

SWA INNOVATION HUB

Potential Waste Opportunity – Recycled Crushed Glass

Project number 10092

South West Gateway Alliance

April 2021

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1 Introduction

1.1 Scope

The Sustainability Waste Alliance (SWA) Innovation Hub has been engaged by the South West Gateway Alliance (SWGA) via Level 5 Design (L5D) to investigate the prospective use of Recycled Crush Glass (RCG) in end products to meet the SWGA's quality, value for money and programme requirements for the BORR project.

The Sustainability Waste Alliance Innovation Hub was established to specifically undertake technical investigations of this sort, in order to facilitate and enable best practice waste management practices in the transport sector, in the South West and beyond.

The work complies substantially with the requirements of the Project Brief titled 'Potential Waste Opportunity Recycled Crush Glass SWGA-00-135-10-MEM-0002', which has five main tasks as follows:

1. Analysis of local market,
2. Development of product specifications,
3. Development of cost estimates,
4. Calculation of sustainability and ISCA requirements associated with the utilisation of RCG products, and
5. Preparation of a business case.

This report addresses the first of those tasks, and more specifically:

- Confirms the quantum of waste glass from the South West (SW) region, that is not currently being recycled;
- Identifies the current list of 3rd party certified suppliers of RCG in the South West and Perth and Peel region;
- Confirms current capability and capacity of local suppliers to produce RCG to meet anticipated specifications of recycled crushed glass;
- Identifies other additional RCG products with potential to be produced in the South West that would be available for utilisation on BORR;
- Details the required milestones and gaps in the supply chain required to be overcome to ensure availability of RCG to the project;
- Provides a Risk and Opportunity Register detailing all risks and opportunities, current status / controls, proposed mitigation treatments and controls, control owners and date to close out controls;
- Provides a list of funding avenues available to RCG suppliers; and
- Estimates the preliminary quantum of RCG end product available to the project.

The focus of this work is on five different applications of RCG in the BORR project. These include:

- As pavement in local government roads
- As a drainage blanket
- As a decorative feature in noise walls / screens
- As an additive to non-structural concrete blocks
- As an element of Principal Shared Paths (PSP)

1.2 Method

The SWA has been working on the opportunity of recycling glass into road projects for many months. The knowledge gained from this process has informed this current work. Building on what had already been done on the 'state of play', an intensive outreach program was undertaken to quickly gather the required information from the supply chain on waste glass volumes, processes, prices and associated matters.

The method employed included:

1. Confirming the scope of works
2. Obtaining relevant documentation and contact lists
3. Engaging with key agencies including the Department of Water and Environmental Regulation (DWER), South West Regional Waste Group (SWRWG), Main Roads (MRWA), etc to identify issues, constraints and opportunities,
4. Contacting past users of RCG in road projects in Australia
5. Defining preliminary specifications to facilitate discussions with suppliers
6. Sourcing lists of approved glass recyclers and 3rd party approved suppliers
7. Undertaking market research to identify waste glass volumes and supply chain issues
8. Contacting waste glass recyclers in Western Australia
9. Engaging with local and interstate suppliers of RCG to confirm indicative estimates of supply and pricing information
10. Benchmarking prices based on similar RCG products sold interstate
11. Mapping the supply chain
12. Undertaking site visits to glass processing facilities in Perth
13. Facilitating industry interactions, in particular with WARRRL and its suppliers
14. Documenting the outcomes including official quotations received from key suppliers

This work included a series of phone, email and face to face interactions using a consistent set of market survey tools and approach to requests for information from all potential suppliers and collaborators.

Companies that were contacted for information of this market analysis can be found in Appendix A.

1.3 Qualifications

This 'state of play' of the market for recycled crushed glass (RCG) was completed over the course of 2-3 weeks. The following commercial and strategic factors have been identified as having a bearing on how the South West Gateway Alliance (SWGA) proceeds:

1. The RCG specifications used for the market analysis task documented in this report are preliminary and are not approved as being fit for purpose and further work on specifications is required to give more confidence on the numbers quoted;
2. The South West market for glass lacks scale and has infrastructure gaps;
3. Transport distances to Perth from regional areas suggest processing glass into RCG in the South West and other regions may be viable when landfill diversion and regional economic factors are taken into consideration;
4. Transport distances to glass-to-glass recycling facilities in South Australia may justify a higher rate of recycling through RCG applications in infrastructure, such as roads;

5. Benchmarking prices against mature Eastern States markets may provide useful information on the floor for RCG pricing in Western Australia;
6. The Perth RCG market does not appear to be dependent on glass sourced from the regions.

Additional work on cost-factors, specifications, and strategic scale value-for-money considerations, including the feasibility of co-investment by industry and Government in enabling infrastructure, would better inform how the SWGA can invest in RCG trials for the greatest benefit to the project, the sector, the South West and the State. This is the subject of future tasks not yet undertaken by SWA or commissioned by the SWGA.

2 Background

2.1 Bunbury Outer Ring Road (BORR) Project

The Bunbury Outer Ring Road (BORR) project is a significant part of the Western Australian Recovery Plan for the South West. The \$852M BORR is proposed to consist of 27 km of four-lane highway connecting Forrest and Bussell Highways and 21 km of local government (LG) roads. This is one of the key components in the long-planned transport network for South West Western Australia.

The objective of the BORR is to produce the necessary road infrastructure to support the increased traffic between regional areas and reduce the impacts of vehicle movements on the local residential population. Additionally, the project aims to enhance sustainability outcomes for the infrastructure associated with the Project.

SWGA has set a sustainability commitment to incorporate into the works 100% of waste glass from the Greater Bunbury area that is not currently being recycled and destined for Landfill.

2.2 The SWA and SWGA

The Sustainability Waste Alliance (SWA) is a collaboration of key agencies, working together across sectors and industries to achieve more than would otherwise be achieved in isolation. The SWA is focussed on driving innovative outcomes via the SWA Innovation Hub.

The SWA was established by the Office of Major Transport Infrastructure Delivery (OMTID) and key stakeholders to deliver on the commitment made to the Department of Water and Environmental Regulations (DWER) to identify additional specific opportunities for using recycled materials in upcoming major infrastructure projects starting with the BORR. This includes building on the Towards 100 philosophy as documented in the Recycle First Plan for BORR¹.

The South West Gateway Alliance (SWGA) is a Consortium of both owner and non-owner participants established by Government to deliver the BORR Project.

SWGA and SWA have agreed to work together through a leadership governance group chaired by the A/Managing Director of OMTID to optimise the delivery of the six waste focus materials identified in the document "Recycling First Plan" in the BORR Project whilst ensuring the achievement of regional and Aboriginal business and employment opportunities in the South West.

SWGA and SWA wish to identify innovative practices to maximise opportunities for resource management, resource recovery and recycling on BORR that will lead to better, value-for-money outcomes for the road and waste industries in Western Australia. The BORR project will become a model for:

- best practice in utilising applied road and waste recycling technology,
- engagement with Local Government to apply best practice in resource recovery and recycling of road project waste, and
- supply chain behavioural changes towards a 'Circular Waste Economy'.

¹ Recycle First Plan for BORR, SWA Innovation Hub, November 2020

3 Production of Recycled Crushed Glass

3.1 Sources of Waste Glass

There are currently several sources of waste glass in the South West. This includes:

- Container Deposit Scheme (CDS) glass
- Municipal Solid Waste (MSW) / Yellow top bin waste glass
- Construction and Demotion (C&D) waste glass
- Commercial and Industrial (C&I) waste glass

The recycling of CDS glass intended for high end products is currently undertaken in South Australia. The scheme is administered by WARRRL (WA Return Recycle Renew Ltd) and crushing and sorting is undertaken in Perth by WAglass.

Non-sorted contaminated MSW from yellow top bins including glass is transported to Perth for sorting and processing.

Volumes of C&D and C&I glass are reportedly very small (< 100 tonnes), co-mingled, and currently non-viable to process separately. At present it is largely landfilled at various locations across the South West. Audited numbers will be released by DWER in its inaugural summary of mandatory waste reporting data for all waste manager with volumes greater than 1,000 tonnes.

Waste glass produced in the South West represents approximately 7% of the total produced across the State.

More information on the supply chain is provided in Section 3.

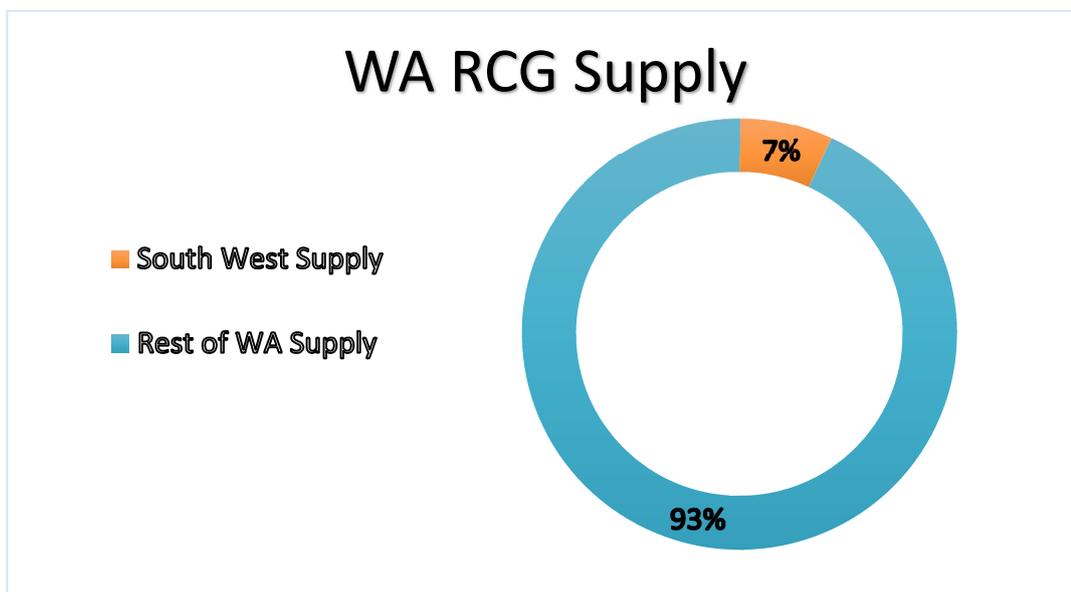


Figure 3.1 – Percentage of State Supply in the South West

3.2 Status of RCG in the South West

There are currently no producers of RCG in the South West. There are also no Material Recovery Facilities (MRF) located in the South West to sort comingled glass from other waste streams. Nor are there any glass beneficiation / crushing plants currently located in the South West.

A strategic business case is currently being prepared by the SWA for an investment in a MRF at Stanley Road in Kemerton that would be able to sort local glass from comingled waste streams for beneficiation.

3.3 Glass Recycling for Road Projects

Waste glass recycling into end products suitable for road projects involves a number of different process as shown in Figure 3.2. The source of the glass impacts on the number of processes that are necessary to achieve a viable end product for the BORR.

CDS glass has the benefit of already being collected, sorted, aggregated, and transported to a central point. It can move straight to the contamination removal and crushing process.

Other sources of waste glass require additional processes to be established in the South West. This includes the additional steps of collection, transfer and separation. The major volume of this glass comes from MSW via yellow top bins.

At the moment the only glass crushing facilities that operate in Western Australia are located in Perth. This includes plant operated by WAglass (for CDS glass) and others for MSW glass.

The contamination removal process involves removal of plastics, metals, organics and other contaminants with the major focus on the removal of paper. The removal of sugars and odours can be done in a number of different ways including washing or heating.

The WAglass plant in Perth has an additional sorting process that separates green, amber and flint coloured glass streams.

End products can be produced to predefined specifications using a range of different equipment. An impact crusher is an important piece of equipment in order to get the glass to a meet the required particle size distribution.

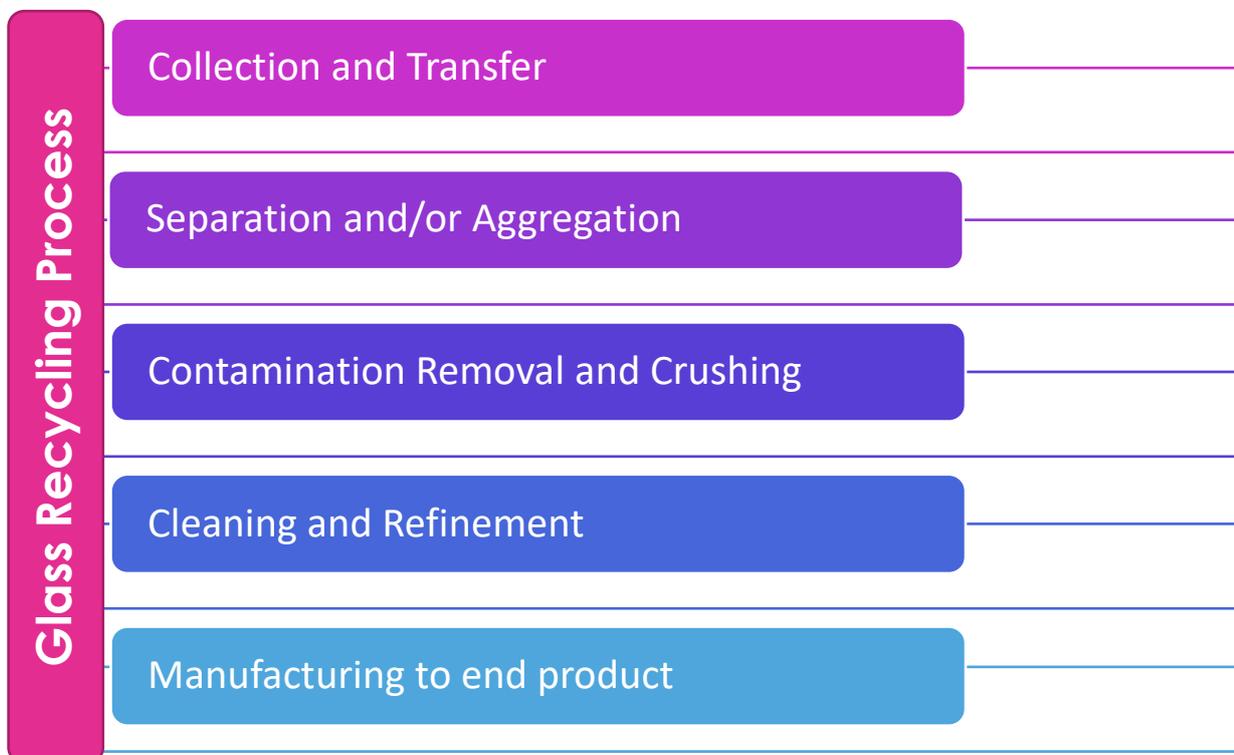


Figure 3.2 – Glass Recycling Process

3.4 Current Specifications

The major road infrastructure components within a typical Main Roads' project are illustrated in Figure 3.3.

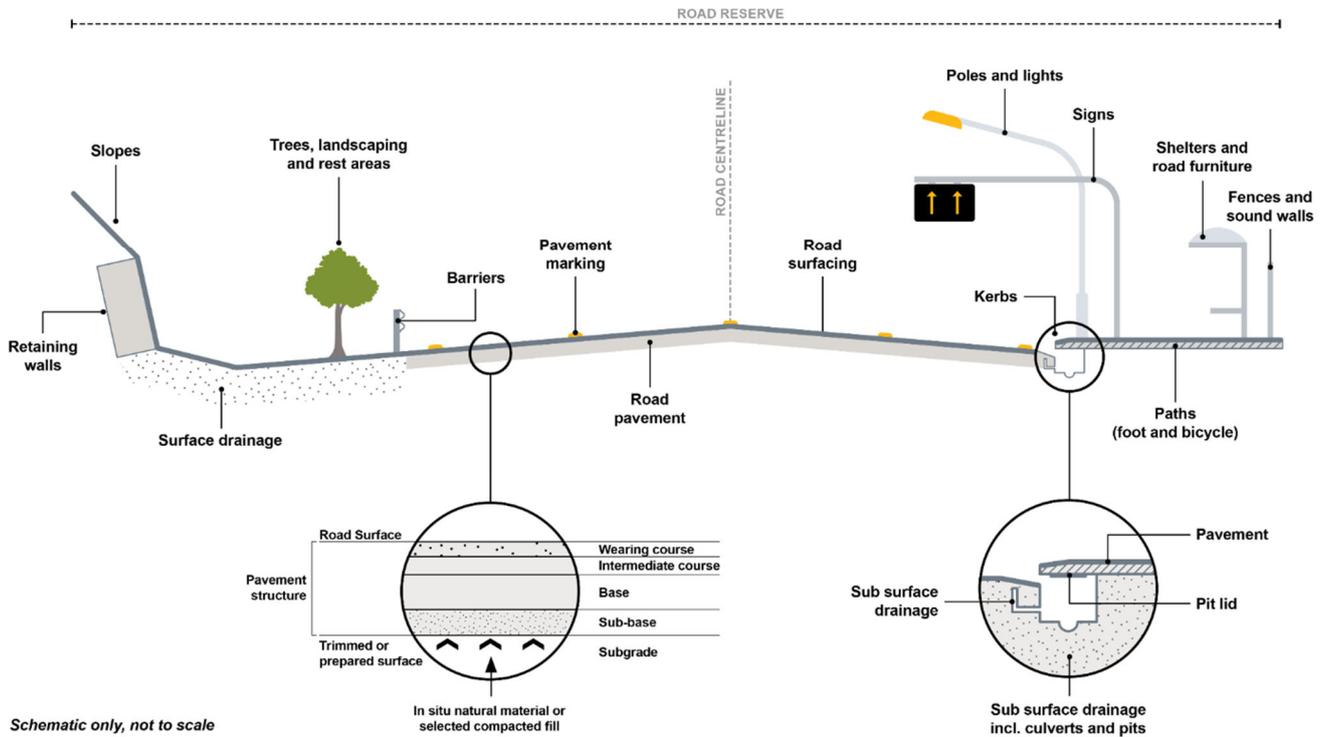


Figure 3.3 - Main Roads Road Infrastructure Components

Specification 302.10.1 applies to the application of recycled crushed glass in earthworks inclusive of subgrade materials and can be used in:

- Fill
- Temporary tracks in heavy clay to reduce bogging of equipment
- Bedding Sand
- Drainage
- Retaining Walls

Main Roads specifies that the preference is for glass to be reused as it contains significant embedded energy and does not degrade over time. Where reuse is not possible, Main Roads recommend recycling glass to produce other new glass products. This is currently not feasible in Western Australia due to the absence of the required local glass reprocessing facilities. Main Roads accepts that the use of recycled glass in road building is a low-value application (down-cycling) of the material but is part of an interim solution to reduce waste glass sent to landfill.

Recycled glass beads are used to manufacture glass beads that are applied to road marking paint to provide better visibility at night and in wet conditions. They act as a reflector to vehicle lights in the paint. There is potential for heavy metal contaminants to be present in some recycled products. The exclusion of heavy metals in glass beads is

managed through a specification for the supply of glass beads for pavement markings, allowing them to be used on WA roads.²

3.5 Glass Applications in the BORR

3.5.1 Specified End Products (RCG Types)

The Recycled First Plan (RFP) for BORR identified a number of potential applications for RCG end products as shown in Figure 3.5³.

The Project Brief identified the following potential RCG end products in the BORR, which aligns quite well with the RFP:

- Drainage blanket
- Decorative feature in concrete
- Non-structural concrete blocks
- Principal Shared Pathways (PSP)
- Road pavement (Basecourse) in LGA Roads

3.5.2 Specifications and Product Relationships

Figure 3.4 illustrates the relationships within the glass waste stream between the glass products described in the Project Brief and RCG end products sought from RCG suppliers.

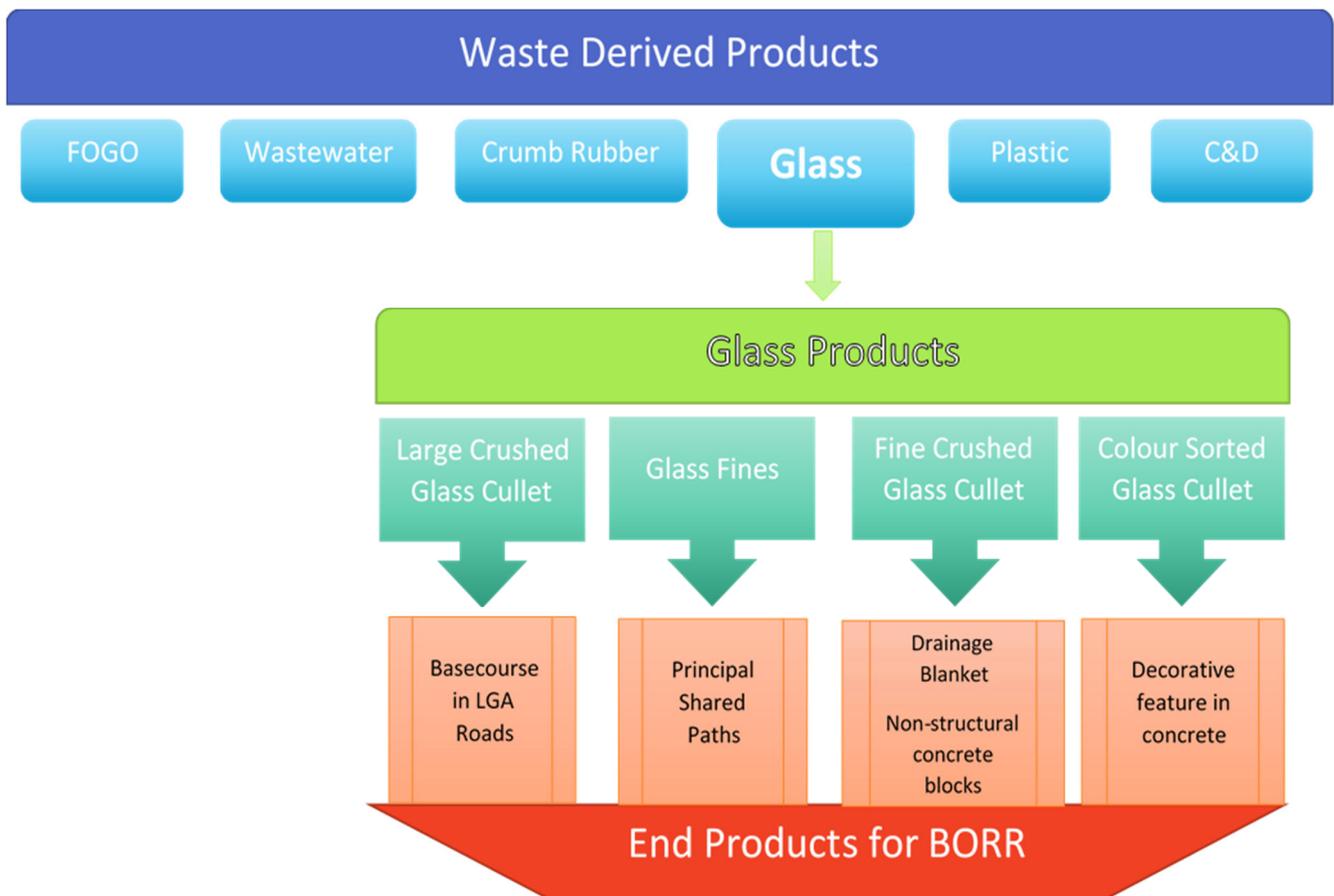


Figure 3.4 – Relationship between Products

² This section is drawn directly from "Recycled Materials at Main Roads Reference Guide, January 2021", which can be found at <https://www.mainroads.wa.gov.au/globalassets/community-environment/sustainability/recycled-materials-reference-guide.pdf>

³ Recycled First Plan for BORR, Sustainability Waste Alliance, November 2020

3.5.3 Preliminary Specifications Provided to Suppliers

Suppliers were asked to provide RCG prices and volumes to the following preliminary specifications:

- Basecourse in LGA roads – as per MRWA Specification 302 to be blended to achieve MRWA 501 specification for basecourse.
- Sand in drainage blankets and non-structural concrete blocks – as per Australian Standard AS2758 with no solid contaminants, no odours, with and without sugars.
- Decorative feature in concrete - colour sorted - small volume (<100 tonnes) proposed for walls.
- Glass fines below 75 microns for use in PSPs and special wearing applications.

These specifications were developed by the SWA Innovation Hub to provide suppliers a range of products and market price points. Further information is outlined in Appendix B.

The following additional detail to the above preliminary specifications was provided to suppliers:

- Contamination and glass types must comply with Roads to Reuse contamination and requirements. Glass must be sourced from food and beverage containers and building or window glass. Glass shall not be used from recycled glass classified as hazardous waste, laboratory equipment, televisions, computers, cathode ray tubes, porcelain products or cook tops. The cullet shall be cleaned to ensure that undesirable odours are eliminated.
- Foreign material content shall be limited to the values in Main Roads' Specification 302 Table 302.05, reproduced below.

Material	Maximum % Retained by Mass on 4.75mm Sieve
High Density Materials (brick, tiles, etc.)	5.0
Low Density Materials (plastic, plaster, etc.)	2.0
Wood and other vegetable matter	1.0

Table 3.1 – Foreign Material Content

The allowable foreign material content detailed in Main Roads' Specification 302 may be too high for some road applications e.g. as a sand replacement on on-structural concrete or asphalt, and further work will be needed to identify the appropriate level of foreign material in those applications in the next task where end product specifications will be defined.

3.5.4 New End Products

The following additional products were identified during the market analysis that were not included in the Project Brief:

- In discussions with WAglass and SmartLite, a potential application for RCG fines (0.75 microns and less) to improve the durability of the surface layer of path wearing courses and in other special applications.
- The Main Roads Recycled Materials Reference Guide 2021 indicates that glass beads from recycled crushed glass are used in line marking paints to improve reflectivity.

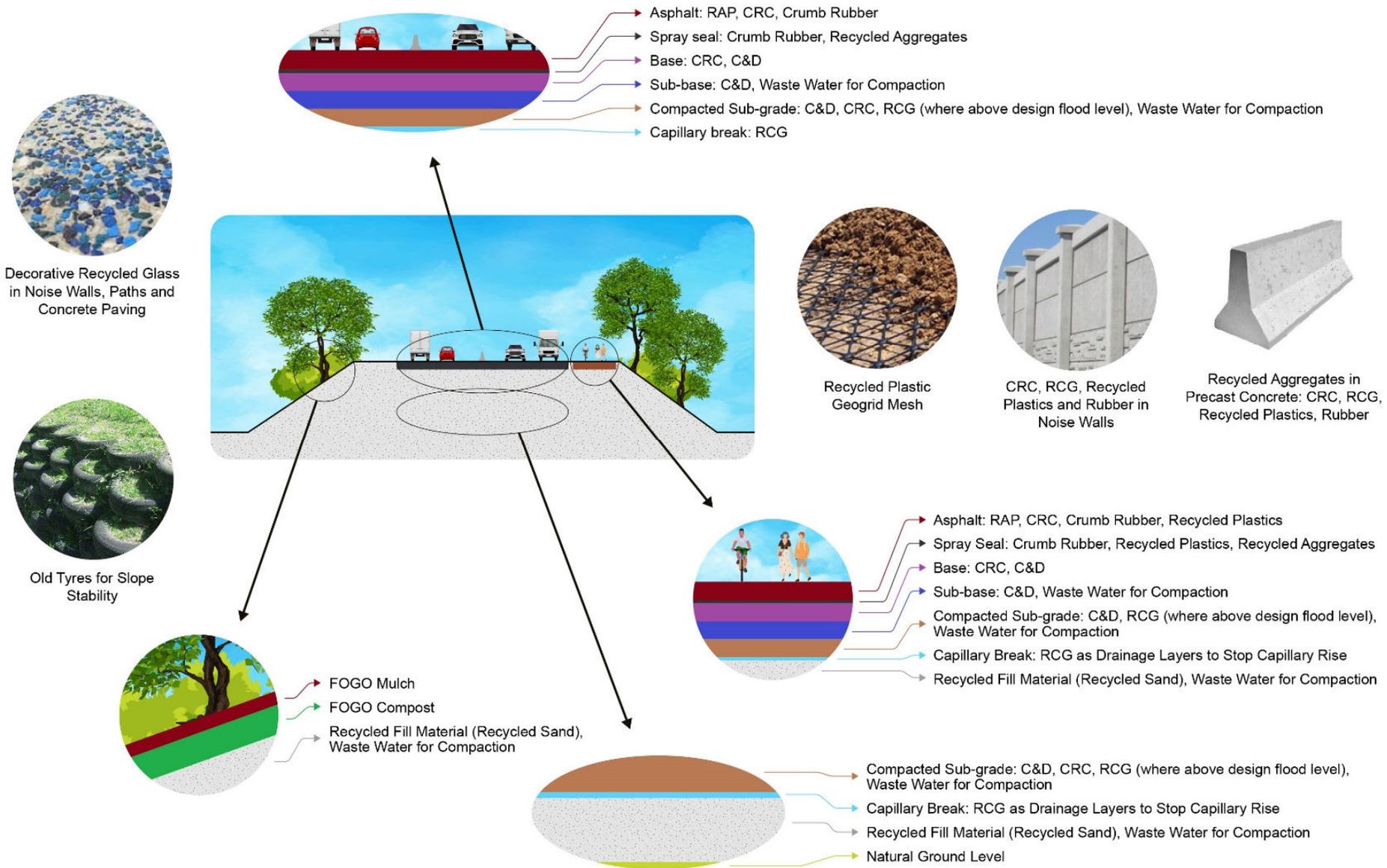


Figure 3.5 - BORR indicative cross section showing recycled waste as potential end products

4 Supply Chain

4.1 SW Glass Sources

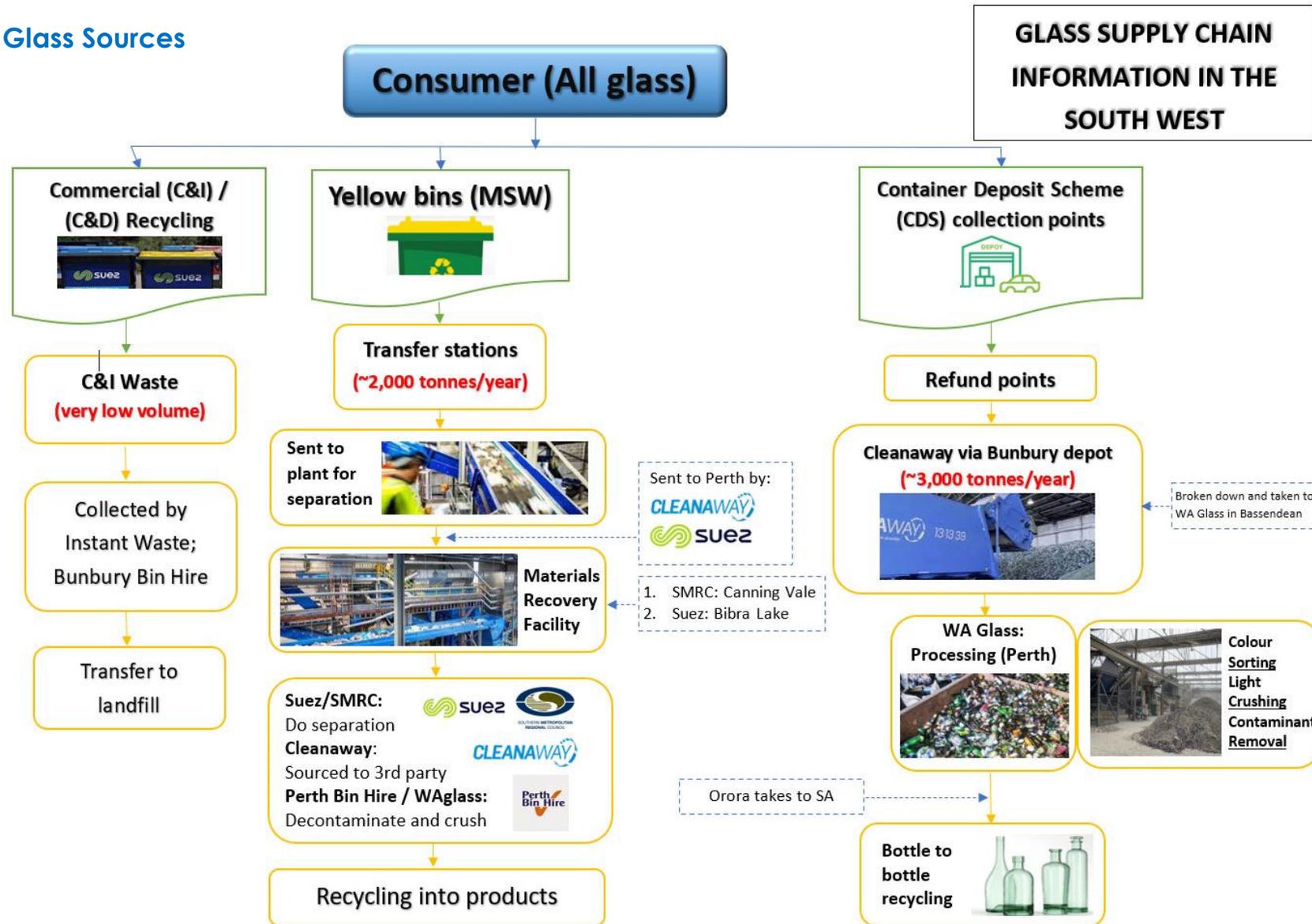


Figure 4.1 – South West Glass Supply Chain

4.1.1 South West Container Deposit Scheme (CDS) Glass

CDS glass in the South West is returned to 19 refund points located throughout the region. The material is consolidated to aggregation points where Cleanaway pick up the material in steel cages or hook bins and take it to the processing facility in Bunbury. The material is broken down and loaded into larger trucks in Bunbury for transport to WAglass in Bassendean. The material is beneficiated at WAglass to prepare it for bottle-to-bottle recycling which includes colour sorting, light crushing and removing contaminants. Orora then takes the material from WAglass in Bassendean to their glass furnace in South Australia for bottle-to-bottle recycling. We have been advised by WARRRL that the volume of CDS glass collected from the South West is approximately 3,000 tonnes per annum.

4.1.2 South West Solid Municipal Waste (SMW) Glass

There are two Material Recycling Facilities (MRF) in WA, both located in Perth. These facilities take co-mingled recyclables from yellow top bins in the South West and elsewhere. One is owned and operated by the Southern Metropolitan Regional Council, which takes glass from its Perth Metro member local governments. The second is owned and operated by Suez. It takes glass from Perth and surrounding regions, including the South West. Suez is unable to provide glass tonnages specific to the South West, as it is comingled when received and processed as it arrives along with waste from other areas. This is because there is no sorting facility or MRF of the required type currently located in the South West. Should this change then there is the possibility to sort and stockpile the glass in the South West. Glass from both MRF's is sent to a third party for processing. At the moment the volume of SMW glass obtained from the South West has been estimated at approximately 2,000 tonnes per annum.

4.1.3 South West Commercial and Industrial (C&I) Glass

The results from the first year of mandatory reporting for waste managers collecting more than 1,000 tonnes of waste glass is due before the end of the current financial year. The volume of C&I glass is not expected to be large. Anecdotal evidence from South West carting companies suggests that the glass tonnage is too small and too difficult to source to be meaningful to the BORR project.

4.1.4 South West Construction and Demolition (C&D) Glass

Until mandatory reporting numbers are published later this year it is not possible to provide detail on the C&D glass collected in the South West. This glass is currently landfilled. A 2019 Report by the Sustainable Built Environment Cooperative Research Centre estimates that C&D glass ranges from 0.75-2 percent of total C&D waste by tonnage. The estimate for the South West in that report was only 14 tonnes.

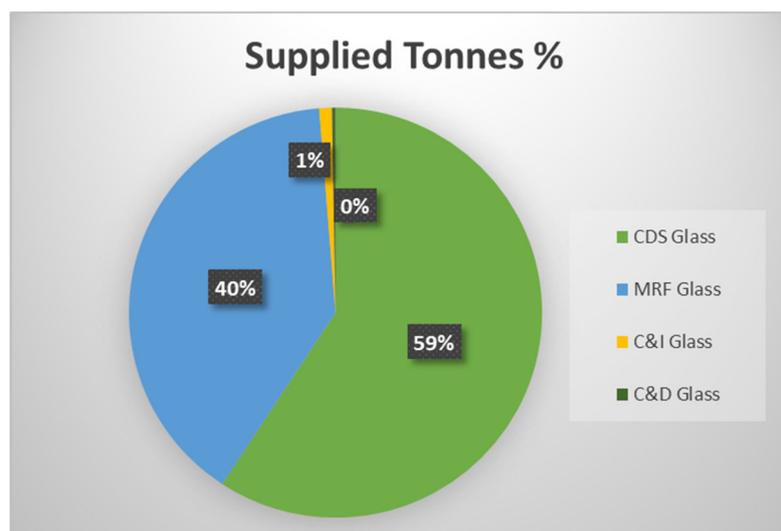


Figure 4.2 – South West Glass Distribution

4.2 Major Glass Suppliers

4.2.1 South West Recycled Glass Market

The following RCG suppliers have indicated an interest in providing South West sourced RCG to the BORR project:

- WARRRL – Containers for Change is operated by WA Return Recycle Renew Ltd. (WARRRL) – an independent, not-for-profit company responsible for establishing the collection network and operating the scheme under state government oversight. WARRRL was appointed on 18 July 2019, as the scheme coordinator for Containers for Change and subject to conditions of appointment. This includes a network of CDS collection points across WA, including an aggregation depot at Bunbury Harvey Regional Council in the South West. WARRRL is interested in working with SWGA and Main Roads to determine the feasibility of establishing regional RCG facilities at central points across its regional network. WARRRL currently contracts out its South West RCG collection and processing operations to Cleanaway. The goal is to determine the ability to deliver RCG at a competitive price and reduce transportation costs to Perth. WARRRL views the BORR project as a potential test-case to determine whether RCG meeting Main Roads specifications can be delivered at competitive prices at regional locations throughout the state.
- Peel Resource Recovery (PRR) – located adjacent to Stanley Road in the South West. It previously supplied RCG to Main Roads, withdrawing from the market and selling its processing plant when prices made the business unviable. They do not have RCG processing facilities currently. To recommence supplying RCG requires investment in a new RCG processing facility, which hinges on securing adequate ongoing procurement through Main Roads. The company is an approved Roads to Reuse supplier.
- WAglass – sorts, cleans and crushes CDS glass in Perth under contract to WARRRL. The majority of this glass is contracted to Orora, in South Australia, for recycling into beverage containers. WAglass have advised that they can meet the preliminary specifications and is interested in assisting with establishing a facility in the South West, in partnership with WARRRL. They are able to build and supply glass crushing and processing equipment to requirements.
- Cleanaway – carts South West CDS glass to WAglass in Perth under contract to WARRRL, supports local processing of South West CDS glass, and is currently in discussions with WARRRL.
- Suez – carts comingled South West yellow bin recyclables including glass for sorting at its MRF in Perth. SW glass tonnages are not large and currently cannot easily be sorted out before transport to Perth due to lack of appropriate South West sorting infrastructure. Suez have indicated that if there was a MRF in Bunbury that they would be happy to use it and supply their waste glass into the project at no cost.
- Instant Waste – collects C&I and C&D skip bin waste in the South West – they report very low glass tonnages per annum.
- Bunbury Ezy Bins – collects C&I and C&D skip bin waste in the South West – they also report very low glass tonnages per annum.

4.2.2 Perth Recycled Glass Market

The glass market in Perth is larger and more diversified than in the South West. The following suppliers produce products and offer services of potential value to the BORR project.

- WARRRL – as in 4.2.1.
- WAglass – as in 4.2.1.
- Capital Recycling – supplies recycled crushed glass for local recycling applications and has process and product expertise relevant to the BORR project. The company declined to participate in the BORR project, due to transport costs from Perth.
- Perth Bin Hire – receives Southern Metropolitan Regional Council (SMRC) SMW glass and provided approximately 70,000 tonnes of recycled crushed glass to the Northlink project. Perth Bin Hire is contracted to process MSW glass and is currently the State's largest RCG supplier.
- Mode2Group – provided recycled crushed glass process engineering and sample audit design expertise to Perth Bin Hire and the Northlink project.
- Cleanaway – as in 4.2.1.
- Suez – as in 4.2.1.

4.2.3 Eastern States Recycled Glass Market

The RCG market in the Eastern States is more established with existing processing infrastructure already in place. Some major suppliers are listed below. Some of these, e.g. Alex Fraser, have received substantial financial investment by state government allowing them to establish infrastructure, make their operations more viable, and set the price of their product to be more cost competitive.

- Alex Fraser – a major supplier of recycled crushed glass for road applications in Victoria.
- Envirosand Recycled Glass – a supplier of recycled crushed glass for road applications in Queensland.
- Schneppa Glass – a supplier of decorative glass for non-structural concrete applications in Victoria.
- SmarterLite – a Victorian supplier of durable glass pavement surfaces for principal paths. These products are low volume and viable for shipping to Western Australia.



Figure 4.3 – Example of recycled glass applications in asphalt and paint additives

4.3 Third Party Certification

4.3.1 Quality Management System (QMS) Certified Suppliers

Western Australia's largest waste management companies are all QMS certified, while smaller operations generally are not, as set out in Table 4.1 below:

Company	Certified	Type
WARRRL	NO	Does not own or operate assets directly - relies on third parties to collect, cart and process glass
WAglass	NO	
Cleanaway	YES	ISO 9001 (quality), AS/NZS 4801 (OH&S) and ISO14001 (environment)
Capital Recycling	NO	
Instant Waste Management	NO	
Suez	YES	ISO 9001 (quality), AS/NZS 4801 (OH&S) and ISO14001 (environment)
Bunbury Ezy Bins	NO	
Peel Resource Recovery / Cross Bros	NO	Internal QMS systems, but not third party certified
Bunbury Harvey Regional Council	NO	
Perth Bin Hire	NO	

Table 4.1 – List of Companies with Third Party Certification

4.3.2 Approved Recyclers

The Container Deposit Scheme is administered by WARRRL under contract to DWER. To become an approved glass recycler, applicants notify WARRRL of their interest by emailing plmr@warrl.com.au. WARRRL makes the decision as to a glass recycler's suitability to be on the list, according to established guidelines. Table 4.2 is an extract of approved glass recyclers in Western Australia pertinent to the project. The full list of approved glass recyclers is given in Appendix C.

WA Approved Glass Recyclers

Cleanaway
Perth Bin Hire – Appala Holdings Pty Ltd
Suez
WAglass

Table 4.2 – Extract list of some approved recyclers

For SWGA to use CDS glass in the BORR project, it will require SWGA to become an approved recycler. WARRRL have indicated that this is relatively straightforward and they can assist with the process. Confirmation from DWER that CDS glass can be recycled into roads is given in Appendix D.

4.3.3 Roads to Reuse (R2R) Approved Suppliers

The Main Roads specification for recycled crushed glass requires similar quality controls as for construction and demolition waste (see Figure 4.4).

There are currently three R2R approved suppliers in the metropolitan region (Urban Resources, Wastestream Management, and WA Recycling). Peel Resource Recycling is the only supplier in the South West that has been approved subject to audit. They currently have no stockpiles of glass or any existing arrangements in place to process glass.

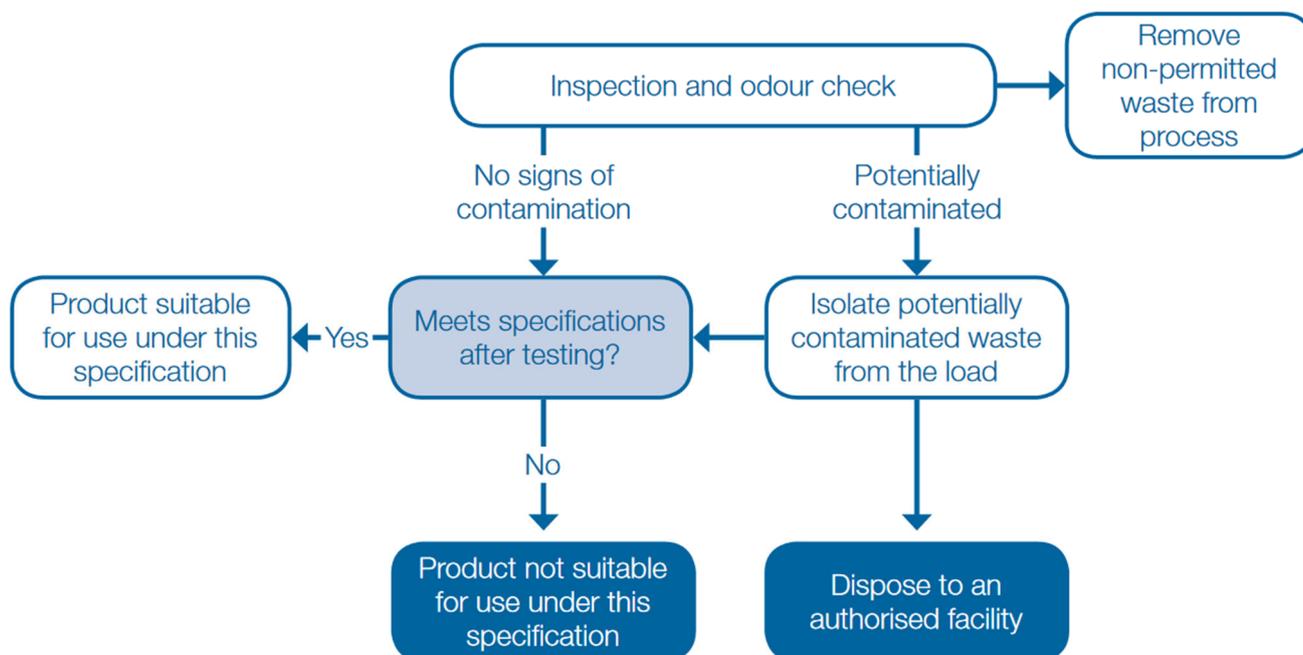


Figure 4.4 – Process Controls

4.4 SW Glass Supply Chain Gap Analysis

The South West supply chain for glass has both gaps and potential.

1. There is not a local MRF, meaning unsorted SMW glass is carted to Perth and is not available for local processing into RCG for use in roads.
2. There is currently no RCG processing equipment in the South West. A facility could be justified for South West SMW and CDS glass based on transport savings, provided local demand for RCG by Main Roads, local government roads and the property development sector is developed.
3. Development of RCG specifications for higher value road applications and some form of commitment to its ongoing use in roads is required to expand demand in the South West.

The South West glass waste management industry has significant gaps. The transportation cost from Perth is seen as making high volume products uncompetitive. Decorative glass is not significantly affected by these costs and can be supplied from Perth or the eastern States. WARRRL is motivated to work with its contractors and SWGA / Main Roads to determine the merits of establishing regional RCG facilities to reduce transport costs and generate other local and regional benefits. CDS glass costs less to process, as it is sorted and relatively clean. Yellow bin glass requires sorting and decontamination; however, it has less value to others, and should be able to be obtained for no direct cost or for a fee. Bunbury

Harvey Regional Council's Stanley Road facility is a prospective location for a South West RCG facility, as it is convenient to the BORR, a CDS aggregation depot for the South West. BHRC has indicated an interest in providing land for an RCG facility. The industry has advised that 10,000 tonnes of RCG per annum is the minimum volume for plant efficiency.

1. Supply Chain Option 1: SW RCG Pathway

New processes and facilities required (short transport distances to local sorting and processing facilities):

- a. SW SMW glass goes to SW MRF – facility required;
- b. SW CDS glass is aggregated at BHRC – existing process / facility;
- c. SW CDS and SMW glass is locally sorted and processed into RCG, compliant with end product specifications (yet to be produced);
- d. SW RCG is utilised in SW road projects, including BORR trials.

2. Supply Chain Option 2: Perth RCG Pathway

Current recycling process (long transport distances with high costs leading to large, centralised facilities):

- a. SW comingled SMW (including glass) are carted to the Suez MRF in Perth for sorting with recyclables from other regions – existing process / facility;
- b. SW CDS glass goes to BHRC – existing facility;
- c. Suez SMW glass (comingled with glass from other regions) goes to Perth Bin Hire for processing into RCG – existing process;
- d. SW CDS glass is carted to WAglass in Perth (see Figure 4.5) for RCG processing to required end product specifications – existing facility;
- e. SW RCG is carted to the SW for BORR project trials.

The most probable mechanism for delivering cost-effective RCG products to the BORR appears to be establish a relationship with WARRRL to source and process South West glass near Bunbury.

The current supply chain for the South West is illustrated in the flow charts contained in Appendix E and F.

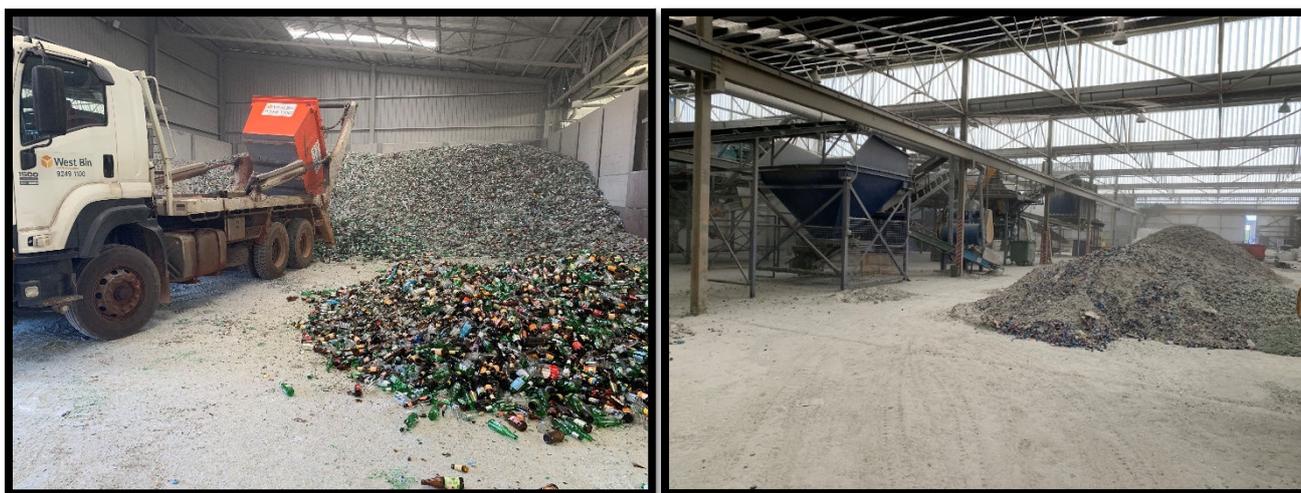


Figure 4.5 – Example of glass sorting and crushing facility (WAglass)

5 Pricing and Volumes

5.1 RCG Prices

Gate prices for the different classes of RCG that were specified have been obtained from WA suppliers including WARRRL and WAglass and interstate suppliers such as SmarterLite, are given in Table 5.1 with supporting documentation included in Appendix G. These gate prices are indicative estimates based on the best information available at the time.

RCG Application	Indicative gate price
Basecourse blend for LGA road pavements	\$XX/tonne (less \$XX/tonne rebate on CDS glass)
Sand in drainage blankets and non-structural concrete blocks	\$XX/tonne (less \$XX/tonne rebate on CDS glass)
Decorative feature in concrete	\$XX/tonne
PSPs and hard-wearing surface applications	\$XX/tonne

Table 5.1 – Indicative prices based on preliminary specifications and current supply estimates

Basically, the more refined the RCG product the more expensive it is to purchase.

The price of the first two products listed in Table 5.1 are contingent on the crushing and refinement of 30,000 tonnes of RCG over a three year period. It includes an allowance for capital and operating costs including equipment to crush, decontaminate and refine the RCG end products. Where sugars and odours must be removed it also allows for that infrastructure to be provided. It does not allow for the provision of land, hardstand areas, warehousing, enclosed stockpile areas, servicing and dust extraction. More detail is included in Section 5.3 and the WARRRL offer contained in Appendix G.

Should circumstances change (such as the volume of supply or the cost of plant and equipment) then the information supplied on the price of RCG materials will alter.

Prices of RCG were benchmarked against more mature markets in the Eastern States. Gate prices for recycled sand (5 mm) of between \$25 and \$30 per tonne (plus GST and transport to site) were received. Quotes from suppliers Alex Fraser in Victoria and Evirosand from Queensland are referenced in Appendix H. The expectation for the BORR should be that equivalent product will not be less than this amount received from more mature markets. The transport costs of CDS glass to Adelaide are significant and some portion of the cost saved could offset the cost of producing RCG in the South West.

5.2 South West Glass Tonnages

It is estimated that it will be possible to obtain a maximum of 5,000 tonnes of RCG sourced from the South West per annum. This is a combination of CDS and SMW glass. The CDS glass from the South West can be sourced and processed more easily than South West yellow top bin glass, which will require additional sorting and cleaning.

If stockpiling commences immediately, a maximum of 10,000 tonnes can be delivered to the BORR project within the next 2 years, and 15,000 tonnes within 3 years. This could be supplemented with additional waste glass feedstock from surrounding regions (say 15,000 tonnes) to reduce the price per tonne of producing RCG for the BORR project.

Of the five RCG end products considered, the majority of the demand is likely to be driven by the need for drainage blankets or basecourse materials in LGA roads. The other RCG end products are likely to have a need for a much lower volume of glass.

5.3 Cost of Establishing an RCG Beneficiation Plant

The cost of plant establishment in the South West will vary depending on the end product requirements and number of recycling processes (see Section 3.3) that are needed.

Indicative estimates of crushing, decontamination and cleaning equipment have been supplied by WARRRL and WAglass. This varies between \$900k and \$1.4M. The higher costs cater for additional crushing as well as glass cleansing (to remove sugars and odours). This excludes the cost of land, warehousing, enclosed stockpile areas, hardstand areas, servicing, scrubbers and dust extraction.

If an agreement can be reached with the Bunbury Harvey Regional Council (BHRC) to host an RCG facility then indications are that land already held by BHRC in Stanley Road can be used for the purpose. Alternatively the SWGA or Main Roads can provide land within the project or elsewhere in Bunbury for this purpose.

The indicative cost of concrete hardstand areas, warehousing, enclosed stockpile areas, servicing, scrubber and dust extraction has been indicatively estimated for a small RCG facility capable of processing approximately 10,000 tonnes of glass per annum using the Australian Construction Handbook, Rawlinsons, 2020 (Perth indices). Where direct comparisons were unavailable the nearest similar use in Perth has been assumed.

The outcome suggests that the minimum cost of establishing an RCG beneficiation plant in the South West may be as much as twice the cost of the crushing, decontamination and cleaning equipment, i.e. indicatively between \$2.5-3M. This cost has not been market tested and more precise estimates are the subject of later tasks not yet commissioned.

The CAPEX to establish a RCG beneficiation plant can be sourced in a number of ways. It can be provided by industry in response to procurement signals or commitments made by the SWGA or local government. It can be directly funded by the SWGA or local government. It could be partially secured through government grants (see Section 6.2). Or it could be the subject of a solicited market led proposal. The latter is the proposed next step recommended by the SWA.

6 Other Considerations

6.1 Risk and Opportunity Analysis

A Risk and Opportunities register is in Appendix I.

6.2 Available Grants

There are Western Australian and Federal grants available to support investment in glass sorting and processing facilities. This also applies to larger materials recovery facilities, that are able to process more than one waste stream.

Two examples of relevant grant programs are the state government WasteSorted and Regional Economic Development (RED) grants. There is also a possibility of a Market Led Proposal to Government. More information is provided in Appendix J.

6.3 Value Proposition to Government

The Container Deposit Scheme (CDS) has a fund that collects consumer beverage container surcharges and other revenues collected from the beverage industry. WARRRL is paid out of this fund to administer the scheme. The amounts paid to consumers, collectors and transporters are paid by WARRRL, not Government. Therefore, the price of glass proposed by WARRRL to Main Roads is a market price with no flow on costs to Government.

South West glass used by Main Roads confers additional waste diversion and transport saving benefits in line with the Department of Transport's commitments to DWER under its Recycle First Plan for BORR⁴ and 'Towards 100' philosophy. Combining CDS glass with SMW glass is a way to scale up volumes in the South West (and potentially other regional areas) to improve the viability of local processing into road products.

Main Roads already purchases recycled glass products for decorative features and paths. It may be possible to utilise SW recycled glass to produce some of these products.

The largest market for recycled glass in WA is currently for crushed glass in construction activities due to the low margins associated with transporting glass to interstate glass cullet processors.⁵

It is clear that without developing ongoing demand for RCG in WA roads the local market for glass products will not develop.

⁴ Recycle First Plan for BORR, SWA Innovation Hub, November 2020

⁵ Recycling Activity in Western Australia 2018-19, ASK, July 2020



Equivalent of
80,000,000
glass bottles

7 Findings and Recommendations

The major findings and recommendations from this market analysis for RCG are as follows:

1. There are no existing RCG suppliers or glass processing facilities located in the South West. There are also no Material Recovery Facilities (MRF) located in the South West to sort commingled glass from other waste streams.
2. There are currently several sources of waste glass in the South West. This includes CDS glass, SMW (yellow bin) glass, Construction and Demotion (C&D) waste glass and Commercial and Industrial (C&I) waste glass. The benefit of CDS glass is that it has already been recovered, separated, and transported to a central point. Other sources of waste glass require additional processes to be established in the South West. This includes the additional steps of collection, transfer, separation and recovery. Nearly all of this non-CDS glass comes from yellow top bins. C&I and C&D waste glass from the South West represents only a very small fraction of the waste stream and is currently unviable to recover.
3. The South West produces approximately 5,000 tonnes of waste glass per annum. The primary components are CDS glass (~3,000 tonnes pa) and yellow bin glass (~2,000 tonnes pa). Essentially none of this South West generated glass is recycled in the South West.
4. Over a 3 year period a total of 15,000 tonnes of CDS sorted glass from the South West, the Great Southern and parts of the Wheatbelt can be committed by WARRRL to the BORR project. WARRRL will pay SWGA \$XXXX per tonne to receive CDS glass in Bunbury if it is recycled into end products on the BORR project. There are advantages to the State in taking this approach versus transporting it all the way to Adelaide for recycling. This includes reduced transport costs, local employment, local investment, etc.
5. Approximately 5,000 tonnes of SMW glass can be recovered from the South West over a 3 year period for use in the BORR project. This contaminated waste glass is currently being transported to Perth for sorting at one of two existing MRFs. To recover it in the South West for processing into RCG end products will require an investment in a MRF in the South West. Sorting it and decontaminating it in the South West would save transport costs, which could be recovered to offset the cost of glass beneficiation plant investment. Together with the CDS glass mentioned above this would compare to taking the equivalent of 80,000,000 glass bottles out of the waste stream.
6. Further work on specifications, costs and the preparation of a case for go/no go on different products is needed to be done as a priority by the SWA Innovation Hub to give greater confidence in the opportunity and to better understand the value for money proposition of various RCG applications in the BORR. The SWA-SWGA Governance Group to provide approval for the SWA Innovation Hub to proceed immediately with further tasks within the RCG Project Brief on this basis.
7. A market led proposal should be solicited as soon as possible to firm up all co-investors and further test the market analysis findings in this report including zero waste glass recoverable cost and initial WARRRL rebate offer.

APPENDIX A: Suppliers connected with Recycled Glass

Company Name
WARRRL
WAglass
Cleanaway
Capital recycling
Instant Waste Management
Suez
JJ Richards
Bunbury Ezy Bins
PRR/Cross Bros
BHRC
Alex Fraser (Vic)
Schneppa Glass (Vic)
SmaerLite (Vic)
Catalano Brothers
Carbone Bros
City of Busselton
BGC
Visy (Vic)
Hazell Bros
Fulton Hogan
Crushed Glass Concepts (Vic)
Polytrade Recycling (Vic)
AAA recycling (SA)
Aldinga Recycle Centre
Daws Road Bottle Co
Astron Sustainability (Vic)
Ausino Commodities (Hongkong) Limited (Vic)
Vanden Industries (Vansec) (Vic)
YM United Enterprise (Vic)
Polytrade

Company Name
Genuine Recycling Group PTY LTD (Qld)
Auswaste Recycling Pty Ltd (Qld)
Australian Recycled Plastics
CRG (Vic)
True Eco Glass
Coloured Recycled Glass Pty Ltd
Enviro sand (Qld)
BottleCycler Australia Pty Ltd
URM

APPENDIX B: Preliminary Specifications

In order to obtain consistent responses on quantities and pricing of RCG products, two preliminary specifications were provided by the SWA Innovation Hub to all suppliers. One specification related to basecourse in pavements in local government roads, once blended, and the other to a sand replacement for use in drainage blankets and non-structural concrete elements.

As a basecourse blend - The cullet shall be well graded and comply with a prescribed particle size distribution and the retained material >4.75mm shall not contain more than 1% of particles with a maximum dimension ratio greater than 5:1. It must comply with the Main Roads grading envelope (302.3 below) for gravel to enable blending.

Sieve Size (mm)	% Passing
9.5	100
4.75	70 - 100
2.36	35 - 88
1.18	15 - 45
0.30	4 - 12
0.075	0 - 5

Table A1 - Main Roads Glass Cullet Specification 302.03 - Particle Size Distribution

As sand replacement – Use Australian Standard 2758.1, as shown below.

FINE AGGREGATE—RECOMMENDED GRADINGS

Sieve aperture mm	Mass of sample passing, percent	
	Natural fine aggregate	Manufactured fine aggregate
9.50	100	100
4.75	90 to 100	90 to 100
2.36	60 to 100	60 to 100
1.18	30 to 100	30 to 100
0.6	15 to 100	15 to 80
0.3	5 to 50	5 to 40
0.15	0 to 20	0 to 25
0.075*	0 to 5	0 to 20

Table A2 - Australian Standard AS2758

All specs (crushing) - A shape crushing plant (e.g. Barmac impact crusher or equivalent) shall be included in the process to produce the glass cullet.

Washed sand replacement - The glass must be free of sugars, as sugars may cause concrete and asphalt to fail.

APPENDIX C: WARRRL Approved Recyclers

The following list was obtained directly from DWER.

Astron Sustainability

Ausino Commodities (Hongkong) Limited

Australia Resources International Pty Ltd

Australian Recycled Plastics

Auswa Group Pty Ltd

Auswaste Recycling Pty Ltd

Chairay Sustainable Plastic Company Pty Ltd

Cleanaway

DDT Holding Pty Ltd

Genuine Recycling Group PTY LTD

Green Machines Lab Pty Ltd

Haoze International trading Pty Ltd

Industrial Metal Service

Kangaroo Plastics Technology

Karratha Environmental Crushing Pty Ltd

Oatley Resources Australia Pty Ltd

Orora PACKAGING COMPANY, WA BASED

Perth Bin Hire- Appala Holdings Pty Ltd KWINANA, WA

Polytrade

Protrade Networks

Recycling Plastics Australia

Remondis Australia Pty Ltd CANNINGVALE

Sell & Parker

Sims

Vanden Industries (Vansec)

Visy

WAGlass

WestCoast Impex Pty Ltd trading as Enviro Recycling

YM United Enterprise

APPENDIX D: Confirmation from DWER on CDS glass

From: **Ross Belton** <ross.belton@dwer.wa.gov.au>

Date: Tue, 23 Mar 2021 at 15:08

Subject: RE: CDS policy officer

To: Erik Stanton-Clements <erik.stantonclements@gmail.com>

Hi Erik

Yes you are correct. Recycled glass from the CDS can be used in roads.

Regards

Ross Belton

A/Manager Container Deposit Scheme

Department of Water and Environmental Regulation

Level 7, Prime House, 8 Davidson Terrace, JOONDALUP WA 6027

T: (08) 6364 7027

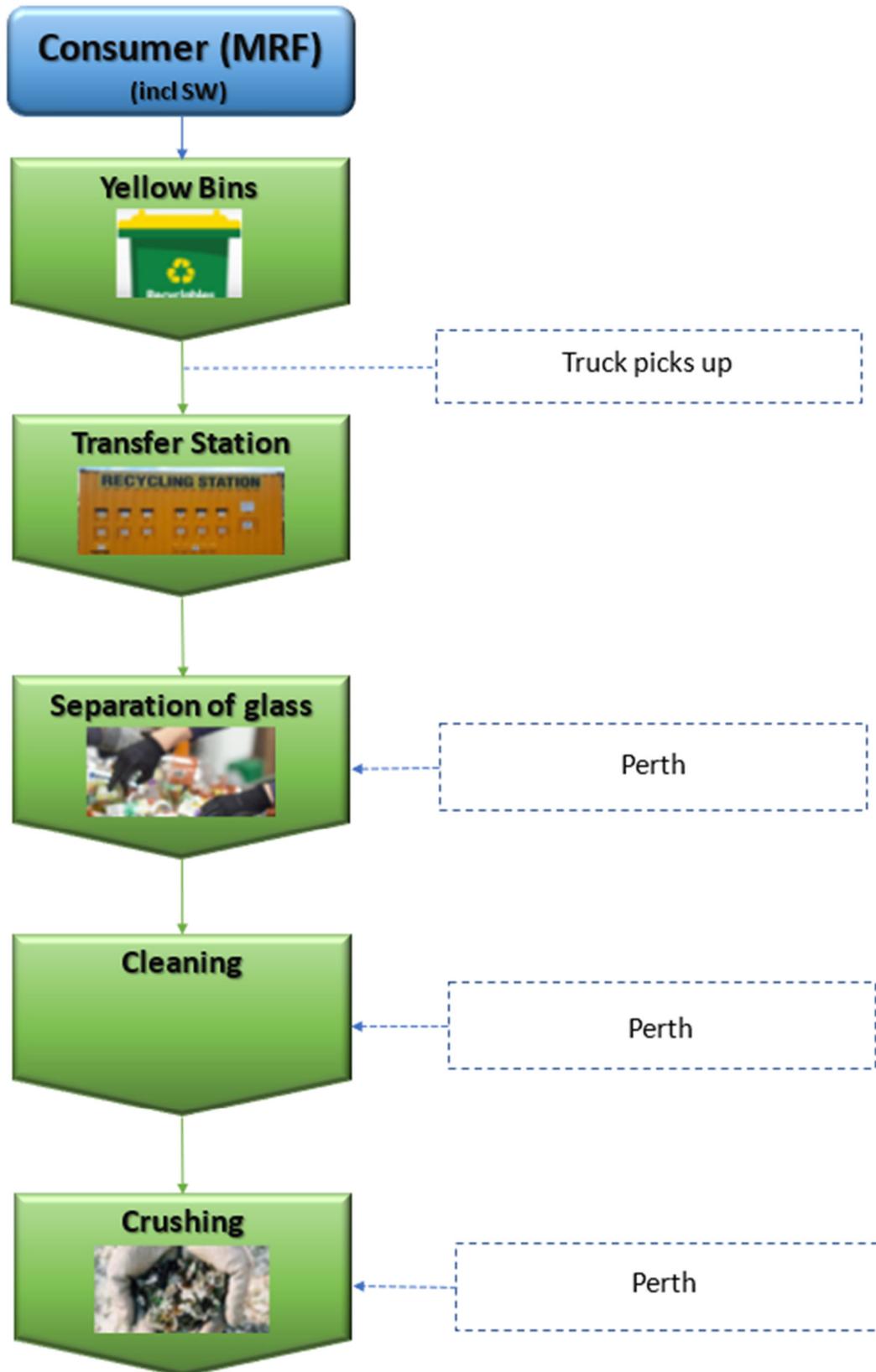
E: ross.belton@dwer.wa.gov.au | www.dwer.wa.gov.au

Twitter: [@DWER_WA](https://twitter.com/DWER_WA)

APPENDIX E: South West CDS Glass Supply Chain



APPENDIX F: South West Yellow Bin (SMW) Glass Supply Chain



APPENDIX G: Letters of offer

Redacted Material

APPENDIX H: Price Benchmarking

Redacted Material

Redacted Material

APPENDIX I: Risk and Opportunity Register

Risks and Opportunities	Current Status / Controls	Mitigation and Controls	Control Owners SWGA, SWA, Supplier, LGA, MRWA, DoT	Control Closeout Date
Approvals from Main Roads on specifications	Lack of existing WA specifications for proposed end product uses To achieve approvals may require extensive work to provide sufficient confidence	Adopt approved specifications from other jurisdictions or Australian Standards Engage with Main Roads early and work together collaboratively	MRWA, SWA, SWGA	Sep 2021
Glass can be produced to the required specification	Existing information to inform pricing and volumes is preliminary and more work on specifications is needed ASAP	Immediate work needs to commence on the development of specifications to give more confidence on supply quantities and prices, and certainty around quality	SWGA, SWA, MRWA	April 2021
Demand for glass products	BORR design to incorporate findings of SWA process	SWA and SWGA design team to work more collaboratively Develop higher value RCG road specifications Improve procurement certainty	SWGA / SWA	May 2021

Risks and Opportunities	Current Status / Controls	Mitigation and Controls	Control Owners SWGA, SWA, Supplier, LGA, MRWA, DoT	Control Closeout Date
Supply of SW glass	Supply is likely to be influenced by procurement and investment decisions	Commence the development of a business case to inform a market led proposal Explore supply contract	WARRRL / other suppliers / SWGA / MRWA / BHRC / SWA	June 2021
Funding for MRF in SW	BHRC seeking MRF funding / BHRC & Government decision	Procure RCG from Perth for trials / BHRC and Government decision	BHRC/LGA, Feds, SWDC, SWGA	Sep 2021
Timing and cost of establishing a RCG facility in Bunbury to create supply from the South West	Timing to establish may exceed available timeframe Cost of establishment is indicative and will vary	Procure RCG from Perth or elsewhere for trials / implementation Undertake further investigations to give greater confidence on establishment costs	SWGA, WARRRL, BHRC	Oct 2021
Quoted prices for RCG products change	Pricing is currently indicative and will change as the specifications are further developed, demands are clarified, establishment costs are refined, and the timing of the BORR project needs become more certain	Proceed with additional tasks to develop specifications, firm up pricing, and prepare case for go/no go on different products	SWGA, SWA, MRWA	April 2021
RCG products are fit for purpose	Products ability to meet performance requirements is not yet clear	Commence specification and trial development work	SWGA, SWA, MRWA	April 2021

Risks and Opportunities	Current Status / Controls	Mitigation and Controls	Control Owners SWGA, SWA, Supplier, LGA, MRWA, DoT	Control Closeout Date
RCG products deliver whole of project benefits to the State Government	Broader benefits to government and the project are important	Commence business case including multi-criteria analysis / scorecard to capture the benefits	SWGA, SWA	Apr 2021
RCG commitments	A commitment exists to use 100% of waste glass not already recycled	Proceed with additional tasks to develop specifications, firm up pricing, and prepare case for go/no go on different products.	SWGA, SWA	April 2021

APPENDIX J: Information on Relevant Grant Programs

WasteSorted Grants

WasteSorted Grants – Infrastructure and Community Education 2020-21 (WasteSorted Grants) are a State Government initiative administered by the Waste Authority.

WasteSorted Grants provide funding for:

- recycling infrastructure development
- community education initiatives and events that contribute to waste avoidance and resource recovery.

WasteSorted Grants replace the Community and Industry Engagement (CIE) Program, which commenced in 2017 and has invested over \$4.5 million in new infrastructure and programs to reduce waste and increase recycling in Western Australia.

The Waste avoidance and resource recovery strategy 2030 (waste strategy) contains objectives to avoid waste, recover more value and resources from waste, and protect the environment. Integral to this is supporting local recycling infrastructure, which helps to create jobs and minimise the costs and impacts of unnecessary transport, progressing the waste strategy's vision of moving Western Australia towards becoming a circular economy. Also important is supporting work to change waste-related behaviour through education and the development of better-practice systems and processes.

WasteSorted Grants support projects which focus on the State Government's priority waste materials, including plastics, paper and cardboard, organics (including food organics), construction and demolition waste, metals, glass, textiles and hazardous waste.⁶

Applications for the latest round of funding closed in September 2020. To be notified of future funding rounds, interested parties can register at <https://www.wasteauthority.wa.gov.au/#subscribe>.

Regional Economic Development Grants

Regional Economic Development (RED) Grants. The RED Grants program is a State Government initiative that invests in community-driven projects that support efforts to create long-term economic growth and job sustainability in our regions.

The State Government's Royalties for Regions program will invest \$28.8 million towards the RED Grants program over five years for projects that will directly benefit regional communities.

Each of the Regional Development Commissions (RDC) manage the grant round process for their region and will provide advice to applicants during the application process.

Eligible applicants can apply for round 3 of RED Grant funding for individual projects that contribute to sustainable jobs, expand or diversify industry, develop skills and capability, attract new investment or maximise recovery from COVID-19 impacts to the region.

Over \$13 million has been invested towards 137 approved projects across the nine regions from rounds one and two of the RED Grants program.

⁶ <https://www.wasteauthority.wa.gov.au/programs/view/roads-to-reuse>

Round 3 applications are now closed. The next round of funding has not been announced. Applicants can be notified of future grant rounds by contacting the South West Development Commission at 9792 2000 or grantscoordinator@swdc.wa.gov.au.

Market Led Proposals

The establishment of an RCG facility in the SW may attract Government support if proposed as a Market Led Proposal.

Market-led Proposals (MLP) provide a vehicle for Government and the private sector to work together to create jobs and stimulate the economy in Western Australia. The MLP Policy is designed to enable businesses to submit a unique proposal to government, providing a single channel and a clear, consistent and transparent process.

An MLP is an unsolicited proposal from the private sector to government to:

- build and/or finance infrastructure
- provide goods or services
- purchase a government owned asset

Additional information can be found at <https://www.wa.gov.au/organisation/department-of-finance/market-led-proposals>

Federal Funding

The Commonwealth committed previously committed funding over four years to boost waste and recycling services. Some of that went via the (Recycling) Manufacturing Modernisation Fund and was used to lever State money. The State delivered the program which was restricted to using plastics and rubber. Suez also received funding for cardboard/paper recycling in Perth.

With the larger waste export ban coming into effect from mid-2024 we can expect more Commonwealth funding programs to be released. One of these only just announced is the Recycling and Clean Energy National Manufacturing Priority road map, which launched under the \$1.5 billion Modern Manufacturing Initiative (MMI). It identifies key areas of opportunity and actions for government and industry to work together to lift manufacturing capability in recycling and clean energy. Businesses with projects focused on Recycling and Clean Energy can apply for grants under the MMI – Applications are open until 5 May 2021.

Co-funding for manufacturing projects is being provided across two streams:

- Manufacturing Translation Stream: helps Australian manufacturers translate high quality research and ideas into commercial outcomes and support businesses to scale-up and become more competitive and resilient.
- Manufacturing Integration Stream: helps Australian manufacturers to access domestic and international value chains, propelling their goods and services into new markets and fostering Australia's reputation as a modern manufacturing leader.

Australian Government funding will be provided on a co-investment basis and will cover up to 50 per cent of eligible project expenditure.

