ACS750 Recycled Crushed Glass

Contents

ACS750.1 Scope

This specification sets out the material requirements for Recycled Crushed Glass (RCG) for the following purposes in Auckland Council-Family projects (see Clause 4 Definitions):

- Installation of buried concrete pipe in accordance with AS/NZS 3725
- Installation of buried flexible pipelines in accordance with AS/NZS 2566 Parts 1 and 2
- Installation of pipeline infrastructure associated with construction and maintenance of buried concrete and flexible pipelines
- Reinstatement of trenches and other openings following maintenance of existing pipelines and pipeline infrastructure in accordance with the above
- Low-risk Auckland Council-Family applications not covered by existing specifications when approved by Auckland Council on a case-by-case basis[1].

Guidance on the safety aspects of RCG usage, which may differ from those of natural aggregates used in similar applications, is also provided in the Appendix B of this specification to ensure appropriate use of RCG.

This specification applies to RCG supplied by any producer or contractor for any of the above purposes unless otherwise approved in advance by Auckland Council on a case-by-case basis.

This specification specifically excludes:

- Use of Recycled Concrete Aggregate, Recycled Crushed Brick, Reclaimed/Recycled Asphalt Pavement, and any other type of Recycled Aggregate
- RCG for use in buildings, structures and applications other than pipeline infrastructure and low-risk applications described herein
- RCG for use in concrete, asphalt, embankment fill and earthworks
- Applications for which the use of RCG is specifically covered by other Auckland Council-Family specifications
- Methods of producing, storing, transporting, and handling RCG, other than aspects described herein
- Requirements for the design and construction of buried pipelines in which RCG may be used other than the selected aspects described herein

[1] Risk-level of infrastructure projects concerning the use of RCG need to be addressed on a case-by-case basis by the asset owner/specifier/regulator.

- Requirements for the evaluation of the economic and embodied carbon benefits and costs of RCG used in any application.[2]

Any physical Contract Works Specification, which may amend this specification where necessary, takes precedence over this specification.

ACS750.2 Interpretation

For the purposes of this specification, the word 'shall' refer to requirements that are essential for compliance with this specification. The word 'should' indicate a recommended practice.

ACS750.3 Referenced standards / specifications / guidelines

The following Standards and Specifications are referenced by this specification:

- ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
- AS/NZS 3725:2007 Design for Installation of Buried Concrete Pipes
- AS/NZS 2566.1:1998 Buried Flexible Pipelines – Part 1: Structural Design
- AS/NZS 2566.2:2002 Buried Flexible Pipelines – Part 2: Installation
- ASTM D4791-19, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate, November 2023
- Auckland Council Standard Specification ACS510 Earthworks. Version 2.0, Rev 2, March 2023
- Auckland Council Standard Specification ACS710 Pipeline Construction. Version 2.0, Rev 3, March 2023
- Auckland Council Standard Specification ACS740 Recycled Aggregate. Version 1.0, Rev 1, July 2025
- Auckland Transport Specification for Infrastructure Works Series 0800: Specification for the Supply of Aggregates

[2] Appendix C discusses the approach that such evaluations should consider, but does not set specific requirements.

- Ministry for the Environment "Measuring emissions: A guide for organisations, 2024 detailed guide"
- NZS 4407:2015 Methods of Sampling and Testing Road Aggregates
- NZTA M/4 Specification of Basecourse Aggregates, New Zealand Transport Agency, 2024
- Transport for NSW Test Method T276 Foreign Materials Content of RCA
- USEPA SW-846 test method 1312: 1994 Synthetic Precipitation Leaching Procedure. Part of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. United States Environmental Protection Agency, September 1994.

ACS750.4 Definitions

For the purposes of this specification the following definitions apply:

ACS750.4.1 Recycled materials

Recycled Crushed Glass (RCG) – also known as glass cullet, is produced from the crushing and processing of previously manufactured glass. RCG is commonly sourced from glass containers (i.e. bottles, jars and similar glass vessels), windows and waste glass produced as a result of breakage and rejection through quality control during the manufacturing process. Depending on the origin and recycling process, the source material can contain foreign materials including but not limited to metals and organics (e.g. paper labels, wood, plants, food residue), which shall be removed during the washing and screening process.

ACS750.4.2 Other definitions

Buried Pipeline Embedment	• Material used for support under and around the pipe, described as bed, haunch, and side zones in ACS710. • The extent of embedment is specified in the corresponding buried flexible and concrete pipeline standards; AS/NZS 2566.1 and AS/NZS 3725. • Note: for flexible pipes (as per AS/NZS 2566), the pipe overlay is considered part embedment.
Foreign Material Content (FMC)	• FMC refers to any extraneous physical material existing in RCG, after processing, with different inherent properties.

	• FMC shall be determined using the Transport for NSW T276 test method, except that the "reclaimed glass" shall be substituted for "recycled concrete"
Leachate	• Leachate is defined as in Chapter J1 of the Auckland Unitary Plan.
Particle Size Distribution (PSD)	• The particle size distribution shall be determined using the wet sieve test method in NZS 4407 Test 3.8.1.
Particles Shape	• Flat and elongated particles shapes in coarse RCG, shall be determined using test method in ASTM D4791-19, except that the test sample shall be taken as the material retained on the 4.75 mm sieve.

ACS750.5 Source materials

RCG shall be produced from food and beverage waste container glass, or window glass and shall be free from any putrid odour. Unless otherwise approved in advance by Auckland Council, the source shall be free of glass from the following sources:

- Cathode-ray tubes
- Fluorescent and incandescent lights
- Glass recovered from electrical equipment
- Glass recovered from a laboratory source
- Porcelain products or cook tops
- Glass from hazardous waste containers
- Coated glasses including mirrored glass
- Glass from laminated windows including vehicle windscreens
- Security glass.

Specific source material properties are specified in Clause ACS750.9 of this specification.

ACS750.6 Stockpiles

All stockpiles shall be managed to prevent material segregation or breakdown, with clear separation from water courses to mitigate risks of leachate contamination, in accordance with Auckland Council specification ACS510.

The contractor shall detail specific requirements for RCG stockpiling in the project-specific Construction Environmental Management Plan (CEMP) for Auckland Council's approval.

RCG comprising materials of different quality shall either be maintained in separate stockpiles or blended to ensure consistent material properties.

ACS750.7 Sampling and testing

Representative samples of RCG shall be taken from conveyor belt, bin, stockpile, or truck, in accordance with NZS 4407, Parts 2 and 3, unless otherwise approved in advance by Auckland Council.

All testing shall be performed by a laboratory with IANZ accreditation for the specified tests, unless otherwise approved in advance by Auckland Council.

ACS750.8 Compliance

RCG that does not comply with this specification shall be rejected or be tested and approved in advance by Auckland Council as a variation under a contract works specification.

ACS750.9 Source property tests

ACS750.9.1 General

The suitability of the RCG production shall first be demonstrated by the criteria specified in Clauses ACS750.9.2 and ACS750.9.3.

The source property testing shall be completed on samples of the nominated source material/s after washing to be crushed and used for subsequent RCG production.

If a nominated source material changes, crushing and production of the affected RCG shall only proceed if the re-tested source material properties are shown to comply with this specification.

ACS750.9.2 Determination of foreign materials content

RCG shall not contain more than 5% foreign materials by mass in total. The percentages of foreign materials in each source material shall be determined as the mass retained on a 4.75 mm sieve by the Transport for NSW T276 test method and the following types of materials shall not exceed the limits shown below:

- Type I Materials: Metals and Ceramics: < 0.5%
- Type II Materials: Plaster, Clay lumps and other friable material: < 0.5%
- Type III Materials: Rubber, Plastic, Bitumen, Paper, Cloth, Paint, Wood, and other vegetable or decomposable matter: < 0.5%
- Other Materials: The combined total of any other types of foreign materials not listed above and of any Type I, Type II and Type III materials shall not exceed 5%.

ACS750.9.3 Compliance

If the requirements of Clause ACS750.9.2 cannot be met, the nominated source material(s) shall be rejected, unless otherwise approved by Auckland Council.

ACS750.10 Production property tests

ACS750.10.1 General

The suitability of the RCG product shall be demonstrated by the sampling and testing specified in Clauses ACS750.10.2 to ACS750.10.6 before the RCG is used.

ACS750.10.2 Production property sampling

All samples shall represent the current source material(s) and their production techniques.

The minimum sampling rates from Lots of RCG shall be large enough to complete all production testing are given in Table 1.

Table 1: Minimum Sampling Rate for Production Property Tests

Number of Consecutive Complying Lots[3]	Minimum Number of Samples for Testing per Lot
First 4 Lots	2
Each Additional Lot	1

[3] If any test sample does not comply, the Lot that the sample was taken from shall be rejected, and the number of consecutive complying lot shall be reset to zero.

The maximum Lot size is 500 tonnes, unless otherwise approved by Auckland Council.

The Contractor may submit a proposal to the Principal to increase the size of a Lot up to 1000 tonnes, where the process control has achieved a consistent product for minimum 5 consecutive Lots conforming to the requirements of this Specification. Where the Lot size exceeds 500 tonnes, the number of samples for testing shall be at the rate of minimum one sample per Lot.

Sampling for and completion of the necessary production acceptance testing to demonstrate compliance with this specification shall be carried out not more than three months before delivery for construction, from and to nominated stockpiles.

This requirement may with prior approval from Auckland Council be waived if traceability of complying production testing and stockpile management is documented by a certified plant quality assurance system.

ACS750.10.3 Cleanliness requirements

RCG shall be free from objectionable odours and contaminants.

Washing may be used where required to eliminate objectionable odours and to reduce potential contaminants to an acceptable level.

ACS750.10.4 Particle size distribution (PSD)

The PSD of RCG for pipe bedding of trench for concrete and flexible pipelines shall, in the first instance[4], conform with the distribution given in

Table 2 when RCG is tested according to NZS 4407:2015 Test 3.8.1 Wet Sieving Test.

[4] The PSD of RCG for specific applications may instead conform with the relevant PSD tables from the following existing specifications:

- For rigid pipes designed and installed as per ACS710.13.3: ACS510 Table 2 – “Course and Fine pipe bedding.”
- For flexible pipes designed and installed as per AS/NZS 2566: AS/NZS 2566.2 Tables G2 and G3.
- For rigid pipes specifically designed and installed as per AS/NZS 3725: AS/NZS 3725 Tables 6 and 7.

Table 2: Particle Size Distributions for RCG Bedding

Sieve Size (mm)	Weight Passing (%)
9.5	100
2.36	100 – 50
0.600	90 – 20
0.300	60 – 10
0.150	25 – 0
0.075	10 – 0

ACS750.10.5 Particles shape

The size fraction of the RCG retained on the 4.75mm sieve shall not contain more than 1% of flat or elongated particles with a maximum to minimum dimension ratio greater than 5:1, when tested according to ASTM D4791-19.

ACS750.10.6 Mobility of potential environmental contaminants

The mobility (leachability) of potential contaminants within the RCG shall be determined on the RCG product fraction finer than 4.75 mm using the synthetic precipitation leaching procedure (SPLP) of USEPA SW-846 Test Method 1312 using extraction fluid #3. The resulting leachate (‘extract’) shall then be analysed for the contaminants listed in Table 3.

The concentration of contaminants in the RCG extract shall conform with the limits given in Table 3 unless agreed otherwise by the Contract Administrator.

If there is reason to suspect that the RCG may contain additional contaminants, (e.g. visual or olfactory evidence), then additional testing should be undertaken at the direction of a suitably qualified and experienced practitioner. Such RCG shall not be accepted unless approved by the Contract Administrator.

Table 3: Acceptance criteria for potential leachable chemical contaminants

Contaminant	Maximum allowable concentration in RCG extract (µg/L) (notes 1 and 2)
Arsenic	24
Cadmium	0.2
Chromium	3.3
Copper	1.4
Lead	3.4
Mercury	0.6
Nickel	11
Zinc	8
Benzo(α)pyrene	0.2
DDT	0.1

Notes to Table 3:

1. The limits in Table 3 are based on the freshwater concentration limits for 95% species protection cited in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).
2. The concentration of the contaminant determined in accordance with USEPA 1312 as described herein and expressed as the concentration in the RCG extract.

Appendix A Blending RCG with Natural or Recycled Aggregates

Appendix A1.1 General

RCG can be used as supplied or blended with other aggregate materials. Blending RCG with other materials shall be at Auckland Council's approval on a case-by-case basis. Adding RCG, in suitable proportions, can provide environmental benefits without compromising the mechanical properties of the material. Where blended with other materials it shall comply with the following:

- The RCG shall be uniformly blended with the aggregate such that there is no segregation (concentrated portions) of glass in the aggregate mix.
- For blended RCG with other aggregates, the RCG product shall comply with this specification[5], and the overall material must comply with the other specification that the RCG will be blended with.

Appendix A1.2 Compliance with specifications

The following specifications represent examples of standards that currently permit use of RCG (including glass as foreign material) including up to a defined limit without express permission from the principal.

- Auckland Council Standard Specification ACS740 Recycled Aggregate. Version 1.0, Rev 0, December 2023
- Auckland Transport Specification for the Supply of Aggregates for Road Pavement Construction, Volume 6, Series 0800
- NZTA M/4 Specification of Basecourse Aggregates, New Zealand Transport Agency, 2024.

In addition, NZTA M/4 specification allows for the proportions of RCG in excess of the limit to be used at the discretion of the principal (Auckland Council), provided that extra technical

[5] Single graded RCG can be mixed with other aggregates on case-by-case basis. When it is to be blended with other aggregate material the single graded RCG does not need to meet the PSD requirement of Table 2 in this specification.

performance requirements, including glass strength and durability for specific applications, will be satisfied.

The exceedances of RCG proportion limits specified in any other specifications requires approval by Auckland Council.

Appendix B Safety considerations

This section covers examples of safety issues and mitigation measures unique to RCG that producers, contractors and designers should consider. They are not intended to replace any Health and Safety or Safety in Design obligations.

Appendix B1.1 Examples of potential safety issues

Designers, suppliers and contractors should be aware of potential safety issues with the handling of glass. Some examples are:

- Unprocessed glass may have sharp edges, although crushing is likely to produce aggregates with more rounded particles which lessen the risk of cuts.
- The production and handling of crushed glass can produce dust and inhalation risks.
- RCG may have a slightly higher incidence of skin abrasion, compared to naturally sourced aggregates due to its inherent material properties.
- Source materials may contain contaminants or foreign materials, leading to potential handling hazards.

Appendix B1.2 Examples of mitigation measures

Some examples of mitigation measures are:

- Use of PPE such as coveralls, gloves, eye protection or other site gear to reduce risk of cuts and abrasion.
- Maintaining a suitable moisture content and using suitable particulate dust masks to reduce the risk of dust inhalation.
- Washing glass to remove contaminants and reduce handling hazards.

Appendix C Framework for cost benefit analysis (CBA)

RCG is produced from glass that is collected from kerbside recycling and from factory glass offcuts. The glass is then screened, crushed, and graded, then sold to customers for use on construction sites.

Using RCG as an alternative for natural aggregate can provide environmental and community benefits by reducing demand on waste disposal sites, by reducing the need for quarrying and by reducing carbon footprint.

Cost benefit analysis is a tool that can be used to help compare the costs and benefits of using RCG and other recycled aggregates (RAg) in place of natural aggregates (NAg).

Auckland Council expects that the following factors shall be considered when evaluating the costs and benefits or otherwise of using RCG. Some of the following information may be commercially sensitive, and the information shall be treated as such.

Information required for comparison

The sources of NAg, RAg, and RCG are very different. NAg is sourced from natural rock in fixed hard rock quarry locations (e.g. by blasting and excavation). RAg is typically produced from construction waste using mobile operations. In both cases fixed costs are high, and environmental consequences (e.g., embodied carbon / global warming potential) can be significant, particularly with traditional plant and processes. In comparison, RCG is acquired through kerbside collection from households or from manufacturer's waste material.

Information required to compare the cost and benefits include:

- Cost of the product
- Potential reduction in landfill volumes
- Potential reduction in quarrying volume
- Emissions from production.

Table 4 shows that despite the differences in the sources and preparation of these materials, a common approach can be used for RCG, RAg and NAg provided that the differences in the processing stages are accommodated so as to avoid double counting or omissions.

Table 4: Comparison of the stages of preparation for RCG, NAg and RAg

Activity	RCG	NAg	RAg	Notes
Source	Kerbside collection Manufacturer's waste	Quarrying, or gravel extraction	Demolition	For RCG, the collection process is the source of the material.
Sort and clean source material before transport to processing facility	N	N	Y	Glass is sorted at the processing facility. Demolition waste may be sorted at demolition site and on delivery to factory.
Transport to processing facility	Y	[1]	Y	For RCG, the collection process is the source of the material. .
Inspect source material on delivery	N	[1]	Y	To inspect RAg for asbestos-contaminated demolition waste.
Stockpile and test before processing	Y	Y	Y	
Sort, clean and inspect source material	Y	N	N	NAg is processed before transport to the processing facility, and RAg on delivery.
Crushing and screening	Y	Y	Y	NAg could be partly or fully processed at the quarry. RAg could be partly or fully processed at the demolition site. RCG may require special crushing equipment due to its high abrasion value.
Washing	Y	N	N	NAg and RAg may be washed/rinsed to manage fines content, but RCG needs washing to remove potential contaminants. All may use rinsing for dust control
Stockpile and test after processing	Y	Y	Y	
Point of sale or supply	Y	Y	Y	
Transport to point of use	Y	Y	Y	Transport costs and emissions are influenced by distance between point of supply and construction site. RCG typically has lower bulk density than

				NAg or RAg and transport may be cheaper per m^3.
Waste transport to landfill	Reduced	None	Reduced	Glass and demolition waste may otherwise have been transported to landfill

[1] Quarried material may be processed on site or at an adjoining site.

Appendix C1.1 Cost information

Cost of materials

RCG, RAg, or NAg come from different sources and are each prepared differently. However, they are all sold as pre-graded materials by volume. This means that the price per m^3 at the point of sale is an effective comparison of the different products.

Costs at the point of sale or supply will be specific and highly reliable as they can be traced to individual purchase orders.

Transport costs

Transport costs are influenced by tonnage transported and by the distance between the point of supply and the construction site. Reliable transport costs per tonne can be obtained from transport companies. However, density of the supplied product influences tonnage of a given volume of materials which could potentially vary between the different sources, and this would need to be accommodated in any cost benefit analysis. RCG typically has a lower bulk density than RAg or NAg. Where conversion between volume and tonnage is required, this can be based on direct measurement of density or on supplier's product information.

Installation practices

While installation practices are project-specific and need to be assessed on a case-by-case basis', they are essentially the same for all materials, whether RCG, RAg, or NAg. The cost of installation will be much more strongly influenced by site conditions and installation specifications than by the product itself and it is therefore excluded from consideration in cost benefit analysis of these materials from different sources.

The cost of the installed product is therefore:

A [cost of aggregate at point of supply] + B [cost of transport from supplier to site] + C [cost of installation]

- A is directly influenced by the type of material supplied.

- B is influenced by the number and location of suppliers around Auckland and may be influenced by the type of material supplied where the density is materially different.
- C is directly influenced by the extent of the work and is the responsibility of the developer or budget manager to determine the project-specific installation cost during the CBA.[6]

Appendix C1.2 Landfill volume reduction

Where recycled aggregates (including recycled crushed glass) are used in place of natural aggregate, the volume of material disposed to landfill is reduced by 1 m^3 for every 1 m^3 of recycled material used in its place. There are also landfill volume reductions for glass unsuitable to be remelted but reused as RCG, as this glass would have gone to landfill.

However, the aggregates are all sold as pre-graded materials by volume (or by weight). This means that the volume purchased at the point of sale is an effective comparison for the different products.

Volume or tonnage sold will be specific and highly reliable as it can be related to specific purchase orders. However, there may be a need to accommodate density of the differently sourced aggregates if this is materially different.[7]

Transport and installation requirements do not affect landfill volume reduction and are therefore excluded from consideration in cost benefit analysis of aggregates from different sources.

Appendix C1.3 Quarried volume reduction

Where RAg and/or RCG are used in place of NAg, the volume of material quarried is reduced by 1 m^3 for every m^3 of recycled material used in its place. There are also savings related to lower environmental compliance and upkeep costs for the quarry.

[6] RCG is less sensitive to water content during compaction than most NAg or RAg, which allows installation during wet weather and potential positive implications for cost.

[7] The landfill reduction is based on in-situ volume of RCG and not tonnage.

However, the materials are all sold as pre-graded materials by volume (or by weight). This means that the volume purchased at the point of sale is an effective comparison for the different products.

Volume or tonnage sold will be specific and highly reliable as it can be related to specific purchase orders. However, there may be a need to accommodate the density of the differently sourced aggregates if this is materially different.

Transport and installation requirements do not affect quarried volume reduction and are therefore excluded from consideration in cost benefit analysis of the materials from different sources.

Appendix C1.4 Emissions

As the extraction, collection and processing requirements for NAg, for RAg and for RCG are very different, it is most appropriate to compare the emissions impact at the point of sale or supply.

Environmental Product Declarations (EPD) are site and source specific and should therefore be suitable for comparing NAg, RAg and RCG products at the point of distribution where they are provided by the suppliers. However, there are different schemes that cover EPDs and they are not always directly comparable.

If, however, detailed and consistent information is not available from suppliers, the Ministry for the Environment document "Measuring emissions: A guide for organisations, 2024 detailed guide." is intended *"...to help you measure and report your entity or organisation's greenhouse gas (GHG) emissions on a voluntary basis."* It would therefore be used as a useful basis for the suppliers to provide emissions figures for comparison.

As with dollar costs, transport is largely dependent on travelled distance between supplier and site, and can be determined by using standard data sources, such as the Ministry for Environment document noted above.

Installation practice will be much more strongly influenced by site conditions and installation specifications than by the product itself. The installation impact on emissions should be determined on a case-by-case basis when determining impact on emissions of using materials from different sources.

Appendix C1.5 Overview

The costs and benefits of using material from different sources can be determined reliably with respect to reductions in landfill volume and reduced quarrying volumes at the point of sale or supply. Transport costs can also be sourced reliably to accommodate the impact on cost and emissions of delivering material from the point of supply to the construction site.

The availability of reliable and directly comparable information on the effect of using different sources on emissions is currently less clear cut. If, however, this data is either not available or is not in a readily comparable format, national guidance exists that could be used by suppliers to provide consistent information.

This approach can accommodate various NAg and different forms of RAg and RCG, but in addition it can also accommodate different supply sources for the individual materials. For instance, glass from Auckland recycling collection, from factory waste, and from North Waikato recycling collection can be directly compared by considering the cost, volume and emissions impact at the point of sale.

The approach outlined above would also be suitable for RCG blended with other aggregates (whether natural or recycled), provided that the cost and benefits are determined at the point of sale (i.e. after any additional processing and blending), and that any relevant transport effects are accounted for.

Appendix C1.6 Assumptions and limitations

- It is assumed that for each application the volume of material required remains the same for RCG, NAg, and RAg.
- Where conversion between volume and tonnage is required, this can be based on direct measurement of density or on supplier's product information.
- Full financial data may be commercially sensitive and may not be readily available. However, price and volume at point of sale should not be sensitive and should be readily available and highly reliable.
- It is considered unlikely that full emissions data exists for the Auckland region (notably because robust data for actual use of RCG is not currently available), and because there is some variation between different environmental assessment schemes. However, suitable national systems for determining emissions assessments in a consistent manner exist and could be used by suppliers if needed.

- This CBA framework has been developed based on available data. It is expected that, as the use of RCG expands, further data associated with costs and benefits will be collected for quantitative analysis.
- Provided these considerations can be accommodated then useful comparisons can be made.