

# CASE STUDY

## Demonstrating the performance and cost effectiveness of recovered crushed glass (RCG) in NSW Roads: Waverley Council

### Background

The project is a partnership between Waverley Council, the Australian Food and Grocery Council's Packaging Stewardship Forum, the former Department of Environment, Climate Change and Water (now Office of Environment and Heritage NSW), the Roads and Traffic Authority NSW (RTA) and the Roads & Transport Directorate of the Institute of Public Works Engineering Australia. The project has seen the construction of two local Bondi roads using 83 tonnes of recovered crushed glass (RCG) equivalent to more than 460,000 stubbies.

Waverley Council's vision is to be an environmentally responsible community which manages its water, waste and energy resources efficiently<sup>1</sup>. Bondi Beach, Australia's most famous beach is located in the municipality, attracting Sydney residents and visitors from Australia and around the world. In 2010 Waverley Council embarked on a trial to utilise glass collected from kerbside recycling collections in road construction.

Two sites were chosen to provide traffic conditions that would adequately test the pavement and meet the RTA's requirements, being:

- heavy duty pavement – high vehicle count, high percentage of trucks.
- 100m trial lengths that were level and straight.
- 3 configurations along the trial length including a control.

The project used RCG as a sand replacement to demonstrate that this is an accepted product for use in NSW roads.

### Key Outcomes

The results of the finished pavement indicate no noticeable difference in the performance of the asphalt pavement and the non-flexible concrete pavement with 44% RCG actually improving performance by 4%.



### Summary of the project

The two demonstration sites, located half a kilometre away from the sands of Bondi Beach, have used RCG as a substitute for virgin quarried sand in asphalt and concrete road surfaces.

**Asphalt:** The first 100m stretch of road in Blair Street was laid in June 2010 with three sections using no RCG; 2.5% RCG; and 5% RCG in the asphalt road. 2.4 million vehicles have travelled along the road in the first year at an average speed of 42 kph with no discernable difference in performance between the three configurations.

**Concrete:** The second pavement at O'Brien Street was laid in March 2011 with three sections using no RCG as a control; with one 44% RCG; and one with 56% RCG in a concrete mix. In the three months since opening, 1.45 million vehicles have used the road with no discernable difference in performance between the three road sections.

### Technical summary: performance and testing

**Asphalt Road:** No strength tests have been performed on the asphalt pavement to compare the control section with the glass/sand mix however a visual comparison appears to be identical.

**Concrete Road:** Concrete testing on samples at the time of construction shows that all three sections exceeded the strength specification substantially.

<sup>1</sup> <http://www.waverley.nsw.gov.au/environment>

However the rate of curing and overall strength was greatest with the 44% RCG concrete, with the 56% RCG concrete demonstrating the lowest strength. The difference may have been due to the water component added to the mix. Workability of the concrete during construction the control and the 44% RCG mix was similar, but the 56% RCG mix was slightly lower. These results may indicate that there is an optimal proportion of glass that can be put into the mix design – in the order of 44-56%.

The RCG concrete mix component materials compare with normal concrete mix as follows:-

Mix Name	Control (Kg)	44% Glass Sand (kg)
Cement (Blue Circle SL)	290	290
Fly Ash (Earring)	70	70
20mm Dunmore	320	320
20/10 BFS	440	440
10mm Dunmore	280	280
DSS 27BA	566	311
Fine Sand (Kurnell)	189	104
Glass Sand 2.5mm		170
Glass Sand 0.8mm		170
Total Dry	2155	2155

### Costs and benefits

The total cost of producing the two trial pavements was approximately \$140,000 however this included “start up” costs such as trial mixes and testing. If the costs associated with the project being a trial were removed, the actual cost is estimated at \$125,000.

The benefits of using RCG as part of the normal production process for large scale projects could be significant, reducing the cost of the production of concrete and asphalt because the cost of RCG is less than buying natural washed sand, transporting it from outside the region as supply reduces<sup>2</sup> in Sydney, and paying landfill costs (reducing local government costs).

The Blair Street asphalt project found a total saving of \$1,140 by using 6 tonnes of RCG instead of virgin sand:-

	Natural Washed Sand	RCG
Tonnes	6 tonnes	6 tonnes
Cost per tonne- (assume mid point)	\$16-\$30	\$13
Transport distance from source to manufacture	>100km at \$30 per tonne	Local supply
Saving to Council from Landfill costs for glass per tonne	\$0	\$150
Cost of buying aggregate mix	\$138	\$78
Landfill Cost Saving to Council	\$0	-\$900
Transport Cost Saving to Council	\$0	-\$180

As the cost of naturally washed sand in Sydney and the cost of landfill increases, the financial benefits of using glass will increase significantly.

### Markets for recovered crushed glass

RCG product available commercially in Australia can be blended with natural and recycled aggregates.

RCG can be used in concrete and asphalt as a fine aggregate material that can be blended with other natural aggregates prior to mixing with the other components in concrete and asphalt. The maximum recommended blend for sealed and unsealed roads is 5%-10%; for heavy duty granular base 15%; and 30% for pavement sub base and light duty road base.

The product can also be used as engineering fill or blended with natural or crushed sands for use as pipe or block paving bedding as defined in the relevant specifications.

For more information contact: [chris.jeffreys@afgc.org.au](mailto:chris.jeffreys@afgc.org.au) or [www.afgc.org.au/psf](http://www.afgc.org.au/psf) - Glass recovery and recycling

<sup>2</sup>[http://www.sydneyconstructionmaterials.com.au/const\\_sand.html](http://www.sydneyconstructionmaterials.com.au/const_sand.html)