ROBINVALE POPULATION DETERMINATION: Briefing Paper

Prepared for:
Swan Hill Rural City Council

15 July 2019

Geografia

Geografia Pty Ltd
• Demography • Economics • Spatial Analytics
Level 21, 15 Collins St Melbourne VIC 3000
+613 9329 9004 | info@geografia.com.au | www.geografia.com.au

Summary

INTRODUCTION

- This briefing paper outlines a population estimation exercise to provide a more accurate measure of the actual, daily resident population in the Robinvale SA2.
- There has been substantial evidence to suggest that Robinvale's true year-round population is notably higher than the official Estimated Resident Population (ERP) of 3,359[1] . ERP is intended to be a count of the official resident population and not a count of the actual population present at any one point in time. In most cases the difference may be negligible, but, for places like Robinvale, which have a high proportion of semi-permanent residents and seasonal workers, the difference between the actual (service) population and the ERP can be large.
- Over the years, the evidence for a large gap between Robinvale's service population and ERP has included:
    - Anecdotal evidence from public and private goods and service providers who have noted significantly higher draws on their services than would be expected from a population of 3,359;
    - Higher than expected demand for housing; and
    - A recognition that many permanent or semi-permanent residents of Robinvale avoid being counted in the Census.
- The intention of this study is to add more rigour to identifying the service population of the Robinvale township (including any seasonal variation) and thereby quantify the true facilities, services and housing needs.
- Figure A shows the different population estimates over time. What is most obvious is the relative similarity: quite different methodologies deployed by different people over time have produced similar results. This adds to the argument that the estimates are robust as they all point to a total actual

[1] This is the Robinvale SA2 ERP for 2017.

resident population that is around 2.2-2.9 times the ERP and this has been consistent over the last decade.

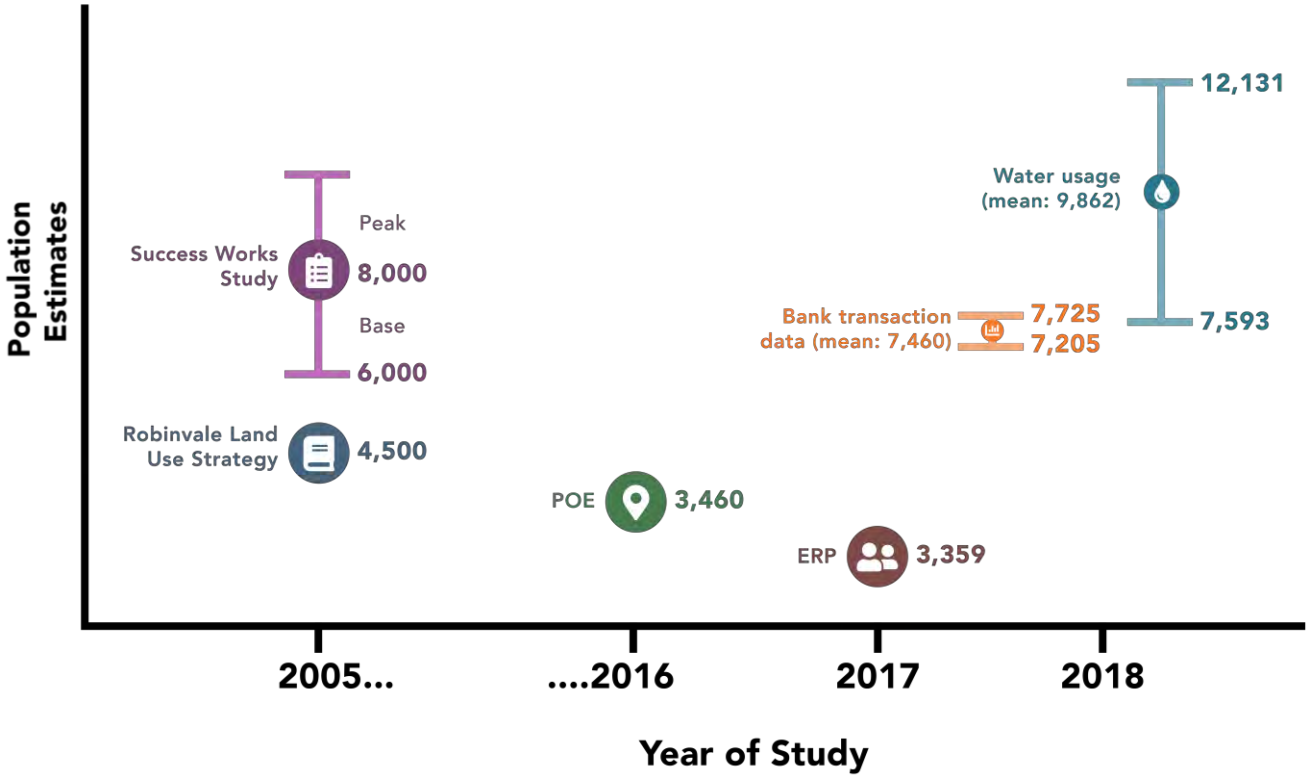

Figure A: **Service Population Estimates**
Source: Geografia, 2019

KEY FINDINGS

- Based on Spendmapp[2] data, per capita local purchases of goods from Grocery Stores and Supermarkets (from residents and visitors) for all metropolitan and non-metropolitan SA2s across Australia shows a mean annual per capita expenditure of around $4,500. For Robinvale SA2, the figure is a little over $5,100.

- Given any purchases in Robinvale will be limited by the offer (with many residents and visitors likely to shop in Mildura or Swan Hill) and by the fact that many residents are there to work and save and will be reducing their outgoings, we would expect a lower per capita spend in Robinvale, than even the non-metropolitan average (that is, less than $4,500 per person per annum). That we

[2] Spendmapp.com.au

see a value 13% higher is *prima facie* evidence that the ERP is undercounting the actual year round population.

- On the basis of this, a triangulation method was implemented to find a good estimate of the service population range for Robinvale SA2. Short of an extensive (and expensive) on site survey, this is considered the most reliable method, particularly given the difficulty reported in counting hard to reach residents in Robinvale.
- The two most reliable methods deployed in this study use bank transaction data and water usage data (with the former considered the more reliable of the two methods).
- The bank data method identified non-resident cardholders regularly purchasing goods and services in Robinvale SA2, which suggests they were present in the SA2 regularly throughout the year. The water data method used aggregated residential water consumption and a State Government estimate of typical rural per capita consumption to estimate the true population.
- From this information, we find two sets of estimates:
    - **7,205-7,725, mean 7,460** (from the bank data); and
    - **7,593-12,131, mean 9,862** (from the water usage data).
- Given the bank data derived estimate is the more reliable (the water data method is highly sensitive to the assumption about per capita consumption), the two mean values have been given a weighting of 0.8 and 0.2 respectively.
- From this, the evidence suggests there is a mean population in Robinvale in the order of 7,900 residents. This figure is for the total population, including the Estimated Resident Population count from the ABS.
- The monthly aggregated spending pattern over 12 months shows a relatively consistent population range, peaking in March; dipping in November; and with a variation of around 900 from the low to the high point (Figure B).

- Scaling up to the mean value of 7,900 over the year (the weighted average of the bank data and water consumption data derived methods), the variation suggests a range between 7,000 in November to 8,800 in March[3].

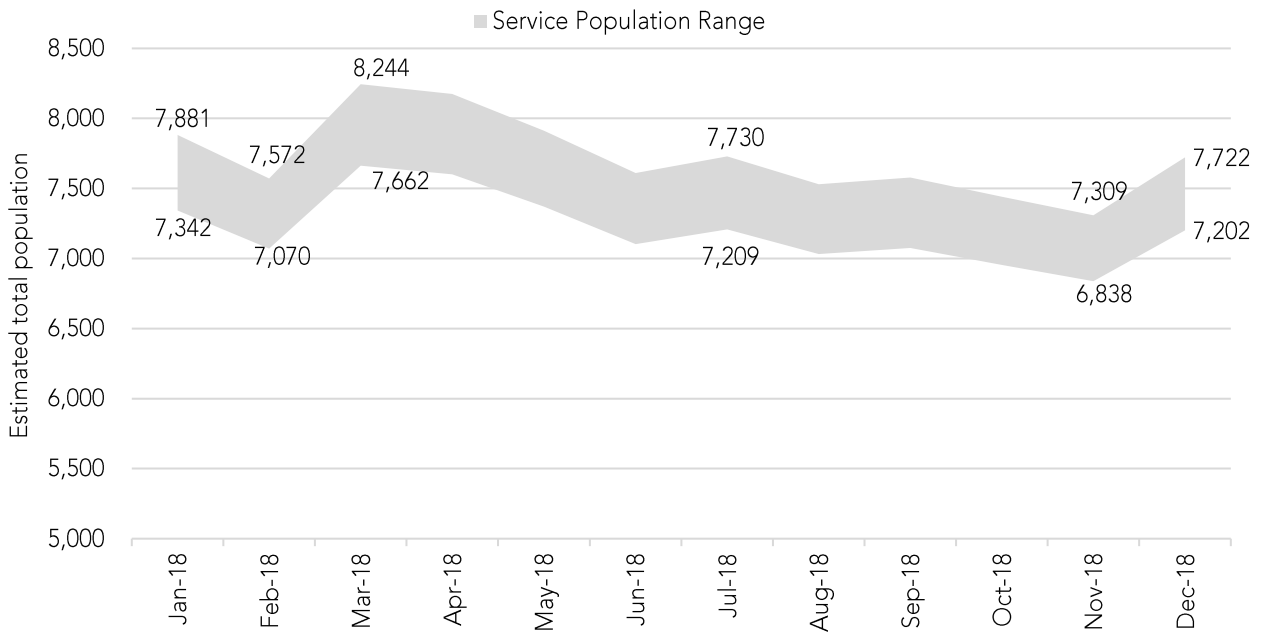

Figure B: **Bank Data Derived Estimated Total Service Population, Robinvale SA2**
Source: Geografia, 2019

[3] Note, this is based on one full calendar year of bank data (2018) and should be re-evaluated with subsequent years.

Contents

Page

Figures

Page

Tables

Page

1.0 Introduction

This briefing paper outlines a population estimation exercise designed to provide a more accurate measure of the actual, daily resident population in the Robinvale SA2. The intention is to identify the service population of the Robinvale township (including any seasonal variation) and thereby quantify the actual facilities, services and housing needs.

1.1 Background

Swan Hill Rural City Council has commissioned Geografia and Advanced Demographic Modelling to investigate and report on the 'service population' of the Robinvale SA2 (see Figure 1 for the Study Area). A service population is the actual daily population of a location, counting permanent residents, visitors (i.e. tourists) and transient workers (workers regularly in the location, but not recorded as permanent residents).

One of the reasons for this work is that while it it widely recognised that the ABS Census is one of the better national population surveys in the world, it often undercounts certain groups within a population. This includes Indigenous residents, seasonal agricultural workers, FIFO or DIDO workers and new migrants. This is particularly problematic in remote locations where this temporary, transient, hidden or visitor population is effectively part of the permanent resident base and should be (but is not) included in the Estimated Resident Population (ERP). The ERP is the count used to inform policy, planning and public service provision levels. It is, therefore, critical that the number is a fair reflection of the actual service and facility demand in a town, city or location.

Unlike metropolitan areas, where, for example, a service population in a CBD includes daily commuters and can be many times larger than the ERP, in rural areas, distances are too far to consider daily commuting, or day visitors and most of these additional de facto residents are permanently based in the location for weeks, months or even years.

As the ERP only counts the official permanent residents and is not a count of the actual people present in a place at a particular time, it is not always an ideal measure for ongoing facility and service demand planning.

PRIMA FACIE EVIDENCE FOR AN UNDERCOUNT

Over the years, several studies have acknowledged (and attempted to address) the information gap around the real, permanent or semi-permanent population in Robinvale. Over this time evidence has mounted that there are significantly more residents than the official ERP suggests. This evidence has included:

- Anecdotal evidence from public and private goods and service providers who have noted significantly higher draws on their services than would be expected from a population of 3,359;
- Higher than expected demand for housing; and
- A recognition that many actual permanent or semi-permanent

residents of Robinvale avoid being counted in the Census.

Using Spendmapp[4] data, per capita local purchases of goods from Grocery Stores and Supermarkets (from residents and visitors) can be quantified for all metropolitan and non-metropolitan SA2s across Australia. This shows a mean annual per capita expenditure of around $4,500. For Robinvale SA2, the figure is a little over $5,100.

Given purchases in Robinvale will be limited by the offer (with many residents and visitors likely to shop in Mildura or Swan Hill) and by the fact that many residents are there to work and save and will be reducing their outgoings, the Robinvale per capita spend should be less than $4,500 per year. The fact that it is 13% higher is *prima facie* evidence that the ERP is undercounting the actual year round population.

On this basis, this study explore several methods to obtain a better measure of the actual, year-round population. These are explored in Section 2.0.

[4] Spendmapp.com.au

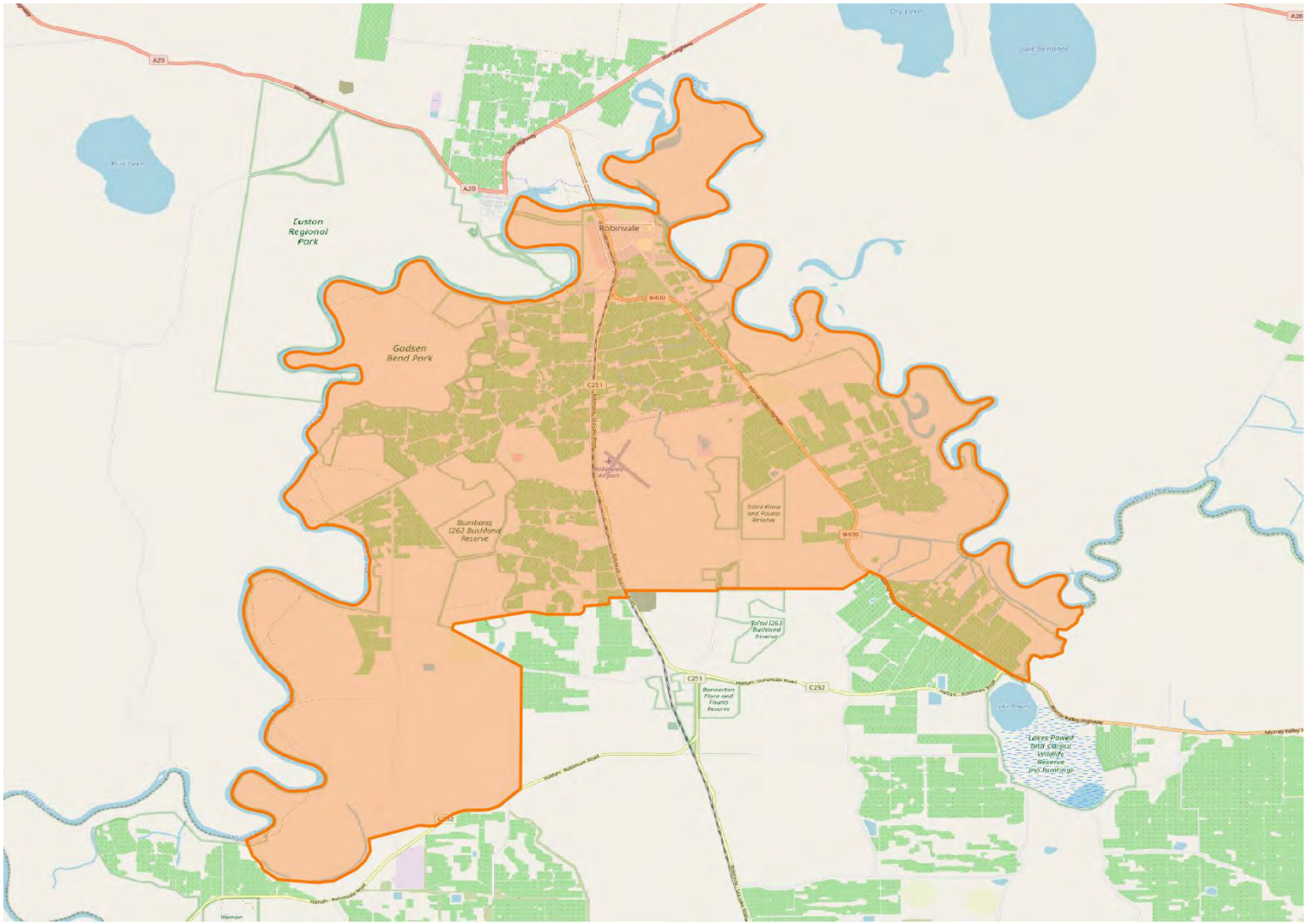

Figure 1: **Study Areas**
Source: Geografia, 2019

2.0 Findings

A triangulation method has been used to estimate a robust population range for Robinvale SA2. Short of an extensive (and expensive) on site survey, this is considered the most reliable method, given the difficulty reported in counting hard to reach residents in Robinvale. The two most reliable methods use bank transaction data and water usage data respectively. From this, we find a reasonable set of estimates from a low of 7,593 to a high (probably an outlier) of 12,131. The preferred estimate is derived from bank transaction data and produces an estimated range of 7,205-7,725. These figures include the Estimated Resident Population count from the ABS.

2.1 Qualitative insights

As part of the research, a series of interviews with regional stakeholders were completed. They include the business and organisation representatives listed in Table 1.

Table 1: **Stakeholder Summary**

Stakeholder	Key observation
Lower Murray Valley Water	• A significant population correction would affect the water authority's own planning • Fluctuations across the year are significant (note: interviewees do not live in Robinvale.
Office of the Skills Commission	• Robinvale is one of the most sustainable rural towns in the country because of the growth in agriculture and horticulture
Elders Real Estate	• Big population increase during grape harvest season Feb-Apr • Most workers not heavy users of services because they don't want to spend money
Lamattina Farms	• Employs 30-40 temporary workers – the individuals change but the number stays fairly constant • For every 1 seasonal worker who completes the Census, there would be 2 who do not
Robinvale College	• Enrolment fluctuations are not a result of changes in the labour force, but in Indigenous family changes • Limited housing supply keeps the resident population down – teachers have to commute
Robinvale Network House	• Many workers own homes in other places that they prefer to use in Census, even though they spend much of the year in Robinvale • There could be as many as 3,000 Malaysians in Robinvale at certain taimes of year
Census Collection Supervisors	• Aware that many houses visited in the run up to the 2011 Census under-reported • Repurcussions affecting Centrelink payments have a big impact on Census participation
Robinvale Pioneer Ford	• Witnessed makeshift living quarters made out of tarps and caravans on a private property with ~40 workers living in it • If any month is quieter, it's August (Census month)
Robinvale Post Office	• Fluctuations throughout the year are small. Visits to the post office to send money back home are fairly constant
Robinvale Amcal Pharmacy	• Overseas workers are predominantly Malaysian • Most foreign workers would be totally unaware of the Census

Stakeholder	Key observation
Euston Club	• Peak season is Mar-May, off season is Sep-Nov • Serving over 480 meals on our busiest nights • Observes quite a high number of itinerant workers from other states
Robinvale Resource Centre	• Workers often leave Robinvale in August to visit family • The most recent and biggest group of overseas workers is from Malaysia • Fear of anything that might affect their visa status prevents many from completing the Census
The Riverside Caravan Park	• Big swell in the harvest season Dec-Apr, new workers coming every day to look for accommodation • Workers mostly there for 3-6 months, though thinks they would not use many services

While most interviewees observed a population peak in February to April and some reported a dip in August, the most persistent feedback was that the 'itinerant or temporary' population in Robinvale is quite steady. This confirms the findings of the 2005 Success Works study, which found that the corporatisation of horticulture had led to year-round activity (and therefore year-round demand for labour). It also aligns with the bank transaction analysis, which does not show a significant fluctuation in unique cardholder counts during the year.

Providers of in-person services (e.g. the post office and pharmacy) are particularly aware of how permanent the non-permanent residents are. One interviewee said that seasonal workers are "almost classed as local".

There are estalished groups within Robinvale such as workers from China, who are more often on skilled worker visas and people from Vietnam, the Phillipines and Cambodia who have long-standing communities in Robinvale. The consensus view is that these groups are likely to comply with census collection. However, there are also less established groups such as workers from Malaysia who are likely to be hyper-vigilant about avoiding anything they percieve might jeopardise their visa status (whether or not those fears are founded). Such groups have become skillful at "going under the radar" and for this reasaon are the most difficult to quantify.

All of these challenges to collecting accurate Census data have been explored and discussed in previous population studies. More recently in 2016, the controversy surrounding the ABS' decision to retain names and addresses may also have heightened any existing fears and further reduced the number of complying seasonal workers.

Further to these known issues regarding Census data collection, the interviewees offered the following indicators of a population higher than the official ABS count:

- Workers housed in commercial properties (no specific numbers available);
- A popular dining venue serving up to 480 meals on a busy night in peak season;
- The same venue recording 1,767 non-resident sign-ins per week during peak season;
- Signs of overcrowding - overflowing rubbish bins[5], noise, multitudes of cars, workers bush camping by the river;
- 4,773 unique customer prescriptions filled in a recent 12 month period. Although these are unique customers, there is no way of determining the proportion that are non-resident. Moreover, there is no publicly available data on per capita prescription rates in Australia. Consequently, this data

[5] The City of Darwin is investigating the use of data on rubbish (by weight) to estimate the municipal service population.

cannot be relied upon to derive a population count, except insofar as to say the figure of 4,773 *suggests* either a higher resident poulation count, or that Robinvale is a popular destination for pharmacy services;

- Qualitative observation of populations by Census collectors prior to the Census night[6]; and
- Issues affecting recent Census collections, for example, immigration raids the day before the 2006 Census that deterred many seasonal workers, and a Taxi Directorate raid that had the same effect the week of the 2011 Census.

With the exception of school enrolments, pharmacy and venue data, this information is not sufficiently comprehensive to derive a reliable quantitative measure of the population. However, these latter inputs can help to validate the analysis. A short summary of them is provided below.

1. SCHOOL ENROLMENTS

The 2005 Success Works Study used actual school enrolments for Robinvale and Euston, and the proportion enrolled as reported in the 2001 Census to derive a 2001 base population (effectively an ERP) for Robinvale and Euston of 4,944. This was some 400 more than the ABS 2001 count of 4,514. However, given that we have very little quantitative knowledge about how many of the uncounted residents have children in Robinvale, this methodology is considered to be unreliable.

2. PHARMACY PRESCRIPTIONS

The 4,773 unique pharmacy prescriptions suggests the ERP is significantly lower than the actual resident population. We can assume:

- Not every member of a household requires a prescription. However, we have no way of estimating the proportion of household members who do visit the pharmacy; and
- Some of the prescriptions are for visitors who are just passing through.

3. VENUE VISITS

The local major dining and entertainment venue provided confidential information on ATM usage, poker machine revenues and temporary (non-resident) visitor numbers. The trends in ATM and poker machine usage are consistent with the peaks in March and April and dip in August and September we find in the bank transaction data (see Section 2.3).

Venue visitor data accounts for people aged 18 and over, not resident within a 25km radius of the venue. In March 2018 there were 7,068 visits[7] (1,767 per week), by adults not resident in Robinvale or Euston. Over 65% of these visitors were signed in using a passport (as opposed to other forms of identification). It is a reasonable assumption that most of these visitors are overseas workers who form part of the service population of Robinvale.

SUMMARY

The preceding three factors provide further evidence that the ERP is not a reliable measure of the actual, semi-permanent service population of Robinvale SA2.

[6] The ABS indicated in writing that in 2006 and 2011, when Census forms were being distributed, the total number of male and occupants in each dwelling was noted down. This was not done for the 2016 Census and for the prior Censuses, the data could not be made available.
[7] This is not a unique visitor count, and probably includes repeat visits

In summary, we can draw the following information from this qualitative analysis:

- All respondents stated that the Census seriously undercounted the true population, although no one was able to estimate the degree of undercounting.
- There is considerable interest from almost all interviewees in the outcome of the Study, and subsequent changes in Robinvale, particularly with regard to overcrowded housing and increasing the available housing. Of the 54 staff who work at Robinvale College, 13 live outside Robinvale itself because they have been unable to find accommodation in the town.
- When asked to estimate the cash/non-cash split for transactions by non-permanent residents, most respondents said about 50/50.
- Venue visitors suggest there may be up to two non-permanent residents for every permanent resident in the Shire (based on the 65%:35% ratio of sign-ins using passports or Australian identification data such as a driver's licence).

2.2 Existing estimates

The 2017 ERP for Robinvale SA2 was 3,359. At the 2016 Census the count was 3,382 and the Place of Enumeration[8] count was 3,460, fewer than 100 more than the ERP. These figures are widely considered to be significantly lower than the true 'resident' population of Robinvale SA2. That is the service population.

In the case of remote locations like Robinvale, a service population is effectively a resident population as there are few goods and services available in easy reach and, so, the population relies on what is available in Robinvale (in terms of health, housing, education, groceries etc).

Various projects have been commissioned to identify the true population of Robinvale. This includes a comprehensive 2005 study, which estimated up to 8-10,000 residents in the Robinvale-Euston catchment. As with this study, various triangulation methods were used to reach this figure. The study used proxy data inputs such as births and school enrolments and a reference class forecasting method (i.e. using similar locations with known populations) to derive the estimate. This study uses a similar technique, with the additional method of using bank transaction data. The benchmark for the analysis is taken from the data in Table 2. That is, we can be reasonably confident that, if the result of the new analysis produces an estimate in the ranges below (that is, more than the ERP or POE), then it is further confirmation of the robustness of the current and previous work.

Table 2: **Existing Population Estimates**

Estimation	Population	Year	Comment
ERP	3,359	2017	Considered a significantly low estimation of the service population count.
POE	3,460	2016	Includes visitors on Census night. Note that the bank transaction data (see next Section) confirms that the low point in economic activity in Robinvale is not at Census time, but in February, therefore, the count cannot be considered a low estimate for this reason.
2016 Census count of non-residents	300	2016	This is the count of people enumerated in Robinvale SA2 with a usual address 'elsewhere in Australia or overseas. It is almost certainly an undercount.

[8] This refers to where people were on Census night.

Estimation	Population	Year	Comment
Robinvale Land Use Strategy	4,500	2005	Derived qualitatively and includes nearby townships.
Success Works Study	6-8,000 (base) and 8-10,000 (peak)	2005	Year-round estimate for Robinvale-Euston catchment.

Source: Geografia, 2019

2.3 New estimations

1. USING BANK DATA

Amongst its data sets, bank transaction data sourced from Spendmapp provides a count of unique cardholders spending in a specific location. These cardholders are defined as residents of, or visitors to Robinvale SA2[9]. Information is also available on when they spend, how much they spend, and what they buy. Combined it provides a useful way to estimate the local service population. That is, the actual daily population in Robinvale.

Due to privacy issues there are some limitations on how this data can be used (for example, we cannot track individual cardholders by age and sex). Nonetheless, we can get a reasonable count of unique cardholders who are not residents of Robinvale SA2 (their bank account details list them as resident elsewhere), but are making regular work and non-work hour transactions in Robinvale purchasing goods and services one would expect of people using Robinvale as their service centre (e.g. buying groceries, professional services and transport services).

The steps to estimate the population from the unique cardholder count are:

1. We exclude unique cardholders who make fewer than five transactions in a year (and are, therefore, likely to be passing through as occasional visitors).
2. We exclude commuters as well. That is, people who do not live in the Robinvale SA2, but are within daily driving distance and are recorded making regular transactions in the town. These people are considered daily commuters, but not residents (the drive time limit has been set at 60 minutes). See Figure 2.
3. We then have an estimate of all unique cardholders per month (to account for the seasonal variability). This provides a ranged count over the year (from the low point in February to the high point in March).
4. We then multiply the cardholder count by a derived ratio of young dependents to adults using two different dependency ratios calculated from the ABS Census data. The lower (0.13 dependent non-cardholders per cardholder) is from the age profile of POE visitors to Robinvale – the ratio of 0-17 year olds to 18+ year olds) and the second (0.28) is the ratio of 0-17 to 18+ residents of Robinvale.

These steps provide us with an estimate of the total population range of people who are living in Robinvale, but not recorded as residents. Figure 3 shows the range, which, over the year averages, 3,846 to 4,366. With the addition of the ERP count (as formally documented, permanent residents, these are excluded from the 'visitor cardholder' count), this gives a total population of between 7,205-7,705. Figure 4 shows how this might vary during the year.

[9] We can distinguish the place of residence of each cardholder down to ABS suburb – SSC - level, or SA2.

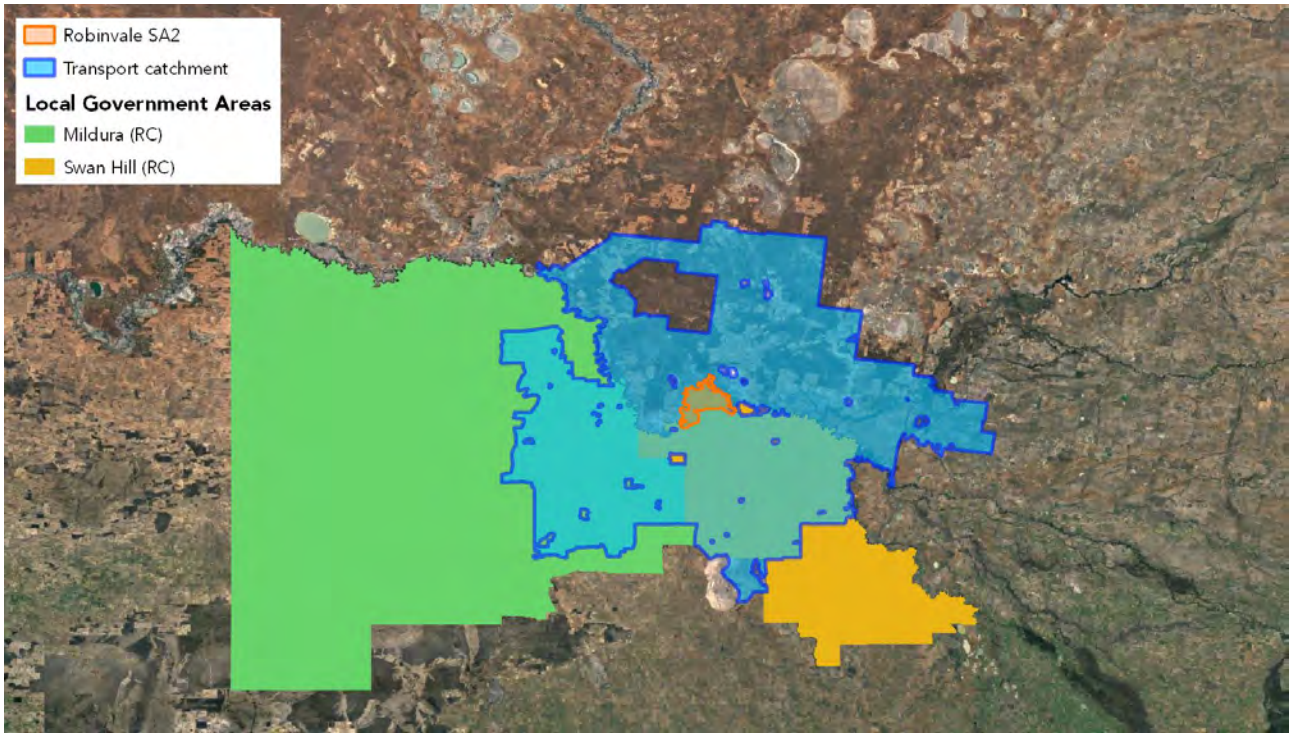

Figure 2: **Commuter and Catchment, Robinvale SA2**
Source: Geografia, 2019

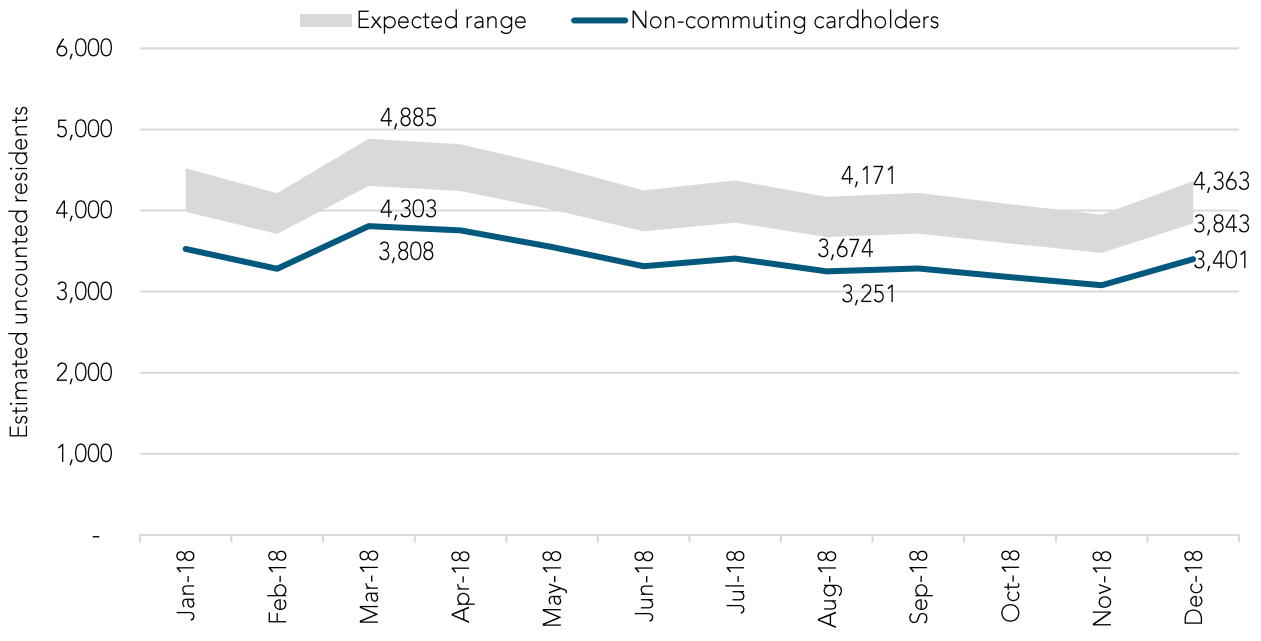

Figure 3: **Temporary and Transient Resident Count by Month**
'Expected range' includes the ERP plus the uncounted residents derived from the bank data estimation (shown here as 'non-commuting cardholders'). Source: Geografia, 2019

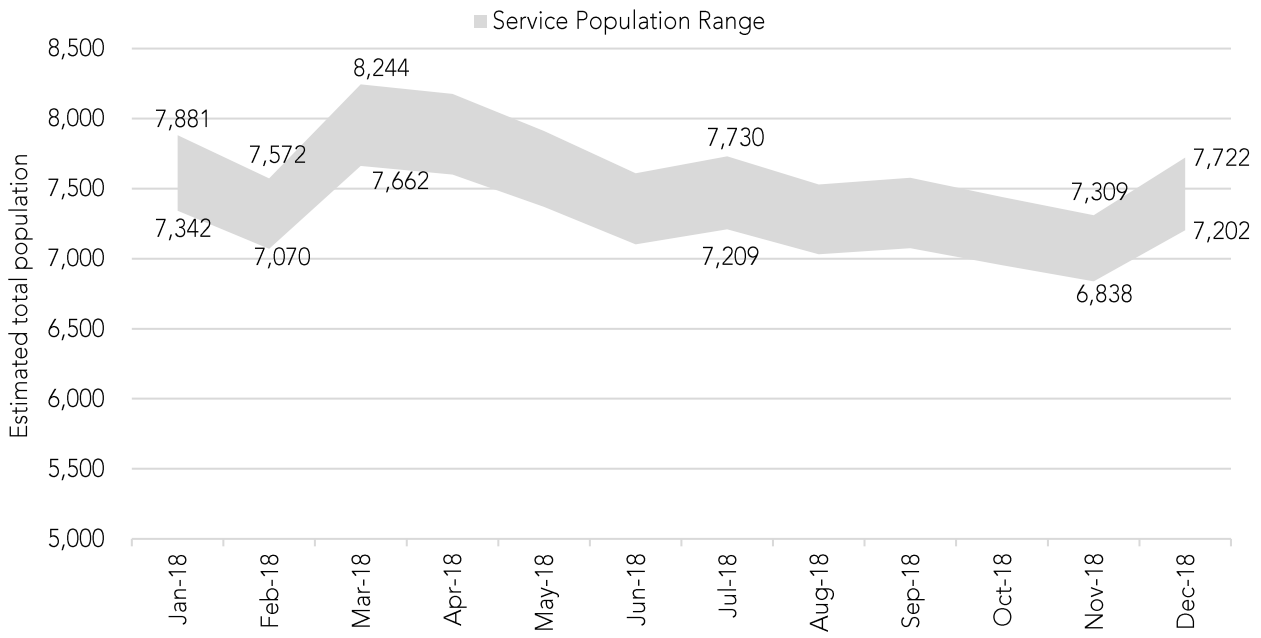

Figure 4: **Estimated Total Service Population, Robinvale SA2**
Source: Geografia, 2019

There are, obviously, risks associated with this estimation technique. These are documented in Table 3.

Table 3: **Bank Transaction Method Risks and Response**

Risk	Response
Excludes individuals who make no expenditure transactions in Robinvale SA2 (cash only or rely on other service centres)	This is considered a low risk. We are attempting to estimate the number of unrecorded workers in Robinvale and can assume they are earning income and therefore, have the capacity to, and need for, purchasing goods and services (food and so forth) locally. While some may go to Swan Hill or Mildura for services, it is unlikely they make no transactions at all during the year in Robinvale.
Excludes residents under 15 years old	Corrected for by using dependency ratio estimates to quantify the ratio of cardholders to family members.
Some 'ERP residents' may not be recorded as resident cardholders	The bank data is provided with close to 100% certainty that cardholder addresses are correctly located.

Source: Geografia, 2019

Given how the risks are mitigated, this is considered the best method currently available.

2. WATER USAGE

Lower Murray Water provided water usage data for the Robinvale township. This has been used to estimate the true resident population.

According to the Department of Agriculture, the typical per person water use in rural Victoria is 120-180L/day, with the higher figure more typical of summer. Applying this to seven years of water consumption data provided by Lower Murray Water, we can calculate an estimate of total persons living in Robinvale. Figure 5 shows the geographical bounds of the area for which residential water consumption data is available and Figure 6 shows quarterly water consumption for this area.

While there is clearly a highly seasonal variation in consumption, as well as a slight

upward trend, we have no way of determining whether these are due to a seasonal fluctuation and overall increase in the population respectively, or an annual and long-term change in consumption habits.

Based on water consumption, then, we estimate a resident population of 6,409 ± 1,474.

Note that this data is only available for the geographical area shown in Figure 5 (the purple boundary is the five SA1s that encompass this area). This means it will be an undercount of the Robinvale SA2 population. To scale this up to the SA2, we have used the ratio of the summed Census count of residents in the SA1s that encompass the area shown in Figure 5 to the SA2 population. This produces an estimate of 9,862 ± 2,268, or 7,593-12,131.

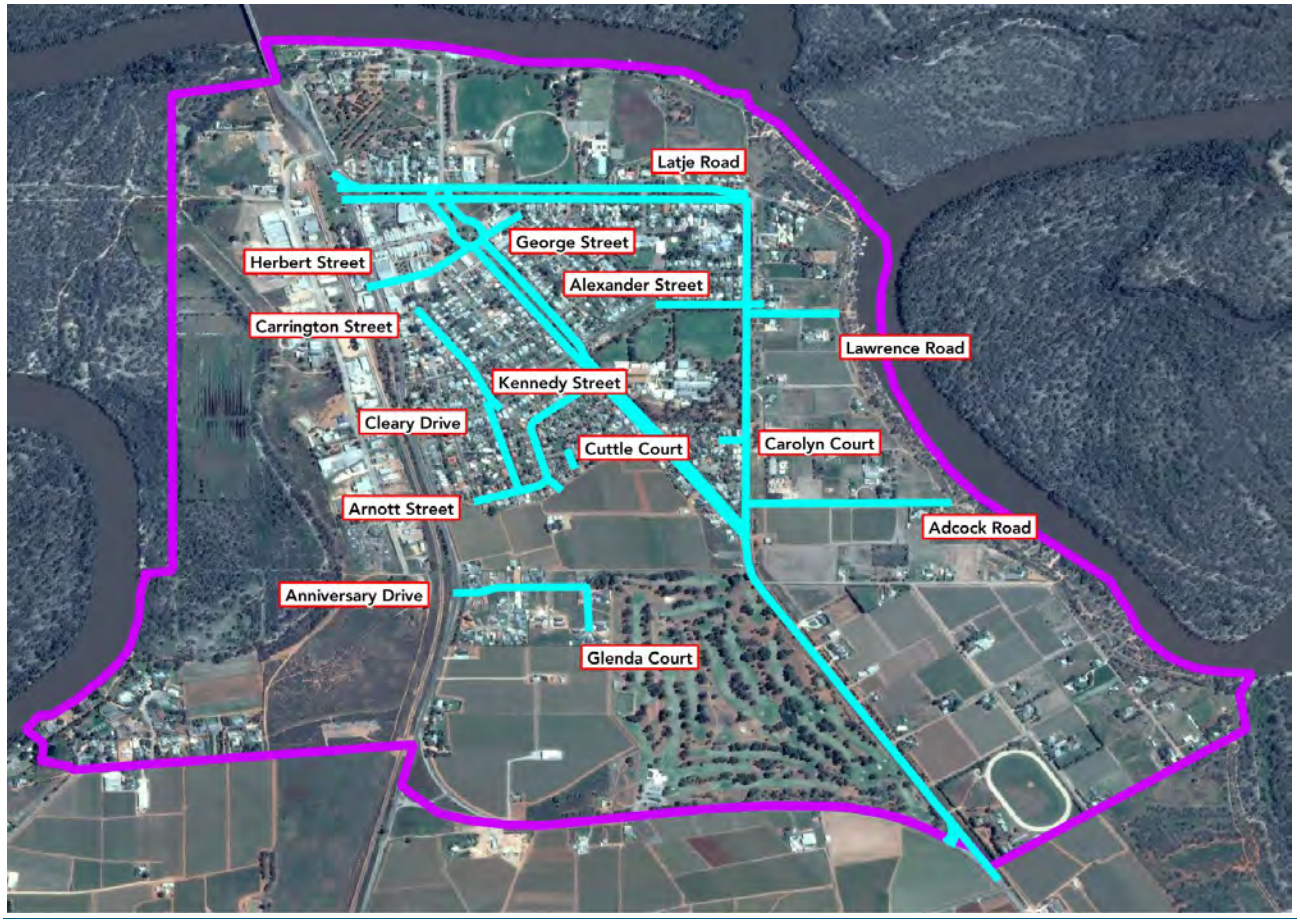

Figure 5: **Water Consumption Area, Robinvale**

Note the boundary shows the SA1 geographies that encompass the water data geography. Source: Lower Murray Water, 2019; ABS, 2017; Geografia, 2019

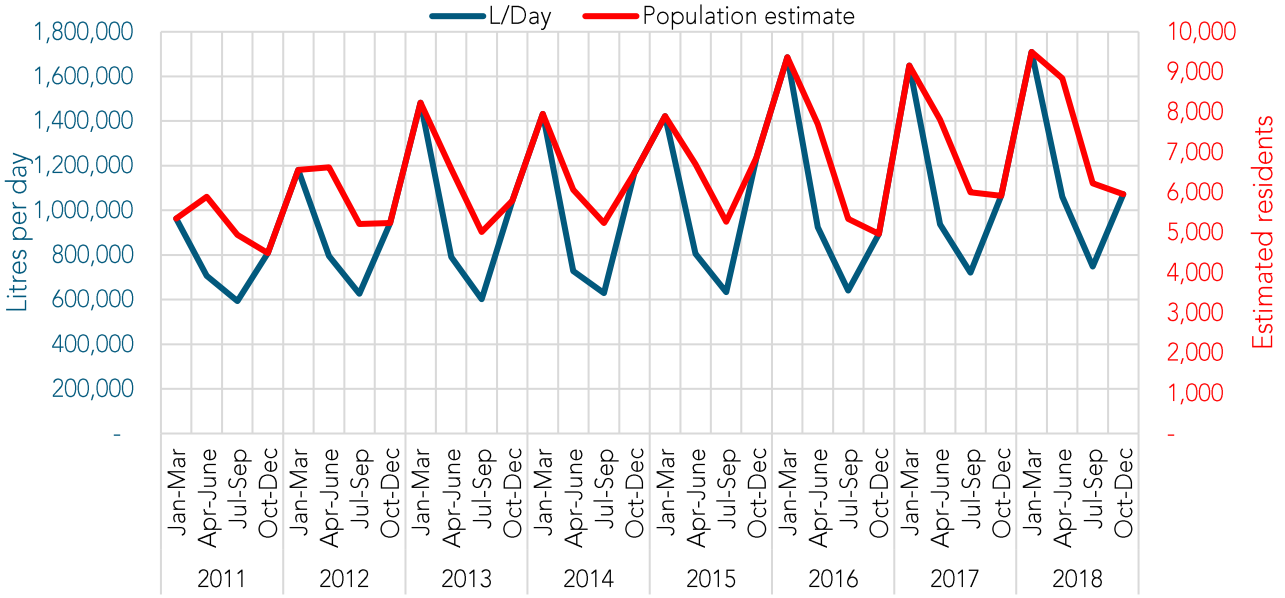

Figure 6: **Daily Water Consumption, Robinvale 2011-2018**
Source: Lower Murray Water, 2019; Geografia, 2019

3. ESTIMATION BY PROPENSITY TO NOT COMPLETE THE CENSUS

The ABS has undertaken various research projects to estimate Census over and undercounts. This is mostly addressed through a Post Enumeration Survey (PES), and then any over or undercount corrected through the rebasing of the Estimated Resident Population. In theory, then, the errors (e.g. of missing certain cohorts, or getting a non-response for certain dwellings) are addressed. This means the ERP can be relied upon as an accurate count.

However, as the qualitative research has shown, there are significant cohorts of people in Robinvale (and in other, similar settings) that are not accounted for in these recalculations. If we assume that the rebasing is not working in Robinvale, we can add the estimated missing count to the ERP.

Indigenous residents

Much of the ABS's research into over and undercounts focuses on Aboriginal and Torres Strait Islander communities. The latest finding concludes there is an average undercount of Indigenous residents of 17.5%. Based on the 2016 count of Indigenous residents in the Robinvale SA2, this would mean there are 307 and not 261 Indigenous residents in the SA2. Adding the difference increases the ERP to 3,428.

Dwelling coverage

Each Census also reports a dwelling response rate that indicates *"…the number of private dwellings that returned a completed Census form as a proportion of all private dwellings believed to be occupied on Census night."* (ABS, 2019).

Assuming the missing dwellings are 100% occupied by Indigenous or temporary residents (e.g. fruit pickers), we can make a simple calculation using an average household size of 3.59 (calculated using 2016 Census data) to estimate an additional 248 residents in Robinvale SA2 not picked up in the PES adjustments. This brings the ERP to 3,676.

Net undercount by country of birth

The ABS reports that Australian-born residents have the highest undercount rate (8.1%). Given the anecdotal evidence that it is undocumented workers, or new migrants in Robinvale that are more likely to be missed in the Census, the formulation of this undercount rate is likely to be irrelevant and, so it is not considered here.

Given that this ABS research identifies undercounting through the PES, and, in all likelihood, the very same people in Robinvale not counted in the Census are also not likely to be participants in the PES, applying the techniques described above are very unlikely to capture the true undercount. All it achieves is to improve the ERP estimate.

Overall, then, while this information may be useful, it is not included in the triangulation exercise.

4. ENSEMBLE ESTIMATE

By considering all of the methods deployed, we have two population range estimates for Robinvale SA2:

1. **7,205-7,725** - The smaller (and lower) bank transaction data derived estimate.
2. **7,593-12,131** - The larger (and higher) water usage derived estimate.

Averaging these produces a range of 7,399-9,928, with a mean of 8,664.

However, we cannot be as confident of the water consumption data as we can of the bank data. This is because the water consumption method is very sensitive to the per capita water use assumption. Consequently, the two estimates should be weighted. For this exercise, the bank data was given a weighting of 0.8 and the water consumption derived value a weighting of 0.2. This generates a mean estimate of 7,944.

Given the variation in bank transactions over the year (as seen in Figure 3), this population may vary from around 7,000 in November to 8,800 in March. However, a longer time-series of transaction data is needed to confirm this.

What we can say is that the mean estimate from the bank and water consumption data methods falls well within the Success Works estimation.

OTHER METHODS

Analysis of the interview outcomes and the method using a propensity to not complete the Census suggests there is little value in continuing to examine most of the data sources identified, not least because it has proven difficult to gain support for these qualitatively derived alternative methods.

Several authorities suggested that mobile phone usage would be a useful source of data. While tower data was not available for this Study (due to the cost) but it is worth noting for future reference, although it is important to note that mobility data has limitations, not least of which are:

- Each phone service only has data for their customers (so, for example, Telstra data has 25% coverage). The data is usually scaled up from this using Census data, so there is a substantial degree of estimation involved;
- No phone users are 18 are counted; and
- EU citizens are excluded.

More detailed bank transaction data can also be purchased that provides age and gender information. This can further refine the estimation method outlined earlier by focusing on the specific age cohorts usually associated with the undercounted population (e.g. young workers). For this Study the cost of this additional data was prohibitive.

3.0 Commentary on Method

For the purposes of arguing for recognition of a larger resident population, we have outlined the methodology used in Section 2.0 and why this is considered robust.

3.1 Using bank data to estimate population

Bank transaction data is a highly accurate dataset that documents the residential address of cardholders and the location and timing of the transactions they make.

By using 'unique visitor cardholders' we are accounting for all people who use any card (a unique cardholder may have more than one card from more than one bank, but 'unique' refers to the individual, not the card. This includes international cardholders and, therefore, people such as overseas backpackers working in horticulture.

According to people interviewed for this study, many transactions are made with cash only in Robinvale. However, research from the Reserve Bank of Australia has shown a persisentily declining cash/non-cash ratio of transactions, which is now almost zero for any transactions over $100. While many smaller transactions will undoubtedly be in cash (and therefore not picked up as a cardholder transaction), we consider it highly unlikely that services such as doctors' appointments are paid using cash.

Where there is some uncertainty in this method, it relates to using a scaling factor (e.g. a dependency ratio) to account for non-cardholder members of the family household (primarily dependents under 15).

We then used two different ways to calculate the Robinvale SA2 dependency ratio, finding a range from 0.13 to 0.28. That is, for every cardholder, there are between 0.13 and 0.28 dependent non-cardholders. This is the scaling factor used in the analysis.

To test this, data from a sample of 12 rural LGAs currently using Spendmapp was examined to measure the ratio between resident cardholder and ERP. This gives us an alternative, non-Census reliant way to define a range for cardholder/non-cardholder family members. We found a range from 0.25-0.45. Given our scaling factor overlaps with this range, we can draw from this that the method is reliable.

Overall, then, using the unique cardholder count is a cost-effective method for estimating a service population. It is an innovative method of applying 'big data' to the long-standing problem of knowing how many people a local council needs to service. While it does have limitations (not all residents are cardholders and not all cardholders make transactions), the best alternative (mobile phone data) suffers from similar problems and, certainly for this study, it a more costly method.

3.2 Water usage

The water usage method delivered a plausible, but wide range estimate of the resident population. This is because of the sensitivity of the method to the average per person daily consumption rate. We believe further analysis and additional data to improve this method.