

## LONDON PURPOSE-BUILT FLATS RECYCLING RESEARCH PROJECT

# QUALITATIVE COMPARATIVE ANALYSIS OF RECYCLING PERFORMANCE

Evaluation of the London purpose-built flats recycling research project using Qualitative Comparative Analysis (QCA). An initial effort to unpack the conditions that are necessary and/or sufficient to observe higher capture rates from flatted properties.



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This document provides the supporting evidence and analysis for the evaluation of the Resource London Flats recycling project.

**Document reference:**

(please use this reference when citing WRAP's work): [WRAP, 2019, Banbury, Qualitative Comparative Analysis of recycling performance in London flats, Prepared by Mark Roberts & Rachel Devine]

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**Front cover photography:** Flats Recycling Package implemented on Peabody estates

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## Glossary

*WCA* – Waste Composition Analysis

*Case* – a case study. In this study the case is at an estate level

*Condition* – a factor, or a combination of factors, that may influence or explain the outcome

*Outcome* – the outcome is the result in question which may or may not be explained by the condition(s). In this study two outcomes were investigated; capture rate and capture rate change

*Binary-value* – a descriptive term used to describe the raw data associated with a condition that can have one of only two values e.g. present or absent, yes or no, above or below a defined threshold

*Continuous data* – the raw data associated with a condition that can have an infinite number of values e.g. percentage data can be any value from zero to 100%

*Discrete data* – the raw data associated with a condition that can only take on certain values e.g. bin quality score can be any number from zero to ten at 0.5 intervals

*Fuzzy score* – when a condition has more than two possible values it can be converted to a value between zero and one. A fuzzy score can be continuous, four-value or six-value. For example, a four-value scale might be used to classify “Strongly Agree”, “Agree”, “Disagree” and “Strongly Disagree” as 1, 0.67, 0.33 and zero respectively

*Truth table* – a table of all the theoretically possible ways to describe a case using every condition. The table highlights the presence or absence of every condition for each case

*Configuration* – a row in the truth table. The term used to describe a case by listing the presence/absence of every single condition

*Combination* – a term used to describe a case by listing the presence or absence of some of the conditions

*Sufficiency* – the degree to which one, some or all the conditions are sufficient for the outcome. Sufficiency scores can be from zero to one

*Parsimonious Solution* – A calculation to find the simplest logical explanation(s) of the outcome

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*Table 1: Glossary of outcomes and conditions used in the QCA alongside their code name*

<b>QCA code name</b>	<b>Outcome or condition</b>	<b>Type of condition</b>	<b>Description</b>
capture rate	Outcome	N/A	Capture rate at each estate ranked from highest to lowest (relative)
capture rate 50	Outcome	N/A	Capture rate at each estate, those above 50% scored 1, and those below 50% scored 0
capture rate change	Outcome	N/A	Change in capture rate at each estate ranked from highest to lowest. We used 80% benchmark to determine the capture rate change as the "potential" reached
in home	Condition	Intervention	In-home storage solution: free plastic bags and hooks
tenant pack	Condition	Intervention	Free information pack from Peabody detailing what can and cannot be recycled
smaller bins	Condition	Intervention	Small bins that were placed on each estate in addition to main bin storage area
emotive	Condition	Intervention	Emotive signage on display at estates about recycling and impact on future generations
feedback	Condition	Intervention	Feedback posters that were placed on estates to inform residents of how well they were recycling
caretaker	Condition	Contextual factor relating to the estate	Measure of caretaker input e.g. how often caretakers recycled on behalf of residents during the project
bin inside	Condition	Contextual factor relating to the estate	Location of main bin storage
food waste	Condition	Contextual factor relating to the estate	Presence or absence of food waste stream
chutes	Condition	Contextual factor relating to the estate	Presence or absence of chutes
low prop 15 to 34	Condition	Contextual factor relating to residents	Low proportion of 15 to 34 year olds
homeowners	Condition	Contextual factor relating to residents	High proportion of homeowners
lifts	Condition	Contextual factor relating to the estate	Presence or absence of lifts
bin quality	Condition	Contextual factor relating to waste disposal provision prior to interventions	Measure of bin quality at pre-intervention stage of the project

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resavvolume	Condition	Contextual factor relating to waste disposal provision prior to interventions	Measure of residual waste available volume (in L per/hh/week) at pre-intervention stage of the project
mdravvolume60L	Condition	Contextual factor relating to waste disposal provision prior to interventions	Measure of mixed dry recycling available volume (above or below 60L hh/wk) at pre-intervention stage of the project



## **Acknowledgements**

Peabody Estates provided the raw data for resident demographics at each estate. Estate inventories, waste tonnage and waste composition analysis were conducted by Resource Futures and funded by Resource London. Resident interviews were conducted by Winning Moves. The authors would also like to thank Karl King from Winning Moves for undertaking a peer review of the analysis.

# 1.0 Introduction

## 1.1 Background

The poor performance of communal flats or estates collections is well documented, with WRAP research showing that even well-established schemes yield around 50% less recycling than average low-rise properties.

London, which has a high and growing proportion of flats, achieved a recycling rate of 33% in 2016/17. This is a considerable way short of the 2020 recycling target of 50% for the UK and the Mayor of London stretch target of 65% for municipal waste recycling (including commercial waste).

Urban environments are one of the most challenging in terms of increasing participation in recycling services and capture rates of the target materials. The potential factors that affect recycling performance in flats are complex and many factors may contribute to outcomes. WRAP's Dense Urban literature review (2015) showed there is too much variety in household contexts and barriers to recycling to be able to generalise for flats as a whole.

## 1.2 Peabody Flats Project

### 1.2.1 Overview

In order to understand the barriers and behaviours, and to identify solutions that will increase recycling rates in flats, Resource London invested in a three-year flats initiative working with one of London's largest housing associations, Peabody. The project aims to understand the waste and recycling behaviour of residents living in estates and address barriers by improving the quality of recycling provision and testing a series of behavioural interventions. Combinations of activities were trialled across 10 estates (with two additional comparison estates) in six boroughs in central London: Camden, Hackney, Islington, Lambeth, Tower Hamlets, and Westminster.

As part of the effort to evaluate the effectiveness and value for money of the Flats Recycling Package and behavioural interventions, Resource Futures was commissioned to deliver a waste monitoring and waste compositional analysis (WCA). The aim of this waste monitoring project was to determine the amount and type of waste and recycling produced by the selected estates, normalising it per household before and after the Flats Recycling Package and behavioural interventions and took place. The research included 1,643 households.

The pre-intervention monitoring and WCA was completed in May and June 2018. The post-intervention WCA was completed in May and June 2019, while an interim phase took place in winter 2018. In this report only the pre- and post- intervention data are analysed.

## 1.2.2 Flats Recycling Package and behavioural interventions

After the initial phase of WCA, the Flats Recycling Package (including new bins and signage) was introduced across all 12 estates, including the comparison estates, to bring recycling and refuse services up to a common quality standard. It was designed to eliminate fundamental barriers to recycling that had been identified in the ethnographic research and estate inventories, such as issues with poor access and quality of bins, cleanliness and signage. This provided a common platform on top of which specific behavioural barriers could be targeted by the behavioural interventions. The behavioural interventions and Flats Recycling Package are described in Table 2.

	Description	Intended outcomes
<b>Flats Recycling Package</b> (Figure 1)	<ul style="list-style-type: none"> <li>Clean and well-maintained bins and bin areas</li> <li>Adequate collections to prevent overflows and appropriate recycling capacity (min 60l/hh/wk)</li> <li>Appropriate apertures on recycling bins big enough to accept plastic bags of recycling and with locked reverse lids</li> <li>Collection of the six main recyclable materials<sup>1</sup></li> <li>Clear and visible signage on and above the bins</li> <li>Convenient location of recycling bins for residents</li> <li>Recycling leaflet sent to residents once a year</li> <li>Posters highlighting recycling messages displayed in a central location (where possible)</li> <li>Residents informed of what they should do with bulky waste items</li> </ul>	<ul style="list-style-type: none"> <li>Residents think recycling feels easier</li> <li>Residents are more motivated to recycle and have a positive experience when they recycle</li> <li>Residents have a better knowledge of what can and cannot be recycled</li> </ul>
<b>Tenant Pack</b> (Figure 2)	A pack delivered to residents with Peabody branding that included a booklet of information about recycling, a notepad and pencil. It was designed to form a 'social contract' between Peabody as landlord and what they expect of their residents / tenants with regards to recycling	<ul style="list-style-type: none"> <li>Residents are more motivated to recycle</li> <li>Residents have a better knowledge of what can and cannot be recycled</li> </ul>
<b>In-home solution</b> (Figure 3)	A pack containing a roll of recycling bags and two hooks delivered to residents, intended to help residents manage space constraints on storing recyclables and to minimise the effort needed to transport items to bins.	<ul style="list-style-type: none"> <li>Residents think recycling feels easier – to store and transport recyclables</li> <li>Residents are more motivated to recycle</li> </ul>
<b>Additional Smaller bins</b> (Figure 4)	Smaller bins installed in convenient locations for residents to use on the way in / out of the estate, with clear signage about what can be recycled. Intended to make recycling more visible and enable more frequent deposits.	<ul style="list-style-type: none"> <li>Residents think recycling feels easier</li> <li>Residents have a better knowledge of what can and cannot be recycled</li> </ul>
<b>Emotive signage</b> (Figure 5)	Signage used in the residual bin areas and on chutes using images of families to encourage residents to think about future generations and encourage them to recycle. Intended to prompt residents to question a 'binning' mindset in favour of being a recycler.	<ul style="list-style-type: none"> <li>Residents are more motivated to recycle</li> <li>Residents have a better knowledge of what can and cannot be recycled</li> </ul>
<b>Feedback mechanism</b> (Figure 6)	Posters displayed within noticeboards on the estates and are changed every two months. The posters use various messages such as praise for residents to recycle, what can and cannot be recycled, and what happens to recycling after it leaves the estate. Intended to strengthen social norms for recycling and enhance a sense of involvement in the recycling system.	<ul style="list-style-type: none"> <li>Residents are more motivated to recycle</li> <li>Residents have a better knowledge of what can and cannot be recycled</li> </ul>

Table 2: Brief summary of the Flats Recycling Package and behavioural interventions

<sup>1</sup> Paper, card, glass, food and drink cans, plastic bottles, and mixed rigid plastics (tubs, pots and trays)

# Qualitative Comparative Analysis of Recycling Performance



Figure 1: The Flats Recycling Package

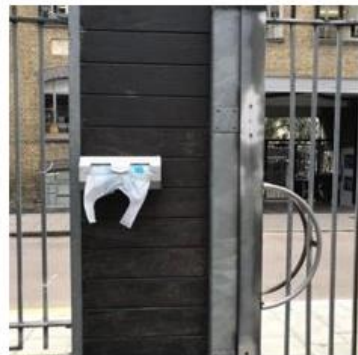
# Qualitative Comparative Analysis of Recycling Performance



Figure 2: Tenant pack – A5 4-page booklet, notepad, pencil, questionnaire and prize draw



Pack includes: Information card, 1 x roll of sacks and 2 x hooks



Dispensers with free sacks



Hooks in action

Figure 3: In-home solution

# Qualitative Comparative Analysis of Recycling Performance



Figure 4: Smaller bins

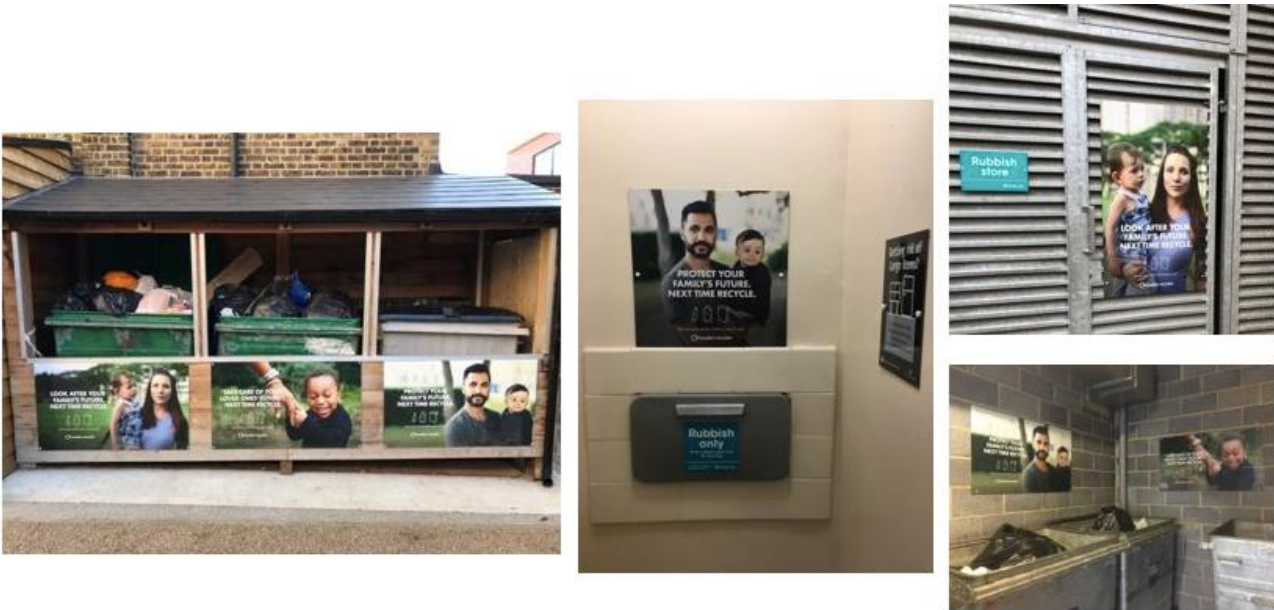


Figure 5: Emotive signage



Figure 6: Feedback mechanism

Case study	Behavioural interventions					Estate names
	In-home solution	Tenant pack	Smaller bins	Emotive signage	Feedback	
C (comparison)	0	0	0	0	0	Estate A Estate B
1	0	1	1	1	1	Estate I Estate J
2	1	1	0	0	1	Estate G Estate H
3	1	0	1	0	0	Estate K Estate L
4	0	1	0	1	1	Estate C Estate D
5	1	0	0	1	0	Estate E Estate F

Table 3: Summary of the different behavioural interventions that were implemented at each estate. Each combination of behavioural interventions was implemented at two estates to assess consistency of results. Behavioural interventions were not implemented at Comparison estates which only received the Flats Recycling Package.

### 1.3 Research questions

As part of this project, WRAP and Resource London wanted to understand the factors affecting recycling performance in flats. The project aimed to address several key questions:

1. What were the factors that affected recycling performance prior to implementation of the Flats Recycling Package and behavioural intervention schemes? (to establish a baseline)

2. What are the factors that affect current recycling performance given the implementation of the Flats Recycling Package and different behavioural intervention schemes?
  - a. Does the Flats Recycling Package affect current recycling performance?
  - b. Do any of the behavioural interventions affect current recycling performance?
  - c. Are any of the factors that affect current recycling performance, the same as those identified before the Flats Recycling Package and behavioural intervention schemes were implemented?
3. What are the factors that must be present or absent to achieve the greatest improvement in recycling performance?

The research uses the pre- and post-intervention waste tonnage monitoring and WCA data, demographic data from Peabody, and the flats inventories conducted by Resource Futures to look at factors that are present or absent in estates observed to have a higher capture rate or a higher capture rate change.

## 1.4 Selecting a recycling performance metric

There are many ways to express recycling performance and typically “recycling rate” is used in the waste management sector. However, in this study, recycling rate was not the primary focus and instead capture rates were used. This is because recycling rate is a proportion of the total waste produced at an estate and therefore can be skewed by other factors such as:

- a) an anomalously high amount of residual waste;
- b) changes in purchasing behaviour of residents – for example residents may decide to make a switch from packaged to unpackaged items or from non-recyclable to recyclable packaging, and *vice versa*;
- c) changes in packaging provided by manufacturers.

Capture rate is considered to give a more accurate indication of recycling behaviour since it is a measure of whether residents are putting the “correct items in the correct bin”.

Capture rate refers to the quantity of a particular target material or group of target materials by the service or scheme designed to accept that material or group of materials. As such capture rate is the proportion of a target material that has been collected relative to the total arisings on that material. Therefore, capture rate is thought to be a more accurate indication of resident recycling behaviour as it:

- provides a measure of whether or not residents are correctly recycling target materials;
- it is not influenced by the quantity of the targeted material;



- it is not influenced by the amount or non-target material.

## 1.5 Research objectives

The analysis presented in this report represents an initial effort to unpack the conditions that are necessary and/or sufficient to observe higher capture rates from flatted properties.

1. To identify the pre-existing factors that affected flats recycling performance prior to implementation of the intervention schemes;
2. To identify the factors that affected flats recycling performance after implementation of the intervention schemes;
3. To identify the factors that affected the *change* in flats recycling performance from pre- to post-intervention schemes.

## 2.0 Research approach

Past evaluations of recycling performance in flats have faced difficulties when generating statistically robust data, notably where measuring impact relies on:

- Waste collection data – where service or scheduling issues cause anomalies in the data to an extent that it cannot be used to measure impact with confidence;
- Measuring waste from a large enough combined sample of households to provide a statistically robust basis for generalising. Where data are combined across areas (e.g. collection rounds or estates) to create the overall sample, anomalies in one or more sub-samples can undermine the whole evaluation.

In particular, ‘noise’ in the data, that cannot be explained, for one or more of the sub-areas within an overall sample, can undermine the quality of the data to a point that it is not possible to demonstrate the effects of the behavioural interventions with any confidence. There are many sources of such ‘noise’ including for example:

- Lack of control by the evaluation team over the collection of waste for weighing, including inconsistencies in what waste is collected for weighing and/or how weight data is recorded;
- For understandable reasons, operational priorities taking precedence over accurate weighing: for example, where waste from containers from a target area is not always kept separate from other waste before being weighed, or vehicles being re-routed to maintain an uninterrupted collection service;
- Problems in delimiting the target area for monitoring and evaluation to ensure that only waste from that area and target residents is measured;
- Service disruptions or interruptions which cause anomalous fluctuations in waste collected;
- The timing of collections, especially if ‘before’ and ‘after’ waste samples are collected at different times of year and seasonal effects cannot therefore be controlled for;
- In addition, “effect sizes” (the scale of impact of the intervention) may sometimes be too small to be clearly detectable within the margins of error of the sample sizes being used. Typically samples of 1,100 households with margins of  $\pm 3\%$  for participation or resident surveys are deemed to be statistically robust. To increase sample sizes to reduce error margins to a point that changes smaller than 3% could be identified would be prohibitively costly.

An alternative approach is to use a theory-based evaluation using a case study approach to underpin a Qualitative Comparative Analysis (QCA).

QCA is used in this study as it has been designed to deal with complexity, where many factors may contribute to outcomes; and for its ability to deal with "wicked issues" where complexity arises from external factors outside the project's scope of influence.

There are many external factors that can be associated with waste and recycling performance:

- Affluence
- Presence of children
- Age profile of occupants
- Levels of environmental awareness/concern
- Space internally and externally
- High/medium/low rise
- Presence of a lift
- Tenure
- Dedicated/shared/no caretaker
- Presence of residents' associations and how active it is
- Resident turnover/transience
- Levels of anti-social behaviour
- Type of collection (chutes/communal bins)
- Placement of containers in relation to buildings
- Signage
- Means of access to the building
- Access to the bins by non-residents
- Collection frequency

QCA can combine quantitative and qualitative data that has been collected for different causal factors, including those that are difficult or impossible to quantify accurately. A key strength is its reliance on case studies (e.g. whole estates irrelevant of population size on that estate) rather than statistically reliable samples (e.g. the threshold of 1,100 households/respondents recommended by WRAP for surveys) and its tolerance of small sample sizes (e.g. from 5+ cases).

## 2.1 What is Qualitative Comparative Analysis (QCA)?

QCA is a rigorous method that enables a systematic comparison across case studies to reveal which causes (known as 'conditions' in QCA), or configurations of conditions, contribute to differences in outcomes (e.g. capture rate) across the cases. The analysis seeks to identify factors or combinations of factors that appear necessary and/or sufficient for the outcome of interest to be observed. QCA can combine quantitative and qualitative data to cover different theorised causes (e.g. in this project, contextual factors such as delivery process, estate characteristics, demographics etc.) and it has been

used in other policy areas (e.g. health, education). It uses Boolean logic to determine which factors or combinations thereof must be present to observe a particular outcome.

### 2.1.1 An analogy of the Boolean logic that underpins QCA

If a person is given three items of clothing to wear; a shirt, a tie and a pair of trousers, there are eight theoretically possible ways to wear those items: all, none or combinations thereof (Table 4). Alongside wearing these items, if the person is also described based on how professional they look, we can assess which item, or combinations of items, must be worn in order to look professional. For example, we can see that wearing a shirt, tie and trousers would look professional, as would wearing a shirt and trousers. We can deduce that wearing a shirt AND trousers is therefore necessary and sufficient to look professional, but a tie is not. In this example it is important that a shirt is worn with trousers since wearing only a shirt, or only a pair of trousers, would look unprofessional.

Example	Description	Shirt	Tie	Trousers
1	Professional	Y	Y	Y
2	Professional	Y	N	Y
3	Unprofessional	Y	Y	N
4	Unprofessional	N	Y	Y
5	Unprofessional	Y	N	N
6	Unprofessional	N	Y	N
7	Unprofessional	N	N	Y
8	Unprofessional	N	N	N

*Table 4: Boolean logic clothing analogy part 1. Theoretically possible ways to wear three different items of clothing against professionalism.*

If for example, we introduced a new item that could be worn then the number of theoretically possible combinations would increase from eight to 16. If, when worn, the item always made the person appear unprofessional, e.g. a snorkel, we could deduce that to look professional it is necessary to wear a shirt AND trousers and NOT a snorkel.

Example	Description	Shirt	Tie	Trousers	Snorkel
1	Professional	Y	Y	Y	N
2	Professional	Y	N	Y	N
3	Unprofessional	Y	Y	N	N
4	Unprofessional	N	Y	Y	N
5	Unprofessional	Y	N	N	N
6	Unprofessional	N	Y	N	N
7	Unprofessional	N	N	Y	N
8	Unprofessional	N	N	N	N
9	Unprofessional	Y	Y	Y	Y
10	Unprofessional	Y	N	Y	Y
11	Unprofessional	Y	Y	N	Y
12	Unprofessional	N	Y	Y	Y
13	Unprofessional	Y	N	N	Y
14	Unprofessional	N	Y	N	Y
15	Unprofessional	N	N	Y	Y
16	Unprofessional	N	N	N	Y

Table 5: Boolean logic clothing analogy part 1. Theoretically possible ways to wear three different items of clothing and a snorkel against professionalism.

Using the above analogy, the example number is the *case*, the level of professionalism is the *outcome* and an item of clothing is a *condition*.

## 2.2 Data treatment and calibration

In this report, estates will be referred to as *cases*, the mixed dry recycling capture rate at each estate is referred to as the *outcome* and the factors that may explain the outcome are referred to as *conditions*.

### 2.2.1 Justification for conditions

An iterative approach was adopted such that the results from Objective 1 influenced the decisions made when conducting QCA for Objectives 2 and 3. The approaches adopted were slightly different for each objective and are detailed in the following sections.

#### Approach undertaken to address Objective 1:

Objective 1: To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (pre- intervention schemes).

There are many conditions that may explain the observed capture rates at each of the 12 estates. However, when using QCA, prior knowledge of the expected impact of the condition on the outcome is required. Additionally, data on conditions must be available for every case. If data are lacking for one or

more cases, the researcher must either drop the condition(s) from the analysis or remove the case(s) with incomplete data. For some estates, there are conditions that may explain or partially explain the outcome, but datasets were only available for some of the estates.

In this project, it was considered more important to include all 12 cases in the analysis than to include additional conditions and lose cases. However, without further investigation, dropping conditions due to lack of data runs the risk of removing conditions that may influence the outcome. To test the potential importance of conditions that were to be dropped from the final analysis, “experimental” QCA runs were undertaken where cases were dropped instead of conditions. The results of the experimental QCA runs (using 10 out of 12 cases) show that the conditions that were due to be dropped were not important since they are neither necessary nor sufficient for the outcome.

Conditions chosen for QCA therefore had to fulfil four fundamental criteria

1. Prior knowledge is available for the expected impact of the condition on the outcome;
2. Supporting reports and/or data detailing the impact of the condition on the outcome (from internal or external peer-reviewed sources) must be available;
3. Raw data for each condition must be available for all 12 cases;
4. If raw data are not available for all 12 cases, the analyst must review the condition/conditions and assess their importance to the overall project. Experimental QCA runs can be performed using all conditions, but dropping cases where data are lacking. If experimental runs show that the condition is not “important”, then the condition can be dropped from the final QCA.

Only conditions that met all four criteria were included in the analysis. For some conditions, criteria 1 and 2 were met but raw data were lacking for some cases. As a result, conditions were included in experimental QCA runs before a decision was made to either include or omit them in the final QCA (Table 6).

In total, nine conditions were identified that fulfil the above criteria:

- Mixed dry recycling available volume (above or below 60 L threshold)
- Residual waste available volume
- Food waste collection
- Residual waste chute provision
- Quality of free-standing communal bins
- Location of free-standing communal bins
- Low proportion of 15-34-year olds
- Percentage of homeowners
- Lift provision

Conditions relate to the quality of waste disposal provision, the layout of each estate, and the profile of residents. It was expected that the presence or absence of conditions explain capture rates prior to implementation of the Flats Recycling Package and implementation of intervention schemes at each estate (please refer to table 6).

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Condition	Criteria 1 Prior knowledge available for expected impact of condition on the outcome	Criteria 2 Supporting reports and/or data	Criteria 3 Raw data available for all 12 cases	Criteria 4 Experimental QCA run output indicates that condition is not “important”	Used in the final QCA
Mixed dry recycling available volume (above or below 60 L threshold)	✓	✓	✓	N/A	✓
Residual waste available volume	✓	✓	✓	N/A	✓
Food waste collection	✓	✓	✓	N/A	✓
Residual waste chute provision	✓	✓	✓	N/A	✓
Quality of free-standing communal bins	✓	✓	✓	N/A	✓
Location of free-standing communal bins	✓	✓	✓	N/A	✓
Low proportion of 15-34-year olds	✓	✓	✓	N/A	✓
Percentage of homeowners	✓	✓	✓	N/A	✓
Lift provision	✓	✓	✓	N/A	✓
Percentage of single occupants	✓	✓	X	✓	X
Percentage of occupants under 16 at an estate	✓	✓	X	✓	X
Average length of tenancy	✓	✓	X	✓	X
Presence of high-rise buildings (+7 floors) at an estate	✓	X	✓	✓	X
Bulky waste often left in communal bin area	X	X	✓	✓	X

*Table 6: Conditions that were initially identified alongside whether the condition fulfils the criteria and whether the condition is included in QCA. The list of conditions is not exhaustive but explains the justification for conditions in the final QCA.*

### Approach undertaken to address Objective 2:

**Objective 2:** To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (post- intervention schemes).

Most of the conditions used in the QCA to address Objective 1 were used in the second phase to address Objective 2. This is because the presence or absence of certain conditions is still likely to influence recycling performance irrespective of the changes that were implemented at estates during the project. However, since all estates were brought up to the Flats Recycling Package standard, the conditions associated with Flats Recycling Package were omitted from the phase 2 QCA. Those conditions are mixed dry recycling available volume, residual waste available volume and bin quality. In addition, the

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presence or absence of a particular intervention scheme was also included in the QCA for phase 2. Table 7 summarises the conditions in phase 2 QCA.

Condition	Included in Phase 1 QCA	Included in Phase 2 QCA	Explanation
Mixed dry recycling available volume (above or below 60 L per hh/wk threshold)	✓	X	Flats Recycling Package implemented and all estates had more than 60L mixed dry recycling available volume per household per week. This was achieved either by purchasing additional free-standing bins or increased frequency of collections.
Residual waste available volume	✓	X	Flats Recycling Package implemented and all estates had adequate residual waste available volume. This was achieved either by purchasing additional free-standing bins or increased frequency of collections.
Quality of free-standing communal bins	✓	X	Flats Recycling Package implemented and all estates were brought up to the same high quality. Bin signage was improved, and new bins purchased (see section 1.2.2)
Food waste collection	✓	✓	Did not change between pre- and post- intervention WCA
Residual waste chutes provision	✓	✓	The number of chutes at estates did not change between pre- and post- intervention WCA
Location of free-standing communal bins	✓	✓	Did not change between pre- and post- intervention WCA
Low proportion of 15-34-year olds	✓	✓	Whilst there is a high turnover of residents at some estates, the proportion of 15-34-year olds is assumed to have remained approximately the same between pre- and post- intervention
Percentage of homeowners	✓	✓	Whilst there is a high turnover of residents at some estates, the proportion of homeowners is assumed to have remained approximately the same between pre- and post- intervention
Lift provision	✓	✓	Did not change between pre- and post- intervention WCA
Tenant Pack	X	✓	Intervention scheme
In-home solution	X	✓	Intervention scheme
Smaller bins	X	✓	Intervention scheme
Emotive signage	X	✓	Intervention scheme
Feedback	X	✓	Intervention scheme

*Table 7: Conditions included in Phase 2 QCA compared to Phase 1 alongside an explanation for including or dropping the condition.*

A key limitation of analysing only the capture rate at the post-intervention stage is that the raw capture rate data does not take into account the recycling performance of estates prior to implementation of the Flats Recycling Package and behavioural interventions. For example, some estates which had a higher capture rate prior to the project also had the highest capture rate in the post-intervention WCA (e.g. Estate B; Table 8) and some estates that had a lower capture rate pre-intervention also had a lower capture rate post-intervention (e.g. estate L; Table 8). However, this was not consistent between cases and some estates that had a higher capture rate at the pre-intervention stage had one of the lowest capture rates at the post-intervention stage, despite an overall performance improvement (e.g. estate E; Table 8).



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Estate		Pre-intervention capture rate	Post-intervention capture Rate
Estate A	46.2%	51.5%	
Estate B		65.1%	76.3%
Estate C		41.0%	48.1%
Estate D		37.3%	45.6%
Estate E		38.2%	41.7%
Estate F		37.8%	42.7%
Estate G		49.3%	43.4% <sup>2</sup>
Estate H		26.9%	52.6%
Estate I		35.1%	55.4%
Estate J		26.2%	39.3%
Estate K		40.7%	52.0%
Estate L		26.8%	31.5%

Table 8: Capture rate at each estate pre- and post-changes

Nevertheless, it was important to evaluate the factors that are present or absent in cases with the highest capture rate to understand the relative influence of conditions and assess what the most important factors are. It must be noted that the QCA applied in phase 2 therefore seeks to address the factors that are present or absent in cases observed to have a higher capture rate at that particular point in time. This approach does not seek to evaluate the full effect of the Flats Recycling Package and/or behavioural interventions since it does not consider the *change* in capture rate.

### Approach undertaken to address Objective 3:

**Objective 3:** To identify those factors/conditions that are present or absent in flats observed to have a higher *change* in capture rate (from pre- to post-intervention schemes)

Most of the conditions used for the QCA in Objectives 1 and 2 were used in the third phase to address Objective 3. The presence or absence of these conditions is still likely to have influenced the change in recycling performance of estates irrespective of the changes made during the project. Even though all estates were brought up to a Flats Recycling Package standard in terms of recycling provision, the standard of provision was variable between estates at the pre-intervention stage. WRAP and Resource London wanted to assess the impact of the Flats Recycling Package on capture rate change at estates. It

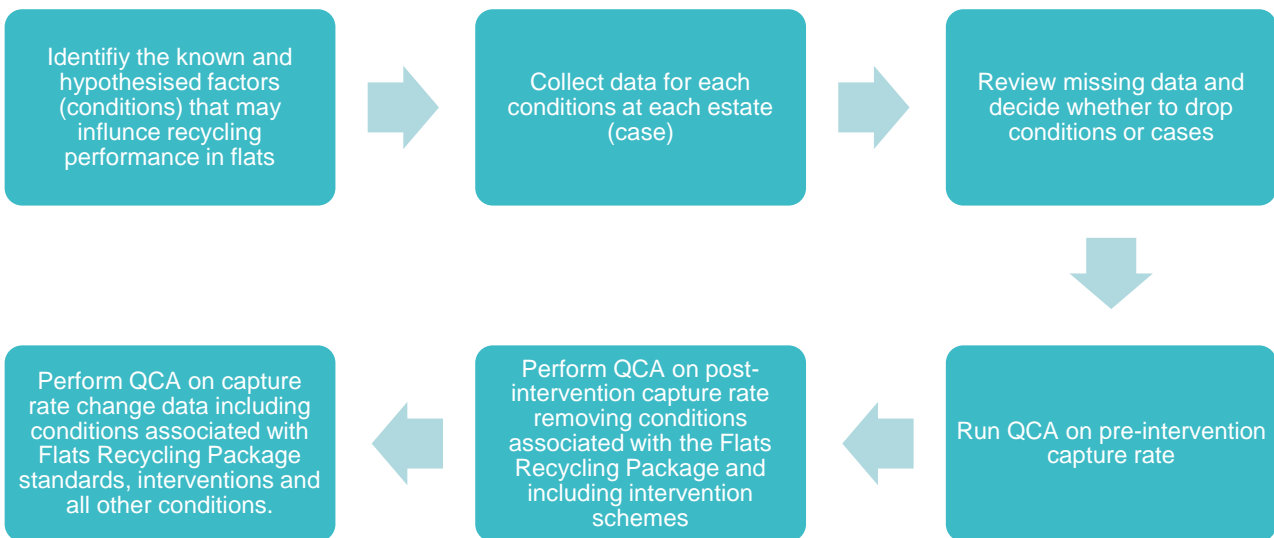
<sup>2</sup> Through the waste compositional analysis, it was observed that capture rate decreased between the pre- and post-monitoring. This report does not attempt to explain this result.

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was therefore hypothesised that if estates with the greatest capture rate change also had the poorest level of provision at the pre-intervention stage, then it could be concluded that the Flats Recycling Package were successful. The conditions associated with the Flats Recycling Package were therefore included in phase 3 QCA. Those conditions are: mixed dry recycling available volume, residual waste available volume and bin quality. In addition, the presence or absence of a particular intervention scheme was also included in the QCA for phase 3. Table 9 summarises the conditions in phase 3 QCA.

Condition	Included in Phase 2 QCA	Included in Phase 3 QCA	Explanation
<b>Mixed dry recycling available volume (above or below 60 L per hh/wk threshold)</b>	X	✓	Flats Recycling Package implemented at all estates, but mixed dry recycling available volume was variable between estates at the pre-intervention stage.
<b>Residual waste available volume</b>	X	✓	Flats Recycling Package implemented at all estates, but residual waste available volume was variable between estates at the pre-intervention stage.
<b>Quality of free-standing communal bins</b>	X	✓	Flats Recycling Package implemented at all estates, but bin quality and signage were variable between estates at the pre-intervention stage.
<b>Food waste collection</b>	✓	✓	Did not change between pre- and post-intervention WCA
<b>Residual waste chutes provision</b>	✓	✓	The number of chutes at estates did not change between pre- and post-intervention WCA
<b>Location of free-standing communal bins</b>	✓	✓	Did not change between pre- and post-intervention WCA
<b>Low proportion of 15-34-year olds</b>	✓	✓	Whilst there is a high turnover of residents at some estates, the proportion of 15-34-year olds is assumed to have remained approximately the same between pre- and post-intervention
<b>Percentage of homeowners</b>	✓	✓	Whilst there is a high turnover of residents at some estates, the proportion of homeowners is assumed to have remained approximately the same between pre- and post-intervention
<b>Lift provision</b>	✓	✓	Did not change between pre- and post- intervention WCA
<b>Tenant Pack</b>	✓	✓	Intervention scheme
<b>In-home solution</b>	✓	✓	Intervention scheme
<b>Smaller bins</b>	✓	✓	Intervention scheme
<b>Emotive signage</b>	✓	✓	Intervention scheme
<b>Feedback</b>	✓	✓	Intervention scheme

*Table 9: Conditions included in Phase 2 QCA compared to Phase 1 alongside an explanation for including or dropping the condition.*



*Figure 7: Summary flow chart of the methodological approach*

### 2.2.2 Description of conditions and their expected impact on the outcome

The raw data associated with each condition were then described as either binary, continuous, or discrete.

There are 10 binary-value conditions in the final QCA. These conditions can have one of two values such as “present” or “absent”, or the raw data is above or below a defined threshold (Table 10). For example, “food waste collection” is either “present” or “absent” in a given case.

For binary conditions, the expected impact on the outcome was described using the following format: “if the condition is present, or when the condition exceeds a pre-defined threshold, does the outcome increase or decrease?” (Table 10). For example, when lifts are present at an estate, it is expected that mixed dry recycling will increase since residents who live in high-rise buildings with lift provision would have improved access to the communal bin areas. For the condition “mixed dry recycling available volume”, when the raw data value is above the 60 L threshold, it is expected that mixed dry recycling

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performance will increase since residents should have access to more free-standing bins per week in which to put their household mixed dry recycling.

For the remaining 5 conditions, the raw data are either continuous or discrete. The raw data for “15-34-year olds” is a percentage and therefore continuous, whereas the raw data for “Quality of free-standing communal bins”, is discrete and on a 0.5 interval scale (Table 10).

For continuous and discrete data, the expected impact on the outcome was described using the following format: “if the raw data are high (relative to other cases), does the outcome increase or decrease?” (Table 10). For example, when there is a high percentage of homeowners, it is expected that the amount of mixed dry recycling will be higher since homeowners typically recycle more than other types of resident. In comparison, when there is a high percentage of 15-34-year olds (relative to other cases), the mixed dry recycling amount will be less since this age band typically recycle less than other age groups.

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Condition	Raw data description	Raw data type	Expected impact on outcome and why	Existing evidence or hypothesised impact on the outcome?
<b>Mixed dry recycling available volume (above or below 60 L threshold)</b>	Litres per household per week calculated. Case is above or below 60 L threshold	Binary	When above 60 L threshold outcome should increase. If there are enough recycling bins provided, or if the collection frequency meets the required capacity, then residents have enough capacity in which to put their recycling waste.	WRAP research from kerbside collections
<b>Residual waste available volume</b>	Litres per household per week, no thresholds identified	Continuous	When high outcome should increase. If there are enough residual waste bins provided, or if the collection frequency meets the required capacity, then residents have enough capacity in which to put their residual waste. If residual waste capacity is too low, then residents put residual waste into recycling bins, thus contaminating the load. In addition, if residual waste capacity is too low, then bins are overflowing and the bin storeroom is untidy, thus disincentivising residents to recycle.	WRAP research from kerbside collections and previous reports on flats and residual waste volume. Ethnographic research used in this project linked to capacity, untidy bin storeroom and motivation of residents to recycle
<b>Quality of free-standing communal bins (signage, working order, uniform)</b>	Cases rated from zero to 10 on a 0.5 interval scale using questions developed by the authors	Discrete	When high outcome should increase. If there is clear signage on and around bins and bins are clean and in working order, residents think recycling feels easier. Residents are more motivated to recycle and have a positive experience when they recycle. Residents also have a better knowledge of what can and cannot be recycled	WRAP research from kerbside collections
<b>Food waste collection</b>	Present/Absent	Binary	When present outcome should increase. Residents who have a food waste stream typically recycle more than those that do not. <sup>3</sup>	WRAP research
<b>Residual waste chute provision</b>	Present/Absent	Binary	When present, outcome should increase. Residents with chutes have a clear separation between recycling and residual waste disposal. Communal chutes are conveniently located and remove the need for longer trips to communal bin store rooms when disposing of residual waste.	Hypothesised

<sup>3</sup> As the focus of this project is mixed dry recyclables the food waste collected on those estates with food waste recycling provision was treated as residual and therefore does not influence the calculation of overall capture rate per estate.

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<b>Location of free-standing communal bins</b>	Inside/Outside	Binary	When free-standing communal bins are inside outcome should decrease, when outside outcome should increase. If bins are inside a communal bin storeroom residents are de-incentivised to recycle. Estates with bin store rooms had large volumes of bulky waste. From ethnographic research, residents described using the bin store room to dispose of their recycling as an unpleasant experience. Interviewees said that the bulky waste in the bin storeroom disincentivised them to recycle.	Ethnographic research conducted as part of this project
<b>Proportion of 15-34-year olds</b>	Percentage data obtained from Peabody Estates	Continuous	When high outcome should decrease. This age group typically recycle less than other age groups.	WRAP research from kerbside waste collections
<b>Homeowners at each estate</b>	Percentage data obtained from Peabody Estates	Continuous	When high outcome should increase since homeowners typically recycle more than other types of resident e.g. private rent or market rent properties	WRAP research from kerbside waste collections
<b>Lift provision</b>	Presence/Absence of lifts	Binary	When present outcome should increase. Residents who live in high-rise buildings with lift provision would have improved access to the communal bin areas.	Logical hypothesis
<b>Highly active caretaker</b>	Present/Absent	Binary	When present outcome should increase. Caretakers that recycle more than three times per week on behalf of residents.	Logical hypothesis
<b>Intervention scheme 1: In-home solution</b>	Present/Absent	Binary	When present outcome should increase. Ethnographic research conducted as part of this project indicated that recycling is difficult in flats due to lack of space.	WRAP research on EASE of recycling and Ethnographic research in this project
<b>Intervention scheme 2: Tenant pack</b>	Present/Absent	Binary	When present outcome should increase. This intervention should improve residents' knowledge about recycling.	WRAP research on KNOWLEDGE of recycling and Ethnographic research in this project
<b>Intervention scheme 3: Smaller bins</b>	Present/Absent	Binary	When present outcome should increase. Ethnographic research conducted as part of this project indicated that recycling is difficult in flats due to lack of space and that residents see recycling as a chore rather than a part of the daily routine.	WRAP research on EASE of recycling and Ethnographic research in this project
<b>Intervention scheme 4: Emotive signage</b>	Present/Absent	Binary	When present outcome should increase. This intervention should encourage more residents to recycle and improve their motivation to do so.	WRAP research on MOTIVATION to recycle and Ethnographic research in this project

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<b>Intervention scheme 5: Feedback posters</b>	Present/Absent	Binary	When present outcome should increase. This intervention should encourage more residents to recycle and improve their motivation to do so.	WRAP research on MOTIVATION to recycle and ethnographic research in this project
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*Table 10: Summary of the different conditions included in this project*

### 2.2.3 Converting raw data to a QCA score

Prior to performing QCA, raw data values were converted to a value between  $\geq 0$  and  $\leq 1$  based on the extent to which the condition is true of that case.

In this project, for binary-value conditions, if the presence of the condition is typically associated with an increase in the outcome, then the case scored 1. In contrast, when the presence of the condition is associated with a decrease in the outcome, the case scored zero. For example, estates with lifts scored 1 and estates without lifts scored zero.

Conditions with continuous and discrete data may require transforming to fuzzy scores. Unlike binary-value conditions which can only score a zero or 1, fuzzy scores can be any value between  $\geq 0$  and  $\leq 1$  and can be either continuous or multi-value.

Continuous fuzzy scores can be any value between  $\geq 0$  and  $\leq 1$  at 0.01 intervals and multi-value fuzzy scores are typically four-value (0, 0.33, 0.67, 1) or six-value (0, 0.2, 0.4, 0.6, 0.8, 1).

For conditions with continuous or discrete data, if a high raw data value is typically associated with an increase in the outcome, then the case has a fuzzy score between  $> 0.5$  and  $\leq 1$ . In contrast, if a high raw data value is associated with a decrease in the outcome, the case has a fuzzy score between  $\geq 0$  and  $> 0.5$ . In fuzzy set QCA (fsQCA), cases given a 0.5 fuzzy score are dropped from the analysis. As such, fuzzy scores of 0.5 were not used.

### 2.2.4 Assigning fuzzy scores to conditions

In order to transform conditions into fuzzy scores it is often recommended to perform a calibration so that the condition matches or conforms to external standards. For a continuous fuzzy score calibration, the researcher must specify the values of an interval-scale variable that correspond to three qualitative breakpoints that structure a fuzzy score: the threshold for full membership (fuzzy score = 0.95), the threshold for full non-membership (fuzzy score = 0.05), and the cross-over point (fuzzy score = 0.5). These three benchmarks are used to transform the original values into fuzzy membership scores, using transformations based on the log odds of full membership.

Continuous fuzzy calibrations are recommended<sup>4</sup> for datasets where:

- conditions have continuous raw data,
- conditions have clearly defined external thresholds, and
- there are many cases relative to conditions.

<sup>4</sup> Ragin, C. (2000) *Fuzzy-Set Social Science*. The University of Chicago Press, Chicago. pp 1-370.



In this research, conditions with continuous data are: residual waste available volume, chute provision, percentage 15-34-year olds, and percentage homeowners. These conditions however do not have externally derived thresholds that explain the outcome. Only the expected relative impact of each condition on the outcome is currently known. For example, if an estate has a low proportion of 15-34-year olds, it is expected that the estate will recycle more, but the population of 15-34-year olds in Peabody properties is unknown. Therefore, we are unable to conclude whether the cases in this study have a high or low percentage of 15-34-year olds compared to the population of Peabody estates. Additionally, with few cases (12 estates) and a relatively high number of conditions, it was deemed unsuitable to perform a continuous fuzzy score calibration.

Multi-value scales can be used when there are no existing standards to define thresholds for full or non-membership. Instead, researchers can use descriptive statistics of the raw data relating to each condition to define thresholds for fuzzy scores. If using the raw data from each condition to define fuzzy scores, it is important to note that the fuzzy score will show the positions of cases relative to each other but will not determine if a case meets or exceeds an external standard relative to the wider population.

### 2.2.5 Assigning a fuzzy score to the outcome

With the exception of Estate A, all other estates were considered to have poor capture rates at the pre-intervention stage when compared to “good” capture rates for kerbside collections (80% or higher). A four-value fuzzy score was therefore used to calibrate the outcome and estates were benchmarked relative to each other. It is of course possible to benchmark cases against the London or UK recycling targets however, both the volume (L) and rate of mixed dry recycling at every estate was considerably lower than external targets. Despite an overall increase in capture rates from pre- to post-intervention, the capture rates at the post-intervention stage were still considered to be poor/moderate in comparison to a “good” capture rate of 80% for kerbside collections. Therefore, if cases were categorised by comparison to kerbside collections each case would be assigned the same QCA score, rendering the analysis futile. A key limitation of positioning cases relative to each other is that the QCA seeks to explain the differentiating factors between poor and very poor performance, as opposed to explaining why estates have high capture rates when others do not.

Nevertheless, cases were positioned relative to each other using the overall capture rate from the pre- and post-intervention WCA data. At the pre-intervention stage capture rates ranged from 26.2 % to 65.1 % with a mean capture rate of 39.2 %. At the post-intervention stage, capture rates improved at every estate (except for Estate G) and capture rates ranged from 31.5 % to 76.3 % with a mean capture rate of 48.3 %. Capture rate summary statistics are provided in Table 11. Once cases were ranked relative to each other, each estate was scored using four-value fuzzy scores.

Summary Capture rate	Max	Min	Median	1st Quart	3rd Quart	IQR
pre-intervention	65.1%	26.2%	38.0%	29.0%	44.9%	29-44.9 %
post-intervention	76.3%	31.5%	46.8%	42.0%	52.5%	42-52.5 %

Table 11: Summary statistics for pre- and post-intervention capture rates across all estates

## 2.2.6 Deciding four-value fuzzy scores

In a four-value fuzzy scale, a fuzzy score of zero would correspond to non-membership, a score of 0.33 would describe a condition that is “partially out”, a score of 0.67 describes a condition that is “partially in”, and 1 describes a condition with full-membership.

Two methods were used to convert raw data to fuzzy scores:

- Position cases relative to each other using the median and interquartile range;
- Position cases using a 50 % threshold.

When using the median and interquartile range, a fuzzy score of zero would correspond to values less than the 1st quartile, a score of 0.33 would correspond to values between the 1st quartile and the median, a score of 0.67 would correspond to values between the median and the 3rd quartile, and a score of 1 would correspond to values greater than the 3rd quartile.

The median and interquartile range method was applied to conditions with discrete or continuous data. Where there is a high proportion of cases with zero values for the condition in question, this method was not applied due to the strong skew effect of zero values on the median and interquartile range, especially for a dataset of only 12 cases. For example, the percentage of homeowners can be any value from 0 % to 100 % and in this dataset, 6 out of 12 cases have 0 % homeowners.

For conditions with continuous data, and which have a high proportion of zero values, the 50 % threshold method was used to define fuzzy scores. Cases with raw values of zero were assigned a fuzzy score of zero, and cases with raw data values of 100 % were assigned a fuzzy score of 1. For 0.33 and 0.67 scores, a threshold of 50 % was used to determine whether a case is “partially out” or “partially in”. Raw data values below the 50 % threshold were “partially out” and assigned a fuzzy score of 0.33, and raw data values above the 50 % threshold were “partially in” and assigned a fuzzy score of 0.67.

Each variable and its corresponding fuzzy score, whether binary or four-value, are described in appendix A. All conditions and their corresponding binary or four-value fuzzy score were combined and used in the QCA. These are provided in Table 12 below.

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Estate	MDR available volume 60L threshold	Residual waste available volume	Food Waste	Chutes	Bin Quality	Bins inside	15-34-year olds	Home-owners	Lift provision	Caretaker	In-home solution	Tenant Pack	Smaller bins	Emotive signage	Feedback
Estate B	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0
Estate D	1	0	0	1	0.33	0	0.33	0	1	0	0	1	0	1	1
Estate J	1	0.67	1	0	0.67	1	0.33	0.67	1	1	0	1	1	1	1
Estate H	0	0	1	1	0.33	0	0.67	0	0	0	1	1	0	0	1
Estate A	0	0.33	0	0	1	1	1	0	0	0	0	0	0	0	0
Estate I	0	0.67	1	1	0.67	0	0.67	0.33	0	1	0	1	1	1	1
Estate F	1	1	0	1	0	0	0	0	0	1	1	0	0	1	0
Estate E	1	0.33	0	0	1	1	0	0.67	1	1	1	0	0	1	0
Estate G	1	1	0	1	0	0	0.33	0.33	1	0	1	1	0	0	1
Estate C	1	1	0	1	1	1	1	0.33	0	1	0	1	0	1	1
Estate L	0	0.67	0	1	0.33	1	0	0	0	1	1	0	1	0	0
Estate K	0	0.33	0	1	0.67	1	1	0	0	1	1	0	1	0	0

Table 12: All conditions and corresponding binary- value or fuzzy score

## 3.0 QCA process

This section of the report details the process undertaken for QCA including software choice and solution output.

### 3.1 Software choice

QCA can be run in one of many software packages, but when the researcher is using a dataset with fuzzy scores, an appropriate QCA software package must be used. The most common software packages that can use fuzzy scores are “fsQCA”<sup>5</sup> and “Stata”<sup>6</sup>. Whilst these software solutions offer various procedures, neither covers the full range of essential functionality. In consequence, users have often been limited in their analyses when using one software or had to switch back and forth between different programs. In recent years, researchers have switched from using Stata and/or fsQCA to the more comprehensive *QCApro*<sup>7</sup> package that is run in the statistics software, R. In this study, QCA was run in the R package *QCApro* since this software offers the full range of functionality unlike other software packages<sup>8</sup>.

### 3.2 QCA continued

Qualitative Comparative Analysis is a technique for determining which logical conclusions a dataset supports. The analysis begins by listing all the possible configurations of conditions, followed by applying the rules of logical inference to determine which descriptive inferences or implications the data supports.

#### 3.2.1 Truth table

QCA begins by listing and counting all the types of configurations which can occur taking into account whether the condition can be binary or categorical. For instance, if there were four conditions of interest, {A, B, C, D}, and A and B were binary (could take on 2 values), C could take on 3 values and D could take on 4, then there would be 48 possible types of combinations of variables, not all of which would necessarily occur in real life. QCA can determine which descriptive inferences or implications are empirically supported by a data set.

<sup>5</sup> Ragin CC, Davey S (2009) fs/QCA: fuzzy-set/qualitative comparative analysis [version 2.5]. Department of Sociology. University of Arizona, Tucson

<sup>6</sup> Longest KC, Vaisey S (2008) fuzzy: a program for performing qualitative comparative analyses (QCA) in Stata. *Stata J* 8(1):79–104

<sup>7</sup> Thiem, A. (2018) Advanced Functionality for Performing and Evaluating Qualitative Comparative Analysis. R Package Version 1.1-2. URL: <http://www.alrik-thiem.net/software/>

<sup>8</sup> Thiem, A and Adrian, D. (2013) “QCA: A package for Qualitative Comparative Analysis.” *The R Journal* 5 (1):87-97. URL: <https://journal.r-project.org/archive/2013-1/thiem-dusa.pdf>

The first step of QCA is the truth table which is a data matrix that contains all values of the conditions and the outcome (Table 13). Conditions with fuzzy scores of 0.33 are converted to zero and conditions which scored 0.67 are converted to 1. The truth table shows all theoretically possible configurations and their observed presence in cases. It is not important how often a certain configuration is found. Configurations are then scored from zero to 1 on how sufficient they are for the outcome. The cases that are not sufficient for, or slightly sufficient for the outcome can be also used in the QCA for counterfactual arguments when using the Parsimonious Solution output.

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inhome	tenantpack	smallerbins	emotivesign	feedback	binquality	resavvolume	MDRavvolume60L	Outcome Value	N	Cases
0	0	0	0	0	0	0	1	1	1	Estate B
0	1	0	1	1	0	0	1	1	1	Estate D
0	1	1	1	1	1	1	0	1	1	Estate I
0	1	1	1	1	1	1	1	1	1	Estate J
1	1	0	0	1	0	0	0	1	1	Estate H
1	0	1	0	0	1	1	0	0	1	Estate K
0	0	0	0	0	1	0	0	0	1	Ebury
0	1	0	1	1	1	1	1	0	1	Estate C
1	0	0	1	0	0	1	1	0	1	Estate F
1	0	1	0	0	0	1	0	0	1	Estate L
1	0	0	1	0	1	0	1	0	1	Estate E
1	1	0	0	1	0	0	1	0	1	Estate G

*Table 13: Example truth table. The table includes a preliminary assessment<sup>910</sup> of whether the presence or absence of the conditions for a case are related to the outcome. In this example the truth table shows which configurations are observed in cases with a higher capture rate (scored 1) and those cases that have a lower capture rate are scored zero. The column “N” refers to the number of cases with that configuration and the case is also listed.*

<sup>9</sup> Thiem, A and Adrian, D. (2013). “QCA: A package for Qualitative Comparative Analysis.” The R Journal 5 (1):87-97. URL: <https://journal.r-project.org/archive/2013-1/thiem-dusa.pdf>

<sup>10</sup> Ragin, C. C. (2006). Set relations in social research: Evaluating their consistency and coverage. Political Analysis, 14, 291–310.

### 3.2.2 Combinations, necessary and sufficient

In QCA's next step, inferential logic or Boolean algebra is used to simplify configurations to the minimum set of inferences supported by the data. For instance, if the presence of conditions A and B is always associated with the presence of any value of D, regardless of the observed value of C, then the value that C takes is irrelevant. Thus, all possible inferences involving A and B and any of the possible values of C may be replaced by the single descriptive inference, "(A and B) implies the particular value of D".

The central function of the QCA package that performs the minimisation is 'eqmcc' (enhanced Quine-McCluskey)<sup>1112</sup>. The researcher can specify one of three solution outputs: The Complex Solution, The Intermediate Solution and The Parsimonious Solution to determine which conditions explain the outcome. In this study the Parsimonious Solution was used since it is a calculation that finds the simplest logical explanation(s) of the outcome. The Parsimonious Solution also uses all possible configurations in the truth table, irrespective of whether a configuration is populated by a case. This enables the researcher to engage in counterfactual thinking e.g. if certain condition(s) are not present in a configuration whether the outcome would still be true.

Combinations of conditions can be described as necessary or sufficient. A condition is defined as necessary if it must be present for an outcome to occur. A condition is defined as sufficient if by itself it can produce a certain outcome. The sufficiency score states the degree to which the configuration or combination of conditions is sufficient for the outcome<sup>13</sup>. Coverage measures how much of the outcome is covered (or explained) by each solution term and by the solution as a whole<sup>10</sup>. Even combinations that only slightly explain the outcome are included in the output. This is advantageous to the researcher since combinations that occur frequently may not necessarily make sense in real life and the unique configuration of a case could be due to chance. Combinations with a slightly lower inclusion score may make sense when applied to the real world. The specific cases relating to each combination are also listed but it is down to the researcher to interpret the output using established knowledge.

Combinations are described alongside sufficiency and coverage scores. Conditions that are CAPITALISED are present and conditions that are lowercase are absent. Conditions joined by an asterisk\* mean that the conditions are combined. For example, MDRAVVOLUME60L\*BINQUALITY, would mean: MDR available volume combined with bin quality score. The cases that each combination applies to are also noted.

<sup>11</sup> A. Dusa. Enhancing Quine-McCluskey (2007). WP 2007-49, COMPASSS, 2007. pp 92

<sup>12</sup> A. Dusa (2007). A mathematical approach to the Boolean minimization problem. *Quality & Quantity*, 44(1): 99–113.

<sup>13</sup> Ragin, C (2008). User's guide to Fuzzy-Set/Qualitative Comparative Analysis. Department of Sociology University of Arizona. URL: <http://www.u.arizona.edu/~cragin/fsQCA/download/fsQCAManual.pdf>

## 4.0 Results

### 4.1 Objective 1

To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (pre-intervention schemes).

The Parsimonious Solution output appears complex, however, conditions associated with Flats Recycling Package are usually capitalised (present) as are HOMEOWNERS, LOWPROP15TO34, LIFTS. Chutes are typically lower case (absent) as is foodwaste. Each of the above conditions in isolation pass the common-sense test in that each was hypothesised to be associated with higher capture rates (Table 10: Summary of the different conditions included in this project). For example, a lower proportion of 15-34-year olds is positively associated with higher capture rates which is supported by WRAP's segmentation and Recycling Tracker research.

However, these conditions do not come out in isolation and are always in combination with another factor. The coverage scores indicate that there are also case exceptions for each of the combinations of conditions presented.

**Supersubset** output – when the conditions are simplified into pairs or threes the key combinations are:

- BINQUALITY+MDRAVVOLUME – 0.6 coverage
- foodwaste+HOMEOWNERS - 0.6 coverage
- HOMEOWNERS+BINQUALITY+RESAVVOLUME – 0.64 coverage
- LOWPROP15TO34+HOMEOWNERS+RESAVVOLUME – 0.62 coverage
- chutes+BINQUALITY+RESAVVOLUME - 0.62 coverage

As shown by the coverage scores there are exceptions for each of the combinations above. Individually, there are four cases which seem inconsistent with each combination (five cases for the fourth combination). There are only two cases; Estate J and Estate F where none of these explanations seem to fit. Given these logical inconsistencies there may be additional conditions that are contributing to the presence of higher capture rates pre-intervention. Some differences may be explained by conditions not included in the study as they did not fulfil the fundamental criteria for inclusion in the analysis (section 2.3.1). Further work is required to understand these conditions, which could include additional societal barriers such as affluence, resident attitudes and beliefs around recycling, influence of a resident's association, or external factors that can be theorised to drive waste and recycling performance (section 2.0).



## Qualitative Comparative Analysis of Recycling Performance

The results demonstrate the importance of better-quality waste and recycling provision although there are also other societal factors that explain variations in capture rates e.g. the presence/absence of resident profile such as the level of home ownership and the profile age of residents.

### 4.2 Objective 2

To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (post-intervention schemes).

The authors considered conducting QCA with an outcome variable which ranks relative performance, rather than achievement of a particular milestone in recycling or capture rate performance. However, the authors felt that this would present a risk in that it would reduce the external validity of the analysis. In practice, a ranked outcome variable would help to understand the configurations of conditions necessary and/or sufficient to achieve a capture rate of over 46%. Whilst grounded in analysis of the current performance data, this figure is somewhat arbitrary when viewed from the perspective of external validity. Therefore, this was reviewed prior to finalising the analysis. The authors took the methodological decision to adjust the outcome definition to explain capture rates of 50% or greater as it is thought to be a more logical threshold when stakeholders ask what can be concluded from the analysis. Results presented here are expressed as either above 50% (score of 1) or below 50% (score of zero) capture rate.

#### Parsimonious Solution

##### Run 1 – Objective 2

Combination	Sufficiency	Coverage	Cases
bininside*FOODWASTE	1	0.400	Estate H, Estate I
bininside*LOWPROP15-34	0.670	0.268	Estate H, Estate I
caretaker*BININSIDE	1	0.400	Ebury, Estate B
caretaker*CHUTES	1	0.400	Ebury, Estate B
ChutesLOWPROP15-34	0.802	0.534	Estate H, Ebury, Estate B
FOODWASTE*CHUTES	1	0.400	Estate H, Estate I
FOODWASTE*homeowners	0.835	0.334	Estate H, Estate I
FOODWASTE*lifts	1	0.400	Estate H, Estate I
FOODWASTE*LOWPROP15-34	0.802	0.268	Estate H, Estate I

*Table 14: Parsimonious Solution output for Run 1 Objective 2: To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (post-intervention schemes). Capture rate was categorised as above or below 50%. Chutes were categorised as zero or 1 and all conditions were included except for the behavioural interventions.*

## Qualitative Comparative Analysis of Recycling Performance

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The presence of food waste recycling facilities appears to be a contributing factor to higher capture rates when in combination with either “LOWPROP15-34”, “CHUTES” or in the absence of “lifts” or “homeowners”. However, the presence of a food waste recycling facility in itself is not sufficient for higher capture rates as one estate where this is present without the other associated conditions listed above is not included within the coverage. Also, it is likely that the presence of the Flats Recycling Package also bolstered this increase in recycling. This suggests that the lower capture rates overall in the pre-intervention monitoring were more likely to be associated with other issues in meeting the Flats Recycling Package. Once corrected by introducing the Flats Recycling Package, you see that the presence of food waste and chutes have the expected impact on capture rate.

The absence of a caretaker is another factor drawn out by the analysis as having high capture rates, which is not what one would have hypothesised. However, this condition was only present at Estate A and Estate B so it is possible that perhaps this was caused by something specific at these cases. The absence of a caretaker is not sufficient in itself. However, when in conjunction with inside bins and chutes it is sufficient. Furthermore, two of the estates included here are the comparison estates which were already performing well in the pre-monitoring.

The analysis also shows that a low proportion of 15-34-year olds is associated with a higher capture rate, as previous research supports, but this condition is not sufficient in itself as it is presented alongside either the absence of “binsinside” or “caretaker” or the presence of food waste collections. This is in contradiction to the pre-intervention results, where the absence of a food waste collection was associated with higher capture rates. Although, this discrepancy could be due to wider issues with waste and recycling services prior to the changes on the estates or with food waste collections. For example, two of the three estates with food waste collections also had mixed dry recycling available volume lower than 60L per household per week.

As with objective one, the results show low coverage for all of the solutions presented in the results. There are estates that provide exceptions for each of the combinations above. Given these logical inconsistencies there may be additional conditions that are contributing to the presence of higher capture rates pre-intervention. Some differences may be explained by conditions not included in the study. Again, further work is required to understand these conditions which could include additional societal or physical barriers as theorised to drive waste and recycling performance (section 2.0).

## Qualitative Comparative Analysis of Recycling Performance

### Run 2 – Objective 2

Combination	Sufficiency	Coverage	Cases
caretaker*HOMEOWNERS	1	0.222	Estate B
emotivesign*HOMEOWNERS	1	0.222	Estate B
FEEDBACK*lifts	0.890	0.445	Estate C, Estate I, Estate H
FEEDBACK*LOWPROP15-34	0.802	0.445	Estate C, Estate I, Estate H
LOWPROP15-34*HOMEOWNERS	0.858	0.332	Estate B
LOWPROP15-34*LIFTS	0.834	0.277	Estate B
TENANTPACK *lifts	0.890	0.445	Estate C, Estate I, Estate H
TENANTPACK*LOWPROP15-34	0.802	0.445	Estate C, Estate I, Estate H
caretaker*BININSIDE*LIFTS	1	0.167	Estate B
caretaker*chutes*LIFTS	1	0.167	Estate B
emotivesign*BININSIDE*LIFTS	1	0.167	Estate B
emotivesign*chutes*LIFTS	1	0.167	Estate B
emotivesign*feedback*LIFTS	1	0.167	Estate B
feedback*caretaker*LIFTS	1	0.167	Estate B
inhome*emotivesign*LIFTS	1	0.167	Estate B
inhome*feedback*HOMEOWNERS	1	0.167	Estate B
inhome*feedback*LIFTS	1	0.167	Estate B
inhome*foodwaste*HOMEOWNERS	1	0.222	Estate B
inhome*smallerbin*HOMEOWNERS	1	0.222	Estate B
inhome*tenantpack*HOMEOWNERS	1	0.167	Estate B
inhome*tenantpack*LIFTS	1	0.167	Estate B
tenantpack*caretaker*LIFTS	1	0.167	Estate B
tenantpack*emotivesign*LIFTS	1	0.167	Estate B
inhome*BININSIDE*foodwaste*LIFTS	1	0.167	Estate B
inhome*foodwaste*chutes*LIFTS	1	0.167	Estate B
inhome*smallerbins*BININSIDE*LIFTS	1	0.167	Estate B
inhome*smallerbins*chutes*LIFTS	1	0.167	Estate B

*Table 15: Parsimonious Solution output for Run 2 Objective 2: To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (post-intervention schemes). In this QCA run, capture rate is ranked and the behavioural interventions were included.*

In reference to the outputs for Estate B, the result is essentially a description of the conditions. During the pre-intervention phase Estate B was the estate with the highest recycling performance and its pre-intervention performance was higher than the post-intervention performance of all of the other 11 estates. The challenge here is that the analysis is looking for a causal explanation for performance that was already high in the pre-project monitoring. Objective three explores this by including pre-intervention capture rate as a condition in the analysis.

The results demonstrate that Estate B is likely to be an outlier. This suggests that there is/are further condition(s) influencing the capture rate at Estate B for which this project has been unable to include in this analysis as they did not fulfil the fundamental criteria (2.3.1).

## Qualitative Comparative Analysis of Recycling Performance

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**Supersubset** output – when the conditions are simplified into pairs or threes the key combinations are:

- foodwaste (Coverage 0.63)
- LOWPROP15TO34 + smallerbins (Coverage 0.60)
- LOWPROP15TO34 + LIFTS (Coverage 0.61)
- LOWPROP15TO34 + HOMEOWNERS + caretakers (Coverage 0.63)
- LOWPROP15TO34 + HOMEOWNERS + emotivesign (Coverage 0.61)
- BININSIDE + HOMEOWNERS + LIFTS (Coverage 0.61)

The results demonstrate the importance of societal and residential profiles on higher capture rates, namely LOWPROP15TO34 & HOMEOWNERS. These conditions are never presented in isolation and are therefore not sufficient. HOMEOWNER is in conjunction with the presence of LOWPROP15-34, LIFTS, BININSIDE or the absence of caretakers, emotivesign. LOWPROP15TO34 is in conjunction with LIFTS, HOMEOWNERS or the absence of emotivesign, smallerbins.

Food waste appears to be sufficient for a higher capture rate in isolation from other conditions. However, the presence of a food waste recycling facility in itself is unlikely to be sufficient. The presence of the Flats Recycling Package also bolstered this increase in recycling. It is likely that once the Flats Recycling Package was implemented on estates the presence of food waste collections enhanced the impact on mixed dry recycling performance.

As with objective one the results show low coverage for all of the solutions presented in the results. There are estates that provide exceptions for each of the combinations above. Given these logical inconsistencies, there may be additional conditions that are contributing to the presence of higher capture rates pre-intervention. Some differences may be explained by conditions not included in the study. This suggests that resident profile characteristics are likely to be a significant factor in explaining higher performing estates post Flats Recycling Package implementation and intervention role out. Again, further work is required to understand these conditions which could include additional societal or physical barriers as theorised to drive waste and recycling performance (section 2.0).

This analysis found that none of the behavioural interventions are associated with higher capture rates.

## 4.3 Objective 3

To identify those factors/conditions that are present or absent in flats observed to have a higher *change* in capture rate (from pre to post intervention schemes).

### Parsimonious Solution

If we change the condition ‘chutes’ from a binary 1 or 0 to a ranked fuzzy version the analysis requires more computational memory due to the length of the solution output. The analysis has therefore drawn on the binary version of the condition.

#### Run 3 - Objective 3

Combination	Sufficiency	Coverage	Cases
inhome + LIFTS	0.78	0.390	Estate B, Estate D, Estate J
CHUTES + LOWPROP15-34 + mdravvolume60I	0.85	0.335	Estate I, Estate K, Estate H

*Table 16: Parsimonious Solution output for Run 3 Objective 3: To identify those factors/conditions that are present or absent in flats observed to have a higher change in capture rate (from pre- to post-intervention schemes). The analysis uses capture rate change, all conditions and chutes are categorised as 1 and zero.*

The analysis suggests that the presence of LIFTS or the absence of inhome is sufficient for capture rate change. This presents a logical inconsistency given that it was hypothesised that the inhome solution would lead to higher capture rates, as it was designed to overcome the storage barriers within flats. In part this result is likely to be driven by the inclusion of Estate B and the uplifts from the Flats Recycling Package. Also, this could be coincidental for the other cases where they happened to have lifts and weren't cases where the in-home intervention was implemented.

The second solution, the presence of CHUTES and LOWPROP15-35 with the absence of mdravvolume60L, pre-intervention indicates that recycling service provision, societal factors and an estate's physical structure are important conditions for increased capture rate. The poor recycling provision pre-intervention suggests that the Flats Recycling Package is a sufficient intervention to increase capture rate on estates with a low proportion of 15-34-year olds.

Again, the analysis found that none of the behavioural interventions are associated with higher capture rates. This suggests that the Flats Recycling Package is driving the increase in recycling performance and that this is having a larger effect on capture rate change than the behavioural interventions layered on top.

## Qualitative Comparative Analysis of Recycling Performance

With both solutions presented, the coverage scores are low and as such there are exceptions for each of the combinations above. Given these logical inconsistencies there may be additional conditions contributing to the presence of higher capture rate change.

### Run 4 – Objective 3

Combination	Sufficiency	Coverage	Cases
FEEDBACK*mdravvolume60l	1	0.333	Estate I, Estate H
inhome*binquality	1	0.388	Estate B, Estate D
inhome*SMALLERBINS	0.835	0.278	Estate I, Estate J
SMALLERBINS*EMOTIVESIGN	0.835	0.278	Estate I, Estate J
SMALLERBINS*FEEDBACK	0.835	0.278	Estate I, Estate J
SMALLERBINS*MDRAVVOLUME60L	0.670	0.112	Estate J
TENANTPACK*mdravvolume60l	1	0.333	Estate I, Estate H
TENANTPACK*SMALLERBINS	0.835	0.278	Estate I, Estate J
Binquality*resavvolume*mdravvolume60l	0.752	0.167	Estate H
inhome*resavvolume*MDRAVVOLUME60L	0.858	0.333	Estate B, Estate D
INHOMEResavvolume*mdravvolume60l	0.801	0.222	Estate H
INHOMESmallerbins*mdravvolume60l	1	0.167	Estate H
Smallerbins*binquality*mdravvolume60l	1	0.112	Estate H

*Table 17: Parsimonious Solution output for objective three - To identify those factors/conditions that are present or absent in flats observed to have a higher change in capture rate (from pre- to post-intervention schemes). This run includes capture rate change and only conditions associated with behavioural interventions and Flats Recycling Package. There were no conditions associated with the resident or flat profile.*

Overall, estates with low bin quality, mixed dry recycling available volume below 60L/hh/wk and low residual waste available volume at the pre-intervention stage, had a high capture rate change. Estates which did have a higher capture rate change did also have a particular intervention within the QCA output solutions; however, for the behavioural interventions the QCA solutions seem descriptive of the estate pairings. Furthermore, given that the performance of the comparison estates was already high, allowing less 'room' for improvement, we are unable to conclude that the behavioural interventions are sufficient for the observed change.

Consistently those that had lower quality waste and recycling services to begin with experienced higher changes in capture rate, therefore the estates that had poorer service quality in the pre-monitoring experienced greater increases in capture rate, indicating that the Flats Recycling Package was associated with the observed improvements. The QCA outputs suggest that the individual impacts of the different behavioural interventions are too small in comparison to the impact of the Flats Recycling Package or there's too much other noise/variation to understand which behavioural interventions beyond the Flats Recycling Package are the most effective, either in general or in particular circumstances.

## Qualitative Comparative Analysis of Recycling Performance

### Run 5 - Objective 3

Combination	Sufficiency	Coverage	Cases
FEEDBACK*mdravvolume60l	1	0.333	Estate I, Estate H
Inhome*binquality	1	0.388	Estate B, Estate D
Inhome*lowprop15-34	1	0.278	Estate D, Estate J
INHOME* <b>LOWPROP15-34</b>	0.670	0.223	Estate K, Estate H
Inhome*SMALLERBINS	0.835	0.278	Estate J, Estate I
<b>LOWPROP15-34</b> *binquality	0.901	0.498	Estate B, Estate H
SMALLERBINS*BINQUALITY	0.859	0.335	Estate J, Estate I, Estate K
SMALLERBINS*EMOTIVESIGN	0.835	0.278	Estate J, Estate I
SMALLERBINS*FEEDBACK	0.835	0.278	Estate J, Estate I
SMALLERBINS* <b>LOWPROP15-34</b>	0.835	0.278	Estate I, Estate K
TENANTPACK*mdravvolume60l	1	0.333	Estate I, Estate H
TENANTPACK*SMALLERBINS	0.835	0.278	Estate J, Estate I
Binquality*resavvolume*mdravvolume60l	0.752	0.167	Estate H
BINQUALITY*RESAVVOLUME*mdravvolume60l	0.835	0.278	Estate I, Estate K
EMOTIVESIGN*binquality*resavvolume	1	0.167	Estate D
EMOTIVESIGN*FEEDBACK*binquality	1	0.222	Estate D
Emotive*FEEDBACK* <b>LOWPROP15-34</b>	0.670	0.112	Estate H
EMOTIVESIGN*FEEDBACK*lowprop15-34	1	0.278	Estate D, Estate J
EMOTIVESIGN*FEEDBACK*resavvolume	0.752	0.167	Estate D
FEEDBACK* <b>LOWPROP15-34</b> *resavvolume	0.801	0.222	Estate H
Inhome*EMOTIVESIGN*resavvolume	0.752	0.167	Estate D
Inhome*FEEDBACK*resavvolume	0.752	0.167	Estate D
Inhome*resavvolume*MDRAVVOLUME60L	0.858	0.333	Estate B, Estate D
INHOME*resavvolume*mdravvolume60l	0.801	0.222	Estate H
INHOME*smallerbins*mdravvolume60l	1	0.167	Estate H
Inhome*TENANTPACK*resavvolume	0.752	0.167	Estate D
<b>LOWPROP15-34</b> *RESAVVOLUME*mdravvolume60l	1	0.278	Estate I, Estate K
Smallerbins*binquality*mdravvolume60l	1	0.112	Estate H
TENANTPACK*EMOTIVESIGN*binquality	1	0.222	Estate D
TENANTPACK*emotivesign* <b>LOWPROP15-34</b>	0.670	0.112	Estate H
TENANTPACK*EMOTIVESIGN*lowprop15-34	1	0.278	Estate D, Estate J
TENANTPACK*EMOTIVESIGN*resavvolume	0.752	0.167	Estate D
TENANTPACK* <b>LOWPROP15-34</b> *resavvolume	0.801	0.222	Estate H

*Table 18: Parsimonious Solution output for Run 5 Objective 3: To identify those factors/conditions that are present or absent in flats observed to have a higher change in capture rate (from pre- to post-intervention schemes). In this run of the QCA the capture rate change and conditions associated with the Flats Recycling Package, the behavioural interventions and lowprop15-34 were included.*

### Supersubset analysis

When the conditions are simplified into pairs or threes the key combinations are:

- EMOTIVESIGN + resavvolume (Coverage 0.62)
- Lifts + inhome (Coverage 0.60)
- bininside + HOMEOWNERS + resavvolume (Coverage 0.64)
- bininside + LOWPROP15to34 + FEEDBACK (Coversge 0.60)
- binsinside + LOWPROP15to34 + TENANTPACK (Coverage 0.60)
- bininside + LOWPROP15to34 + INHOME(Coverage 0.60)
- bininside + FOODWASTE + LOWPROP15-34 (Coversge 0.60)
- FOODWASTE + inhome + EMOTIVESIGN + BINQUALITY (Coverage 0.60)
- FOODWASTE + chutes + EMOTIVESIGN + BINQUALITY (Coverage 0.6)

Again, the influence of LOWPROP15TO34 is evident, indicating that higher proportions of 15-34-year olds is likely to be a barrier to achieving higher capture rates. Increases in capture rate were observed on all but one estate and so it is possible to increase capture rate indicating that the Flats Recycling Package is important for improving capture rates. However, the supersubset analysis results indicate that higher proportions of 15-34-year olds are a limiting factor. As with objective one and two, the results show low coverage for all of the solutions presented in the results. There are estates that provide exceptions for each of the combinations above. Given these logical inconsistencies, there may be additional conditions that are contributing to the presence of higher capture rates pre intervention. Some differences may be explained by conditions not included in the study. Again, further work is required to understand these conditions which could include additional societal or physical barriers, as theorised, to drive waste and recycling performance (section 2.0).



## 5.0 Key findings

The QCA results provide a number of key findings that go some way to explaining the pre-intervention capture rates as well the observed changes in capture rate post intervention.

### 5.1 Conditions that may explain recycling performance

#### 5.1.1 pre-intervention performance

Objective: To identify those factors/conditions that are present or absent in flats observed to have a higher capture rate (pre-intervention schemes).

The presence of conditions associated with service provision (BINQUALITY, MDRAVVOLUME, RESAVVOLUME) as well as societal factors (LOWPROP15TO34+HOMEOWNERS) are positively associated with higher capture rates relative to the other estates in the study. Each of the above conditions in isolation pass the common-sense test in that each was hypothesised to be associated with higher capture rates. For example, a lower proportion of 15-34-year olds is positively associated with higher capture rates which is supported by WRAP's Recycling Tracker research. Although none of the above are necessary and sufficient in isolation as they are always present in conjunction with other conditions.

MDRAVVOLUME + BINQUALITY appears in the QCA outputs without other contextual factors, suggesting that the service provision is advantageous and having good bin quality and/or available mixed dry recycling volume contributes to higher capture rates. However, there are four of the twelve cases where this isn't the case. They aren't in the top half of the capture rates despite having the MDRAVVOLUME and/or BINQUALITY.

Estates where each household has a minimum of 60 L mixed dry recycling available volume per week, combined with a high bin quality score (relative to the other cases in the analysis), have a comparatively higher capture rate prior to implementation of the Flats Recycling Package. This justifies the Flats Recycling Package that was implemented after the first phase of waste tonnage and WCA.

It is important to note that an external threshold was not defined for bin quality scores and estates were benchmarked relative to each other. Therefore, QCA cannot detect the optimum bin quality score that is necessary to increase recycling performance, nor can these results be viewed in the context of the wider population e.g. London or UK flats. Nevertheless, cases with better bin quality and MDR available volume above 60 L/hh/wk had higher capture rates than those with poorer bin quality and less than 60 L/hh/wk MDR available volume.

### 5.1.2 Flats Recycling Package provision

During the roll out of the Flats Recycling Package phase, every estate was provided with a minimum of 60 L/hh/wk available MDR volume and the quality of both residual waste and MDR free-standing bins was improved. Improvements included: providing clean bins that are not damaged or broken, making free-standing bins uniform in style and colour for each waste stream, and putting clear signage that indicates the relevant waste stream on every bin.

Overall, estates with low bin quality, mdravvolume below 60L and lowresavvolume from the pre-intervention, plus either the presence or absence of an intervention, had a high capture rate change. Consistently those that had poorer waste and recycling facilities to begin with experienced higher changes in capture rate. Therefore, the estates that had poorer waste and recycling facilities in the pre-monitoring experienced greater increases in capture rate, indicating that the Flats Recycling Package were a key driver of the observed increases in recycling performance.

### 5.1.3 Limiting factors

The results demonstrate the importance of societal and residential profiles on higher capture rate and capture rate changes. For example, LOWPROP15T034 and HOMEOWNERS are shown to be associated with higher capture rates indicating that higher proportions of 15-34-year olds is likely to be a barrier to achieving higher capture rates. Increases in capture rate were observed on all but one estate indicating that the Flats Recycling Package is a key driver for improving capture rate. However, results indicate that higher proportions of 15-34-year olds are a limiting factor.

HOMEOWNER is in conjunction with the presence of LOWPROP15-34, LIFTS, BININSIDE or the absence of caretakers, emotivesign. LOWPROP15-34 is in conjunction with LIFTS, HOMEOWNERS or the absence of emotivesign, smallerbins. However, there are also estates that provide exceptions for each of the combinations suggesting that there may be additional conditions that are contributing to the presence of higher capture rates. Some differences may be explained by conditions not included in the study. Further work is required to understand these conditions, which could include additional societal barriers such as affluence, resident attitudes and beliefs around recycling, influence of a resident's association, or external factors that can be theorised to drive waste and recycling performance (section 2.0).

Estate B is an important anomaly to note as the results of the QCA are essentially a description of the conditions. In the case of Estate B the analysis is looking for a causal explanation for a performance that was higher than the other cases during the pre-intervention stage. However, for Estate B, its pre-intervention capture rate was higher than the post intervention capture rates of all of other cases. This demonstrates that Estate B is likely to be an outlier, suggesting that there is/are further condition(s) influencing the capture rate for which this project has been unable to include in this analysis, as they did not fulfil the fundamental criteria (2.3.1). Further work is required to understand these conditions;

which could include additional societal or physical barriers as theorised, to drive waste and recycling performance (section 2.0).

#### 5.1.4 Behavioural interventions

This analysis found that there is little evidence that the behavioural interventions are associated with capture rate change. The analysis for capture rate change indicates that poorer waste and recycling facilities are always in combination with one of the behavioural interventions, however the particular intervention/combination of behavioural interventions are not consistent enough for us to conclude that any particular intervention(s) impact the outcome. The QCA indicates that the Flats Recycling Package had a bigger impact than the behavioural interventions. There will likely be circumstances in which particular behavioural interventions do and don't work well, however that the results of the QCA are inconclusive for behavioural interventions. This is likely because there are too many behavioural interventions or combinations of behavioural interventions, large variation in the estate, and large variations in resident profile characteristics to get a clear picture from a small number of cases.

This is re-enforced when we take into consideration the fact that the comparison estates, that had a presence of the conditions associated with the Flats Recycling Package, were achieving higher capture rates pre-intervention and therefore had less 'room' for improvement.

## 6.0 Limitation

A key limitation of QCA is that it is case-study oriented. Therefore, the results from this research are unique to the estates used in the analysis. As a result, it is not possible to recommend a threshold for a particular condition that would increase recycling performance at an estate outside of this project. It is also not possible to place a level of confidence or percentage likelihood that if a condition or combination of conditions were actioned at an estate, recycling performance would increase, or indeed by how much. This is because each case is seen as an entire unique population, rather than a representative sample of a greater whole. The 12 cases instead provide a rich evidence base for Local Authorities and landlords to translate actionable “causes” of poor recycling performance to other comparable estates.

There are several other limitations of the QCA approach adopted in this research:

- a) In this project the analysis is conducted on a small number of estates that will not be perfectly representative of the population as a whole (e.g. all flats estates in London or the UK)
- b) The comparison estates were higher performing during the pre-intervention stage and in the case of Estate B, its pre intervention capture rate was higher than the post-intervention capture rates for each of the other cases. This does not pose a problem in a QCA; however, Estate B clearly shows that there may be additional conditions that go beyond what would be expected based on the conditions included in this QCA. These additional conditions could be contributing to the presence of higher capture rates. Some differences may be explained by conditions that did not meet the fundamental criteria and were not included in the study (section 2.3.1). The analysis is not designed to provide statistical results, rather it is to explore what factors or combinations thereof are necessary and/or sufficient to generate higher capture rates.

It will not be possible to scale up the findings in a statistically robust way. For example, if we spend X in total across London’s flats then the recycling rate will increase by Y. Similarly, it is not possible to recommend a threshold for a condition that is necessary for the outcome. For example, if the proportion of 15-34-year olds is X, then recycling will increase by Y.

- c) In many cases it has not been possible to bench mark the outcomes or conditions against the wider population and as such many conditions are ranked relative to each other. This presents a weakness in the analysis since it is not possible to extrapolate the finding to a wider population. The reader is directed to appendix 1 where the calibration thresholds are defined.
- d) The number of behavioural interventions or combinations of behavioural interventions, large variation in the estate and resident profile characteristics, and small number of cases mean that it has not been possible to get clear insights into the impact of individual behavioural interventions.
- e) There has been a limit to how far it has been possible to take the analysis within the time available within the project. There were issues with the quality of data provided for inclusion in the QCA and as such we were required to re-run the full range of analysis which meant that it has not been possible to conduct any additional analysis. Recommendations for further analysis

that may help explain the conditions driving capture rates and capture rate change are outlined in section 8.0.

## 7.0 Conclusion

We are able to draw a number of conclusions about presence or absence of conditions that go some way to explaining the pre-intervention capture rates as well as the observed changes in capture rate post-intervention.

The results from QCA highlight the key conditions that, when present or absent, lead to higher recycling performance at an estate. The choice of methodology is justified as conditions are always combined and so a single condition in isolation does not explain the outcome for any of the research objectives. Many combinations also include conditions that cannot be actioned by Local Authorities or Landlords. For example, it would not be cost effective to retro-fit additional residual waste chutes in buildings in order to achieve a higher recycling performance.

Nevertheless, there are several combinations in the QCA output that are sufficient for the outcome and that could be actioned by Local Authorities and Landlords such as improving bin quality and increasing mixed dry recycling available volume.

In this research, QCA has proved useful for understanding the pre-existing factors that affected flats recycling performance, by identifying conditions that are present or absent in estates observed to have a relatively higher amount of recycling.

This research has also provided insight for understanding the conditions present or absent post-intervention that affected the observed increase in capture rate. The estates in which the greatest capture rate change was observed were absent of conditions relating to service provision e.g. bin quality and capacity of residual and mixed dry recycling facilities. This demonstrates the importance of the introduction of the Flats Recycling Package for improving recycling performance of flats. When analysing the conditions for capture rate change, the low minimum standards are found in combination with one or more of the behavioural interventions, however the combination of behavioural interventions is not consistent and so we are unable to attribute impact on the outcome to the behavioural interventions.

The results indicate that it is possible to make it easier for residents of flats to recycle, by introducing the project's Flats Recycling Package. However, a limiting factor to higher capture rates and capture rate change, is the proportion of 15-34-year olds. Therefore, the research suggests that designing behaviour change interventions targeted towards 15-34-year olds, when combined with the roll out of the Flats Recycling Package, it may be possible achieve higher levels of recycling performance from flats. To achieve this, it will be important to identify which combination of conditions/interventions might trigger action among this age group.

In terms of practical steps Local Authorities or Landlords might take to enhance the performance of flats' recycling, there are a number of actions related to service provision that they could take. It is

## Qualitative Comparative Analysis of Recycling Performance

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important to note that none of the suggestions will be sufficient in isolation and therefore combining these will be necessary to achieve increased recycling performance. Actions may include:

- On a limited budget, improve bin signage for MDR and residual waste bins
- Increase MDR capacity above 60L per hh/wk,
- Make sure all bins, whether MDR or residual waste, are in working order and with clear signage (bin quality)
- Comparatively lower residual waste available volume<sup>14</sup>

The results demonstrate that Estate B is likely to be an outlier. This suggests that there is/are further condition(s) influencing the capture rate at Estate B for which this project has been unable to include in this analysis, as they did not fulfil the criteria outlined in section 2.3.1. The unknown condition(s) may explain the higher capture rate observed at Estate B. These conditions might be societal (for example; affluence, employment status; environmental attitudes and beliefs), or related to contextual factors (such as means of access to the building, access to the bins by non-residents).

<sup>14</sup> it is not possible to recommend a threshold for this condition as the fuzzy score calibration was used

## 8.0 Additional research

The analysis presented in this report goes some way to answering the research objects. Through additional analysis it may be possible to further unpick the conditions that are necessary and/or sufficient to observe higher capture rates from flatted properties.

Further research/analysis that may help explain conditions leading to higher capture rates from flatted properties are:

- As discussed earlier in the report Estate B is a likely outlier in terms of its recycling performance. Further analysis should set out to understanding what conditions are driving the observed recycling performance. If every flat performed as well as Estate B, even at pre-intervention levels, capture rates within flatted properties would be vastly improved. By excluding Estate B from the current QCA analysis, using the assumption that it is an outlier, it may be possible to obtain additional insights which may increase our confidence in the conditions that have been key drivers in the observed changes in capture rate.
- Conduct further sensitivity analyses to reveal the extent to which methodological decisions, particularly around calibration of conditions, might affect the findings.
- Interrogate the data to understanding what caused the observed decrease in capture rate on one of the estates where the Flats Recycling Package standard and a package of behavioural interventions were introduced.
- It is likely that in every case there will be conditions driving increases in capture rates and others working to decrease it. Re-phrasing the research question to explain low capture rates may help unpick or identify conditions that may also be important in explaining capture rates.
- Further to the above additional analysis of existing data there is a key research question around understanding how to establish higher capture rates from 15-34-year olds (and other groups that tend to recycle less). In part the issue with flats could just be an inevitability of having lots of people with a lower propensity to recycle in general, and which reside all in the same place. These residents may also live in a context where there are a lot more barriers to recycling than in other types of property.



# Appendix 1: Calibration of conditions

## Available MDR volume 60 L/hh/wk threshold

Prior to implementation of Flats Recycling Package, the amount of MDR available volume at each estate was calculated by multiplying the capacity of each free standing MDR bin by the number of bins and by the number of collections per week. The total was then divided by the number of flats per estate.

$$\begin{aligned} \text{Available MDR Volume (L)} \\ &= (\text{Bin capacity} \times \text{number of bins} \times \text{number of collections per week}) \\ &\div \text{number of flats} \end{aligned}$$

There was a wide range of MDR volume between estates. For example, at Estate C, available MDR volume was 155 L hh/week, in comparison to 23 L hh/week at Estate I (Table 19).

As part of the Flats Recycling Package that was implemented after the first phase of WCA, all estates were provided with a minimum of 60 L hh/wk of MDR bin volume.

One way to assess the success of the 60 L minimum standard, is to determine if estates which had less than 60 L hh/wk MDR volume before the Flats Recycling Package was implemented, recycled less than those estates with over 60 L hh/wk.

Therefore, estates which exceeded the 60 L hh/wk threshold scored 1 and those with less than 60 L hh/wk were scored zero (Table 19).

Table 19: MDR available bin volume/hh/wk with 60L cut off

Estate	MDR Available Volume (L hh/wk)	QCA score
Estate B	89	1
Estate D	62	1
Estate J	72	1
Estate H	30	0
Estate A	27	0
Estate I	23	0
Estate F	61	1
Estate E	129	1
Estate G	87	1
Estate C	155	1
Estate L	41	0
Estate K	46	0

60L or more	1
Less than 60L	0

Since the number of collections per week is included in the calculation of available MDR bin volume, the number of MDR collections per week is not included in the QCA as a standalone condition.

## Residual waste available volume L/hh/wk

If there are estates with low residual waste available volume, either due to a low number of bins or a low frequency of collections per week, residual waste bins can often be full and overflowing. Low residual waste volume was identified by residents in the ethnographic research as a potential factor that may influence MDR. Site visits and collaboration with caretakers highlighted that this is often a result of low collection frequency or missed collections. Low residual waste bin volume can lead to contamination in MDR bins since residents are faced with either stockpiling residual waste inside their home or contaminating MDR bins. This particular scenario was highlighted in the ethnographic research.

Available volume of residual waste bins per household per week was calculated.

$$\begin{aligned} \text{Available residual waste volume (L)} \\ &= (\text{Bin size} \times \text{number of bins} \times \text{number of collections per week}) \\ &\div \text{number of flats} \end{aligned}$$

The available residual waste volume at each estate was then calibrated using the interquartile range (Table 20). Estates with less than 145 L hh/week scored zero, those with 145-184 L hh/week scored 0.33, those with 184-200 L hh/wk scored 0.67, and estates with 200 L hh/week or more scored 1 (Table 21).

*Table 20: Descriptive statistics for residual waste available volume (L) and corresponding fuzzy scores*

<b>Mean</b>	178		<b>QCA description</b>	<b>Fuzzy score</b>
<b>1st Quart</b>	145	<b>fully out</b>	less than 145	0
<b>Median</b>	184	<b>partially out</b>	between 145 and 184	0.33
<b>3rd Quart</b>	200	<b>partially in</b>	between 184 and 200	0.67
<b>Max</b>	314	<b>fully in</b>	greater than 200	1
<b>Min</b>	79			
<b>IQ range</b>	145 - 200			

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Table 21: Residual waste available volume (L) hh/week alongside corresponding fsQCA value.

Estate	Residual waste available volume hh/wk (L)	Fuzzy score
Estate B	89.0	0
Estate D	144.6	0
Estate J	189.3	0.67
Estate H	79.1	0
Estate A	145.1	0.33
Estate I	197.9	0.67
Estate F	223.6	1
Estate E	171.6	0.33
Estate G	170.9	1
Estate C	313.6	1
Estate L	197.2	0.67
Estate K	178.6	0.33

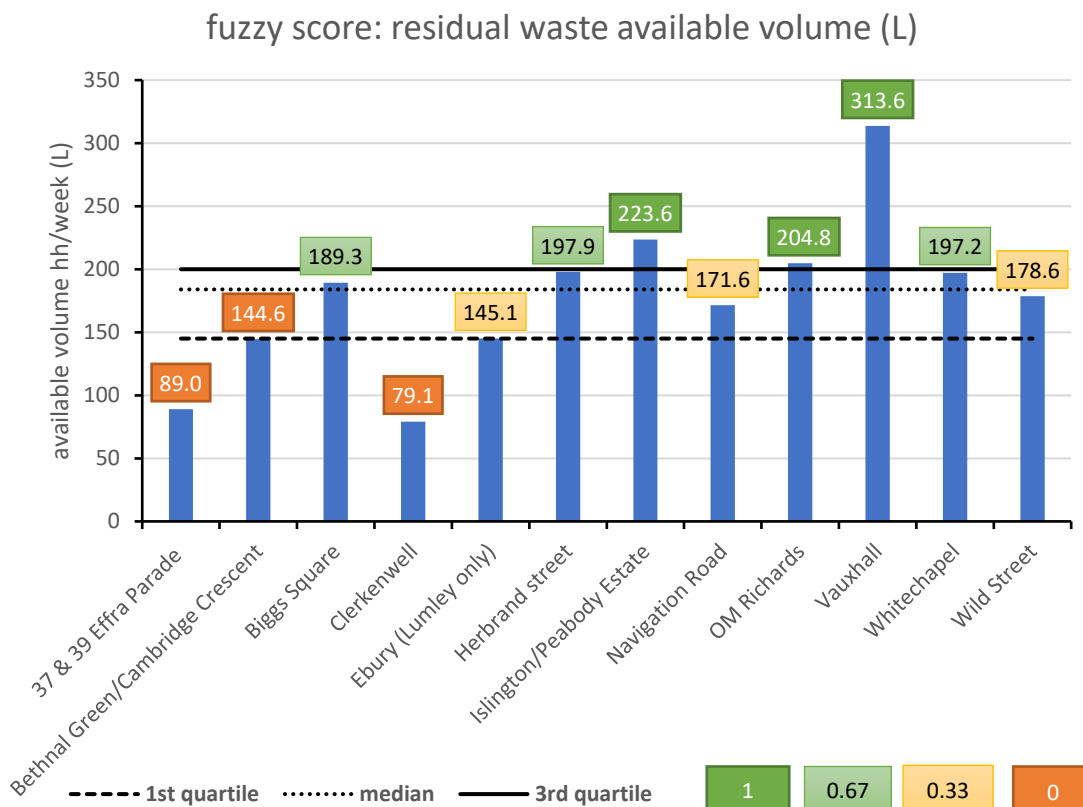


Figure 8: Residual waste available volume scores for each estate with the median and interquartile range highlighted by solid and dashed black lines. Estates with less than 145 L hh/week scored zero (dark orange boxes), those with 145-184 L hh/week scored 0.33 (yellow boxes), those with 184-200 L hh/wk scored 0.67 (light green boxes), and estates with 200 L hh/week or more scored 1 (dark green boxes)

## Food waste collection

According to WRAP research, households with a food waste collection service are likely to recycle more than those without. However, it is unclear whether this applies to flats. Food waste collection was included in the QCA and estates with food waste collection were scored 1 and those without were scored zero (Table 22).

*Table 22: Food waste collection at each estate.*

Estate	Food Waste collection	QCA binary-value
Estate B	No	0
Estate D	No	0
Estate J	Yes	1
Estate H	Yes	1
Estate A	No	0
Estate I	Yes	1
Estate F	No	0
Estate E	No	0
Estate G	No	0
Estate C	No	0
Estate L	No	0
Estate K	No	0

## Residual bin chutes

Typically, it is much more convenient for residents to dispose of residual waste than to dispose of mixed dry recycling. Many estates have chutes which allow householders to dispose of residual waste from each floor of the building, whereas recycling needs to be taken outside the building for disposal, putting an extra burden on users. However, the clear separation between residual waste disposal and mixed dry recycling disposal may improve recycling performance.

The presence of residual waste chutes also increases available residual waste volume. It is assumed that estates with adequate residual waste bin volume, would have lower MDR contamination in free standing bins. It was therefore necessary to assess whether the presence or absence of chutes influences MDR performance.

The available residual waste volume gained by having chutes is difficult to quantify in L/hh/wk, and the distribution and number of chutes within and between estates varies considerably. For example, some estates do not have chutes in any buildings, whereas some estates have chutes on every floor in every building, and some estates have chutes on some floors in some buildings. To capture this level of detail, the presence of chutes at a given estate was not initially categorised as either present or absent. Instead the number of chutes at each estate was calculated based on the total number of floors which contain a chute, as a percentage of the available space (e.g. number of floors in each block) (Table 23).

Since the percentage of floors with chutes can be a value from zero to 100 %, the median and interquartile range were not used to calibrate the data to a four-value fuzzy score. Estates without chutes scored zero, estates with chutes on every floor scored 1. Estates with chutes on less than 50 % of floors scored 0.33, and estates with chutes on more than half of floors scored 0.67 (Table 23; Figure 9).

## Qualitative Comparative Analysis of Recycling Performance

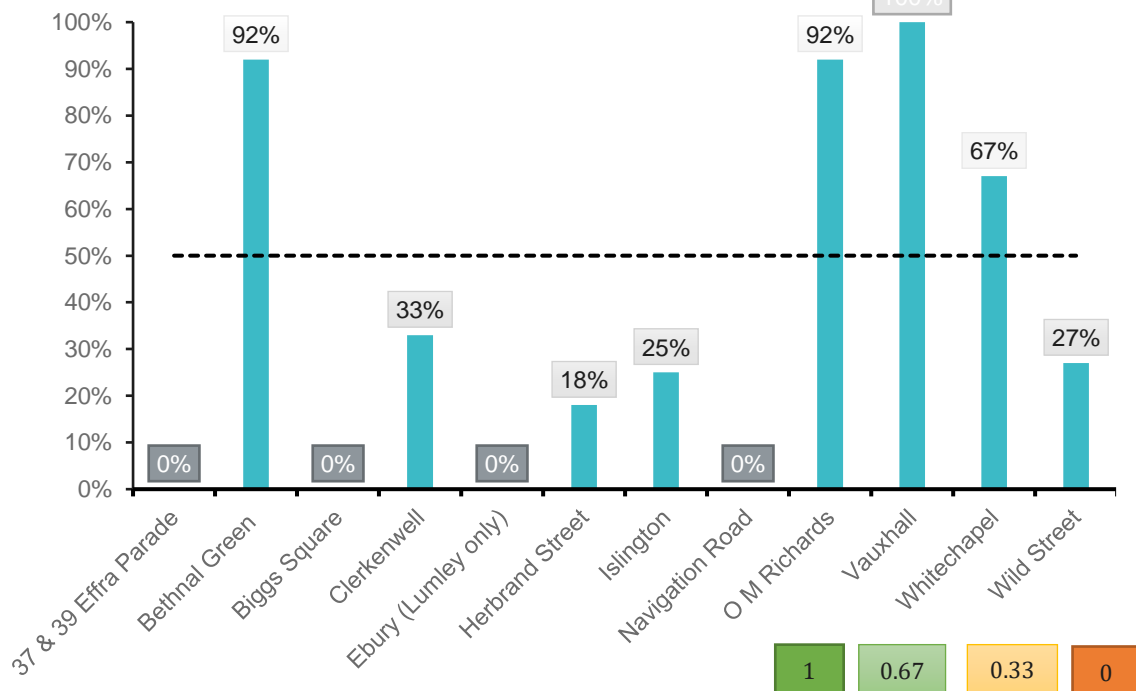
Table 23: Calculation of percentage of floors occupied by a chute and corresponding QCA value

Estate	Number of buildings	Building Name	Number of blocks per building	Block name	Floors per block	Floors with chutes	% floors with chutes	Fuzzy score
Estate B	1	Estate B			4	0	0%	0
Estate D	3	1	3	A	4	4	92%	0.67
		1	3	B	4	4		
		1	2	C	5	4		
				D	5	4		
				E	5	4		
				F	4	4		
				G	4	4		
Estate J	2	1	4		9	0	0%	0
		2	4		10	0		
Estate H	10	A		A	4	1	33%	0.33
		B		B	4	1		
		C		C	4	1		
		D		D	4	1		
		E		E	4	1		
		F		F	4	1		
		H		H	4	1		
		J		J	3	1		
Estate A	2	1-72	1	1-72	5	0	0%	0
		41-80	1	41-80	6	0		
Estate I	4	1	2	A	5	1	18%	0.33
				B	5	1		
		2	2	C	5	1		
				D	5	0		
		3	2	E	5	1		
				F	5	1		
		4	2	G	5	1		
Estate F	10	A		A	4	1	25%	0.33
		B		B	4	1		
		C		C	4	1		
		D		D	4	1		
		E		E	4	1		
		F		F	4	1		
		G		G	4	1		
		H		H	4	1		
		I		I	4	1		
	26-36		26-36	3	3			
Estate E	3	1			12	0	0%	0
		2			5	0		
Estate G	2	1	1	Penton	1	1	92%	0.67
		1	2	Rodney	3	2		
				Prospect	9	9		
Estate C	3	Blocks A-D	4	A	6	6	100%	1
				B	6	6		
				C	6	6		
				D	6	6		
		Blocks F-H	3	F	5	5		

## Qualitative Comparative Analysis of Recycling Performance

				G	5	5		
				H	5	5		
		Blocks J-L	3	J	5	5		
				K	5	5		
Estate L	11	A		A	4	4	68%	0.67
		B		B	4	4		
		C		C	4	4		
		E		E	4	4		
		F		F	4	4		
		G		G	4	4		
		H		H	4	1		
		I		I	4	0		
		J		J	4	4		
		L		L	4	1		
	New building		New building	4	0			
Estate K	10	Blocks A-C	3	A	6	0	27%	0.33
				B	6	0		
				C	6	2		
		Blocks D-G	3	D	6	2		
				E	6	2		
				G	6	2		
		Block H	1	H	6	2		
		Blocks L-N	3	L	6	2		
				M	6	2		
			N	6	2			

fuzzy scores: Chutes



## Qualitative Comparative Analysis of Recycling Performance

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**Figure 9:** Chutes at each estate as a percentage of the number of floors. Estates without chutes are scored zero (dark orange box), estates with chutes on every floor are scored 1 (dark green box). Estates with chutes on less than half of floors are scores 0.33 (yellow boxes), and estates with chutes on more than half of floors are scored 0.67 (light green boxes). Dashed black line marks the 50 % boundary for 0.33 and 0.67 values.



## Bin quality

There were differences in the quality of free-standing bins between estates prior to the implementation of the Flats Recycling Package. Differences in bin quality between estates included:

- the presence/absence of correct waste stream labels,
- the quality of the signage itself,
- whether bins were in working order,
- whether there was any additional waste stream signage on walls near to bins, and
- whether the bins were uniform in style and/or colour.

The quality of both MDR and residual waste bins was improved at all estates during implementation of the Flats Recycling Package.

One way to assess the success of bin quality improvements, is to determine if estates which had the poorest bin quality before the Flats Recycling Package was implemented, recycled less than those estates with higher bin quality.

The quality of bins was typically poor across all estates, however, there were subtle variations. To capture the differences in quality, bins were assigned an overall quality score based on several different parameters.

A quality rating scheme was developed based on a set of questions that aimed to assess the overall quality of communal bins. The description of different bins can be arbitrary, for example, one person may describe signage as “poor”, compared to another who may describe the same signage as “adequate”. As such, different descriptors were assessed using a more objective approach whereby scores were assigned to an estate based on the number on bins which match specific descriptions. If none of the bins on the estate matched the description then the estate scored zero, if less than half of bins matched the description then the estate scored 0.5, and if more than half of bins matched the description then the estate scored 1.

The same questions were asked for MDR and residual waste bins and a score was ascribed to each answer. The total score was calculated, and each estate was assigned an overall bin quality score.

Photographs of MDR and residual waste bins and bin areas were assessed using the following questions:

- How many bins have a label/sticker stating the correct waste stream?
- If bins are labelled, how many bins have visible labels? (e.g. those that are not obscured by walls or are facing the correct way around so the label is clearly visible)
- If bins have a label, how many bins have clean/unmarked labels?
- Is there any additional signage on the walls near the bins that indicates waste stream?
- How many bins are uniform? (e.g. colour/style/working order)

## Qualitative Comparative Analysis of Recycling Performance

Scores were assigned to each question for MDR and residual waste bins for each estate. For questions 1, 2, 3 and 5, the answer could be “None”, “Less than half”, or “More than half”, whereas the answer to question 4 was either Yes or No. For questions 1, 2, 3 and 5, if the answer was “None” the estate scored zero, if the answer was “less than half” the estate scored 0.5, and if the answer was “more than half”, the estate scored 1. For question 4, the “Yes” answers were converted to 1 and the “No” answers were converted to zero (Table 24).

Weightings were not assigned to individual questions since prior knowledge was not available. For example, it is not known whether having the correct waste stream label on a bin has a greater influence on recycling performance than whether bins are in working order.

*Table 24: Questions asked in quality assessment of bin signage. Each possible answer is given alongside its corresponding QCA score.*

		Possible Answer 1	Score	Possible Answer 2	Score	Possible Answer 3	Score
Q1	How many bins have a label/sticker stating the correct waste stream?	None	0	Less than half	0.5	More than half	1
Q2	If bins are labelled, how many bins have visible labels? (e.g. those that are not obscured by walls or are facing the correct way around so as the label is clearly visible)	None	0	Less than half	0.5	More than half	1
Q3	If bins have a label, how many bins have clean/unmarked labels?	None	0	Less than half	0.5	More than half	1
Q4	Is there any additional signage on the walls near the bins explaining the waste stream?	Yes	1	No	0		
Q5	How many bins are uniform? (e.g. colour/style /working order)	None	0	Less than half	0.5	More than half	1

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Table 25: Scores for each question for residual and MDR bins at each estate using the scoring system defined in Table 19.

Estate	Residual waste						Mixed Dry Recycling						Total Score	Fuzzy score
	Q1	Q2	Q3	Q4	Q5	Total	Q1	Q2	Q3	Q4	Q5	Total		
Estate B	0	0	0	0	1	1	1	0.5	0	0	0.5	2	3	0
Estate D	0	0	0	0	1	1	1	1	0.5	0	0.5	3	4	0.33
Estate J	0	0	0	0	0.5	0.5	1	1	1	0	1	4	4.5	0.67
Estate H	0	0	0	0	1	1	1	1	0	0	1	3	4	0.33
Estate A	0.5	0	0	0	1	1.5	1	1	0.5	1	1	4.5	6.5	1
Estate I	0	0	0	0	1	1	1	1	0.5	0	1	3.5	4.5	0.67
Estate F	0	0	0	0	1	1	0	0	0	0	0.5	0.5	1.5	0
Estate E	0.5	1	1	0	1	3.5	1	1	1	0	1	4	7.5	1
Estate G	0	0	0	0	1	1	1	0.5	0.5	0	0.5	2.5	3.5	0
Estate C	1	1	1	0	1	4	1	0.5	0.5	0	1	3	7	1
Estate L	0	0	0	0	1	1	1	1	0.5	0	0.5	3	4	0.33
Estate K	0	0	0	0	1	1	1	1	0.5	0	1	3.5	4.5	0.67

Scores for each question were assigned for residual and MDR bins and an overall bin quality score assigned to each estate (Table 25). To convert bin quality scores to an fsQCA value, the median and interquartile range were used to calibrate scores on a four-value scale (Table 26). Estates with a bin quality score less than 3.63 (1<sup>st</sup> quartile) scored zero, those between 3.63 (1<sup>st</sup> quartile) and 4.25 (median) scored 0.33, those between 4.25 (median) and 6 (3<sup>rd</sup> quartile) were scored 0.67, and estates with a bin quality score greater than 6 (3<sup>rd</sup> quartile) scored 1 (Table 26; Figure 10).

Table 26: Descriptive statistics for bin quality scores and corresponding fuzzy scores

Mean	4.54		
1st Quart	3.63		
Median	4.25		
3rd Quart	6.00		
Max	7.50		
Min	1.50		
IQ range	4 - 6		

	QCA description	Fuzzy score
fully out	less than 3.63	0
partially out	between 3.63 and 4.25	0.33
partially in	between 4.25 and 6	0.67
fully in	greater than 6	1

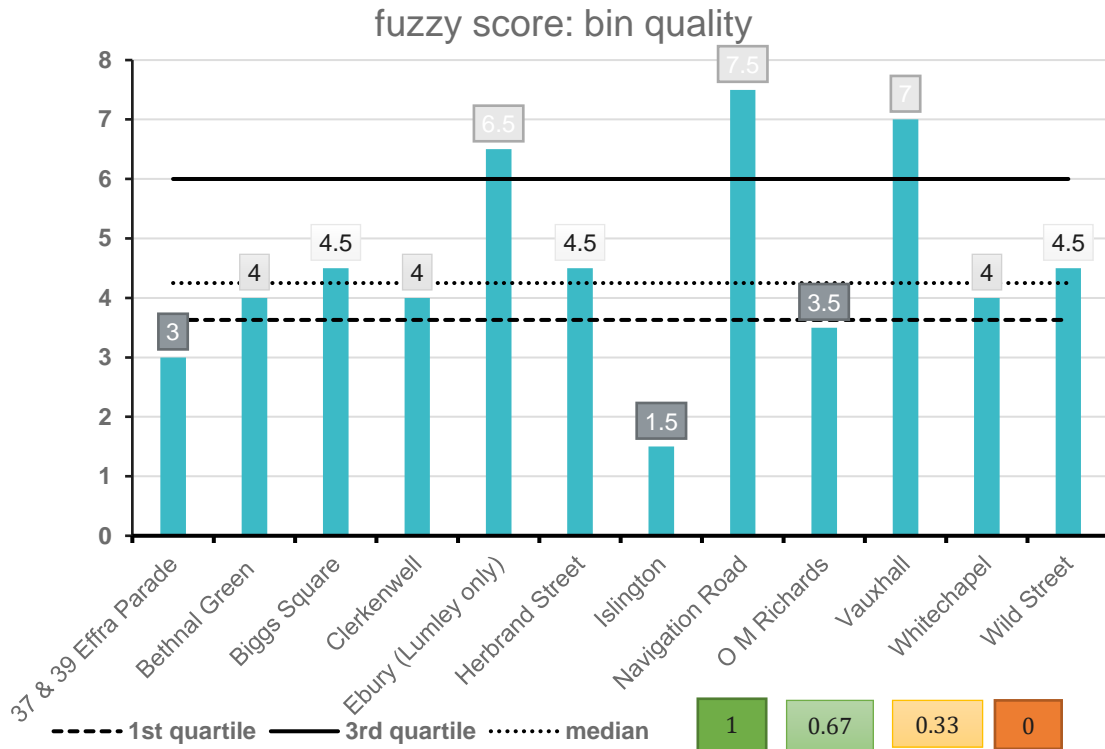


Figure 10: Bin quality scores for each estate with the median and interquartile range highlighted by solid and dashed black lines. Estates with a bin quality score less than 3.63 (1st quartile) scored zero (dark orange boxes), those between 3.63 (1st quartile) and 4.25 (median) scored 0.33 (light orange boxes), those between 4.25 (median) and 6 (3rd quartile) scored 0.67 (light green boxes), and estates with a bin quality score greater than 6 (3rd quartile) scored 1 (dark green boxes).

## Bin location

Free-standing bins (MDR and RES – excluding chutes) are either located inside in a purpose-built storeroom or outside. Estates where most free-standing communal bins are located inside were scored zero and estates where most free-standing communal bins are located outside scored 1 (Table 27).

Table 27: Location of free-standing bins.

Estate	Outside	QCA binary value
Estate B	Inside	0
Estate D	Outside	1
Estate J	Inside	0
Estate H	Outside	1
Estate A	Inside	0
Estate I	Outside	1
Estate F	Outside	1
Estate E	Inside	0
Estate G	Outside	1
Estate C	Inside	0
Estate L	Outside	1
Estate K	Outside	1

## Percentage 15-34-year olds

Resident age data were obtained from Peabody Estates in May 2017, whereas WCA was conducted in May and June 2018. It is therefore likely that the percentage of 15-34-year olds may have changed since the data were obtained. For the purposes of this analysis it is assumed that the percentage of 15-34-year olds has not changed substantially between these dates.

The percentage of 15-34-year olds was calculated by adding the percentage of 15-24-year olds to the percentage of 25-34-year olds from the original dataset obtained by Peabody Estates. WRAP segmentation research demonstrates that 16-34-year olds typically recycle less than any other age group. Therefore, it was expected that the higher the proportion of 15-34-year olds in an estate, the lower the recycling performance. As such, estates with a high percentage of 15-34-year olds were given a low score and estates with a low percentage of 15-34-year olds were scored highly.

The percentage of 15-34-year olds was calibrated to a four-value fuzzy score using the median and interquartile range.

Estates with less than 24 % scored 1, estates between 24-26 % scored 0.67, estates between 26-31 % scored 0.33, and estates with more than 31 % scored zero (Table 28; Table 29; Figure 11).

Table 28: Descriptive statistics for percentage 15-34-year-olds and QCA calibration values

Mean	28%
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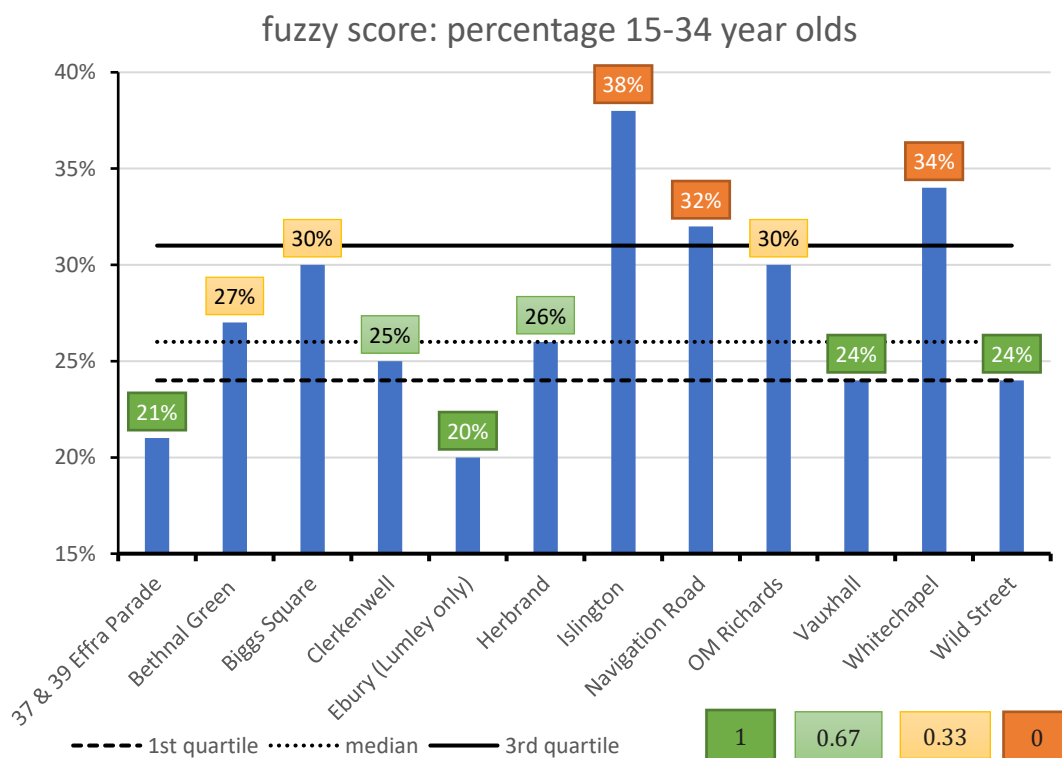
## Qualitative Comparative Analysis of Recycling Performance

1st Quart	24%
Median	26%
3rd Quart	31%
Max	38%
Min	20%
IQ range	24-32%

	QCA description	Fuzzy score
fully out	greater than 31%	0
partially out	between 31% and 26%	0.33
partially in	between 26% and 24%	0.67
fully in	Less than 24%	1

Table 29: Percentage 15-34-year-old data and calibrated QCA values.

Estate	15-24	25-34	15-34	Fuzzy score
Estate B	2%	19%	21%	1
Estate D	15%	12%	27%	0.33
Estate J	0%	30%	30%	0.33
Estate H	13%	12%	25%	0.67
Estate A	7%	13%	20%	1
Estate I	10%	15%	26%	0.67
Estate F	14%	24%	38%	0
Estate E	7%	26%	33%	0
Estate G	11%	18%	30%	0.33
Estate C	11%	13%	24%	1
Estate L	15%	19%	34%	0
Estate K	11%	13%	24%	1



## Qualitative Comparative Analysis of Recycling Performance

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**Figure 11:** *Percentage 15-34-year olds at each estate with the median and interquartile range highlighted by solid and dashed black lines. Estates with less than or equal to 24 % (1st quartile) scored 1 (dark green boxes), those between 24 % (1st quartile) and 26 % (median) scored 0.67 (light green boxes), those between 26 % (median) and 31 % (3rd quartile) scored 0.33 (yellow boxes), and estates with more than 31 % (3rd quartile) scored 0 (dark orange boxes).*

## Type of housing

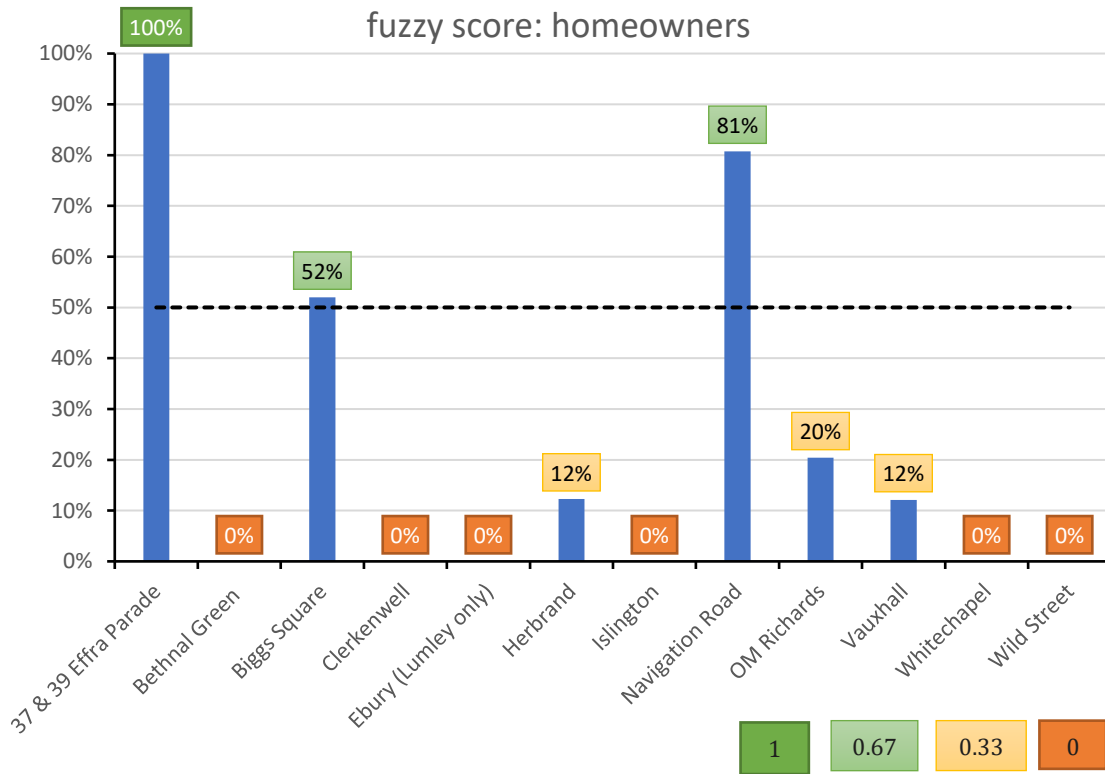
Housing types were split into three categories during the original demographic data collection by Peabody Estates. The categories were “Social Housing”, “Market Rent & IMR” and “Homeowners”. Based on WRAP segmentation, homeowners typically recycle more than any other type of housing category, therefore the percentage of “Social housing” and “Market Rent and IMR” were combined (Table 30). As a result, the new column “Social Housing or Market Rent and IMR” is the negation of “Homeowners” and so only the variable “Homeowners” was used in the QCA.

Since the percentage of homeowners can take a value from zero to 100 %, the median and interquartile range were not used to calibrate the data to a four-value fuzzy score. Instead, estates with 0 % homeowners scored zero, estates with 100 % homeowners scored 1. Estates with less than 50 % homeowners scored 0.33, and estates with more than 50 % homeowners scored 0.67 (Table 30; Figure 12).

*Table 30: Percentage tenancy type at each estate alongside corresponding QCA score.*

Estate	Social housing or Market Rent and IMR	Homeowners	Homeowners Fuzzy score
Estate B	0%	100%	1
Estate D	100%	0%	0
Estate J	48%	52%	0.67
Estate H	100%	0%	0
Estate A	100%	0%	0
Estate I	88%	12%	0.33
Estate F	100%	0%	0
Estate E	19%	81%	0.67
Estate G	80%	20%	0.33
Estate C	88%	12%	0.33
Estate L	100%	0%	0
Estate K	100%	0%	0





**Figure 12:** Percentage homeowners at each estate. Estates without homeowners scored zero (dark orange box), estates with 100 % homeowners scored 1 (dark green box). Estates with less than 50 % homeowners scored 0.33 (yellow boxes), and estates with more than 50 % homeowners scored 0.67 (light green boxes). Dashed black line marks the 50 % boundary for 0.33 and 0.67 values.

## Lifts and high-rise buildings

It is assumed that the presence of lifts increases accessibility therefore estates with lifts scored 1 and those without scored zero (Table 31). Conversely, the presence of high-rise buildings (7 or more floors) reduces accessibility. Therefore, if an estate has a high rise building it is given a score of 0 and if high rise buildings are absent then it is scored 1. Since the QCA values assigned to high rise and lift provision are almost the same e.g. estates with high rise buildings also have lifts, only the variable “lifts” was included in the QCA.

## Qualitative Comparative Analysis of Recycling Performance

Table 31: Estates that contain a lift and estates which have at least one high rise building.

Estate	Lift provision in buildings		High rise building 7 or more floors	
	Present/Absent	QCA score	Present/Absent	QCA score
Estate B	Present	1	Absent	1
Estate D	Present	1	Absent	1
Estate J	Present	1	Present	0
Estate H	Absent	0	Absent	1
Estate A	Absent	0	Absent	1
Estate I	Absent	0	Absent	1
Estate F	Absent	0	Absent	1
Estate E	Present	1	Present	0
Estate G	Present	1	Present	0
Estate C	Absent	0	Absent	1
Estate L	Absent	0	Absent	1
Estate K	Absent	0	Absent	1

Technical peer review

**Technical peer review of RCY135-003: Qualitative Comparative Analysis (QCA)**

**Documents reviewed:**

QCA Flats – Phase 2 – initial ideas and results.docx

QCA – Master Spreadsheet\_22-07-2019.xlsx

**Document author:**

Rachel Devine, Mark Roberts

**Peer reviewer:**

Karl King, Winning Moves

NB comments 1-12 were made on the basis of the initial analysis conducted by WRAP, and assumed the data underpinning the analysis were accurate. Corrections and amendments made to the dataset prior to the final round of analysis mean that some early findings were inaccurate. Readers should disregard, therefore, any references to early results in columns A and B.

	<b>A. Issue to be clarified</b>	<b>B. Thoughts or concerns of peer reviewer</b>	<b>C. Response from report author</b>	<b>D. Response from peer reviewer</b>
1	Whether the current formulation of the overall analysis by capture rate is fit for purpose – external validity	<p>As raised in previous discussion and comments, conducting QCA with an outcome variable which ranks relative performance, in effect, rather than achievement of a particular milestone in recycling or capture rate performance, risks reducing the external validity of the analysis.</p> <p>In practice, the way the current analysis is structured will help WRAP to understand the configurations of conditions necessary and/or sufficient to achieve a capture rate of over 46%. Whilst grounded in analysis of the current performance data, this figure is somewhat arbitrary when viewed from the perspective of external validity.</p> <p>The peer reviewer recommends this is reviewed prior to finalising the analysis as there is opportunity to tweak the outcome</p>	Although grounded in the analysis of the current capture rate data, the authors agree that a 46% threshold appears arbitrary when viewed from the perspective of external validity. Cases are now expressed as either above 50% (score of 1) or below 50% (score of zero) capture rate.	<p>The peer reviewer is satisfied with the response from the author.</p> <p>The analysis now helps to understand the conditions and/or configurations thereof that are necessary or sufficient to achieve or exceed a capture rate of 50%.</p>

		<p>definition to explain capture rates of 50% or greater in the post-intervention case (which may be a more logical threshold when stakeholders ask what can be concluded from the analysis).</p> <p>Analysis on this basis could be performed either in addition to or instead of the analysis in the current formulation.</p>		
2	Whether the current formulation of the overall analysis by capture rate is fit for purpose – performance improvement / capture rate change	<p>The proposal to look at changes in Capture Rate as the outcome when looking at presence or absence of particular interventions is appropriate. However, 100% capture rates are unrealistic, so it is recommended that WRAP reviews the approach to estimating the potential improvement in percentage points. This may have no effect on the outcome / relative ranking, but it is worth confirming this in case it does affect the results when expressed on the basis of a realistic top end capture rate.</p>	<p>Capture Rate Change has now been calculated as the potential improvement in percentage points with a top threshold of 80%. It makes no difference to the outcome/relative ranking of estates in comparison to the original 100% top end threshold. The 80% threshold was chosen since this is a realistic top end capture rate for kerbside mixed dry recycling collections. At present the 80% value is, however, an estimate.</p>	<p>The peer reviewer is satisfied with the response from the author.</p> <p>It is reassuring that the outcome is unaffected by the change to a more realistic capture rate.</p>
3	How each variable is defined for the purpose of analysis, along with the rationale	<p>It is recommended that the next iteration of the report includes a glossary / table defining each variable so readers can follow the analysis more easily without needing to cross-reference other documentation.</p>	<p>A glossary is now provided at the beginning of the report.</p>	<p>The peer reviewer is satisfied with the updates. Readers will be able to follow the analysis more easily with reference to the glossary.</p>
4	Naming conventions for variables - FIFTEENTOTHIRTY	<p>It is recommended the name of the FIFTEENTOTHIRTY variable is changed to indicate this is about membership of the set of flats with a <b>low proportion</b> of 15-34 year olds compared to other flats (e.g. lowprop15to34). This will make it easier for others to follow and interpret the analysis more quickly.</p> <p>Responding to a query raised in the paper, this condition should <b>not</b> be dropped from the analysis on the basis it is clearly very strongly associated with capture rates now that all flats have been brought up to the Flats recycling package standard (Run 1).</p>	<p>The condition “FIFTEENTOTHIRTY” is now changed to “lowprop15to34”. The authors agree that this condition should not be dropped from the analysis since it is clear that demographics/estate profile are associated with higher capture rates.</p>	<p>The peer reviewer is glad to see the condition has been retained. Tackling low rates of recycling among 15-34 year olds appears to be a key issue.</p>

<p>5</p>	<p>Proposed variables for exclusion</p>	<p>There is insufficient evidence on the basis of the pre-intervention analysis to justify the exclusion of profiling variables considered for exclusion, as this relates to a situation prior to the Flats Recycling Package being introduced, and variables proposed for exclusion (certainly low15-35 and lifts) appear to be important in the post-intervention runs.</p> <p>The Flats Recycling Package <b>can</b> be excluded where it is now common to all cases – <b>but only</b> for analysis looking at the current capture rate (post-intervention). Moving from low quality facilities to the Flats Recycling Package is a change that contributes to the changes / improvements in capture rates. So it should be included when looking at capture rate change.</p> <p>It is recommended that WRAP pursue option 3 raised at the end of the paper to examine which interventions appear to be associated with the greater improvements in capture rates. This should <b>include</b> the Flats Recycling Package and the behavioural interventions. It is expected that other variables will need to be included after this run to explain the outcomes (e.g. 15-34 and the presence of chutes as an absolute minimum), as it is clear these are having an influence. For example, interventions will be battling against higher percentages of 15-34 year olds in some flats, who have a lower propensity to recycle in general.</p>	<p>The authors agree that there is insufficient evidence for the exclusion of variables based on the pre-intervention analysis. Instead an iterative approach has been taken whereby several runs of conditions associated with current capture rate and capture rate change have been undertaken.</p> <p>When analysing the current capture rates, the Flats Recycling Package is excluded from the analysis since all estates were brought up to the same standard. However, when looking at Capture Rate Change, the Flats Recycling Package is included in the QCA runs since these conditions have impacted the change in capture rate throughout the course of the project.</p> <p>A run was conducted that examined which behavioural interventions and which elements of the Flats Recycling Package (or combinations thereof) are associated with greater improvements in Capture Rate Change. After analysis it appears that estates which had the lowest quality waste and recycling facilities (e.g. estates with less than 60L mixed dry recycling volume per hh/wk; estates with poor bin quality/signage; and estates with the lowest residual waste available volume) had the greatest improvement in capture rates. However, no single Flats Recycling</p>	<p>The peer reviewer is satisfied with the response from the author.</p>
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			<p>Package condition was identified and elements of the Package were either paired together, or paired with the presence or absence of a particular intervention.</p> <p>A secondary run has been undertaken which included the Flats Recycling Package, behavioural interventions, lowprop15to34 and chutes since these conditions were most consistently associated with higher present-day capture rates.</p>	
6	<p>How the results of the revised initial analysis (capture rate instead of kg / hh / week recycled) and lower importance of bin quality should be interpreted</p>	<p>It is interesting that bin quality appears to be less important in the updated pre-intervention analysis, which is now looking at capture rates. It would be interesting for this to be explored further, as it is helpful in the context of limited budgets to understand the relative priority of the factors tested / contexts where bin quality may be less important.</p> <p>It is worth noting the pre-intervention scenario relates to a scenario prior to those flats being brought up to a Flats Recycling Package standard. In some cases of higher bin quality, available volume is lacking, so any benefits arising from high bin quality may be insufficient to overcome the lack of available volume. This may be part of the reason bin quality does not appear to be associated with higher capture rates; however it seems unintuitive as an explanation given bin quality seemed to be associated with greater volumes of recycling in the analysis based on kg/hh/wk. As it is not obvious from the data included so far, it may be that there are factors at work the analysis is not accounting for at present (or not accounting for in full). For example, the extent of caretaker involvement (see comments below).</p>	<p>The authors conclude that kg/hh/week is not a useful measure of recycling behaviour since it is influenced by one-off events and the weight of recyclable material. Capture rate is a measure of whether residents are putting “the right thing in the right bin”. Therefore, comparison of kg/hh/wk to capture rate and capture rate change is somewhat futile.</p> <p>Only free-standing bins were included in the assessment of bin quality and so the authors agree that any interaction between bin quality may not be equally important in all contexts or may be less important in some contexts (e.g. where a greater % of people are using chutes).</p> <p>There may be other factors at play that we cannot account for. For example, data were only available for 10 out of 12 cases for (i) % single occupants and (ii)</p>	<p>The peer reviewer is satisfied with the response from the author.</p>

		The role of chutes in later runs raises a question of whether bin quality (as currently specified) is equally important in all contexts, or may be less important in some contexts (e.g. where a greater % of people are using chutes). It is possible this is already accounted for in the assessment of bin quality.	length of tenancy. As such these conditions are not included in the analysis. It is also possible that other factors where data are not available, such as the proportion of families, may also have an influence on capture rates. The authors recognise the potential influence of “unaccounted for” conditions.	
7	Caretaker involvement and whether the current formulation of this condition is appropriate	The inclusion of caretakers in the current formulation of the analysis is examining the presence or absence of a caretaker as a factor and appears to be of limited use in this format. The qualitative interviews suggested some caretakers were considerably more enthusiastic and active than others. This suggests the analysis ought to include a more nuanced assessment of the role of caretakers, to allow the potential influence of this condition to be considered. At the moment there is only one case where a caretaker is absent, and the variable appears to be of limited use to the analysis. It is suggested that a new variable is created, if the data allows this, to indicate the presence or absence of proactive caretaker action which would increase capture rates.	The authors agree with the points raised. Caretakers are either present or absent at an estate. In closed-ended questionnaires, caretakers described how often they recycle on behalf of residents. They described themselves as either (i) non recyclers (ii) once per week, (iii) twice per week, or (iv) 3 or more times per week.  To indicate the presence or absence of a highly proactive caretaker, estates where caretakers recycle 3 or more times per week scored 1. All other estates scored zero.	The peer reviewer is satisfied with the response from the author. This better reflects feedback from Winning Moves researchers undertaking qualitative research with the caretakers and flat occupants.
8	Exclusion of the Flats Recycling Package actions from the conditions list when looking at capture rate change	Whilst it makes sense to exclude the Flats Recycling Package as a constant in looking at the current capture rate, introducing the Flats Recycling Package will contribute towards changes in capture rates, so should be included alongside the behavioural interventions where the analysis is seeking to understand the conditions that explain the change in capture rates.	The Flats Recycling Package is now included in analyses of capture rate change, but not in analyses of current capture rate.	The peer reviewer is satisfied with the response from the author.
9	Run 1 outcome - FIFTEENTHIRTY	As FIFTEENTHIRTY mirrors the capture rate precisely in the truth table, this result is unsurprising. It appears to be necessary and sufficient to account for the top performing flats based on capture rates once these have been brought up to the Flats Recycling Package standard. No other conditions are required to explain the outcome. This suggests that, once flats are brought	The authors agree with point 9, however amendments have been made to the original data after errors in Waste Composition Analysis conducted by external contractors were noticed and amended. These amendments affected	The peer reviewer is satisfied with the response from the author.

		<p>up to the Flats Recycling Package standard, the profile of flat occupants, and specifically the proportion of 15-34 year olds has a greater bearing on capture rates than other factors. At least in the flats included in the analysis.</p>	<p>the calculations of: (i) capture rate, (ii) MDRavvolume60L, and (iii) resavvolume. As such the initial runs provided in the first round of peer review are no longer accurate. However, 15-34 year olds still appear to have an influence on capture rates and capture rate change, though the results are not as clear-cut as the previous report suggests.</p>	
10	<p>Run 2 outcome – SMALL BINS and chutes</p>	<p>The analysis in run 2 suggests that small bins have been effective in flats with no chutes. The report appears to be inaccurate in reporting that estate L is an exception, as the truth table indicates estate L does have chutes.</p> <p>In the other two cases where the outcome is present it appears that the tenant packs and/or feedback were effective (or at least more effective) in contexts where there was a low proportion of 15-34 year olds in the flats as a whole. In instances where tenant packs and/or feedback were given and the outcome was not present, the flats had a higher proportion of 15-34 year olds.</p> <p>What is also interesting in run 2 is that there is one case with a high proportion 15-34 year olds where the outcome is present, and two with a low proportion of 15-34 year olds where the outcome is not present. It is recommended this is examined further and in conjunction with qualitative evidence to understand which interventions have influenced the behaviour of 15-34 year olds / younger residents and how.</p>	<p>The authors agree with point 10, however amendments have been made to the original data after errors in Waste Composition Analysis conducted by external contractors were noticed and amended. These amendments affected the calculations of: (i) capture rate, (ii) MDRavvolume60L, and (iii) resavvolume. As such the initial runs provided in the first round of peer review are no longer accurate. However, 15-34 year olds still appear to have an influence on capture rates and capture rate change, though the results are not as clear-cut as the previous report suggests.</p>	<p>The peer reviewer is satisfied with the response from the author.</p>
11	<p>Run 3 - Recycling rate</p>	<p>In previous conversations WRAP has expressed concern about the reliability of recycling rate as a measure of flat performance. The peer reviewer agrees that capture rate is the most appropriate measure of those available, as it is less sensitive as a measure of general recycling activity / and more reliable as a measure of changes in recycling behaviour likely to be influenced by the changes. It is unsurprising given the potential</p>	<p>The authors agree and recycling rate has been omitted from the analysis. Capture rate and Capture Rate Change are the only outcomes used in the analysis.</p>	<p>The peer reviewer is satisfied with the response from the author.</p>



		<p>limitations of recycling rate as an outcome that no clear results emerged in run 3. Further justification and review of the outcome data may be required if WRAP intends to look at recycling rates further.</p>		
12	Future runs	<p>WRAP has requested that the peer review at this stage includes suggestions for subsequent runs:</p> <p>It is recommended that runs involving ease, knowledge and motivation are performed on the basis of the current capture rates (as the outcome), and that interventions are excluded from this run on the basis that they are contributing to improved ease, increased knowledge or heightened motivation. This appears to be the intention from the run matrix detailed in the spreadsheet supplied.</p> <p>As detailed above:</p> <ol style="list-style-type: none"> <li>1. Actions taken to bring flats up to the Flats Recycling Package standard should be included as conditions when looking at capture rate change.</li> <li>2. It will be useful to run analysis looking only at the behavioural interventions as conditions affecting capture rate change. However, the results available so far indicate the influence and interplay with context cannot be ignored so key variables associated with the outcomes (15-34, chutes etc) are likely to be required to explain differing levels of performance improvement.</li> </ol> <p>Whilst not without limitations, it would be interesting to examine the absolute increase in capture rates as an outcome, to explore if any interesting patterns emerge from that, and whether these appear distinct from the capture rate change as currently specified. Although it is easier for some flats to improve than others, they still have to act / change their behaviour to achieve that. WRAP could consider including the original capture rate as a condition in the analysis of capture rate change if there is concern the factors already accounted for by other conditions are</p>	<p>After review the authors have decided that the conditions: Ease Knowledge and Motivation are dropped from the analysis. The authors conclude that the sample size from resident interviews is too small to be representative of the Ease Knowledge and Motivational behaviours of all, or most, of the residents at each estate. The sample size ranges from 5-7 respondents, and each estate is comprised of a minimum of 104 households.</p> <ol style="list-style-type: none"> <li>1. The Flats Recycling Package was included when looking at Capture Rate Change</li> <li>2. A run was conducted looking only at behavioural interventions as conditions but the QCA was unsuccessful. The output described each pair of behavioural interventions and no single estate had an inclusion score of 1.</li> <li>3. Chutes and lowprop15to34 are included in the final analysis</li> </ol> <p>The authors conducted a run with absolute capture rate change as an outcome with the original capture rate as a condition. The results show that the</p>	<p>The peer reviewer agrees with WRAP's decisions and is satisfied with the response from the author.</p>

		<p>insufficient. Alternatively, this could be done on the basis of those meeting or not meeting the Flats Recycling Package standard prior to the intervention (if there are a sufficient number of cases where the Flats Recycling Package was being met prior to the changes).</p> <p>It is also recommended that the categorisation of caretakers is reviewed as discussed above.</p> <p>Evidence from the recently completed qualitative work may also be of use in reviewing future run specifications and interpreting the analysis. This will help WRAP to judge which results emerging from the QCA are the most meaningful, as well as to consider the mechanisms involved in formulating the eventual narrative.</p>	<p>original capture rate must be present in each configuration in order to explain the outcome. The authors take this to mean that the absolute change in capture rate should not be used as a stand-alone outcome since the original capture rate has too much of an effect on the outcome (e.g. estates that had a high capture rate to begin with, had the smallest absolute capture rate change). The authors therefore decide to only use Capture Rate and Capture Rate Change (as expressed as the potential to improve to 80% upper threshold).</p> <p>It was not possible to account for the original capture rate on the basis of those cases meeting or not meeting the Flats Recycling Package since none of the cases met the Flats Recycling Package prior to the project.</p> <p>Caretakers have now been re-categorised – see point 7.</p>	
<p><b>Additional comments following review of the draft final report</b></p>				
<p>12</p>	<p>Is the top performing control estate an outlier? And would it be more accurate to describe the 'control' estates as 'comparison' estates?</p>	<p>It is clear from review of the updated analysis and underlying data that the estates identified as 'controls' are among the better performing estates prior to intervention. One 'control' estate stands out in particular, with the highest performance overall, and a pre-intervention capture rate that exceeds the post-intervention capture rates observed for other estates.</p> <p>Such cases can be included in QCA; however, the performance of the top performing estate is considerably higher than the other estates, whilst sharing similar though not identical characteristics to other estates (in terms of the conditions covered in the analysis).</p>	<p>This is now acknowledged in the report and the 'control' estates have been renamed as 'comparison' estates.</p>	<p>The peer reviewer is satisfied with the response from the author.</p>

		<p>Whilst it is possible that the unique configuration of conditions at the top performing estate gives rise to higher performance as an 'emergent effect', in this circumstance, it seems more likely that there is something unique about the top performing estate that is not accounted for in the conditions considered.</p> <p>If there is scope for further research and analysis in future, it is recommended that this is explored further to unpack more fully the factors that lead to markedly higher capture rates at the top performing estate. This may yield insights of use in identifying how performance could be improved further in other flats (and the conditions that may be important but currently missing in this first QCA). The QCA runs described in the existing report could also be repeated excluding the top performing 'control' estate to understand the impact of its inclusion on the results.</p> <p>Ignoring performance prior to intervention, the absence of intervention (beyond ensuring the Flats Recycling Package in recycling service provision) is the most significant difference between control and treatment estates. As a result, it was unsurprising to see some suggestion in the outputs that the absence of intervention beyond the Flats Recycling Package being a potential cause of higher capture rates among the 'control' estates. Including prior capture rates as a condition helps to deal with this somewhat - but it doesn't help to explain why they were performing so well beforehand, despite being below the Flats Recycling Package standard.</p> <p>It is also recommended for the reasons outlined above that the estates referred to as 'control' estates in the draft report are described instead as 'comparison' estates.</p>		
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14	<p>Acknowledging that this is analysis is a first (and time/resource bound) attempt to unpack the factors and configurations thereof that are necessary and/or sufficient for higher recycling/capture rates to be observed.</p>	<p>The report should acknowledge that the exploration of factors affecting recycling performance / capture rates using QCA is novel and that the work undertaken to date is not exhaustive.</p> <p>The peer reviewer understands that WRAP has now used all of the resources available for this QCA. However, the peer reviewer notes that a small number of cases remain in each run that contradict the configurations of conditions identified. Ideally, these would benefit from further scrutiny to understand whether this is explained by the presence/absence of other conditions in those particular cases.</p> <p>If further time becomes available to extend or refine the analysis it is also recommended that the authors conduct further sensitivity analyses along the lines advocated by Barbara Befani in Pathways to change: Evaluating development interventions with Qualitative Comparative Analysis. Available at: <a href="https://openaid.se/app/uploads/2015/03/2016-05-Pathways-to-Change-Evaluating-Development-Interventions.pdf">https://openaid.se/app/uploads/2015/03/2016-05-Pathways-to-Change-Evaluating-Development-Interventions.pdf</a></p>	<p>The report has been updated to acknowledge this is a first attempt at unpacking the conditions that are necessary and/or sufficient to achieve higher capture rates in flatted properties, as well as the first application of QCA to this question. It also acknowledges further work that could be undertaken to develop and refine the analysis further.</p>	<p>The peer reviewer is satisfied with the response from the author.</p>
15	<p>Further analysis / research</p>	<p>It is recommended that the report includes a section to discuss areas for further research and analysis. For example:</p> <ol style="list-style-type: none"> <li>1. To understand what happened in the one case where capture rates went down after the introduction of the Flats Recycling Package</li> <li>2. To reframe the question from the perspective of explaining low capture rates as an outcome – which may prompt identification of other conditions of importance</li> <li>3. To highlight suggestions made for further analysis in comment 14 above.</li> </ol> <p>It is also recommended the final report makes reference to wider work that may be required to increase recycling performance in flats - for example, the broader question of how to increase capture rates for 15-34 year olds in general, irrespective of the type of property in which they reside.</p>	<p>The report now includes a section to discuss further analysis and research.</p>	<p>The peer reviewer is satisfied with the response from the author.</p>





WRAP's vision is a world in which resources are used sustainably.

Our mission is to accelerate the move to a sustainable resource-efficient economy through re-inventing how we design, produce and sell products; re-thinking how we use and consume products; and re-defining what is possible through re-use and recycling.

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