



TOWNSVILLE CITY COUNCIL

Review of Kerbside Recycling Services

February 2004

Ref: 4081-03

NOLAN-ITU Pty Ltd ACN 067 785 853 ABN 76 067 785 853

Suite 70, Level 7, 104 Bathurst Street, Sydney NSW 2000
Telephone: (02) 9283 9361 Facsimile: (02) 9283 9362



NOLAN-ITU PTY LTD

ACN 067 785 853
ABN 76 067 785 853

Copyright © Nolan-ITU Pty Ltd 2004

“ This document is and shall remain the property of Nolan-ITU Pty Ltd. The document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited ”.

REF: 4081-03

Document History and Status

Issue	Status	Date	Project Manager	Reviewer
1	Draft	15 Jan. 04	Euston Ling	Bert van den Broek
2	Final	3 Feb. 04	Euston Ling	Bert van den Broek



TABLE OF CONTENTS

1	INTRODUCTION	1
2	SYSTEM PERFORMANCE	3
2.1	Gross Recyclables Generation.....	3
2.2	Net Recyclables Generation	5
3	KERBSIDE SERVICE BENCHMARKING.....	8
3.1	Financial Cost.....	8
3.2	Measuring Performance Against Established KPIs and Milestones.....	9
3.2.1	Cost Efficiency and Sustainability Assessment Criteria	9
3.2.2	Best Practice Kerbside Recycling Milestones.....	10
3.3	Australian Best Practice for Domestic Kerbside Recycling	11
3.4	Regional Comparison	13
4	DISCUSSION AND CONCLUSIONS.....	14
5	REFERENCES	15

1 INTRODUCTION

In January 2002, Nolan-ITU completed a review of kerbside recycling services for Townsville City Council and the City of Thuringowa. This report considered a number of issues of concern to both Councils and made recommendations for improving the system. The issues considered included:

- Standardising collection systems across the two Councils;
- Discrepancies in the contamination figures provided by the sorting contractor versus the Councils' audit figures;
- Low MRF efficiency in terms of materials recovery and the large proportion of recoverable materials disposed of as waste;
- Problems with markets for recovered materials recovered at the MRF, particularly that for paper and cardboard;
- Risk sharing arrangements in terms of performance incentives and equitable arrangements to optimise materials recovery; and
- Cost and environmental effectiveness of providing a kerbside recycling service.

In the lead up to calling tenders for new kerbside recycling services this report found that:

1. Contamination levels reported by the then contractor were significantly overstated as a result of MRF inefficiencies and lack of appropriate contractual incentives. It also found contamination levels in kerbside recyclables to be unacceptably high which required addressing through such measures as public education;
2. The MRF was not operating efficiently due to insufficient sorting labour and lack of incentives for maximising materials recovery resulting in loads being arbitrarily rejected and consigned to landfill;
3. Markets for recovered material were not actively being pursued by the sorting contractor with some recovered material being disposed of to landfill; and
4. Ineffective risk sharing arrangements based upon commodity prices and quantities of materials on-sold being undermined by a lack of verifiable data, along with the disposal of MRF residues to landfill at nil cost.

Accordingly, it was recommended that separate tenders be called for recyclables collection and recyclables processing, with contractual arrangements being underpinned by flexible risk sharing mechanisms and supported by ongoing community education to maximise the quantity and quality of recyclables presented at kerbside. It was also recommended that the MRF operator pay for the disposal of MRF residues in addition to ensuring the reprocessing recovered materials. Finally, it was recommended that such an arrangement be supported by recyclables collection density being specified to preserve material quality.



Townsville City Council decided to conduct the recyclables collection service using day labour and to contract out the recyclables processing service. In late 2002, Council called for tenders for Recyclable Material Recovery Services and subsequently awarded the contract to Visy who commenced sorting operations at Carrol Street, Mount Louisa in early 2003.

Around this time, Townsville City Council signed a Memorandum of Understanding with the Queensland Environmental Protection Agency for the provision of financial assistance for the purpose of achieving best practice kerbside recycling. Under this MoU, a number of cost efficiency and sustainability assessment criteria were specified, to be achieved according a program of milestones spanning the period of approximately 12 months.

This report reviews the performance of Townsville City Councils kerbside recycling service for the period of 1 January to 31 December 2003, and compares this performance to;

- Service levels specified within the MoU;
- Best practice guidelines throughout Australian states; and
- National averages detailed within the National Packaging Covenant's Independent Economic Assessment of Kerbside Recycling in Australia (2001).

2 SYSTEM PERFORMANCE

2.1 Gross Recyclables Generation

Nolan-ITU understands that all of the estimated 33,330 households in Townsville and an additional 1,370 households on Magnetic Island are eligible to receive a recycling bin if they so choose. Based upon a 100% set out rate for kerbside recyclables, this would amount to 902,000 recycling bin pick-ups in any given year. A monthly breakdown of recyclable bin collections by Council and effective set out rate is given in Table 2-1.

In 2003 there were approximately 554,000 recyclable bin collections carried out in Townsville and Magnetic Island. This equates to a set-out rate of 61.4% which is lower than the estimated national average of 72% for fortnightly kerbside recycling. It should be noted that whilst not all households may choose to utilise Councils kerbside recycling service, the cost of this service is nevertheless charged to all tenements, which is consistent with Council practices throughout Australia.

Table 2-1: 2003 Monthly Recyclables Bin Collections & Effective Set-Out Rate

Month	No. Bins Collected	Effective Set Out Rate
January	48,338	64.3%
February	42,528	56.6%
March	44,704	59.5%
April	46,590	62.0%
May	45,729	60.8%
June	44,144	58.7%
July	48,053	63.9%
August	44,739	59.5%
September	46,335	61.6%
October	49,710	66.1%
November	43,689	58.1%
December	49,429	65.7%
TOTAL	553,988	61.4%

The monthly recyclables returns provided to Council by Visy are given in Table 2-2.



Table 2-2: 2003 Monthly Recyclables Sorting Returns (Tonnes)

2003 Product Sorted at Visy MRF (t)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Adjusted Total (tonnes)
Mixed Paper / Cardboard	240.0	219.0	236.0	224.0	244.0	236.0	261.7	238.4	259.6	268.5	256.9	306.6	2,990.6	3,027.6
HDPE Milk	4.5	5.6	6.2	6.6	7.6	7.0	7.4	7.7	8.1	8.1	7.5	8.4	84.6	85.7
PET	7.3	7.3	7.9	8.3	8.1	7.6	7.6	8.3	8.7	10.2	9.2	10.0	100.2	101.4
Mixed Plastic	6.7	7.3	10.1	9.9	11.0	10.1	10.2	8.9	8.7	11.1	10.2	10.8	114.9	116.3
Liquid Paper Board	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aluminium	5.0	5.1	5.6	7.0	7.0	6.3	7.0	6.4	6.8	7.9	6.6	8.2	78.8	79.8
Glass	54.0	54.0	63.0	75.0	71.0	64.3	60.3	65.2	65.7	69.4	56.2	69.3	767.4	776.4
Glass Fines	47.3	38.0	38.0	29.0	35.0	30.3	35.4	43.4	47.8	53.9	49.5	58.4	505.9	512.5
Steel (Baled)	11.8	10.7	13.0	16.5	12.2	17.7	16.9	16.8	14.9	16.6	16.3	17.9	181.2	183.5
Steel (Scrap)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste	101.0	70.0	67.0	64.5	65.0	61.0	59.0	59.4	63.3	68.8	59.0	70.9	808.7	817.6
Unprocessed Stock	0.0	0.0	0.0	0.0	0.0	3.7	9.8	10.5	7.5	11.2	4.4	21.6	68.5	-
TOTAL	477.5	416.9	446.7	440.8	460.9	443.8	475.2	465.0	490.8	525.8	475.6	582.0	5,700.9	5,700.9

In 2003, Council recorded the collection of 5,639 tonnes of gross recyclables which differs slightly from MRF sorting records at 5,701 tonnes. However, this represents a difference of just 1% and for the purposes of this report, a total of 5,701 tonnes of gross recyclables are taken as having been sorted in 2003 at the Visy MRF located at Carrol Street, Mount Louisa. This equates to 164.3 kilograms for each household which is in excess of the estimated national average of 152.0 kg for 240L commingled recyclable bins. This overall performance is also considerably superior to the 110.8 kilograms per household achieved under the previous contract. A breakdown of this stream is given in Table 2-3.

Table 2-3: Gross Recyclables Breakdown

Stream	Townsville City Council Average for All Households (2003)		National Average for 240L Commingled MGB NPCC Report (2001)	
	kg/hh/yr	%	kg/hh/yr	%
Paper & Cardboard	87.2	53.1%	71.1	46.8%
Glass	22.4	13.6%	37.9	24.9%
Aluminium	2.3	1.4%	0.8	0.5%
PET	2.9	1.8%	4.0	2.6%
HDPE	2.5	1.5%	3.0	2.0%
Mixed Plastics	3.4	2.0%	0.0	0.0%
LPB	0.0	0.0%	1.0	0.7%
Steel Cans	5.3	3.2%	5.0	3.3%
Contamination & System Losses	38.3	23.4%	29.3	19.3%
TOTAL	164.3	100%	152.0	100%

Within the gross recyclables breakdown above, it is interesting to note that the proportion of glass is significantly less than the national average while the proportion of aluminium is significantly more than the national average. While this is a reflection of different consumption patterns, in terms of recyclables capture quantities, a glass bottle weighs in excess of 13 times more than an aluminium can (on a volume for volume basis for the contents).

2.2 Net Recyclables Generation

Contamination, sorting and system losses take place at a number of points within the entire kerbside recycling process. Gross contamination consists of materials which are not able to be recycled or are inappropriately placed into recycling bins by residents, while sorting and system losses are a result of the collection and sorting process. Other forms of contamination include:

- Cross contamination whereby the mixing of materials reduces the overall ability to recover a particular type of material eg mixing of paper types;
- Bagging of recyclables by residents, effectively hindering the sorting process and masking contaminants including medical sharps; and
- Organic contamination of recyclables whereby food and other residues are dispersed amongst recyclables, effectively hindering the ability of these materials to be reprocessed.

Generally within Australia, only polyethylene terephthalate (PET) and high density polyethylene (HDPE) are reprocessed. Whilst there are small markets for other plastics such as polyvinyl chloride, polypropylene, polystyrene these are generally not reprocessed and form a significant proportion of post consumer mixed plastic waste. Notwithstanding this, Visy have advised that the mixed plastics recovered at the Mt Louisa MRF are on-sold to a reprocessor and therefore, only gross contamination and glass fines are disposed of to landfill.

A significant proportion of system and sorting losses are constituted by glass breakages resulting in glass fines. Glass breakages generally occur at the following points:

- Placing of glass bottles and containers within recycling bins by residents;
- Emptying of recycling bins into a collection vehicle;
- Compacting the collected material within the collection vehicle;
- Discharging of collected materials onto the sorting floor / conveyor; and
- Moving and sorting of materials by process equipment including conveyors and trommels.

Because glass fines are a mix of different colours and often have a high proportion of contamination in the form of ceramic chips, rocks / stones and metallic particles which adversely affect the physical strength of glass containers, glass fines are unable to be reprocessed. Minor secondary markets for aggregate and abrasive media exist however, most glass fines are disposed of to landfill.

Therefore, within the sorting figures provided to Nolan-ITU, two material categories are taken to constitute contamination, sorting and system losses. These are:

- Glass Fines (9.0%); and
- Waste (14.4%).



After accounting for these losses, an average of 125.9 kg of net recyclables is generated across all household in Townsville, which is slightly higher than the national average of 122.7 kilograms for 240L commingled bins. While contamination levels are somewhat higher than the national average, it should be noted that contamination levels have fallen substantially from 40.4% to 23.4% since the new service was implemented. A comparison of Townsville's 2002 and 2003 gross and net yields with the 2001 NPCC National Average is given in Table 2-4.

Table 2-4: Yield and Contamination Comparison

Yield	Townsville Households (2002)	Townsville Households (2003)	NPCC National Avg (2001)
Gross Recyclables Yield (kg/hh/yr)	110.8	164.3	152.0
Gross Recyclables Yield (kg/hh/week)	2.13	3.16	2.92
Net Recyclables Yield (kg/hh/yr)	66.1	125.9	122.7
Net Recyclables Yield (kg/hh/week)	1.27	2.42	2.36
Contamination Rate	40.4%	23.4%	19.3%

3 KERBSIDE SERVICE BENCHMARKING

3.1 Financial Cost

In 2002, immediately prior to the introduction of the new service, Townsville was estimated as having 32,000 households while Magnetic Island was estimated to have 1,362 households. Based upon Council's actual recycling service costs, the total cost of providing a kerbside recycling service was \$1,471,898 for the 2001/2002 financial year. Applying this cost across all 33,362 households, the average cost of recycling services was calculated to be \$44.12 per household for that year. A cost breakdown is provided in Table 3-1.

Table 3-1: Cost of Kerbside Recycling Services (Year Ending 30 June 2002)

	Collection		Processing	Total
	Townsville	Magnetic Is		
Income	-	-	-	-
Expenditure	- \$1,330,814	- \$63,480	- \$77,603	- \$1,471,898
Total Service Cost	- \$1,330,814	- \$63,480	- \$77,603	- \$1,471,898
<i>Kerbside Service Cost (\$/hh/yr)</i>	- \$41.59	- \$46.61	- \$2.33	- \$44.12

In 2003, the total cost to Townsville City Council for providing this kerbside recycling services was \$846,205. Applying this cost across all 34,703 tenements in Townsville and Magnetic Island, the average cost of recycling services is calculated to be \$24.38 per household per year, which compares favourably to kerbside recycling costs throughout Australia. A breakdown of the kerbside service cost is presented in Table 3-2.

Table 3-2: Cost of Kerbside Recycling Services (Year Ending 13 December 2003)

	Collection		Processing	Total
	Townsville	Magnetic Is		
Income	\$4,329	\$2,377	-	\$6,705
Expenditure	- \$478,433	- \$73,270	- \$301,208	- \$852,910
Total Service Cost	- \$474,104	- \$70,893	- \$301,208	- \$846,205
<i>Kerbside Service Cost (\$/hh/yr)</i>	- \$14.22	- \$51.75	- \$8.68	- \$24.38

While the above figure includes the cost of collecting recyclables from Townsville and Magnetic Island averaged over the entire number of households, it may be seen that the cost of collecting recyclables from Magnetic Island is 3.6 times greater than the cost of collection on the mainland. Therefore, on a real cost basis, the annual household cost of kerbside recycling services on the mainland is calculated at \$22.90 compared to \$60.42 for Magnetic Island.

In comparing the 2002 figures with those for 2003, it may be seen that Council has achieved substantial cost savings by switching from contract collections to day labour. This saving has far outweighed the increases to Magnetic Island collections and recyclables processing costs, resulting in a total savings of \$625,700 or \$19.73 per household for the kerbside recycling service.

As the increased economies of Councils transition to day labour collection are fully realised (the current cost figures include the change over period to the new service) there is potential for reducing the unit cost of providing the new service. It should be noted that there is potential to increase the set-out rates with public education and hence increase the quantity of recyclables collected. Coupled with contractual provisions specifying a decreasing rate per tonne for sorting as annual tonnages increase, the potential collection cost economies and increased collection quantities provide potential for further cost efficiencies to be realised, thereby resulting in further reductions in the unit cost of Council's kerbside recycling service.

3.2 Measuring Performance Against Established KPIs and Milestones

In 2003, under the National Packaging Covenant's Best Practice Kerbside Recycling Incentive Grants Program, a Memorandum of Understanding (MoU) was signed between the Queensland Environmental Protection Agency (EPA) and Townsville City Council (TCC). Under this MoU, the EPA agreed to provide financial support to TCC for the implementation of a best practice kerbside recycling program, with the objective of increasing "the sustainable yield of recyclables in Townsville and adjoining areas".

Accordingly four kerbside recycling Cost Efficiency and Sustainability Assessment Criteria were set by the EPA to be achieved by TCC with the provision of financial support being scheduled according to a staged approach of three milestones spanning an approximate period of 12 months.

3.2.1 Cost Efficiency and Sustainability Assessment Criteria

A comparison of Townsville kerbside recycling performance in 2003 and the minimum cost efficiency and sustainability criteria required under the MoU is given in Table 3-3. As may be seen, the assessment criteria of cost, workplace practices and recycle mix set by the EPA are being met by Council. Within the MoU, it is not specified whether the minimum yield required to be achieved by Council is gross yield or net yield. However, it is felt that as Council initiates its education program and set-out rates increase, the overall net yield is likely meet or exceed the yield target specified within the MoU.

Table 3-3: Cost Efficiency and Sustainability Assessment Criteria

Assessment Criteria	Minimum Standard Req'd Under MoU	2003 Performance by Townsville City Council
Cost of recycling / household / year	\$25 - \$35	\$24.38
Minimum yield of recyclables / household / week	3 kg	Gross - 3.16 kg Net - 2.42 kg
Practices at contractor's workplaces	Satisfy OH&S Legislation	Details of Contractor's Workplace Health and Safety Plan Sighted.
Core recyclates collected	<ul style="list-style-type: none"> • All Paper & Cardboard • Glass Containers • Aluminium Cans • Steel Cans • PET Containers • HDPE Containers 	<ul style="list-style-type: none"> • Mixed Paper & Cardboard • HDPE Milk Containers • PET • Mixed Plastic • Liquid paperboard • Aluminium • Glass • Steel

3.2.2 Best Practice Kerbside Recycling Milestones

Within the MoU, three milestones have been laid out with the requirement upon TCC to perform specific actions within associated timeframes. These milestones and timeframes are detailed in Table 3-4 along with TCC's verified progress to date.

Table 3-4: Schedule of MoU Milestones and Progress to Date

Milestone Description	Timeframe	Verified Progress to Date
Milestone 1 - Signing of MoU and commencement of project. Submittal of a copy of Recyclables Processing Contract.	March 2003	<ul style="list-style-type: none"> • MoU signed March 2003. • Recyclables Processing Contract between TCC & Visy provided to EPA.
Milestone 2 - Development of a waste and litter education strategy. Provision of promotional support to EPA.	July 2003	<ul style="list-style-type: none"> • Education strategy developed according to Qld EPA’s WasteWise program in conjunction w/ EnviroCom. • Program delivery pending. • Promotional support offered to Qld EPA.
Milestone 3 - Submittal of documentation substantiating achievement of cost efficiency & sustainability assessment criteria. Submittal of evidence of advice to ratepayers of waste and recycling service costs	February 2004	<ul style="list-style-type: none"> • Cost efficiency and sustainability performance assessed by this report. Documentation delivery pending. • Ratepayer advice pending.

3.3 Australian Best Practice for Domestic Kerbside Recycling

A comparison of performances and preferred kerbside recycling service standards is given in Table 3-5. It should be noted that within this table, no avoided landfill costs have been included within the average household and average recycle costs.

As may be seen, the levels currently being achieved by those households utilising the kerbside recycling service within TCC are comparable with those levels specified throughout Australian states.



Table 3-5: Kerbside Recycling Performance and Best Practice Standards Across Australian States

Criteria	Townsville City Council (2003 Results)	NPCC Independent Assessment of Kerbside Recyc (2001)	EcoRecycle Vic. Preferred Standards for Kerbside Recyc (2000)	Nolan-ITU Best Practice Survey for NSW JRG (2002 Recycling Survey)	EPA South Aust (2002 Recommended Kerbside Standards)	Southern Waste Strategy Authority Tas. (2002 Recycling Survey)
Materials Collected	<ul style="list-style-type: none"> • Paper • Cardboard • LPB • Glass • Aluminium • Steel • Mix Plastics • PET • HDPE 	<ul style="list-style-type: none"> • Paper • Cardboard • LPB • Glass • Aluminium • Steel • PET • HDPE 	<ul style="list-style-type: none"> • Paper • Cardboard • Glass • Aluminium • Steel • PET • HDPE 	<ul style="list-style-type: none"> • Paper • Cardboard • LPB • Glass • Aluminium • Steel • PET • HDPE 	<ul style="list-style-type: none"> • Paper • Cardboard • Glass • Aluminium • Steel • PET • HDPE 	<ul style="list-style-type: none"> • Paper • Cardboard • LPB • Glass • Aluminium • Steel • PET • HDPE
Average Household Cost (\$/hh/yr)	\$24.38	\$32 ^b	\$25 - \$35	<\$36	<\$35	N/A
Average Recyclate Cost (\$/net tonne)	\$199	~\$212 ^b	<\$150	<\$143	<\$150 ^d	N/A
Net Yield (kg/hh/wk)	2.42 ^a	2.36	>3.0	>6.1 ^c	>2.5 ^e	2.4 ^f

- a - Net yield excludes glass fines and waste
- b - Rural MGB for commingled recyclables collected on fortnightly basis
- c - In conjunction with 140L MGB for domestic garbage
- d - SA EPA Standards based upon EcoRecycle Victoria Standards
- e - Lower net yield standard due to container deposit legislation
- f - Based upon recycling audit data

3.4 Regional Comparison

The Australian Bureau of Statistics estimates that in 2002, the population of Townsville was 93,911. Taking the figure of 5,701 tonnes of gross recyclables to have been sorted at the Visy MRF in 2003, this equates to a gross recycling rate of 60.7 kg per capita per year. Accounting for waste and glass fines, this equates to a net recycling rate of 46.5 kg per capita. Both of these figures compare favourably with the average figure of 41.6 kg per capita per year reported by the Qld EPA for gross recycling rates across Queensland local governments in 2002. A comparison of gross recycling rates for the best performing Qld local governments is in given in Table 3-6.

Table 3-6: Comparison of 2002 Gross Recycling Rates for Qld Local Governments

Local Government Area	2002 Gross Recycling Rate (kg/capita/yr)
Brisbane City	69.3
Redland Shire	64.8
Caloundra City	63.2
Pine Rivers Shire	62.6
Townsville City Council (2003)	60.7
Gatton Shire	55.5
Rockhampton City	54.6
Maroochy Shire	54.0
Gold Coast City	51.0
Caboolture Shire	49.6
Redcliffe City	47.3
Ipswich City	40.0
Hervey Bay City	37.3
Queensland LG Average	41.6

Source: Qld EPA, The State of Waste and Recycling in Queensland 2002

4 DISCUSSION AND CONCLUSIONS

In 2003, 554,000 recyclable bins were collected in Townsville, representing an effective set-out rate of 61.4%. This recycling service resulted in some 5,701 tonnes or 3.16 kg/hh/week of gross recyclables being collected. This represents an increase in capture of 2,004 tonnes compared with the previous collection contract in 2002 i.e., approximately 50%.

Taking glass fines and waste to constitute contamination and system losses at 23.4%, this resulted in 4,371 tonnes of net recyclables being recovered at Visy's MRF located at Carrol St, Mount Louisa. (Under the previous recycling contract, contamination was reported at 40.4%.) While the present contamination figure is slightly higher than the national average of 19.3%, apportioning the capture of net recyclables over the entire number of Townsville households results in a capture rate of 2.42 kg/hh/week which exceeds the national average of 2.36 kg/hh/week for 240L commingled MGBs.

Notwithstanding contamination and system losses being slightly higher than the national average, the overall levels indicate that the kerbside collection system and MRF are operating within acceptable limits and not resulting in excessive losses of resources. In addition, Visy have indicated that since commencing sorting operations, contamination levels have steadily fallen but would like to see further improvement in this area.

The cost of kerbside recycling services has fallen from \$44.12 per household in 2002 under the previous arrangements to \$24.38 per household in 2003 under the new service, which is below the lower threshold set by the EPA. While collection costs would not increase substantially with increased participation, the per-tonne cost could be expected to fall (in line with those being achieved in metropolitan areas) as capture quantities increase. Furthermore, lower per tonne sorting costs resulting from increased tonnage capture would be expected to further enhance the cost effectiveness of this service.

Therefore, whilst Townsville City Council's kerbside recycling is performing at or beyond the levels specified within the MoU, further improvements may be achieved in the short term as Council implements its education strategy. Of particular importance will be the targeting of educative efforts towards boosting set-out rates by raising general awareness of the kerbside recycling service, leading to increased service utilisation. This would also be expected to raise net recyclable yields on a per household basis and ensure the long term success of the kerbside recycling service by maintaining public awareness of;

- The types of materials suitable for recycling;
- Related materials quality issues;
- Correct presentation of recyclables at kerbside;
- Environmental benefits associated with recycling; and
- Council's general sustainability efforts.

5 REFERENCES

1. Nolan-ITU Pty Ltd (2002), *Review of Kerbside Recycling Systems – Final Report*, for Townsville City Council and The City of Thuringowa.
2. Nolan-ITU Pty Ltd (2002), *Survey and Audit of Kerbside Waste and Recycling Practices and Recommended Kerbside Service Standards*, for South Australian Environment Protection Authority.
3. Nolan-ITU Pty Ltd (2002), *Kerbside Garbage and Recycling Survey*, for Southern Waste Strategy Authority, Tasmania.
4. Nolan-ITU Pty Ltd and SKM Economics (2001), *Independent Assessment of Kerbside Recycling in Australia – Revised Final Report – Volume 1*, for The National Packaging Covenant Council.
5. Queensland Environmental Protection Agency and Townsville City Council (2003), *Memorandum of Understanding – Best Practice Kerbside Recycling Incentive Grants Program*.
6. EcoRecycle Victoria (2000), *Guide to Preferred Standards for Kerbside Recycling in Victoria*.
7. www.abs.gov.au, Demography – Local Government Area (LGA) populations for each State and Territory, *Preliminary Local Government Area (LGA) populations (at 30 June 2002) and final median ages (at 30 June 2001)*.
8. Queensland Environmental Protection Agency, *The State of Waste and Recycling in Queensland 2002*.