RESEARCH REPORT

The role of rubbish collection in litter generation – pilot observational study

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HEARTWARD
STRATEGIC

Contents

Executive summary

A pilot observational study was conducted in late 2021 exploring the extent to which the rubbish collection process is contributing to litter generation in NSW.

Of two methods of observation piloted, pre- collection versus post-collection litter counts, with associated bin observations, proved most successful, and data collected via this method forms the basis of this report.

Fieldwork was primarily conducted in the Canterbury Bankstown local government area and centred on known litter hotspots. A considerable amount of litter was observed, with 43% of observations of residential properties finding litter on the front verge/footpath, even prior to rubbish collection. Paper/cardboard followed by soft plastics were the most observed littered items (accounting for 45% and 13% of counted litter at this time, respectively).

The pilot data from Canterbury Bankstown provides some evidence that the rubbish collection process is, on balance, contributing to litter on our streets and verges. While the analyses reported here are based on a modest number of observations, the number of pieces of evidence and a pattern of results that 'make sense', gives us confidence in these results. In particular:

- A higher proportion of residential properties were observed to have litter on their front verge post-collection (48%) compared to pre-collection (43%) – a similar pattern observed in separate weeks, for both red-lid and yellow-lid bins
- Where litter was present, the average number of littered items was higher post-collection (average of 2.5 littered items) compared to pre-collection (average of 2.2 littered items)
- Litter counts were 17% more likely to be higher than lower, post-collection compared to pre-collection.

Findings suggest that damaged or over-full/overflowing bins may be contributing to litter generation, with 16% of yellow-lid bin observations and 13% of red-lid bin observations finding the bin to be damaged and/or overflowing. Properties with a damaged or overflowing bin were:

- 5% more likely to have litter observed on their property pre-collection (presumably as litter may already have blown or spilled out of the compromised bin) and
- 22% more likely to have a litter count that was higher, than have a litter count that was lower, post- compared to pre-collection

The hypothesis that wind may be implicated in rubbish blowing out of the top of bins is at least somewhat supported by the finding that soft plastic was the litter type most likely to have increased after rubbish-collection, from pre-collection levels. No further clues came either from bin observations, or the very limited set of truck observations completed in Ryde.

Moving forward, pre- and post-collection litter counts with bin observations presents a practical approach to assessing litter generation through the rubbish collection process, albeit a relatively resource-intensive one. It also still leaves unanswered questions about the cause of litter leakage, and why for some types of littered items, counts actually decreased pre- to post-collection. Exploration of an improved process for directly observing the waste collection process may be warranted.

Background and methodology

RESEARCH AIM

The NSW EPA, Litter Prevention Unit, approached Heartward Strategic in relation to conducting primary research to understand the extent to which the rubbish collection process is contributing to litter generation in NSW.

METHOD

An observational study was deemed most appropriate and a two-prong method for data collection designed, that included:

- **Pre-collection observations made the night prior to scheduled rubbish collection**

  The aim of this exercise was to assess the extent of litter already present (through a simple, base-line litter count), and factors that may contribute to litter being generated during rubbish collection, such as over-full/overflowing bins. The pairs of field staff conducting this 'audit', who were contractors of fieldwork company TKW, were required to document what they saw using an agreed proforma.

- **Observations made during rubbish collection, with post-collection litter counts**

  In a subsequent shift, the following morning, it was hoped that field staff would **follow the rubbish collection truck as it emptied bins**, directly observing what occurs and any litter generated through the process. The second member of the pair would conduct a further litter count, enabling any changes in litter levels since the pre-collection observations, to be measured.

PILOT FIELDWORK

As the chosen methodology was experimental and there were a number of unknowns, it was decided that the study would be run as a pilot with a modest fieldwork component only, in order to trial the methodology before potentially rolling it out on a larger scale.

The cooperation of two councils was secured and fieldwork proceeded as follows:

City of Ryde

- Week 1
  - Time 1 (Sunday 21 November, 4-8pm) – prior to red-lid bins being emptied
  - Time 2 (Monday 22 November, 7-11am) – as the collection truck passed through to empty the red-lid bins

- Week 2 - *CANCELLED*[1]

Canterbury Bankstown

- Week 1
    - Time 1 (Monday 29 November, 5-9pm[2])– prior to red-lid bins being emptied
    - Time 2 (Tuesday 30 November, 7-11am) – as the collection truck passed through to empty the red-lid bins
- Week 3
    - Time 1 (Monday 13 December, 5-9pm) – prior to the yellow-lid bins being emptied
    - Time 2 (Tuesday 14 December, 8-12noon[3]) – as the collection truck passes through to empty the yellow-lid bins

METHODOLOGICAL AND DATA LIMITATIONS

A number of challenges were experienced in this pilot study that:

- provide guidance on how the method would need to be amended before it could usefully be applied on a larger scale; and
- resulted in a smaller final data set being achieved than was expected:
    - meaning that not all analyses planned were able to be conducted – we were unable to examine the influence of street context on litter (e.g. the presence of litter on adjacent non-residential properties) or any differences between multi-dwelling and single-dwelling residences (the sample included just 29 multi-dwelling residences, with just 5 in Canterbury-Bankstown); and
    - with very little by way of truck observations.

[1] Two shifts were scheduled for evening of Monday 29 and morning of Tuesday 30 to observe pre and post yellow-lid bins being emptied. Unfortunately, it was only discovered on the morning of Monday 29 that miscommunication between NSW EPA and council on days of collection meant that residential yellow-lid bins had already been collected earlier that morning. As such, these two shifts were cancelled.
[2] The starting time for Time 1 shifts was pushed back an hour to 5pm for Canterbury Bankstown after it was discovered in Ryde that a large proportion of bins were not yet out at 4pm.
[3] The final start time was pushed back an hour to 8am after it was discovered during an earlier Canterbury Bankstown shifts that the truck emptying yellow-lid bins did not start coming through the area until around 8am.

The challenges experienced are summarised under the following headings:

- **Waste collection operations**

  Smooth and successful execution of the two-prong method for data collection designed for this study, presupposed that field staff would know in advance the streets where waste collection would occur during their Time 2 shifts. It also pre-supposed that field staff would have advance knowledge of the routes the truck would follow and/or that trucks would proceed at a pace they were able to keep up with.

  The reality proved to be that:

  - waste collection times varied to a large enough extent to create uncertainty around the streets that would be visited during the Time 2 shifts;
  - waste collection drivers do not follow a set route, as they take into account variables such as traffic bottlenecks;
  - routes taken may see waste trucks re-visit streets from which waste has already been collected, to 'short-cut' elsewhere – this occurred in this pilot where a truck did not stop for an entire stretch of road;
  - some further complexity (in communicating and gaining information on routes and timings) existed for the City of Ryde as it contracts-out waste collection, rather than has this service in-house.

  These realities resulted in the methodology of 'observations made during rubbish collection' proving unsuccessful in this pilot. Field staff needing to gain intelligence, on the morning of Time 2, from council (via the NSW EPA) on the best place to wait for the truck, would not be an optimal approach moving forward. Further, on the occasion that the field staff did successfully follow a truck, the truck did not stop at all for a stretch of road meaning the staff, on foot, quickly lost track of it and were unable to join up with it again, not knowing where it had been heading.

- **Field staff piloting a complex design with changing parameters**

  Usually in fieldwork of this kind, field staff are briefed once and receive full, clear and highly prescriptive instructions in written form well ahead of field-work.

  For this pilot, the challenges noted above were not known at the time written instructions for field staff were developed and field staff were briefed.

  Further, some initial instructions allowed for field staff to make their own judgement calls (for example, for Shift 1, we did not specify the order in which streets should be visited, or indeed that the highest priority streets should be visited first, noting that the number of streets that could be covered in a single shift was overestimated).

  Field staff received modified instructions several times in the lead up to, and during, their shifts, creating some degree of anxiety and confusion.

- **La Nina**

  As fieldwork shifts need to be booked in advance and cannot be cancelled at short notice without penalty, field staff are prepared to work in almost all weather. The first shift for this project, however, was attempted in unanticipated, torrential rain.

  During this shift very few observations were able to be made due to difficulties seeing and recording observations in the rain. Unfortunately staff also did not cover the highest priority, known litter hotspot streets (commencing elsewhere and then running out of time), but then proceeded to cover these at Time 2, resulting in redundant data being generated (post-counts without accompanying pre-counts). In less inclement weather and with clearer instructions (specified starting point and defined route for these initial shifts), these mistakes presumably would have been avoided.

  With consistent, above-average rain across the latter part of 2021 in Sydney, it was generally an unfortunate time for observational research.

Nonetheless, enough sets of pre-collection and post-collection observations have been collected through this pilot to provide some basic insight into the role of the waste collection process in litter generation.

Findings in detail

CANTERBURY BANKSTOWN

A total of 526 sets of pre- and post-rubbish collection observations were completed within this LGA. This included 480 sets of observations on residential properties, which form the basis of the analyses presented in this report[4]. As indicated in Table 1, 211 sets of observations were made in November, and 269 sets were made in December.

Table 1. Canterbury Bankstown sample sizes

	n=
Sets of pre- and post- observations	526
Sets of observations on residential properties only	480
Sets of observations made in November (red-lid bins)	211
Sets of observations made in December (yellow-lid bins)	269

[4] The remaining 46 sets of observations were made on not residential properties (shops, rail land, vacant blocks etc.). This information was gathered as contextual information. Given the relatively modest final sample size for this pilot, analyses drawing in volume of litter on adjacent properties as a variable, have not been possible.

THE PRESENCE OF LITTER, PRE AND POST RUBBISH COLLECTION

As indicated in Table 2, during pre-collection observations, litter was observed during 43% of residential property assessments. This proportion was higher for observations conducted in December (52%) than in November (31%).

Litter was observed at a slightly larger proportion of residential properties post-collection – 48% of properties overall.

Table 2. Residential properties with litter present on the verge/footpath, pre and post rubbish collection – raw number of residences and as a proportion of residential properties observed

	November (red-lid bins)				December (yellow-lid bins)				Overall			
	Pre		Post		Pre		Post		Pre		Post	
	n=	%	n=	%	n=	%	n=	%	n=	%	n=	%
Residential properties with litter	65	31%	84	40%	141	52%	144	54%	206	43%	228	48%

On residential properties assessed as having litter during pre-collection observations, counts of individual littered items ranged from 1 to 11, with the average litter count for residential properties with litter being 2.2.

In contrast, on residential properties assessed as having litter during *post*-collection observations, counts of individual littered items ranged from 1 to 17, with the average litter count for residential properties with litter being 2.5.

A total of 230 individual littered items were counted during pre-collection shifts, and a total of 255 individual littered items counted during post-collection shifts, on residential properties being observed, as illustrated in Table 3 which also breaks these totals down by type of littered item. As illustrated, paper/cardboard was by far the most observed littered item at both time points. Counts of soft plastics increased quite markedly from pre- to post-rubbish collection, by almost half (48%).

For three types of littered items – small recyclable drink containers, takeaway containers and other domestic recyclables – litter counts *decreased*.

Table 3. Number of individual littered items counted

	Pre-collection	**Post-collection**
Paper/cardboard	230	255
Soft plastics	67	99
Small recyclable drink containers	48	40
Takeaway containers, cutlery, cups	45	39
Small items	32	46
Food/organics	15	19
Other domestic recyclables	6	5
Other waste	64	66
TOTAL litter count	**507**	**569**

CHANGES IN LITTER COUNTS ON INDIVIDUAL PROPERTIES

As noted above, both the proportion of residential properties with litter on their front verge/footpath, and the number of littered items counted overall increased between time periods, from pre- to post-rubbish collection. However, as also noted above, for some litter types, litter counts decreased.

A more nuanced assessment of the possible impact of the rubbish collection process can be gained by considering litter at the individual property level.

As illustrated in Table 4, for 27% of the 480 sets of observations made in Canterbury Bankstown, post collection litter counts were higher than pre collection litter counts. However, in almost the same proportion of cases (23%), post collection litter counts were *lower* than pre collection litter counts[5].

A marked difference was observed between the November and December observations. In November when post-collection observations were timed for after the red-lid bin had been emptied (the yellow-bin may not have as yet been emptied), litter was observed to have increased in a much larger proportion of sets of observations (40%) than to have decreased (just 15%).

Table 4. Residential properties for which changes in litter counts occurred between time points

	November (red-lid)	December (yellow-lid)	Overall
Sets of observations for which post collection litter counts were **higher** than pre collection litter counts (i.e. litter increased)	84 (40%)	71 (26%)	128 (27%)
Sets of observations for which post collection litter counts were **lower** than pre collection litter counts (i.e. litter decreased)	31 (15%)	77 (29%)	108 (23%)

[5] In the remaining roughly half of cases, total litter counts remain unchanged.

Across all sets of observations, in cases where post-rubbish collection litter counts were higher than pre- collection litter counts, counts went up by between 1 and 11 littered items, with an average increase of 2.1 littered items per residential property that had experienced an increase.

Across all sets of observations, in cases where post-rubbish collection litter counts were lower than pre-collection litter counts, counts went down by between 1 and 11 littered items, with an average decrease of 1.8 littered items per residential property that had experienced a decrease. These numbers are presented in Figure 5, also split by fieldwork month.

Figure 5. Changes in littered items for residential properties experiencing a change

	November (red)	December (yellow)	Overall
Sets of observations where post collection litter counts were *higher* than pre collection counts			
Total increase in littered items	166	148	264
Increase per residential property (range)	1 – 11	1 – 8	1 – 11
Increase per residential property (average)	1.4	2.1	2.1
Sets of observations where post collection litter counts were *lower* than pre collection counts			
Total decrease in littered items	46	150	196
Decrease per residential property (range)	1 – 4	1 – 11	1 – 11
Decrease per residential property (average)	1.5	1.9	1.8

Nett litter generation can be calculated by summing the change in litter count per set of residential property observations. Overall, the net litter generation was 68 individual items of litter. Breaking this down by type of littered item demonstrates that increases in litter were most likely with respect soft plastics and decreases in litter were most likely with respect small recyclable drink containers. Specifically:

- Positive netts were observed for four types of littered item, namely:
    - Soft plastics +32 items
    - Paper/cardboard +31 items
    - Small items +13 items
    - Food/organics +9 items
- Negative netts were observed for the reaming types of littered item, namely:
    - Small recyclable drink containers - 8 items
    - Take away containers, cutlery, cups - 6 items
    - Other domestic recyclables - 1 items
    - Other waste - 2 items

BIN OBSERVATIONS

Effort was made to make comprehensive bin observations during pre-collection fieldwork (conducted the evening before the bins were due to be emptied). Unfortunately, a large proportion of bins were unable to be observed as they were not yet out on the verge when pre-collection observations were made.

Across the 480 sets of observations made in Canterbury Bankstown 196 observations were made on yellow-lid bins, and 230 observations were made on red-lid bins.

As indicated in Figure 6, red-lid bins were ever so slightly more likely to be in good condition, and not overflowing, but for both types of bin, more than 10% of bins were observed to have issues that could conceivably have resulted in litter spilling out of them, litter being picked out of them by wildlife or litter being blown out by the wind.

Figure 6. Observed condition of residential bins

	Yellow-lid bins	Red-lid bins
Bin observed to be in good condition and not overflowing	164 (84%)	201 (87%)
Observed to have a raised lid / be overflowing	31 (16%)	23 (10%)
Observed to be damaged / missing lid	1 (0%)	6 (3%)
TOTAL number of observations	**196**	**230**

Considering the 239 sets of observations made in Canterbury Bankstown during which at least one type of bin was observed:

- For the 48 cases where at least one bin was damaged or overflowing:
    - 20, or 42%, had litter observed on the property at the time bins were observed
    - 16, or 33%, had a higher litter count post collection versus pre collection
- For the 191 cases where *no* bin was observed to be damaged/overflowing
    - 76, or 40%, had litter observed on the property at the time bins were observed
    - 51, or 27%, had a higher litter count post collection versus pre collection

Few additional, open-ended bin observations were recorded that could provide clues as to how the condition of bins may contribute to litter leakage. In just a few cases, items were noted to have been stacked up next to a bin, e.g. plastic bag of additional recyclables, presumably because the bin was already full. No observations were recorded about wildlife interfering with bins.

RYDE

Too few pre- and post-collection sets of observations were made in the single week of fieldwork conducted in Ryde for findings to be able to be reliably reported here.

To note, however, field staff were able to follow a truck as it emptied bins, for a short duration, with 32 observations made. During these observations, no generation of litter was observed. That is, no waste was observed to fall from bins as they were lifted and emptied, and no waste was observed to fall from the truck as it drove along.

Conclusions and recommendations

CONCLUSIONS

This pilot observational research provides evidence that the waste collection process is contributing to the generation of litter.

While the pilot analyses reported here are based on a modest number of observations, across a modest number of streets, the number of pieces of evidence and a pattern of results that 'make sense' gives us confidence in these results.

Though relatively small changes pre- litter collection to post- collection have been observed, this is to be expected given the waste collection process is just one potential contributor to litter on our streets. We would want to replicate these findings in a future study (broadening the sample of observations on which our conclusions are based) before drawing more hard and fast conclusions about the magnitude of the issue, or what precisely about the waste collection process is contributing to litter generation.

Results from this pilot implicate the following in the creation of litter through the waste collection process:

- soft plastics (more than other forms of waste)
- damaged residential bins, including those missing or with a damaged lid
- residents' actions, such as overfilling, or stacking waste alongside, their bins

However, no conclusions can be drawn from this pilot on the influence of:

- waste trucks (use of the lifting arm, volume of waste already in the truck)
- waste collection staff (including when manually intervening)
- context – other litter on the street, adjacent non-residential properties, type of property (multi- versus single-dwelling), weather (e.g. wind)

RECOMMENDATIONS

Given the above, we believe there is clear value in conducting further research with the aim of:

- generating more sets of observations to confirm and increase confidence in the findings to date
- draw in a larger pool of streets / more council areas, to improve the generalisability of findings
- expand our understanding of what is going on through greater consideration of the role of waste trucks, waste collection staff and context.

Conduct of this pilot was unable to provide robust observation of the waste trucks in action. That is, there was little opportunity to observe any waste falling out of bins or trucks or any corrective action by waste staff. As a result, we are still some way to fully explaining the increase in litter post- compared to pre-collection, or how it is that for some residential properties, litter actually decreased pre- to post-collection. We would recommend that a further attempt is made to achieve direct observations of trucks. Under the piloted method, this would need to involve:

- A pair of field staff working together, but with one following in a car, to enable staff to move more swiftly as necessary to keep up with the truck
- Any such observations being uncoupled with any pre-collection versus post-collection litter counts – field staff would need to be free to follow the truck wherever it went, and not have the competing priority of re-visiting streets on which pre-collection litter counts had already been made.

  A potential solution here would be to have an additional pair of staff brought on board for Time 2 (two staff at Time 1, four staff at Time 2) to focus on truck observations.

Alternatively, the NSW EPA could explore accessing any video footage collected by council directly from the rubbish trucks.

Any future use of the pre-collection versus post-collection observations/litter counts should ensure:

- Shifts are booked well in advance, with staff who are willing to work late into the evening and early the following morning – Time 1 shifts commencing at 7pm may be optimal, to ensure a larger number of bins are out on the verge when staff come through
- The proformas (data count sheets) used by staff to record observations have more fields devoted to bin observations given these observations have proven crucial, reducing the manual recording under 'other observations' of anything other than the bin having a lid raised/overflowing or the bin being damaged
- Streets to cover and the precise route to follow are laid out clearly, so that field staff do not need to make on-the-spot decisions impacting data collected– this would be easier now that this pilot has provided a clearer sense of number of streets able to be covered in a four-hour shift
- The proformas record weather on the day of observation, notably presence of wind.

To ensure any future observational work goes smoothly, we would recommend small-scale deployment of the revised method, before any larger-scale fieldwork endeavour. We would also recommend consideration be given to the fieldwork supplier (Heartward Strategic in the case of this pilot) directly liaising with council (or where relevant the organisation waste collection is contracted-out to), after initial introduction from the NSW EPA. This would streamline communication.

Other research methods that could be considered to complement insight gained from observational research include:

- Confidential interviews with waste collection staff – to collect their observations and self-report behaviours

- Quantitative research with residents – to collect data on the condition of bins, self-report behaviour, and other observations, from a broader cross-section of NSW. Such work could include diary-type observations recorded digitally (by citizen data collectors).