents plastic waste generation, existing sites and operations and logistical features (roads, ports, towns). The visualisation of key research findings can assist in considerations for future opportunities, for example:

- Any aggregation site would be best positioned on a heavy vehicle route.
- Any new site should consider existing sites and what services they offer.

[41] An indicative example – a 40' High Cube Container from Port Brisbane to Port Kelang, Malaysia (a major plastics import port) is approx. $3500 incl export clearance, local carrier & ocean freight. The same container to the same destination out of Townsville would be $1500 - $2000 more depending on the season. Source Priority Cargo Australia

[42] Port of Abbot Point is currently an operational coal port but has been ear marked to service a greater range of industries. See <https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/b6bfe09b-e425-468d-bc01-64e2278a02d6/abbot_point_master_plan.pdf?ETag=d19edd71fff0fdc4e054aa34d554d5c9>

[43] An indicative example – based on full Road trains or B Doubles (Townsville/Bowen cost the same), materials packed into 1 tonne bulk bags (FIBCs) - $115 freight plus 27% fuel surcharge per 1 tonne bag. Source NQ Freighters

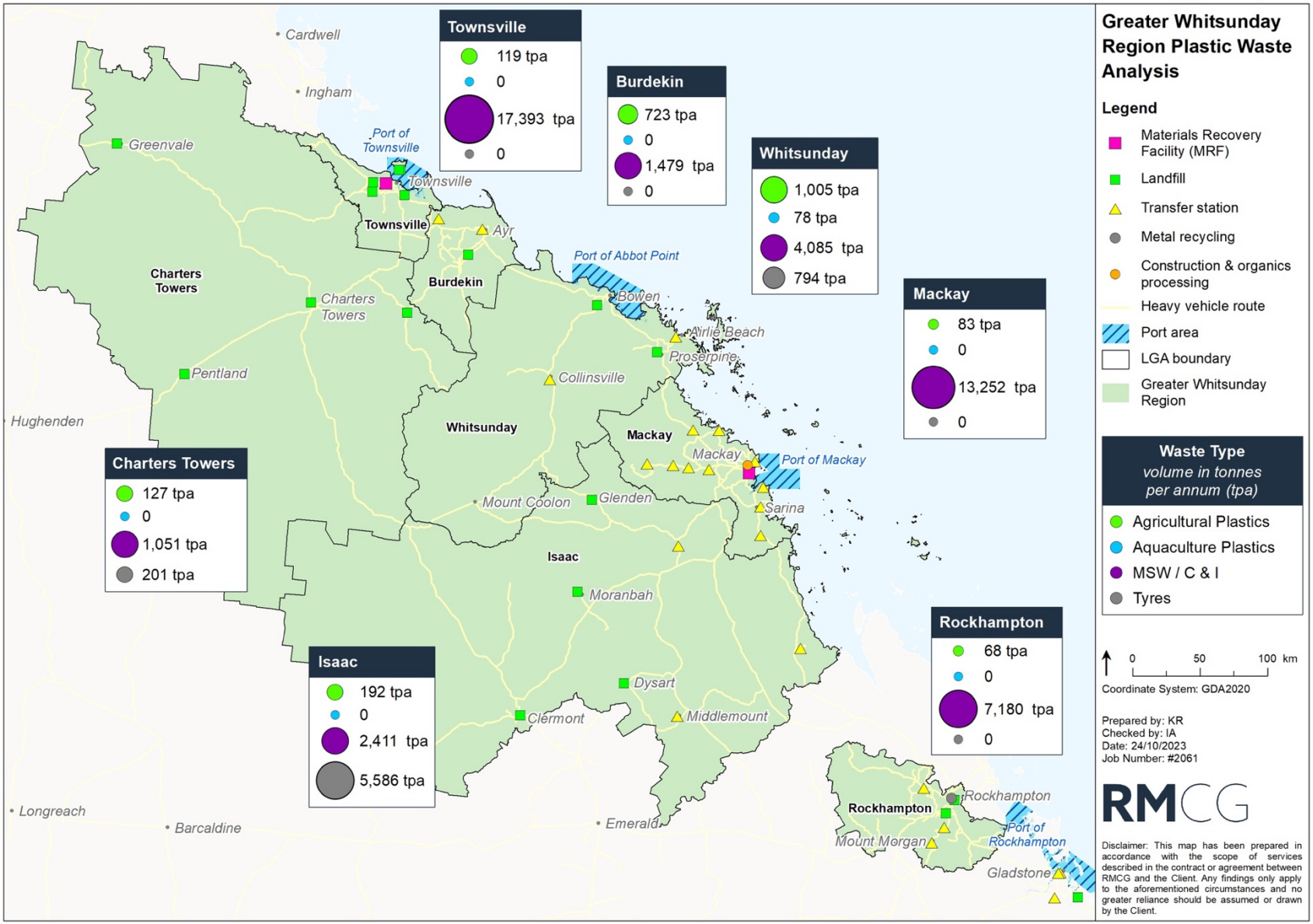

Figure 4-1: Map of the greater Whitsunday region with key features.

5 Discussion and recommendations

5.1 OVERVIEW OF AVAILABLE RESOURCES

Agriculture and aquaculture: The quantification of waste plastics generated in the greater Whitsunday region shows that the agricultural and aquaculture sectors annually generate a volume of approximately **2,400** tonnes across all plastic types in the region. However, the analysis of low and high capture scenarios shows that between **240** and **700** tonnes of these would likely be captured and attractive for recovery. This excludes mulch films, netting and PPE that are not currently recyclable in Australia and also considers the different capture rate scenarios (i.e., not all will participate at 100%). This capture rate could be increased both through successful engagmen and wiliness to participate as well as through redesign of plastic material and development of technologies to recycle these.

An additional **8,000** tonnes of plastics exist within known stockpiles accumulated over previous seasons. However, these are either mixed plastics and of unknown quality or low value and contaminated plastic. Therefore, they should not be viewed as a secure resource for a feasibility study – however some sorted stockpiles of poly pipe and drip tape on farm may become possible to recover. In addition, a spatial analysis found an estimated **6,000 tonnes** of on-farm material. There are likely to be more volumes in areas not assessed. However, poly pipe and drip tape are likely to only be a proportion of these combined stockpiles (with mulch composing a significant amount).

Mining plastics: The engagement with the mines and servicing waste contractors did not provide a detailed estimation of plastic volumes, nor were all mines approachable. However, it was ascertained that PVC, HDPE and clean pallet wrap was generated on a regular basis.

Of note, the 'Pit to Port' project is conducting a quantitative analysis to explore opportunities for material use circularity in BHP/BMA operations. There is an opportunity for this body of work to link in with this project to overlay findings and solutions.

MSW and C&I landfilled plastics: The MSW and C&I residual waste currently landfilled was estimated to include almost **45,000** tonnes per annum of plastic. Increasing recovery of these plastic will require behaviour change (i.e., for businesses and individually to sort plastic into co-mingled services). Also, not all plastic landfilled would be possible or practical to sort in existing MRFs. Nor does the correct recovery technology exist to process all types of plastic such as for example a large range of soft plastics (films, bags), polystyrene, expanded polystyrene or other low value composite plastics. The analysis for low and high capture scenarios suggests that at 10% and 30% recovery increases, between **4,500** and **13,500** tonnes of plastics could become available. There is an opportunity to increase the diversion of this material for sorting, baling and processing. As a mixed product there are greater operational, and infrastructure (optical sorting) costs associated with sorting the valuable plastics from other plastic and contamination.

RECOMMENDATIONS

- Seek avoidance solutions for plastic mulch using soil biodegradable options and/or integrated crop management.
- Focus on recovering agricultural and aquaculture containers/drums and pot, irrigation pipe (poly and HDPE) and tape, Bulka bags.
- Consider if and how mining plastics (not including tyres) could be captured in the same systems as agricultural plastics (i.e., key logistical location, routes).
- Increase MSW and C&I co-mingled plastic through improving trust in system and engagement.
- Collaborate with 'Pit to Port' to seek solutions.

5.2 MARKET DRIVERS

Existing operators: There are two MRFs in Townsville and Mackay operated by Re-Group. There is also Amdett Services and Plastic Recycling which targets agricultural plastic. All three operators received funding in the Regional Recycling Transport Assistance Package and Amdett Services and Plastic Recycling also received a grant in the Recycling Modernisation Fund. This indicates their intention to improve operation and/or grow.

Aggregation and capture: Increasing plastic capture rates (i.e., more of what is currently captured) is likely to be effective when utilising these existing operators' skills, networks and infrastructure. The potential for attracting new operators to increase the range of plastic collected (i.e., new types of plastic types) and sorted and/or increase the pre-processing or potentially local processing may be limited by the existing businesses. A stimulus for existing operators to upgrade and increase their services may assist with this barrier.

Whilst several recycling technology solutions are currently deployed in Australia, for any of these recycling options to capture a significant proportion of the mining and agricultural plastics generated in the region, they would need to have a product stewardship/collection methodology deployed front end, to ensure most of the plastic was retrieved from mines and farms. Naturally, establishing a collection system is reliant on having a market to pre-process and/or process. There are opportunities to increase acceptance of plastic at existing sites such as WTS but also to establish a new site to specifically target agricultural plastics aggregation, sorting and baling.

It should be noted that the attitude for farms to improve their practices has been captured in engagement for this project as well as documented in the National Agricultural Plastic Stewardship scheme project.

Locations: Both Mackay and Townsville demonstrate potential benefits for plastic processing. It is understood that the Mackay MRF technology is reaching its end-of-life and thus the future upgrade could potentially consider new lines and/or additional processing. Mackay has been highlighted as a regional precinct location in state strategy, though notably not for plastic. However, this mapping has not taken into consideration agricultural plastic or the existing operations. Townsville has been strategically mapped as a plastic processing precinct location, with a greater capacity to service more of North Queensland. Townsville also has the biggest population and is closer to Burdekin and Bowen horticultural production areas.

Independent of what occurs in Townsville or Mackay, there is a need for smaller aggregation points for agricultural plastics. Engagement suggests that farmers willingness to travel is very limited and that several aggregation points for the large producing areas would be required (for example, Burdekin, Bowen, Proserpine, Mackay).

These could be located at waste transfer stations or there could be a new site with a new operator possibly located in Bowen.

Markets for recyclates: There is a limited local market for plastic recyclates, so there is little opportunity for closed loop recycling within Australia. However, if effective capture, aggregation, sorting and processing occurs then there is little preventing local manufacturers taking the opportunity to develop a local recycled product.

It is likely that in the short to medium term any sorted and baled, pre-processed or even processed plastic would still be aimed at an export international market. Most of these buyers currently distribute from Brisbane but there is potential that Townsville could be a feasible distribution point.

RECOMMENDATIONS

- Explore local aggregation, sorting and baling locations in Burdekin, Bowen, Proserpine and Mackay targeting mining, agricultural and other industry plastics strategically.
- Explore and support potential plastic processing opportunities located in Townsville or Mackay.
- Collaborate with Gumlu Growers Association to investigate closed-loop recycling for plastic types (for example, pipe and twine).

5.3 TECHNOLOGIES AND SOLUTIONS

Possible recycling options within the region: Relating the identified recycling solutions to the size of the recyclable resource, the maturity of the technologies and the demographics of the region, we have ranked the 3 key opportunities based on their appropriateness as follows:

1. Size Reduction for transport only (sort and bale): This is the lowest cost and smallest required volume option. It is not an approved recycling *process* (under export ban regulations) that will generate a finished product. However, it can increase the recycling of plastics from the region that are not currently being recycled, by making it economical to transport sorted and baled or shredded material to established markets in the large cities, which will also be closer to the markets for finished processed output.

Agricultural, aquaculture and mining plastic could be collected, aggregated and baled. This can be achieved with either a fixed baler, most suitably operated by an existing waste contractor.[44] A fixed baler may also be located within existing sites such as a waste transfer station or established in a small new site. Alternatively, a mobile baler can bale on site and then move across different regions, with the seasonality of plastic waste production.[45] A fixed baler targeting agricultural plastics is already operational south of Townsville, operated by Amdett Services and Plastic Recycling.[46]

Re-Group who manages Mackay and Townsville MRFs would have the capacity to upgrade and increase their processing. This would cater for increased capture of the MSW and C&I co-mingled plastic material currently going to landfill. In addition, these two locations have fixed balers that can bale and distribute many clean, single source plastic streams (for example, clean pallet wrap). Mackay MRF is due for an upgrade in the coming years, and it is possible that their sorting and baling capacities could be expanded to consider a wider range of plastic.

Products from mobile balers or new fixed balers could potentially link in with the existing logistics of existing operators. For example, if a new site would aggregate and bale agricultural plastics in the Bowen/Burdekin area it could be transported to Townsville MRF for transport to markets.

With established collection and sorting in the region, there is nothing stopping future development of processing in the region. For example, should Port of Abbot Point and the industrial hub be developed this could pose an attractive location for processing.[47] Also, as recycling technology advances across Australia, opportunities adapted to the regional plastic generation profile may become feasible and effective.

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[44] An example of a fixed baler installed specifically to target horticultural plastics is in Coffs Harbour at Mid North Coast Recycling.

[45] An example of a mobile baler targeting seasonal plastics is that operated by mechanical recycler Sunshine Group based out of Brisbane. This baler currently bales Dripper Tape for Rugby Farm, which is then shipped to Brisbane.

[46] amdettservices.com.au . Also operate as a Drummuster & Big Bag Recovery collector.

[47] Port of Abbot Point is currently an operational coal port but has been ear marked to service a greater range of industries. See <https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/b6bfe09b-e425-468d-bc01-64e2278a02d6/abbot_point_master_plan.pdf?ETag=d19edd71fff0fdc4e054aa34d554d5c9>

RECOMMENDATIONS

- Target the Bowen and Burdekin area for either a mobile baler or official fixed baler to capture select agricultural plastics.
- Engage in a collaborative conversation with existing operators to determine their appetite to service select agricultural plastic and at what cost. Alternatively, develop a business case for a baling option including engagement with and commitment from farmers to participate.
- Consider putting out a EOI to increase aggregation, sorting and baling material in the region.

2. Flaking/shredding & hot washing: This involves the size reduction of polymers then putting them through a hot washing process to remove contaminants before drying and compressing in one-tonne bulk bags. Selected polymers can be processed in this way and, with appropriate licensing, can be exported to overseas recyclers and even potentially used directly in extrusion processes. Due to the wash plant and drying facilities required, at a minimum 3,000 tonnes per annum, throughput would be required to justify the investment.

The results of this audit show there is insufficient agricultural volume of these materials in the region to justify the establishment of this type of reprocessing. A volume of MSW and C&I plastic feedstock would be required to make such a plant viable in the Greater Whitsunday region. Given the current aggregation of these materials in Townsville and MacKay, one of these two locations would appear to be most viable commercially. Also, it would require an export license holder to operate.

Alternatively, mining plastic may pose an opportunity to get a higher quality and greater volume of plastics. There is also the potential to consider material from a greater region, further north of Townsville. Townsville Port access provides a competitive advantage until Abbot Point Port is operational.

Other market attributes could also contribute to the lack of viability for a small-scale regional (approx. 3,000 tpa) facility. As discussed in section 4.3, existing and planned facilities in SEQ pose a more viable proposal, and current Greater Whitsunday Region operators are already participating in these markets. To turn the dial for the viability of a regional smaller scale facility, support and investment would be required. An example of this would be the Enviroplas Recycling project in Mareeba, Atherton Tablelands, that received $1.1 million for a regional small-scale processing plant. Noting this is not operational and has not yet been proven as a viable concept.

RECOMMENDATIONS

- Quantify current amounts of plastic captured in local MRFs and investigate recycling operators' interest for local processing.
- Consider an EOI to process materials in the region.
- Consider investigating plastic generation further north in Queensland.
- Investigate replicability of Enviroplas Recycling in Atherton Tablelands.

3. Advanced Recycling – small-scale mobile plant: A small-scale mobile pilot plant has been established in North Queensland. The aim is to operate in the Tully area, targeting plastics from the banana farms. If the business operates successfully and can expand the number of mobile plants – it could also conceivably operate in the WRC. The plant, operated by Plastics Pirate, runs a conventional pyrolysis technology – thermal degradation of materials in the absence of oxygen. [48] This means it can potentially process most plastic types

[48] https://plasticspirate.org/ Licensed technology from Scarabtech in South Africa.

and mixed plastics. The operators have indicated a maximum plant output per annum of approx. 800 tonnes. The financial viability & technical veracity of this solution has not been verified.

RECOMMENDATION

- Investigate opportunity, outcomes and need for supporting Plastic Pirates.

Other Options: The other recycling technologies identified require a plastics supply resource of 5,000+ tonnes annually for processing. Of these, mechanical recycling with a wash plant is the most proven and commercially viable in Australia. When combining high grade wash lines and extrusion equipment with an experienced operator, mechanical recycling should be able to reprocess most of the mining and agricultural polymers identified to a high enough level to reuse them as a proportion of the input materials used to create the same products (complete circularity).

As discussed above, for 'flaking and washing', the volume of plastic generated and likely captured in the region requires MSW and C&I plastic to prove practical, and thus Townsville or Mackay with existing MRFs would be the natural locations. However, as previously described, other market attributes, such as current and planned facilities and established end markets in SEQ, are stacked against a local high-tech solution.

As above, regional development support could aid the viability of a recycling facility and servicing a region further north of Townsville could also be beneficial.

RECOMMENDATION

- Seek circular recycling option for poly pipe, drums, pots, twine and plastic types that can be turned back into plastic product (circular recycling).

6 Conclusion

The priority of the WRC is to assist farming operations in improving the recovery of plastic with a preference for stimulating local employment and business development. Whilst a large-scale plastic processing plant has been proven unfeasible in this research, other solutions to address these priorities have been presented.

The relatively small volume of mining and agricultural waste plastics generated annually suggests that most medium to large-scale plastics recycling solutions will not be viable to locate in the greater Whitsunday region. However, the smaller scale options of size reduction or pre-processing of these materials for on-shipment out of the area for final processing could be commercially viable. Active engagement through a stewardship program, combined with a cost-effective collection system of plastics that have been segregated and stockpiled by miners and growers, will ensure higher percentages of these plastics are recovered.

The least cost option may well be to engage with existing operators such as Amdett Services and Plastic Recycling (fixed baler), Sunshine Group (mobile baler) or Re-Group (mobile baler + MRFs) and/or publish an EOI for the service.

Flaking/shredding and hot washing options would require a licensed operator to be located in the area and to establish a business case to export from a local port (Townsville initially and perhaps Abbot Point in the future). This option would need to secure feedstock from MSW and C&I plastic and/or additional agricultural plastic from regions further north of Townsville. Again, a possible solution may be to work with existing waste contractors, such as Amdett Services and Plastic Recycling or Re-Group, who already have plastics sorting infrastructure in place.

The small-scale Advanced Recycling option has promise and is local but has not yet been proven on a commercial scale.

In summary, the technology and current market assessment of feasibility of increasing plastic recycling in the greater Whitsunday region found that regional aggregation and sorting paired with centralised large-scale processing is the most viable option.

However, market drivers such as the Queensland's Precinct Strategy and directive around regional economic development could influence the options developed. Through industry collaboration and funding support, increased regional pre-processing and processing have the potential to be established.

The political and social landscape is conducive to tackling this problem, with governments at both national and state level committing to provide a range of support for localised recycling infrastructure, ranging from direct funding to market development.

Appendix A - Plastic type characteristics descriptions

The key plastic types identified in the quantification are provided in Table A-1 including insight to their attributes (description, polymer composition and form and appearance). This characterisation establishes types of plastic that can/cannot be recycled and what technology is best suited (contributing to the technology assessment in section 4.2).

Table A-1: Plastic materials and streams characteristics.

Material type	Description	Amount (tpa): 1) generated, 2) low capture, 3) high capture	Polymer composition	Form and appearance
Ag, Aqua and Mine: FIBC (Bulk Bags)	Large woven bag, designed to carry up to 1 tonne of weight of material (e.g., fertiliser, feed)	1) 120 (95% bags) 2) 21 3) 44	PP	Soft woven material. Beige, low contamination. Light weight but can be consolidated or baled. Recyclable. Collection through Big Bag Recovery or Bag Muster (only certain brands)
Ag: Twine	Horticultural twines – used in trellised crops		PP Nylon	String form, usually a lot of organic contaminants from trellis crops, clean from bananas. Multi colours. Pre-stretched PP is hard to granulate but can be recycled. Can be baled for transport
Ag and Mine: Chemical drum (90% Ag)	Thick drums from 5 – 20 litres used for chemicals	1) 790 2) 80 3) 390	HDPE	Square or round, hollow. High volume/low weight. Opaque, must be triple rinsed (chem contamination). Recyclable. Collection through Drummuster.
Ag: Plant pots & labels	Plant pots & trays		PP	Injection moulded black (or other colours) rigid thin wall open containers. May have some residual growing medium. Can be nested for transport or baled. Recyclable. Possible collection through Garden City Plastics (VIC)
Ag: Bird/ Hail/ Shade cloth (nets)	Suspended above crops	1) 420 (95% nets) 2) 0 3) 0	HDPE, other composites	Woven white or black mesh, used several years then rolled. Very light weight to volume ratio. Mesh composition very difficult to mechanically recycle.
Ag: Weed mat (mesh)	Woven material used for longer term weed suppression		PP	Woven green or black cloth, may be rolled. 15-year life. Usually deteriorated by the time it is pulled up. Unrecyclable
Ag: irrigation Drip tape, and	Small diameter Irrigation tape. Often used with mulch film. Single use.	1) 400 2) 130 3) 270	LDPE/HDPE	Flat black tube. Light – high volume low weight so must be baled for transport. Often rolled, sometimes with mulch, in continuous lengths, up to 30 -50% dirt content. Recyclable
Ag: Poly pipe	Small to medium diameter irrigation		LDPE/HDPE	Round black tube. Light – high volume low weight so must be baled or tightly coiled for transport. Often rolled in

Material type	Description	Amount (tpa): 1) generated, 2) low capture, 3) high capture	Polymer composition	Form and appearance
				continuous lengths, up to 30 -50% dirt content. Recyclable. Currently collection through Recoil (Netafim tube only).
Ag: Mulch	Thin film used to retain moisture in soil for high value horticulture e.g., strawberries, tomato's, cucurbits.	1) 600 2) 0 3) 0	LLDPE/LDPE	Light film. Black, or black and white material, often rolled with organic plant and dirt content (70%+ by weight) and/or irrigation tape/pipe. Not currently viable to recycle due contamination/ low throughput.
MSW and C&I residual plastic portion	Plastic items currently contained in the residual landfill stream from 7 councils. Typically include non-recyclable plastic (soft, rigid) and some recyclable plastics.	1) 47,000 2) 4,500 3) 13,500	All plastic types including EPS & PVC Often composites	Small (0.2-3 litre in size) and mixed items and plastic types. Unsegregated by type. Basic segregation if the MRF has optical sorting. Without segregation, contaminated with organics, glass, paper. Likely compacted and broken.
MSW Recycling plastic portion	Primarily recyclable such as bottles, packaging, containers. Also, likely to include up to 10% of soft plastic contamination	1) 1,600 (all captured)	PET, HDPE primarily.	Rigid. Mixed colours, generally small (0.2-3 litre in size), moderately clean. Some contamination of other recyclable such as glass, other plastic (soft plastics) and food residues. Much of the plastic, without contamination, are recyclable.
Other streams				
Aqua/ Mine: Pipes	Large diameter thick wall pipes used for liquids	Estimated 100	HDPE	Round, heavy. Medium volume to weight, must be cut to length for transport or shredded. Black, low contamination. Recyclable
Mine: Pallets	Plastic pallets, not reusable when broken. used for transporting freight	20	HDPE	Hard, meter square pallet shape. Black recycled pallets. Low contamination to weight. Recyclable
Mine: off-the-road tyres	Mostly large (2+meter) dump truck tyres of 5+ tonnes also other trucks and forklifts	6,500	Natural rubber/ synthetic rubber (47%), metal reinforcement (12%), fabric (Nylon/Radon) (10%), carbon black/silica (fillers) (22%), oils/anti-degradants/resin (6%), zinc oxide (2%, Curing agents (e.g., sulphur) (1%)	Heavy and bulky. Black. Low contamination to weight. Composite plastic and combined with steel. New opportunity with OTR stewardship.

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