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DRAFT FINAL REPORT

2017 PUGET SOUND REGIONAL TRAVEL STUDY



PREPARED FOR:
PUGET SOUND REGIONAL COUNCIL

SUBMITTED BY:
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STUDY SPONSORS

- Puget Sound Regional Council
- City of Redmond
- City of Seattle

CONSULTANT TEAM

- RSG (Prime Consultant)
- ETC Institute (Sub-Consultant)

GLOSSARY OF TERMS

TERM	DEFINITION
ABS:	Address-based sampling (ABS) draws from a complete list of households within a given geographic area. This study’s sampling frame was the full list of addresses in the specified Census Block Groups (BGs) as available from the United States Postal Service (USPS) Computerized Delivery Sequence File.
ACS:	The American Community Survey (ACS) is an ongoing U.S. Census Bureau survey that gathers demographic and other person- and household-level information. ACS estimates informed this study’s sampling and weighting methods.
BG:	A Block Group (BG) is a statistical division of a census tract and a contiguous geographic area that typically contains 600–3,000 people.
GPS:	This study included a smartphone component that collected Global Positioning System (GPS) coordinates from participants’ smartphone devices. GPS is a satellite system that collects both time and location (latitudinal and longitudinal) points.
Group:	In the context of this study, a “group” refers to the mode through which households completed the travel diary portion of the study. Group 1 households completed Part 2 using rMove (a smartphone app), and Group 2 households completed Part 2 using rSurvey (an online survey platform). Groups were not assigned until each household completed Part 1 (the demographic and household information section).
HH:	In this study, a household (HH) encompassed “anyone who lives in the home, including roommates, relatives, friends, and household help.”
HTS:	A household travel survey (HTS) is a periodic survey that collects trip and other travel information from an entire household for a predefined period (at least one full day).
PSRC:	The Puget Sound Regional Council (PSRC) “is a regional planning agency with specific responsibilities under federal and state law for transportation planning, economic development and growth management.” ¹
RGC:	The Puget Sound region includes 29 Regional Growth Centers (RGCs), which are “locations of the region’s most significant business, governmental, and cultural facilities and are planning for growth.” ²

¹ Source: <https://www.psrc.org/about/what-we-do>

² Source: <https://www.psrc.org/centers>



TERM	DEFINITION
rMove:	rMove™ is a smartphone app designed to collect complete household travel diary information from invited participants. The app is compatible with most Android and iOS phones that are less than four years old. The study was designed to allow approximately 20% of participants to complete Part 2 using rMove.
rSurvey:	rSurvey™ is an online travel survey platform designed to collect complete household travel diary information from invited participants. All participants completed Part 1 using rSurvey, and approximately 80% of participants completed Part 2 of the study using rSurvey.
Travel date:	In the context of this study, a “travel date” is the first (or only) day on which a household reported its trips.
UV:	The City of Seattle has designated 41 areas as urban villages (UV). These are “areas where conditions can best support increased density needed to house and employ the city’s newest residents.” ³

³ Source: <https://www.seattle.gov/Documents/Departments/OPCD/OngoingInitiatives/SeattlesComprehensivePlan/UrbanVillageElement.pdf>

1.0 INTRODUCTION

1.1 | STUDY OBJECTIVES

The 2017 Puget Sound Regional Travel Study followed the 2014–2015 Puget Sound Regional Travel Study and was the start of a planned six-year data collection effort that will likely include two additional data collection waves in 2019 and 2021. The 2017 study, like the most recent studies, collected household- and person-level activity and travel pattern information from residents throughout the Puget Sound Regional Council (PSRC) four-county region.

The overarching goal of the multiyear program is to maintain an updated source of household travel behavior data that:

- supports modeling and planning needs,
- facilitates trend analysis over time, and
- allows for regular study design updates to integrate evolving data collection methods and emerging travel behaviors and transportation issues.

1.2 | STUDY AREA

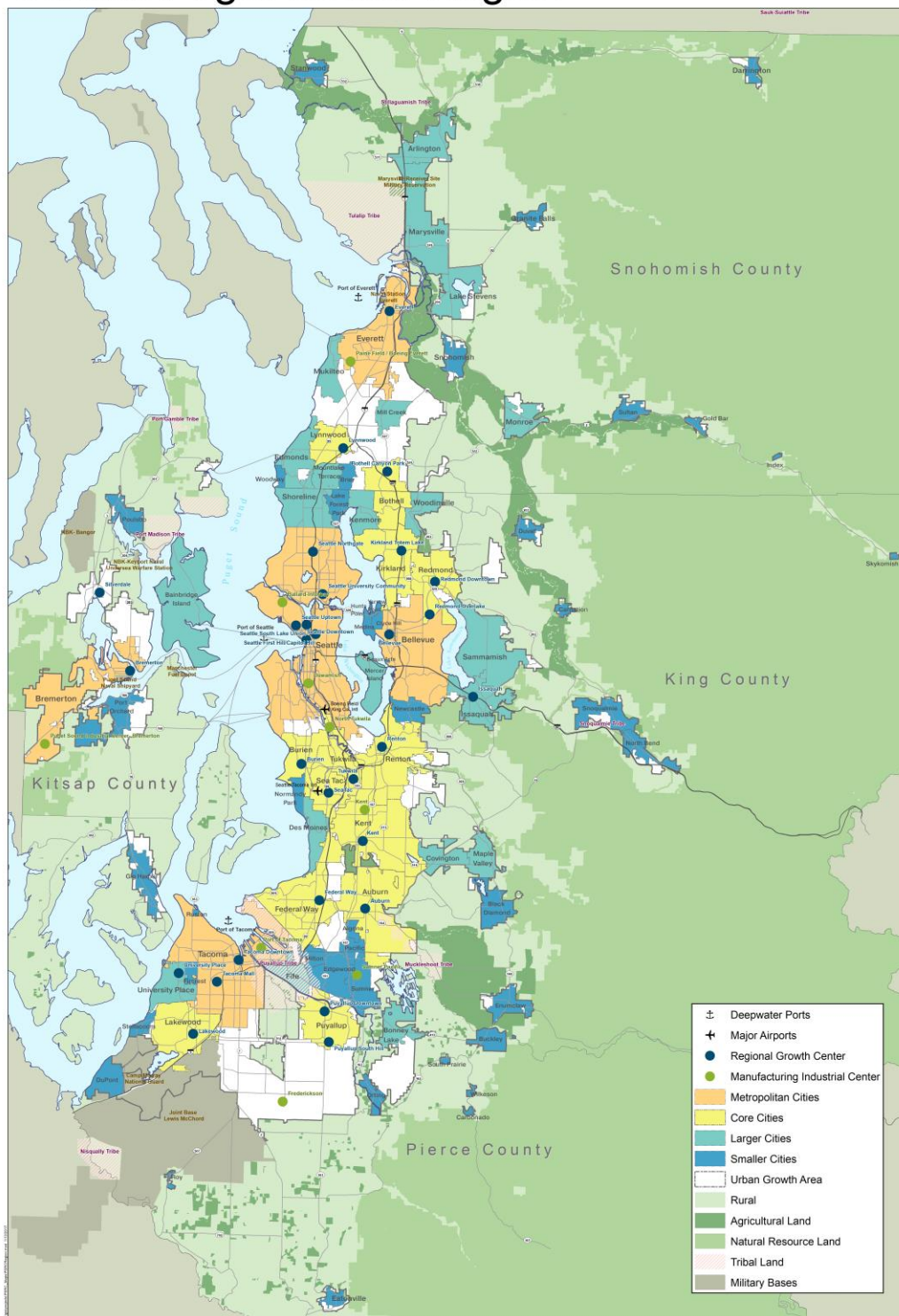
Consistent with recent surveys, the 2017 study encompassed the entire PSRC four-county region, which includes King, Kitsap, Pierce, and Snohomish counties. The region includes 82 cities and towns with a total population of over four million people. The study area comprises approximately 1,495,642 households.⁴

⁴ Estimated residential household population from ACS 2011–2015 five-year estimates.



FIGURE 1: MAP OF STUDY AREA (PROVIDED BY PSRC)

Central Puget Sound Region



1.3 | STUDY TIMELINE

The scope of work for this project included both the design and administration of a one-day household travel diary (approximately 80% of households before data cleaning) and a seven-day smartphone GPS diary (approximately 20% of households before data cleaning). Table 1 documents the project's schedule.

TABLE 1: STUDY TIMELINE

PHASE	TIMELINE
Scope Refinement	Jan. 2017–Feb. 2017
Survey Design	Feb. 2017–Apr. 2017
Survey Implementation	Apr. 2017–June 2017
Data Processing and Cleaning	June 2017–Dec. 2017
Documentation	June 2017–March 2018
Data Analysis and Weighting	Dec. 2017–March 2018
Project Closure	March 2018



2.0 SURVEY SAMPLING

2.1 | SAMPLING GOALS

The 2017 study aimed to sample 3,100 complete households, which equates to a 0.21% sample rate (based on data from the 2011–2015 American Community Survey (ACS)). This sample goal included targets for the three sponsoring agencies:

- **PSRC:** 1,100 complete households in the four-county study region.
- **City of Redmond:** 450* complete households in Redmond.
- **City of Seattle:** 1,550* complete households in Seattle’s urban villages (UVs).

(*These samples exclude any households in those cities surveyed in the core regional sample.)

Typical sample rates for similar studies range from approximately 0.5–1%. The combined sample rate will likely fall within this typical range because the 2017 study was only the first data collection wave of a planned three-wave study—the goal is to combine data across multiple waves. By comparison, the 2014 study had a sample rate of approximately 0.6%. The sections below further explain the process RSG used to determine the final sample rates for each Census BG.

2.2 | SAMPLING METHODS

SAMPLING FRAME

The primary sampling frame was the list of all households in the four-county study region (King, Kitsap, Pierce, and Snohomish counties)⁵. RSG used address-based sampling (ABS) to select and invite households to participate in the study. ABS involves drawing a random sample of addresses from all the residential addresses in each defined geography such that all households in each defined geography have an equal chance of selection for the sample. RSG purchased the final household mailing addresses from Marketing Systems Group, which maintains the Computer Delivery Sequence file from the USPS.

STRATIFICATION

RSG first established the target sample sizes for each region. This was done to achieve the sampling goals for each of the sponsoring agencies. The contracted sample sizes were determined within and by each agency based on long-term data needs; however, to simplify the sampling approach in these overlapping sub-regions (with part of PSRC’s sample coming from the City of Redmond and the Seattle UVs), RSG grouped the proportion of PSRC’s sample expected in the Redmond and Seattle sample sub-regions with the samples for those sub-regions.⁶ Table 2 shows the contracted and adjusted sample sizes for each region.

⁵ The sampling frame was defined and stratified using ACS estimates of number of households in each Census block group; based on these ACS estimates, 17 block groups with no households or very few households (fewer than 33) were excluded from the sample analysis and final sample frame.

⁶ RSG assumed that the PSRC sample should be allocated proportionally to the number of households in ACS 2011–15, so 7.9% (87 out of 1,100) were in the Seattle UVs and 1.7% (19 out of 1,100) in Redmond.

TABLE 2: ORIGINAL AND ADJUSTED TARGET SAMPLE SIZES BY SUB-REGION

SUB-REGION	CONTRACTED SAMPLE SIZE	TOTAL HHs, ACS 2011-15	% OF REGIONAL HHs	HHs IN THE PSRC SAMPLE	ADJUSTED TARGET SAMPLE SIZE
City of Redmond	450	24,398	1.6%	18	468
City of Seattle UVs	1,550	117,421	7.9%	87	1,637
Rest of PSRC	1,100	1,353,823	90.4%	995	995
TOTAL	3,100	1,495,642	100%	1,100	3,100

Once the total sample targets were finalized for each sub-region, the sample targets within each region were stratified to achieve each agency’s objectives. Strata were defined using BGs and ACS data.

“Rest of PSRC” Stratification

Following the same approach as in 2014–2015, the ABS plan for the 2017 study included a combination of simple geographic proportional sampling along with “targeted oversampling” (sampling at higher rates in selected geographic areas of interest) and “compensatory sampling” (sampling at higher rates according to the expected response rates in different BGs). Oversampling efforts were targeted at areas with the highest presence of household types and travel behaviors that are typically underrepresented or rarely found, but of interest for policy and planning goals. By targeting these areas for oversampling, the likelihood of reaching the target demographics increased. The variables considered for oversampling included low-income households, households without vehicles, non-auto commuters, and renter households with young heads of household.⁷ These variables are often spatially correlated across BGs— a high proportion of one or two variables means an increased likelihood that other variables are higher. However, it was also important to identify BGs that were high in one variable, but not others, to improve analysis. (For example, BGs with high numbers of zero-vehicle households that are not located in urban/accessible areas.) Additionally, as in 2014–2015, the sample objectives included oversampling in PSRC’s Regional Growth Centers (RGCs).

To achieve the sampling objective, RSG identified BGs eligible for oversampling. The identification process in the 2017 study used nearly the same logic as in the 2014–2015 study. The “targeted oversample” segments included any BG that met any one of the following criteria, based on data from the 2011–2015 ACS:

- BGs designated as part of an RGC.
- BGs where 35% or more of HHs have income less than \$25,000.
- BGs where 20% or more of HHs do not own a vehicle.
- BGs where 40% or more of workers do not commute by car.
- BGs where 40% or more of HHs are renters with head of household under age 35.

These criteria were based on analysis of these ACS variables which evaluated the concentration of these characteristics; block groups with the highest concentration of these variables of interest were chosen. Specifically, block groups that were approximately in the 90th percentile or above for a given characteristic were chosen for oversampling. (For example, when ranking block groups by the proportion of low-income

⁷ The focus on young renter households is slightly different from 2014-2015, when the focus was on young one-person households, as one-person households tend to have high response rates.



households, RSG found that in the top 10% of block groups, 35% or more households had incomes less than \$25,000). Once the PSRC region BGs were divided into “regular” and “targeted oversample” segments, RSG set sample targets for each of these segments. As was done in the 2014–2015 study, RSG recommended a sample rate in the “oversample” segment that was 2.5 times that of the “regular” sample (or 0.15% for the “oversample” segment and 0.06% for the “regular” segment). This recommendation was based on the assessment of desired sample sizes (and expected results based on ACS data) for these variables of interest. For example, to analyze and model travel behaviors for zero-vehicle households, the desired sample size from block groups with more than 20% zero-vehicle households should be large enough to collect a statistically significant sample of these households.

These segments were then further divided into response rate groups (low, medium, and high response) to conduct “compensatory oversampling,” which produced six sampling segments. Response rates for each BG were predicted using a model developed with ACS data and response rates from previous surveys;⁸ this model indicated which BGs were more likely to have “low,” “medium,” or “high” response rates. These predicted response rates were then reduced slightly to provide more conservative estimates.

“City of Redmond” Stratification

The sampling plan for the City of Redmond was designed using the same logic as for the “Rest of PSRC” (using the same variables and targets for targeted oversampling and using the same model to predict response rates for compensatory oversampling). The main difference was that two BGs designated as “downtown” Redmond were singled out for higher oversampling. A primary objective for the City of Redmond was to obtain approximately half of their sample from their downtown area (composed of two BGs). Based on the expected response rates and total number of households in downtown Redmond, the desired sample size was determined to be difficult to achieve. Thus, RSG and Redmond decided to invite 100% of households in the downtown BGs to maximize the number of possible responses. The city also conducted additional recruitment and outreach activities to encourage response (discussed in Section 4.0). The sample in Redmond was stratified into seven segments using the downtown sample and the targeted and compensatory oversampling. (Two of these potential segments— “low-response” groups in the regular and downtown BGs—did not contain any households.) Like PSRC, the predicted response rates were reduced slightly to be more conservative.

City of Seattle Urban Villages (UV) Stratification

The City of Seattle requested a different type of sampling strategy. The 41 UVs within the city’s sample were split into three types: 1) Urban Centers; 2) Hub UVs; and 3) Residential UVs (also including the two manufacturing/industrial centers). A “minimum target” was set for each type of UV—40 complete households for the Urban Centers, 30 for the Hub UVs, and 20 for the Residential UVs. The sum of these targets was 1,180, leaving another 460 households to reach the total target of 1,640 for this segment. These were distributed in proportion to the number of households living in each UV to set the final targets. Once the sample target for each UV was set, the same model was used to predict response rates and invitation needs (again adjusting down to be conservative). The number of invitations needed in each UV to meet the final targets was then estimated based on the predicted response rates. To reduce the

⁸ Bradley, et al. “Predicting and Applying Differential Response Rates in Address-Based Sampling for a Household Travel Survey,” V. 2526 of the Transportation Research Record (2015)

number of total sub-segments, the UVs were then grouped into ten categories, based on the (rounded-up) percentage of addresses in those BGs that were purchased.⁹ The categories were 100%, 90%, 75%, 60%, 50%, 35%, 30%, 25%, 15%, and 10%. RSG separately monitored the 41 UVs, even though they were grouped for address purchasing.

SAMPLE RATES

Table 3 includes the final sampling segments and sample rates.

⁹ Two UVs (South Park and University Campus) were estimated to require invitations to more than 100% of residential households, based on population size, sample target, and predicted response rates. These UVs were grouped with the “100%” invitation category.



TABLE 3: 2017 SAMPLING SEGMENTS AND SAMPLE RATES

(SEGMENT)	HHs (ACS 2011–2015)	TARGET SAMPLE RATE	TARGET SAMPLE SIZE	PREDICTED RESPONSE RATE	# INVITES
PSRC REGULAR					
(01) low response rate	248,641	0.06%	149	4.35%	3,440
(02) med. response rate	424,662	0.06%	255	5.70%	4,510
(03) high response rate	420,263	0.06%	252	7.60%	3,330
PSRC OVERSAMPLE					
(11) low response rate	162,911	0.15%	244	4.35%	5,630
(12) med. response rate	46,145	0.15%	69	5.70%	1,220
(13) high response rate	51,201	0.15%	76	7.60%	1,020
<i>PSRC Total</i>	1,353,823	--	1,046	--	19,150
REDMOND REGULAR					
(22) med. response rate	3,868	1.10%	43	5.70%	750
(23) high response rate	12,798	1.10%	141	7.60%	1,860
REDMOND OVERSAMPLE					
(31) low response rate	2,185	2.75%	60	4.35%	1,390
(32) med. response rate	1,331	2.75%	37	5.70%	650
(33) high response rate	1,746	2.75%	48	7.60%	640
REDMOND DOWNTOWN					
(42) med. response rate	835	5.70%	48	5.70%	660
(43) high response rate	1,635	7.60%	124	7.60%	1,640
<i>Redmond Total</i>	24,398	--	500	--	7,590
URBAN VILLAGE SEGMENT					
(50) 10%	29,926	0.80%	238	7.95%	3,000
(51) 15%	32,972	1.03%	339	6.85%	4,950
(52) 20%	13,067	1.16%	151	5.78%	2,620
(53) 25%	8,801	1.08%	95	4.32%	2,210
(54) 30%	10,179	1.96%	199	6.52%	3,060
(55) 35%	11,738	1.67%	196	4.77%	4,110
(56) 50%	2,970	3.43%	102	6.87%	1,490
(57) 60%	3,220	2.86%	92	4.76%	1,940
(58) 75%	1,788	4.87%	87	6.49%	1,350
(59) 100%	2,760	5.11%	141	5.11%	2,743
<i>Urban Village Total</i>	117,421	--	1,640	--	27,473
TOTAL	1,495,642	--	3,186	--	54,213

2.3 | SAMPLE MONITORING

Throughout the data collection period, RSG monitored response rates to ensure that the survey response was on target, both overall and by individual segment. This monitoring included several steps.

1. RSG provided an internal project webpage—available to PSRC—that summarized demographic distributions for households that completed the entire study and for household that only completed Part 1 of the study. This webpage was updated automatically daily.
2. RSG also maintained an internal Excel workbook—available to PSRC—that forecasted final completion rates based on observed response rate trends. These rates were monitored by participation group (i.e., rSurvey™ vs. rMove™) to account for differences in methodology. Updated forecasts were shared with PSRC on a biweekly basis.
3. RSG, PSRC, and the cities of Redmond and Seattle conducted a “midpoint review” after the first few weeks of data collection to determine what adjustments might be needed to help meet sampling objectives.

Overall response was monitored at several levels:

- **Primary target:** Meet the total number of households for the study (3,100 HHs across the region).
- **Secondary target:** Ensure that the response is proportional in each sample segment.
- **Tertiary target:** Ensure that the response is proportional across demographics or geographic areas (e.g., by home county or region, UV, household size, income, and vehicle ownership).

During the data collection period, it was important to distinguish between various levels of monitoring because it helped prioritize potential adjustments. For example, when the trends observed at the midpoint review meeting indicated that the survey was below its target for households outside of King County, RSG and PSRC decided to offer an extra incentive (an additional \$10 per household) to the households in those counties. Based on input from the City of Seattle, an extra incentive was also offered to select Seattle UVs. The other adjustment made following the midpoint review meeting was to re-invite households that had recruited but not completed Part 2 of the survey. These households were reassigned to a new travel date for the last week of the study. Below is a full list of the potential adjustments RSG discussed with PSRC and the cities of Redmond and Seattle:

Implemented:

- Reassign/re-invite households that missed their original travel dates.
- Offer larger incentives to households with low-response.

Not Implemented:

- Send additional reminder e-mails.
- Make additional recruitment and reminder phone calls.
- Keep the survey open longer.
- Conduct additional general outreach (e.g., press releases, media outreach).
- Conduct additional targeted outreach (e.g., fliers, door-to-door outreach).



3.0 SURVEY DESIGN

3.1 | OVERVIEW

The 2017 study combined data collection methods, including smartphone, online, and telephone. The goal of this design was to balance the strengths of innovative technologies with traditional experience and best practices derived from traditional market research. This balances the need to adapt new survey methods over time with the need to collect comparable results and conduct trend analysis. As described in more detail in the following sections, the survey design included several stages to recruit and collect data about households, their members, and their travel behaviors during the assigned travel period.

3.2 | SURVEY STAGES AND PARTICIPATION METHODS

As explained in Section 2.0, this study used a traditional ABS approach, and RSG notified invited households via mail (see Section 4.0). The mailed materials instructed households to visit the study website or call a toll-free number to complete Part 1 (the demographic “recruit” survey). Households received instructions for Part 2 (the travel diary) upon completing Part 1.

PARTICIPATION GROUP ASSIGNMENTS

Part 1 of the study included two questions about smartphone ownership. Participants over age 18 were asked to specify what type of smartphone they had (if any) and the phone’s age (i.e., is the phone less than four years old?). RSG then used this information to determine group assignments. Group 2 participants were required to report their travel for one-day online using rSurvey, while Group 1 participants reported their travel for seven days using rMove. The goal at the start of the study was to recruit approximately 20% of total households for Group 1. Based on typical rMove completion rates from previous studies, only 140 households each week could opt into Group 1. The first 140 households in which all adults reported owning rMove-compatible smartphones could opt into Group 1. The remaining households were not offered this option and were assigned to Group 2.

TRAVEL DATE ASSIGNMENTS

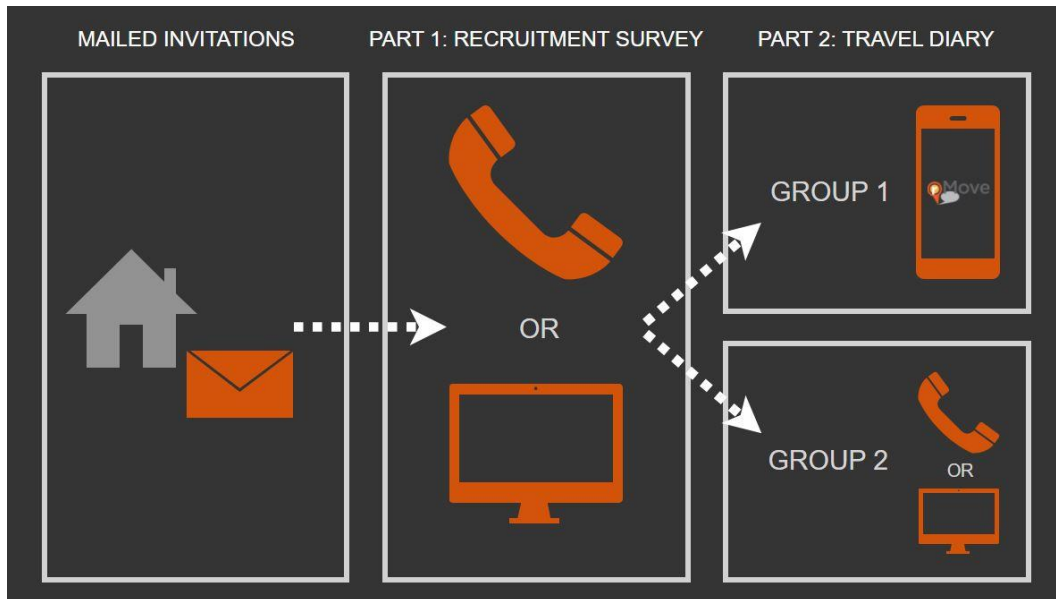
All households were preassigned to a Tuesday, Wednesday, or Thursday travel date during the study period. Travel days were assigned randomly but were proportional across days and within segments. Households that opted into rMove participation were reassigned to a one-week travel period (always beginning on a Tuesday) following the date on which they completed Part 1 (to allow time for the household to download the app and prepare for data collection). rSurvey households that completed Part 1, but that did not complete Part 2, were eligible for travel date reassignment at the end of the study. A total of 433 households were re-invited to participate on May 31, 2017. Of the re-invited households, 21 completed the study.

STUDY COMPONENTS

All households completed Part 1 either via the online survey or through the call center. (When households called the call center, a representative utilized the identical online survey instrument, resulting in consistent data coding for telephone and online responses.) Part 1 collected general demographic information (e.g., household size, household income), established information to facilitate Part 2 (e.g.,

home/school/work addresses, number of vehicles), and obtained any additional household-level information (e.g., whether the home is owned or rented). Part 2 collected all trip and travel day information and any person-level information (e.g., how often the participant bikes or uses transit). Group 1 participants reported their trip and travel day information through rMove and were asked to return to the online survey to answer the additional person-level questions about typical travel behaviors and preferences. (rSurvey participants answered these person-level questions as part of their travel diaries.)

FIGURE 2: STUDY COMPONENTS AND GROUP ASSIGNMENTS



LANGUAGE OPTIONS

The survey (as administered via rSurvey and rMove) was written entirely in English; the online surveys included a built-in Google translate bar. Households that spoke Spanish, Russian, Chinese, Korean, Tagalog, and Vietnamese could also call a separate toll-free line to complete the survey over the phone in their preferred languages. Approximately 75 households used the online Google translate tool to complete the survey.

3.3 | SURVEY INCENTIVES

RSG offered \$10 gift card incentives—as advertised on the study mailed materials—to all households that completed the study. Traditionally, transportation studies offer incentives to boost response rates and decrease the overall cost of mailed invitations (i.e., without incentives, the number of required households to invite increases. This increased mailing cost is greater than the cost of incentives). Invited households could choose from physical or electronic gift cards from either Amazon.com or Starbucks. Households also had the option to opt out of receiving a gift card. These were the same options offered in the 2014–2015 (selected after testing in the 2014 pilot survey). While the study invitations advertised one \$10 gift card per complete household, some households were eligible to receive additional cards or increased increments. All households that completed Part 2 using rMove earned \$15 per adult. Households in downtown Redmond qualified for an additional \$10 at the household level (part of the Redmond outreach plan).



When RSG and PSRC noted that the response rate outside of King County was below target (during the midpoint review), the incentive plan was adjusted further—all households that recruited into the study after the adjustment and lived outside of King County qualified for an additional \$10 at the household level. RSG made the same adjustment for households in selected UVs¹⁰ that were below target and prioritized by the City of Seattle during the midpoint review. These adjustments were designed to increase completion rates among key demographics and geographies. The direct impact of the additional incentives was inconclusive, because the final number of households offered the extra incentive was relatively small and because response rates for the entire region decreased slightly over the course of the study period.

3.4 | HOUSEHOLD, PERSON, AND VEHICLE DATA COLLECTED

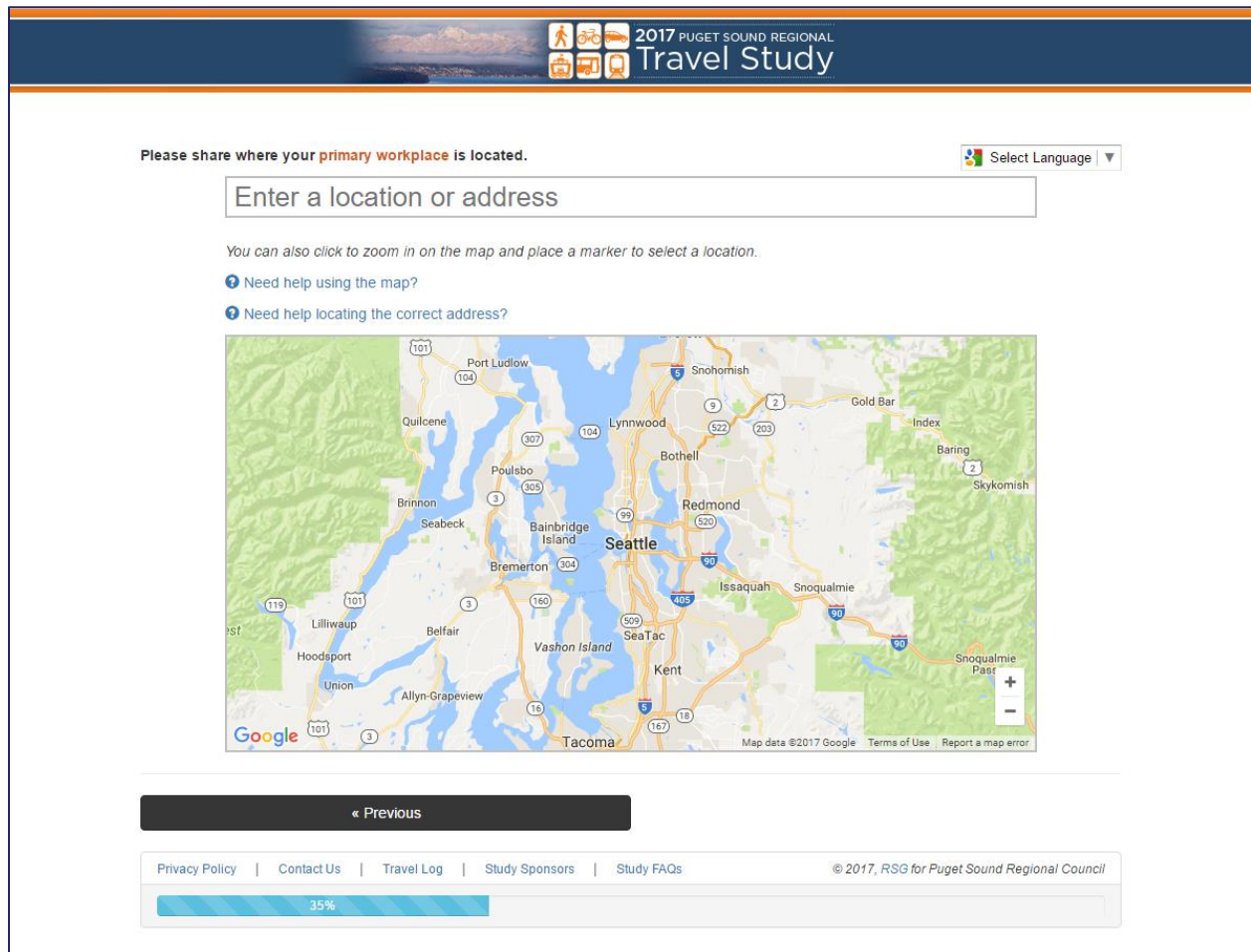
Part 1 of the survey was the main collection source of household, person, and vehicle data. Households could complete this section any time after the study opened, and up to eight days after their assigned travel dates (when their household travel diaries closed). Part 1 was organized into the following question categories:

1. Vehicle ownership.
2. Household membership details (e.g., age, relationship, smartphone ownership).
3. Work and school information.
4. Home and previous home details.
5. Home location preferences.
6. Household income.
7. Incentive and communication preferences.
8. Part 2 completion instructions.

The survey collected all address information for current and previous “habitual” locations (e.g., home address, work address, school address) using a built-in real-time geocoder (see Figure 3).

¹⁰ Belltown, Greater Duwamish, Northgate, Pike/Pine, Pioneer Square, South Lake Union, Upper Queen Anne, and Uptown

FIGURE 3: PRIMARY WORKPLACE LOCATION GEOCODER (RECRUIT SURVEY SCREENSHOT)



3.5 | TRAVEL DIARY DATA COLLECTED

TRIP DATA

Although the rMove and rSurvey platforms varied slightly in user interface/design, most of the information collected was the same. Figure 4 and Figure 5 show example trip rosters in each platform.

Both rMove and rSurvey gathered the following information from participants:

- Data obtained as explicit questions for both modes (rSurvey and rMove)
 - Travel party.
 - Trip purpose.
 - Trip mode(s).
 - Trip costs and other details associated with each mode (e.g., access/egress modes, parking details).



- Data obtained automatically and passively by rMove and asked as explicit questions in rSurvey
 - Trip start and end points
 - Trip start and end times
 - Trip roster

Although much of the collected travel data was the same across platforms, the collection method was not. Group 2 (rSurvey) participants reported all their trip information through recollection whereas rMove collected trip location and time details passively for Group 1 (rMove) participants. (Trip details that could not be passively recorded – such as travel party, trip purpose and mode – were recalled for both groups.) In practice, this often meant that trip start, and end times were more specific among Group 1 trip diaries because rMove collected exact times, whereas the Group 2 diary only recorded times in 5-minute increments. Moreover, when participants are asked to recall all the details their trips, they frequently round departure and arrival times to the nearest 15 minutes (resulting in less precise reports). Group 1 participants could correct passively collected trip data in rMove by splitting their trips into multiple segments, merging their trips, or adding entire trips. They could also report rMove errors (e.g., erroneous/spurious trips). About 4.2% of trips were edited by rMove participants, and about 2.7% of trip surveys reported errors. Group 1 (rMove) participants were still asked to recall their trip purposes and travel parties, among other details.

FIGURE 4: rSURVEY TRIP ROSTER (SCREENSHOT)

Please list, in order, all the places you went between 3 a.m. on Monday, April 10, 2017 and 3 a.m. on Tuesday, April 11, 2017. Select Language ▼

Please provide a unique name or short description for each unique/different place. If driven, got a ride, or rode a bike to/from a transit stop, include this stop as a place below. When all places are listed, click "Next" to continue.

Click and drag a place to re-order the list. Click the **+** icon next to a place to add a new place. Click the **-** icon next to a place to remove it.

I began the day at: WORK **+**

I ended the day at: HOME

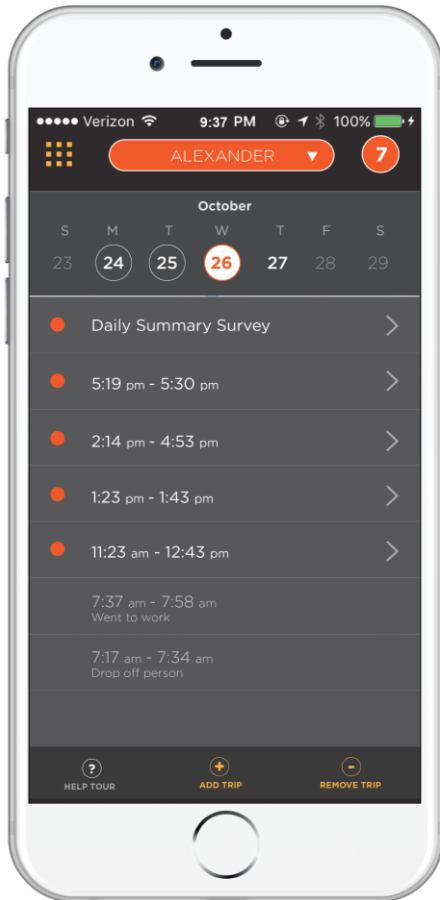
Began the day at: Home
Then went to: Children's school
Then went to: Work
Then went to: Lunch
Then went to: Work
Then went to: Off-site meeting
Then went to: Work
Then went to: Children's school
Then went to: Dentist
Then went to: Home
Then went to: Park
Ended the day at: Home

« Previous **Next »**

[Privacy Policy](#) | [Contact Us](#) | [Travel Log](#) | [Study Sponsors](#) | [Study FAQs](#) © 2017, RSG for Puget Sound Regional Council

30%

FIGURE 5: rMOVE TRIP ROSTER (SCREENSHOT)



TRAVEL DAY DATA

In addition to all trip data, the surveys collected day-level information at the end of each travel day (one day for rSurvey participants and seven days for rMove participants). In both cases, this information included the following:

- Whether that day was typical or atypical (rSurvey one-day diary only).
- Why the participant made no trips (when that was the case) that day.
- What types of deliveries occurred that day.
- How much time the participant spent telecommuting or shopping online that day.

CHILD REPORTING

Although Part 1 collected information on all household members, Part 2 did not require the same level of participation for both children and adults. Adults participating through rSurvey were required to complete full travel diaries for all children between the ages of 5 and 18. During postprocessing, RSG derived individual trip records for children under the age of five based on the trips on which they traveled (reported in the travel party on trips made by other household members). rMove asked Group 1 adults to provide trip information for children under age 18 when no household adult was on the trip (e.g., bus to



school), but were *not* required to answer any day-level information for their children. In both rMove and rSurvey, adults were still asked to report children of any age when they were present within their travel parties.

3.6 | ADDITIONAL DATA COLLECTED

The survey questionnaire also included questions about general travel behavior and preferences that all participants were required to complete to receive an incentive.¹¹ These questions were only available online, so rSurvey participants answered them as part of their travel diaries while rMove participants returned to the online platform following their travel diary completion. These questions included the following:

- Various mode frequencies (how often does the participant typically walk, bike, or use transit, ride-sharing, or car-sharing systems).
- (If uses transit) availability and use of various transit fare payment methods (e.g., cash/tickets/Flex Pass)
- (If travels to school and has a transit pass) school's contribution to transit pass costs.
- Employer transit subsidies and commuter benefits.
- Autonomous vehicle concerns and interests.
- Factors that would encourage increased bike/transit usage.

Various questions were skipped based on age or reporting method. For example, if a participant was under age 16, then they were not asked about their use of car-sharing systems. Also, if a participant's survey was reported by proxy (someone else was answering for them), then they were not asked opinion and preference questions.

3.7 | SURVEY DESIGN UPDATES

While most of the survey design remained consistent with the 2014–2015 study, there were several additions and changes. RSG and the study sponsors implemented these changes—listed in the sections below—to accommodate a combination of regional behavior/transportation shifts and new developments in survey research.

STRUCTURAL CHANGES

In 2015, RSG and the study sponsors invited a panel of participants from the 2014 study to complete a small-scale rMove study. The rMove data were not combined with the 2014 main study data. In contrast, the 2017 study included both rMove and non-rMove (rSurvey) participants within the same data collection period, and RSG provided combined data. The data combination process is described in Section 5.0. The 2017 study included many of the same person-level questions as the 2014 study. However, RSG rearranged the question order to capture key details about typical travel behavior in Part 1 (e.g., school and work commute details) rather than later in the study. The sections below list all content changes in the 2017 study.

¹¹ All rSurvey participants included in the final dataset answered these questions. rMove participants were required to answer these questions to receive an incentive, but were not excluded from the final dataset without them.

CONTENT CHANGES: ADDED/MODIFIED QUESTIONS

- **Race/ethnicity:** The study sponsors added this question in 2017 to inform equity analysis. The question's style closely matched the ACS race/ethnicity format. (See *Part 1 questionnaire*, pg. 20.)
- **Commute details:** These questions were streamlined to reduce respondent burden (e.g., workplace type included only one question rather than multiple questions). (See *Part 1 questionnaire*, pg. 24.)
- **Bike/transit use factors:** These questions change slightly each year based on PSRC planning needs. (See *Part 2 questionnaire*, pg. 41-42.)
- **Smartphone details:** The 2017 study asked only generic (rather than detailed) compatibility questions to determine whether each household was eligible to participate in Group 2. (See *Part 1 questionnaire*, pg. 20.)
- **Toll frequency:** This question was revised to include a day-level filter (i.e., ask if the participant used a toll road on travel day, rather than ask about toll roads for each trip). (See *Part 2 questionnaire*, pg. 14.)
- **Transit pass availability:** The 2017 study included more answer options (i.e., use/no use, availability, and nonapplicable). (See *Part 2 questionnaire*, pg. 36.)
- **Home delivery:** This question's format varied slightly across Group 1 and Group 2 surveys. Group 1 participants were asked to indicate which types of deliveries occurred on each travel day while Group 2 participants were asked to indicate how many of each type of delivery occurred on the travel day. (See *Part 2 questionnaire*, pg. 33.)
- **Travel-replacement activities:** The 2017 study included two questions that asked participants to provide the time they spent teleworking and online shopping on their travel days. (See *Part 2 questionnaire*, pg. 32.)

The 2017 study also included several logistical updates to ensure that the survey was as current as possible. (For example, RSG updated the list of vehicles from which participants could select their household vehicles' year/make/model.)

CONTENT CHANGES: DROPPED QUESTIONS

The following questions were dropped in 2017 either to reduce response burden or to keep the survey up-to-date:

- Travel info use (e.g., websites, apps used for real-time travel info).
- Parking maps (e.g., work parking location, trip parking location).
- Bikeshare questions/answer options.¹²
- Willing to participate in future studies (data will be destroyed at the end of the study for privacy reasons).

¹² The 2017 data collection effort took place after the Pronto bikeshare program was discontinued and before the new dockless bikeshare systems were introduced in summer 2017, therefore questions about bikeshare use during this time could not be asked.



4.0 SURVEY BRANDING, COMMUNICATION, AND ADMINISTRATION

4.1 | STUDY BRANDING

RSG developed the study branding collaboratively with PSRC, reusing many design aspects from the 2014–2015 study. The complete branding package included the study name, logo, color scheme, and font selections. The final 2017 study logo is shown in Figure 6.

FIGURE 6: 2017 STUDY LOGO



4.2 | STUDY INVITATION MATERIALS

Each invited household received three mailings:

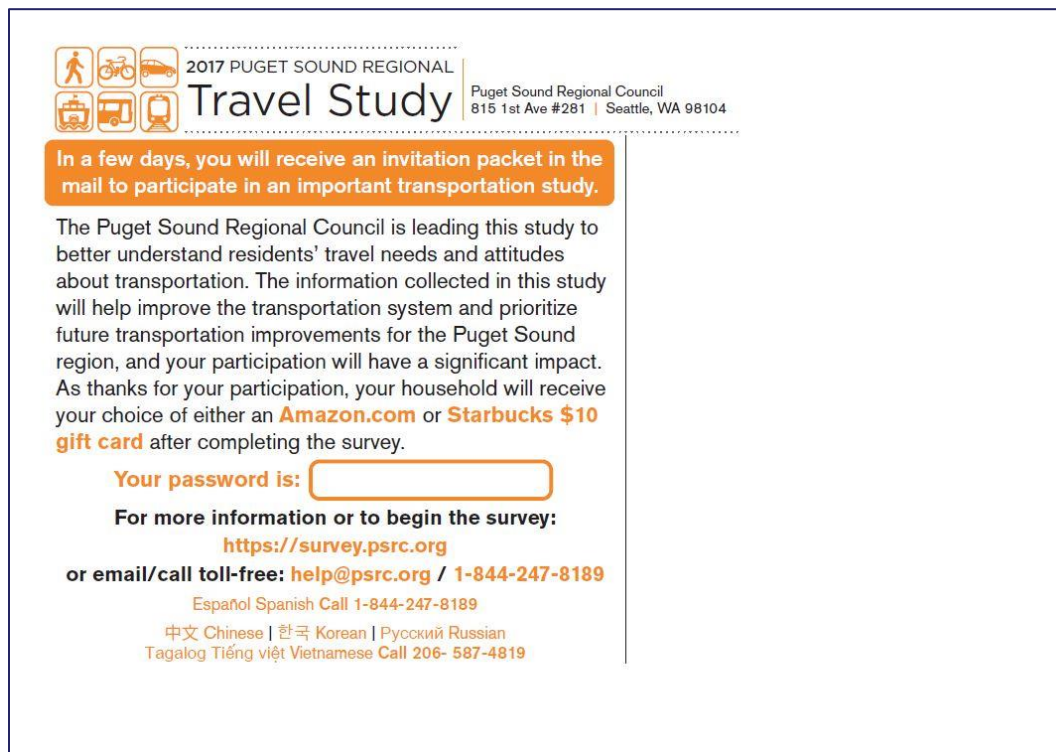
- **Prenotice Postcard:** RSG sent prenotice postcards to invited households in nine waves—each wave corresponded to a preassigned travel week. These postcards (arriving approximately 1.5 weeks before the household’s assigned travel date) notified households that a formal study invitation would be arriving shortly, and that they would be offered an incentive upon study completion. The postcards also invited households to log on to the website or call the toll-free number to learn more about the study and to complete the first portion of the study.
- **Invitation packet:** Formal study invitation packets arrived at each household approximately three to four days before the assigned travel date. The cover letter explained the study purpose, described the steps necessary to complete the study, and included the study sponsors’ logos and a signature from PSRC’s executive director, Josh Brown. The invitation packet also included an Frequently Asked Questions (FAQ) sheet.
- **Reminder Postcard:** Reminder postcards arrived at each household approximately two or three days after the invitation packet to encourage every household to complete the study. Like the initial postcards, these cards included the study phone number, website address, and participant login information.

All mailings were written in English, but the postcards and letter also included separate phone numbers for non-English-speaking participants. The additional languages offered on the postcards were Spanish, Chinese, Korean, Russian, Tagalog, and Vietnamese. PSRC coordinated these language offerings except for Spanish, which the study call center coordinated. An example postcard is shown below in Figure 7 (front) and Figure 8 (back), and examples of all printed materials can be found in the Appendix.

FIGURE 7: EXAMPLE SURVEY POSTCARD (FRONT)



FIGURE 8: EXAMPLE SURVEY POSTCARD (BACK)





Changes to the printed materials in 2017 included omitting the printed travel log (memory jogger insert) from the invitation packet and discontinuing the second reminder postcard. These materials were less critical to study success and provided an opportunity to reduce printing and postage expenses. Undeliverable mail was sent to a UPS box in Seattle that RSG reserved specifically for this study. Each week, UPS counted and recycled the returned mail. 2,704 letters were returned throughout the study, which comprised approximately 5% of all study invitations. The percentage of returned mail varied by zip code, from about 3.5% - 7.5%, but there were no significant patterns to explain different rates. (For example, areas with higher resident turnover did not necessarily exhibit higher rates of return mail.) The overall return mail rate during the 2014 study was just over 10%, so the 2017 return rates were significantly lower than those in this region two years ago. The 2017 return mail rates were also comparable to similar projects in other regions of the United States.

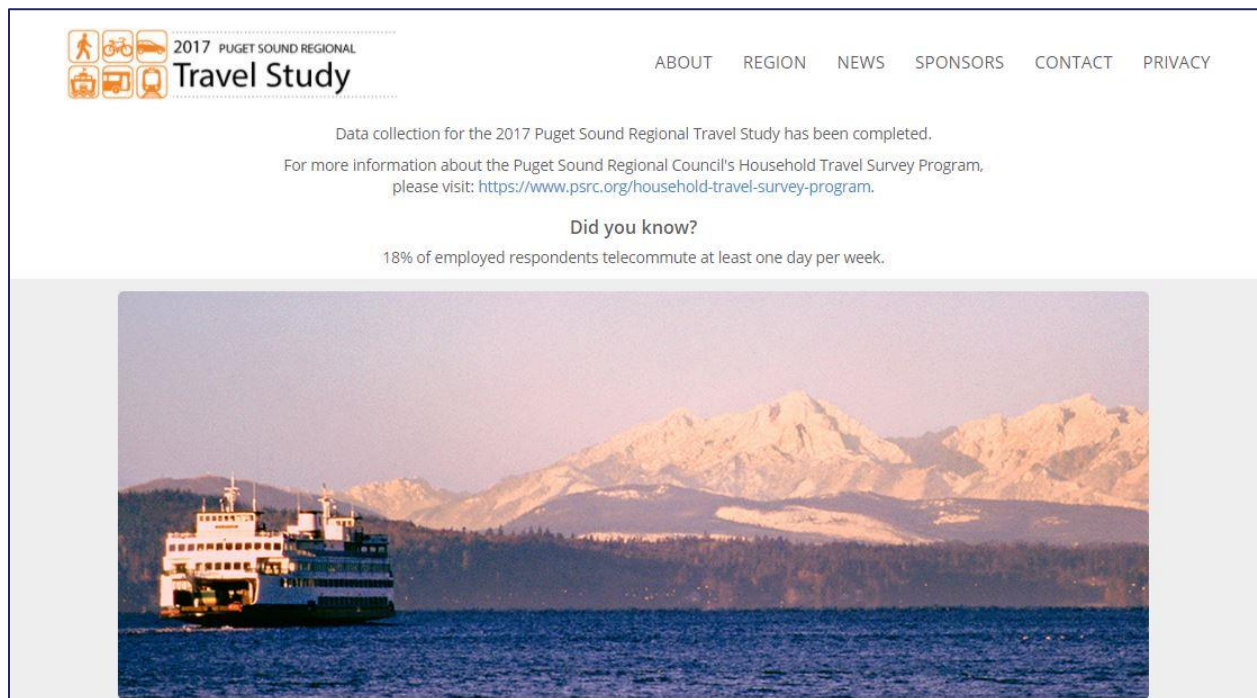
4.3 | STUDY WEBSITE

RSG developed a project website in 2014 to describe the 2014–2015 study and facilitate survey participation. This site was maintained in the interim, and the site design was updated in 2017 to reflect the new study and to provide more current information (e.g., updated FAQs, quotes of support, sponsors). The 2017 website (like the 2014 website) was designed to be simple, intuitive, and easy to navigate on desktop computers and mobile devices. When the study was halfway complete, RSG and PSRC agreed on several study-related “fun facts” that RSG then added to the study website to increase engagement and encourage further participation. These facts were selected to generate interest while avoiding potential unintended bias in future survey responses. The selected facts RSG added to the website included the following:

1. 52% of participants rate “being close to family or friends” as somewhat or very important in choosing their current home locations.
2. 18% of employed participants telecommute at least one day per week.
3. The top three previous home states among participants moved to Washington in the past five years are California, Michigan, and Massachusetts.
4. 24% of participants have lived in their current homes for 10+ years.

While the study was collecting responses, participants could click on a button at the top of the study website that took them directly to the survey’s password entry page. Once the study closed, this button was replaced with a brief message about the study’s closure; this message is shown in Figure 9.

FIGURE 9: PROJECT WEBSITE HOME PAGE



4.4 | PUBLIC OUTREACH

TARGET AUDIENCES

The primary goal of all outreach activities in a randomly sampled household travel study is to maximize participation from invited households using outreach messaging and methods to accomplish the following:

- Communicate the value and importance of the study for local and regional planning needs.
- Legitimize the study and engender trust that collected data would be used appropriately.
- Develop a positive and consistent presence.
- Increase invited households' understanding, awareness, and acceptance of the study.
- Reinforce study invitation messaging and clearly define lines of communication.

Outreach activities were not limited to invited households, but the goal of all activities was to increase study response among those invited (i.e., outreach activities were not designed to recruit volunteers).

OUTREACH ACTIONS

RSG implemented the following actions to promote the study:

- **Updated the official project website:** RSG worked with PSRC, the City of Redmond, and the City of Seattle to update the survey website used during the 2014–2015 study. These updates included changes to the website text, adding news articles to the “News” section, and updating the study sponsors. These steps reinforced the continued relevance of the 2017 study.
- **Developed a formal press release:** RSG worked with PSRC, the City of Redmond, and the City of Seattle to finalize language for a formal press release that the sponsor agencies could post on their respective websites and distribute to local media.



- **Ran Facebook advertisements:** The study team allocated a small expense budget to create and run a Facebook ad in a few specific geographies throughout the study region. This was conducted as a small test; the cost-effectiveness of this kind of outreach was unknown at the start of the survey (i.e., whether social media ads could be targeted to raise awareness among invited households rather than the general population). Additional details are listed in the following section.

Additional outreach activities that were recommended for consideration by the study sponsors included cross-posting the press release or other study information on the websites of other study partners (e.g., local jurisdictions within the study area); coordinating with community groups and organizations to increase support and awareness among local communities; and posting updates on official social media channels. While not all outreach activities were enacted in the 2017 study, PSRC may re-evaluate these and other options for future study waves, based on updated study priorities.

FACEBOOK ADVERTISEMENT

The Facebook advertisement sought to increase awareness among invited households. While Facebook can serve as a great tool for targeting specific demographics, it can be more challenging to target individual households in a random sample. To increase the cost-effectiveness of running the ad, RSG collaborated with the study sponsors to select several small geographies with high densities of invited households. The smallest target geography Facebook offers is a one-mile radius around any provided address. RSG conducted analysis to determine the optimum mile-radius areas and solicited input from the cities of Redmond and Seattle, ultimately choosing the following locations:

- 16345 Cleveland Street, Redmond
- 7742 E Marginal Way S, Seattle
- 1208 E Jefferson Street, Seattle
- 4505 17th Avenue NE, Seattle

These four locations were selected to support priorities from the cities of Redmond and Seattle (i.e., prioritizing downtown Redmond and certain UVs in Seattle); these also represented areas with high invitation densities. RSG specified in the ad setup that only users with *home addresses* within the radii should be targeted.¹³ The goal of this setting was to limit ad costs by excluding visitors to the area.

The final ad settings were as follows:

- The ad was set to optimize clicks (i.e., send traffic to the study website).
- Facebook used automatic bidding and budget management to manage the \$2,600 allotted to the advertisement.
- The ad was shared from a study-specific page¹⁴ that contained introductory study information.
- When clicked, the ad sent users to the homepage of the study website.
- The ad ran throughout the recruitment period—from March 20, 2017 to May 24, 2017.

The final ad design is shown in Figure 10.

¹³ Facebook uses several data sources to determine home location, including reported home city, device location services, and other device connection information.

¹⁴ Facebook page developed for the 2017 study (no longer active): <https://www.facebook.com/2017PSRTS/>.

FIGURE 10: FACEBOOK ADVERTISEMENT



The goal of the 2017 study's Facebook ad was to increase survey awareness/legitimacy, so the ad analytics did not track its direct impact on survey response. However, the ad acted as a trial run if PSRC chooses to use Facebook ads as a response stimulant in future waves.¹⁵

Facebook Ads Can Effectively Reach Large Audiences at Low Costs

The ad reached 116,338 people during its two-month run period – 8,108 of whom clicked on the ad.

Facebook Ads May Reach a Different Audience Than Typically Reached Using Mailed Invitations

The most common group (and cheapest, as measured by cost per unique click) that responded to the ad was between the ages of 18 and 24. This has traditionally been a hard-to-reach population through mailed invitations. Compared to the average of \$0.32 per unique click, this age group cost \$0.28 per

¹⁵ The following list includes basic Facebook analytics definitions:

- **Impressions:** Count of unique views (includes multiple views from the same people).
- **Reach:** Count of unique viewers.
- **Frequency:** Average number of times each person saw the ad.
- **Unique link clicks:** Count of unique viewers who clicked the link.
- **Cost per unique click:** Average amount spent to achieve one unique link click.



unique click. The 25–34-year-old age group was also below average in cost at \$0.28 per unique click (Table 4). While the age composition in a Facebook sample may be different than in a mailed sample, there are likely many other characteristics that would vary across sample types. If the behavioral composition of Facebook-recruited households is different than the composition of mail-recruited households, it is also possible (perhaps even likely) that these households/individuals would also respond to surveys differently on a general level (e.g., require different incentives, expect different outcomes, etc.).

Broad Audience Criteria Does Not Necessarily Guarantee a More Diverse Sample

Although the individuals who viewed the PSRC ad were diverse in many respects, the ad was originally optimized to increase “clicks,” which also meant that Facebook targeted certain types of individuals more heavily, without specifying these targets at the outset. For example, over 90% of the people who viewed the ad viewed it on a mobile device (Table 5). This is partially because far more Facebook sessions occur on mobile devices than on desktops. Furthermore, the mobile device reach was split evenly between iOS and Android devices, but significantly more Android users clicked on the ad. It may not be entirely surprising that iOS and Android have different responses to Facebook ads (e.g., dissimilar click, purchase, and app-install behaviors), but these differences may warrant closer monitoring and consideration when Facebook is used for sampling to avoid possible biases.

Facebook Analytics Provides Limited Geographic Analysis

For privacy reasons, Facebook limits the level of analysis to broad location categories. This is not a concern if the goal is to drive survey responses (and the survey asks participants to provide a home address), but it may affect other early-stage reporting.

Ads Are Easy to Create and Adjust Mid-Campaign

Facebook provides extensive resources to set up and monitor advertisements. Ads are flexible and can be easily adjusted after launch. Whereas mailed invitations take at least two weeks to fully implement and realize, Facebook ads can change in minutes.

TABLE 4: PERFORMANCE BY AGE

AGE	IMPRESSIONS	REACH	UNIQUE LINK CLICKS	COST PER UNIQUE CLICK	CONVERSION (REACH → CLICK)
18–24	162,797	28,069	1,816	\$0.28	6.47%
25–34	147,060	33,089	1,896	\$0.28	5.73%
35–44	91,230	20,780	1,220	\$0.32	5.87%
45–54	72,585	14,259	1,172	\$0.34	8.22%
55–64	67,386	11,157	1,156	\$0.36	10.36%
65+	55,757	8,984	848	\$0.41	9.44%
TOTAL	596,815	116,338	8,108	\$0.32	6.97%

TABLE 5: PERFORMANCE BY DEVICE

DEVICE	IMPRESSIONS	REACH	UNIQUE LINK CLICKS	COST PER UNIQUE CLICK	CONVERSION (REACH → CLICK)
Android Smartphone	379,794	57,355	6,912	\$0.31	12.05%
iPhone	192,520	53,379	920	\$0.40	1.72%
Android Tablet	10,773	2,317	236	\$0.27	10.19%
iPad	10,690	2,348	36	\$0.56	1.53%
Desktop	1,653	720	--	--	0%
iPod or Other	1,385	219	6	\$1.65	2.74%
TOTAL	596,815	116,338	8,108	\$0.32	6.97%

City of Redmond Outreach

The City of Redmond conducted additional activities in their region to maximize participation from their sample, particularly in the downtown Redmond sample area. The city's primary activities included the following:

- Sending an additional letter to households invited to the study to further reinforce the fact that local agencies supported the effort (not just the regional agency).
 - Initially, this additional letter only went to households in the downtown sample area; after the first few weeks, the additional letter was sent to all invited households.
- Offering an additional \$10 incentive to downtown households (as previously discussed).
- Deploying a Facebook ad across the city (like in Figure 10). The specific details of the cost of the ad are available through the City of Redmond.

4.5 | PARTICIPANT SUPPORT

OUTBOUND PARTICIPANT SUPPORT

RSG used several types of outbound participant support throughout the study in addition to the website and printed invitation materials discussed previously. The primary sources of outbound support were automated e-mail reminders, reminder phone calls, and in-app reminders or notifications (rMove participants only).

E-mail Reminders and Phone Calls

During Part 1 of the survey, participants selected how they preferred to receive reminders. RSG required all rMove participants to provide e-mail addresses, and an additional phone number was optional. rSurvey participants could provide just one or the other (phone or e-mail), but most households provided both. Any household that provided an e-mail address received e-mail reminders, while households that only provided a phone number were reminded by phone.

The study call center conducted all phone reminders. These reminders occurred on the following schedule:



- One day before each household's travel date.
- One day after each household's travel date.
- Three to five days after each household's travel date (if the household had not yet completed the study).

As time and budget allowed, the call center also called households who had not yet recruited when a phone number was matched to the invitation address. These calls legitimized the invitation letters and encouraged recruitment.

Reminder e-mails occurred on a similar schedule, although more frequently. RSG sent e-mail reminders on the following schedule:

- One day after each household completed Part 1.
- The Friday before each rMove household's travel week (this reminder also included instructions for how to download rMove).
- One day before each household's travel date.
- One day after each household's travel date (Group 2 only).
- Three to five days after each household's travel date (if the household had not yet completed the study).

rMove households received 1–2 additional e-mails one week after the end of their travel weeks. These e-mails reminded them to return to the online survey to complete the preference questions.

In-App Reminders (rMove)

rMove participants also had in-app reminders to encourage them to complete all surveys during the entire travel period. Participants received notifications as soon as a new survey was available—either several minutes after the end of a trip or the morning after a full travel day. rMove participants reporting for their children by proxy also received reminders to review and add to their children's trip rosters, if needed. Participants had the option to turn off reminders or GPS tracking, but RSG instructions encouraged them to leave these features enabled to ensure that they did not miss any portion of the study. As with most apps, it is not currently possible to know if or when participants turn off their GPS tracking.

INBOUND PARTICIPANT SUPPORT

In addition to all outbound participant support, RSG provided three primary means through which participants could contact study administrators. All participants could call a toll-free number to reach the study call center or e-mail the study inbox with questions. rMove participants also had the option to submit feedback directly through the app. The study website included the toll-free number, study e-mail, and contact information for representatives from PSRC. Anyone with a question or comment could contact the study team or could contact PSRC directly for information, whether they were a participant or simply an interested member of the public.

Participants who called the toll-free number were either connected to a trained representative who could walk them through any issues or answer any questions, or they were asked to leave a voicemail. In total, the call center received 322 inbound calls and made 1,503 outbound calls (primarily reminder calls). RSG staff monitored and responded to the study e-mail inbox and rMove feedback. Inbound communications typically received a response within one business day. Table 6 below shows the breakout of inbound e-

mails and rMove feedback messages, by topic. (Each e-mail is included in only one category, although some e-mails entailed more than one topic.)

TABLE 6: INBOUND E-MAIL TOPICS

E-MAIL TOPIC	COUNT
Gift card inquiry	195
General questions	195
rMove troubleshooting	173
No reply needed (e.g., "Thank you")	107
Comments and feedback	98
Completion status	87
rSurvey troubleshooting	82
Forgot password	81
Volunteer inquiries	71
Travel date reassignment request	53
Unsubscribe request	41



5.0 DATASET PREPARATION

5.1 | OVERVIEW

Dataset preparation and quality control procedures exist at every stage of a study. Before fielding a study, data collection instrument development and testing confirms that survey responses are recorded correctly. During fieldwork, the data collection instruments employ numerous real-time validations and logic checks to ensure consistent coding and logical response combinations and to prevent skipped questions. After the data collection period ends, additional time is spent reviewing, cleaning, and processing the raw data to prepare the unweighted dataset for analysis. This includes combining the travel data collected with the different survey instruments (rMove and rSurvey). The following sections summarize these stages of dataset preparation and quality controls undertaken for the 2017 study. A separate Dataset Guide was provided with the initial dataset and includes more specific details for key elements.

5.2 | DATASET PREPARATION

DATABASE SETUP AND REAL-TIME QUALITY CONTROLS

Prior to a survey launch, RSG conducts quality control on the survey instruments. For the recent study, this included reviewing map displays, question wording, and graphical elements to ensure that the survey and app interfaces were clear and easy to use and that questions were understandable. The goal was to make participation as easy and as intuitive as possible. The prelaunch review process also included both manual and automated review of survey functionality (confirming logical flows and validation) and database records (confirming survey responses and accuracy of passively recorded data).

Real-time data checks employed during data collection help minimize respondent burden and increase response completeness and consistency. This helps reduce data cleaning and recoding after the survey is complete. Examples of these checks include the following:

- Validation logic preventing skipped questions (requiring an answer to each question before moving to the next).
- Logic checking to hide/skip questions or answer choices that are not relevant (e.g., not asking employment questions for children).
- Spatial and temporal checks within each person's trip roster (preventing overlapping trips).
- A "copy trips" feature in rSurvey to reduce respondent burden and ensure consistency of locations, modes, and trip times for jointly made household trips.

These real-time data checks do not eliminate every inconsistency, but they do significantly reduce reporting errors and the need for recoding after data collection is complete.

rMove also included tools to allow participants to validate or correct passively recorded trips during data collection. Participants could split trips (if a short stop, like dropping someone off, was missed), merge trips (if a false stop, like sitting in traffic, was detected), or flag trips if they appeared to have other types of errors (e.g., imprecise routes or times). rMove participants could also add or drop trips entirely throughout their travel period. These user-edits were flagged in the database to be reviewed further by analysts after data collection was complete.

GEOGRAPHIC DATA CHECKS

Geographic data collected in the online survey underwent several review and processing steps during and after data collection. (rMove GPS data are reviewed and processed separately as described in the next section.) During data collection, rSurvey used the Google Maps API to geocode the coordinates for reported home, work, school, and trip addresses. The API was also used to estimate travel times and distances. (These estimates were recorded in the database and shown to participants in real-time to help them verify that they had entered their trip location information correctly.)

Following data collection, RSG took additional steps to process geographic data from rSurvey:

- Reviewed trip distances and speed (by mode) for extreme values to identify potential issues.
- Coded home location points to BGs and broader regional definitions.
- Reviewed differences between sample (invited) home addresses and reported home addresses.

Home Location Review and Selection

Like the 2014 study, the home locations reported in the recruitment survey for the 2017 study were compared to the sampled home locations (where invitations were mailed). For most participants, these locations were identical, but some participants reported a different address in the survey. Often the self-reported address is likely correct (e.g., indicating that someone had recently moved, and the survey invitation was forwarded to them); however, occasionally the self-reported address was for a nonresidential location or was reported at a less precise geographic scale than desired. These differences may be due to someone attempting to protect their privacy (e.g., reporting a nearby intersection or business rather than their home) or may be due to someone simply reporting their general home location (e.g., only reporting the street, city, or Zip Code). Home addresses that were not precisely reported were reviewed more carefully and compared to the sample address and the trip records to determine which home address is most accurate. The recommended hierarchy for reviewing and selecting the final home address for use was as follows:

1. If a precise street address was reported, use the reported address.
 - a. These may be compared to the sampled home address, but unless a business or other nonresidential address is clearly reported, RSG generally assumed that the reported address was current and correct.
2. If an imprecise address was reported (e.g., intersection or street without an address, or just a city or Zip Code), compare to the sample address and trip data to determine which address was most accurate:
 - a. If the participant used rMove, review the GPS locations for any trips where the destination purpose was “home” to evaluate the reported home location.
 - b. If the participant used rSurvey, review the destination for any trips where the destination place name or purpose was “home” to evaluate the reported home location.
 - c. If a more precise and accurate home location is not available in the trip data, review the sample address in relation to the reported address to determine if the sample address was likely current and accurate.



GPS DATA REVIEW AND QUALITY CONTROLS

Before RSG combined the rMove and rSurvey datasets, the rMove data underwent a multistep cleaning process to reduce the number of false/spurious trips the device collects and identify short stops that rMove may have missed (e.g., dropping someone off). Additionally, many participants are not consistent with how they edit trips, thus requiring cleaning after participants send data from their devices at the end of the study.

rMove data cleaning and processing occurred in three stages:

1. **Automated data cleaning:** A machine learning algorithm automatically classified trips (based on previous, manually reviewed datasets) to identify which trips should be automatically dropped, which could be kept as is (without additional review), and which trips were likely to need additional review by analysts in the next stage.
2. **Manual spatial review and correction:** Analysts reviewed trips and trip-path data to determine if one of three possible “corrections” were needed:
 - **Dropping/removing a trip from the dataset** (e.g., a participant walking around his yard is not a valid trip).
 - **Splitting a trip where an additional stop was apparent** (e.g., a participant stops at a coffee drive-thru). In these cases, the answers from the initial trip were applied to all resulting trips after the split.
 - **Joining a trip where a stop between two trips was not apparent** (e.g., mobile device lost signal temporarily in a tunnel or the participant was stopped in traffic). In these cases, the analyst chose which trip’s survey answers were applied to the resulting joined trip. Often, the original answers were the same for both surveys. There were some cases in which a gap between two trips was apparent, but the two trips were *not* joined because the missing trip path was unclear. These cases generally occurred when a user added a trip that did not fit into the details of the bookend trips. These records were flagged as “teleport” trips in the final dataset.
3. **Scripted processing and derivations:** The final stage included various scripted trip corrections and derivations on the initial cleaned dataset. Example steps include the following:
 - Removing points with low accuracy (e.g., ranges greater than 250 meters) and re-derived trip-path distance.
 - “Trimming” departure and arrival times at the beginning or end of trips (where spurious points were collected) to ensure accurate trip times.

DERIVATION OF TRIPS FOR NONPARTICIPATING HOUSEHOLD MEMBERS

Household travel studies require data for all household members to assess complete household travel patterns. However, in the data collection process, some exceptions are allowed where travel can be reported by proxy, particularly for children. In this study, there were three main ways that travel data could be reported or derived for nonparticipating members:

- In rSurvey, a travel diary was not collected for children under the age of five. However, these children could be reported as travel party members on trips made by other household members. Whenever this occurred, that trip was copied to the child's record.
- In rMove, only adults age 18 or older were required to use the app on their smartphones. As with the youngest children in rSurvey, if an rMove household child was reported as a travel party member on an adult's trips, then those trips were copied to the child's record.
- In rMove, if a household had children, one adult was designated to proxy report trips within the app for children. This adult was asked to add trips to a child's roster if the child made an independent trip (e.g., riding the bus to school) or made a trip with someone outside of the household (e.g., getting a ride with a friend's parents).

For children under the age of five, a diary was not required to reduce respondent burden; it is assumed that children in this age range rarely make independent trips. For rMove households, children were not asked to use the app both because of potential privacy concerns and because children may not have their own smartphones or may be less likely to use the study app consistently.

INCOME IMPUTATION

Households had the option of reporting income in ten categories or selecting "prefer not to answer". Those that selected "prefer not to answer" were asked a follow up income question with only five, broader income categories. Then, household income was imputed for the 7% (234) of households that preferred not to report income, rather than forcing those households to provide an answer. The imputation was done using a logistic or "probit regression" model of income category, for the households that did answer the detailed income question. The model includes attributes of the household (worker status, education level, head of household age, home ownership, and housing type) as well as the income distribution in the residence block group, based on the 2008-2012 5-year ACS. The model was estimated using R using the "polr" function.

The household income variable imputation used for weighting was created using the following rules:

- If the household answered the detailed income question, the reported detailed category is used.
- If the household did not answer the detailed income question but did answer the broad income follow up question, the broad income answer was used.
- The provided income for the 3,057 households was used for model estimation (2,923 providing detailed income, and 128 providing broad income category).
- If the household neither answered the detailed nor the broad category income question, a probit regression model was run in R to impute a household income into the broad income category to match the Public Use Microdata Sample (PUMS) targets categories (234 households imputed).

INTEGRATION OF DATA FROM MULTIPLE RETRIEVAL MODES

After the rMove data were cleaned, the rMove and rSurvey datasets were combined, reviewed, and cleaned again. This process involved the following steps:

1. **Merged rMove and rSurvey variables:** In most cases, the daily and trip survey questions were identical or similar. However, in a few cases, the questions were formatted somewhat differently and resulted in slightly different variable types. Wherever feasible, RSG reconciled differences



between variables (rather than kept them separate). In most cases, variables were recoded to retain as much detail as possible. These recoded variables included:

- **Trip mode and purpose**
 - **Trip parking details**
 - **Trip toll details**
 - **Trip cost/payment details**
2. **Aligned the rMove and rSurvey travel days:** Traditionally, travel diaries collect data for a single 24-hour period—from 3:00 a.m. to 2:59 a.m. on the following day. This shift is used to account for trips that extend beyond (or take place after) midnight (e.g., shift workers or people returning from an evening out) but are still part of the “day” that ends at home. The rMove app collects travel diary data for multiple days and—for many reasons—currently defines midnight (calendar day) as the division between days.

To combine the rMove and rSurvey data into one, consistent dataset—and to retain the “traditional” travel day definition used in most travel models—the rMove “days” were redefined with 3:00 a.m. breakpoints. This resulted in the following outcomes:

- Trips that were recorded between midnight and 3:00 a.m. on a given day were assigned to the previous day trip totals/counts (e.g., trips between midnight and 3:00 a.m. on Saturday morning were flagged and counted as part of the “Friday” travel day).
- No trips were recorded between midnight and 3:00 a.m. after the LAST travel day (Monday), so this day does not cover a complete 24-hour period.
- Trips recorded between midnight and 3:00 a.m. on the FIRST travel (Tuesday) were not part of the newly defined travel period. However, these trips were used as a “proxy” for the midnight to 3:00 a.m. period after the LAST travel day (see above). Trips that took place from midnight to 2:59 a.m. on Tuesday morning were listed as “day number = 7,” though the travel date variable still reflected the correct date. Fewer than 1% of all trips required this shift.

Some data elements in the combined dataset required derivation or slight adjustments due to differences between retrieval mode. For example, rSurvey obtained details that were not explicitly asked in rMove (e.g., transit routes and park-and-ride lots used, nicknames, and street addresses for trip destinations). Similarly, the rMove instrument obtained some details that were not asked in rSurvey (e.g., specific transit and parking costs). Wherever possible, rMove and rSurvey responses were combined into consistent variables, but where more detail could be retained (such as cost details), separate variables were maintained.

COMPLETION AND EXCLUSION CRITERIA

Completion Criteria

The last step of dataset preparation involved review of all data records to confirm that they met survey, travel day, and household completion criteria. All households were considered complete if they met the following conditions:

1. The household completed the recruit survey by answering all required questions.
2. All household members completed all trip and travel day surveys on at least one concurrent day throughout their travel period.

All rSurvey households have a single complete travel day. rMove households must have at least one complete travel day (where all surveys are completed on the same day by all household members), but may have up to seven completed travel days. Partially complete rMove travel days are also included and indicated by a variable in the dataset for households that have at least one fully complete day. Among the households that completed at least one travel day, all but six households completed at least one weekday.

Exclusion Criteria

Households were excluded for several reasons. The primary reason for exclusion was that all household members did not complete all trip and daily surveys on at least one concurrent day. Households that indicated a new home address outside the study region were also excluded from the final dataset. Additional exclusion criteria may be included after PSRC reviews the first draft of the dataset.



6.0 EXPANSION AND WEIGHTING

6.1 | ROLE OF WEIGHTING

Household travel surveys cover a fraction of the population, yet the resulting datasets help analyze and make inferences about the population at large. Weighting is the process of comparing selected demographics in the survey to external control data such as the Census or the ACS and adjusting the profile of the survey dataset to improve the representativeness of the population in the study area.

Survey data weighting for this project involved three primary steps:

1. Calculating initial expansion weights to expand the sample to represent the study area population.
2. Adjusting the initial weights to meet marginal population distributions of key household and person-level sociodemographic measures.
3. Calculating trip (and travel day) adjustment factors to account for known reporting biases associated with certain (or any) data collection methods.

6.2 | STEP 1. EXPANSION BASED ON SAMPLING PROBABILITIES

Weights were developed for the PSRC 2017 dataset. First, the number of survey households was expanded to the number of households in each sampling strata by assigning an expansion factor to each household based on the sampling rate (see Table 7). All residential addresses within each sampling strata (described in the study sampling plan) had an equal probability of being invited to the study, but invitation rates varied between the strata to account for targeted oversampling and to account for “compensatory oversampling” where response rates were expected to be low. Each stratum includes separately calculated expansion weights to account for the differences between the probabilities of being invited in each of the various strata. Dividing the number of households present within the stratum (using the most recent Washington State Office of Financial Management (OFM) April 1, 2017 official population estimates¹⁶) by the number of households in the final survey sample produced the initial expansion weight for each sampling segment and strata, as shown in Table 8.

TABLE 7: RESULTS OF INITIAL EXPANSION SUMMARY

SAMPLE SEGMENT	OFM 2017 HHs	COMPLETE HHs IN SAMPLE	INITIAL EXPANSION WEIGHT
City of Redmond	26,308	572	45.99
City of Seattle UVs	139,375	1,862	74.85
PSRC	1,415,993	851	1,663.91
TOTAL	1,581,676	3,285	481.54

¹⁶ Washington State Office of Financial Management (OFM) April 1, 2017 official population estimates <https://www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates/april-1-official-population-estimates>

TABLE 8: RESULTS OF INITIAL EXPANSION WITHIN SAMPLING SEGMENTS

	COMPLETED HHs IN SAMPLE	%	OFM 2017 HHs	INITIAL EXPANSION WEIGHT
PSRC-regular-low	136	4.14	258,543	1,901.1
PSRC-regular-medium	204	6.21	446,272	2,187.6
PSRC-regular-high	222	6.76	437,706	1,971.6
PSRC-oversample-low	158	4.81	169,016	1,069.7
PSRC-oversample-medium	66	2.01	49,180	745.2
PSRC-oversample-high	65	1.98	55,276	850.4
Redmond-regular-medium	60	1.83	3,861	64.4
Redmond-regular-high	141	4.29	13,459	95.5
Redmond-oversample-low	75	2.28	1,972	26.3
Redmond-oversample-medium	36	1.10	1,762	48.9
Redmond-oversample-high	39	1.19	1,951	50.0
Redmond-downtown-medium	71	2.16	750	10.6
Redmond-downtown-high	149	4.54	2,553	17.1
Urban Village—10%	218	6.64	39,378	180.6
UV-15%	399	12.15	37,073	92.9
UV-20%	178	5.42	14,795	83.1
UV-25%	116	3.53	11,376	98.1
UV-30%	195	5.94	11,278	57.8
UV-35%	243	7.40	12,614	51.9
UV-50%	120	3.65	3,971	33.1
UV-60%	131	3.99	3,659	27.9
UV-75%	75	2.28	2,029	27.1
UV-100%	188	5.72	3,202	17.0
TOTAL	3285	100.00	1,581,676	481.5

6.3 | WEIGHTING TARGETS

Using the initial expansion factors shown in Table 8, the expanded sample matched the total number of households for the PSRC four-county study region and for each sampling stratum. If there were no nonresponse biases in survey recruitment and completion, then the initial expansion weights would be accurate enough to obtain a representative weighted sample. However, inevitable biases and the inherent randomness of sampling necessitated further adjustment of the expansion weights. To understand the required adjustments, the initial expanded sample was compared against the following demographic “target” dimensions and geographies were established. The geographical targets were set at the Public



Use Microdata Area (PUMA) level, which in the four-county PSRC region comprises 31 PUMAs (16 PUMAs in King County, two in Kitsap, seven in Pierce, and six in Snohomish). RSG adjusted the initial expansion weights to match demographic control data targets from the ACS PUMS 1-year 2016 data for the following target dimensions:

- Household Targets:
 - Household size (1, 2, 3, 4, 5+).
 - Number of workers (0, 1, 2, 3+).
 - Income group (0-25k, 25-50k, 50-75k, 75-100k, 100-150k, 150k+).
 - Number of vehicles (0, 1, 2, 3+).
 - Age of head of household (under 35, 35-64, 65+).
- Person Targets:
 - Total persons.
 - Gender.
 - Age (0-4, 5-15, 16-17, 18-24, 25-44, 45-64, 65+).
 - Worker status (Worker, Nonworker).
 - Race (White, Asian, Other).
 - University/College student status (student, nonstudent).

The sample did not include a target for student status with school types other than university/college, since the controls on the younger age groups (0–4, 5–15, 16–17) will already give a good estimate of students in the K-12 grades; the university/college student target is intended to split the older age groups into students and nonstudents. The race and university student targets are important as these groups are often underrepresented in household travel survey samples.

To directly align with the initial expansion weights, RSG adjusted the 2016 ACS 1-year data target variables using the WA State OFM 2017 population estimates of household totals. For each of the PSRC region's 31 PUMA geographies, the ratio of the ACS 2016 1-year households total to the OFM 2017 households total was derived and then applied as a scaling adjustment to all household and person target variables accordingly, as shown in Table 9.

TABLE 9: PUMA HH TOTAL SCALE FROM ACS 2016 TO OFM 2017 ESTIMATES

PUMA ID	ACS 2016 1 YEAR HH TOTAL	WA STATE OFM 2017 HH TOTAL	SCALE
11501	50,951	51,378	1.008
11502	45,911	47,897	1.043
11503	44,835	42,092	0.939
11504	46,106	47,328	1.027
11505	45,309	43,981	0.971
11506	47,614	47,660	1.001
11507	36,945	39,647	1.073
11601	71,530	74,756	1.045
11602	53,305	54,372	1.020
11603	76,989	86,286	1.121
11604	55,365	54,874	0.991
11605	61,934	58,700	0.948
11606	47,047	48,627	1.034
11607	57,472	59,632	1.038
11608	57,596	58,679	1.019
11609	53,846	53,743	0.998
11610	53,129	53,238	1.002
11611	51,311	48,798	0.951
11612	48,664	48,608	0.999
11613	45,114	45,425	1.007
11614	41,558	41,003	0.987
11615	45,079	43,048	0.955
11616	41,212	40,650	0.986
11701	47,081	48,274	1.025
11702	45,482	48,350	1.063
11703	47,198	48,297	1.023
11704	45,616	46,409	1.017
11705	47,501	46,941	0.988
11706	53,238	52,318	0.983
11801	50,431	49,266	0.977
11802	51,563	51,399	0.997
TOTAL	1,566,932	1,581,676	1.009



6.4 | STEP 2. REWEIGHTING SURVEY HOUSEHOLDS TO EXPANSION TARGETS

RSG completed the reweighting using list-based iterative proportional fitting (IPF), programmed in Pascal and then translated the code into R. List-based IPF is like conventional IPF used in weighting but allows for both household-level and person-level weighting variables to be included in a single list at the household level, with the amount that each household contributes toward each target.

The IPF procedure looped over the demographic target dimensions (created from 2016 1-year PUMS data and scaled to the WA State OFM 2017 HH totals), and the survey data with initial expansion weights, and gradually adjusted the weights to match the target values. The program was run for 10,000 IPF iterations so that each target cell value is matched within 1%, with minimum weight ratio at 0.25x of the initial expansion weight and a maximum weight ratio at 6x. It is RSG’s current judgment from household travel survey weighting experience that the weights should not exceed 6x the initial expansion weights to match the targets as closely as possible while avoiding extreme values.

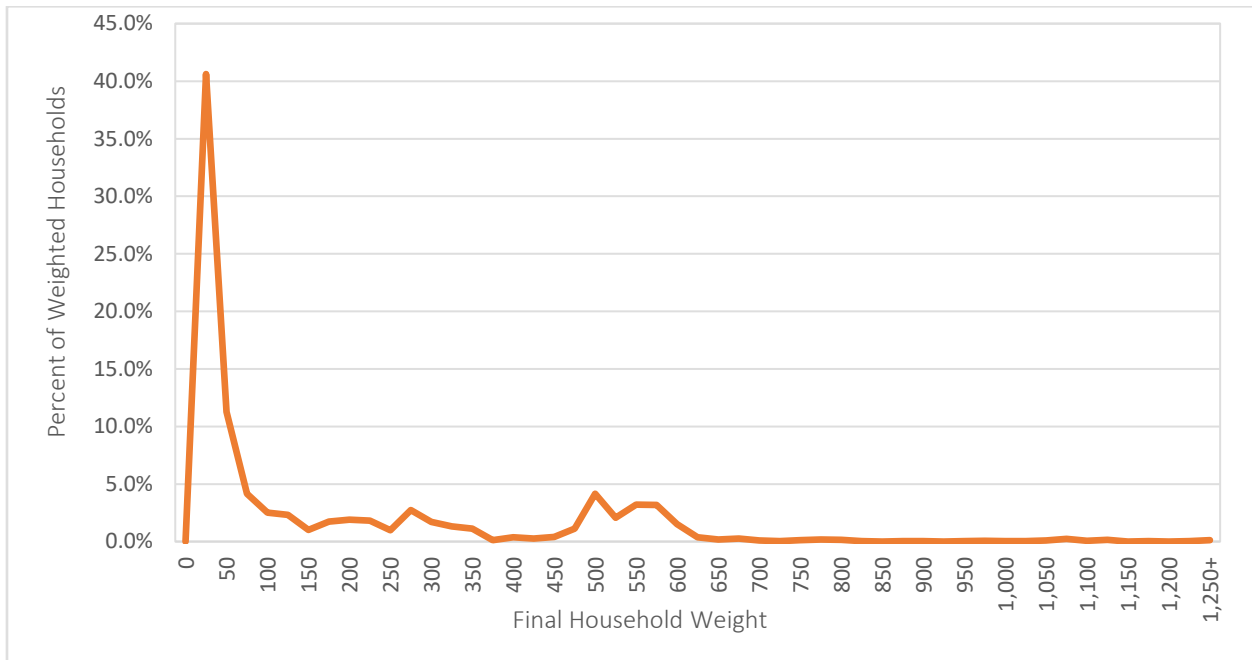
After the initial IPF results were evaluated, RSG combined PUMA geographies in the PSRC region to further refine the target geographies in consideration of adequate sample size in each geography. This additional geographic refinement was based on ensuring adequate sample size of completed households in similar demographic/geographic areas. Rather than allowing extreme weights, best practice is to combine areas to reduce the effect of small cell sample sizes. The City of Redmond (PUMA 11607) was oversampled, as noted in the sample plan, which resulted in adequate completed sample households to remain a distinct PUMA target geography for regional weights.

TABLE 10: PUMA HH TOTAL SCALE FROM ACS 2016 TO OFM 2017 ESTIMATES

COMBINED PUMA GEOGRAPHY	PUMAS
Seattle	11601
Seattle	11602
Seattle	11603
Seattle (Central)	11604,11605
Redmond	11607
Rest of King County	11606,11608,11609, 11610,11611, 11612,11613,11614,11615,11616
Pierce County and Kitsap County	11501,11502,11503,11504,11505,11506,11507,11801, 11802
Snohomish County	11701, 11702, 11703, 11704, 11705, 11706

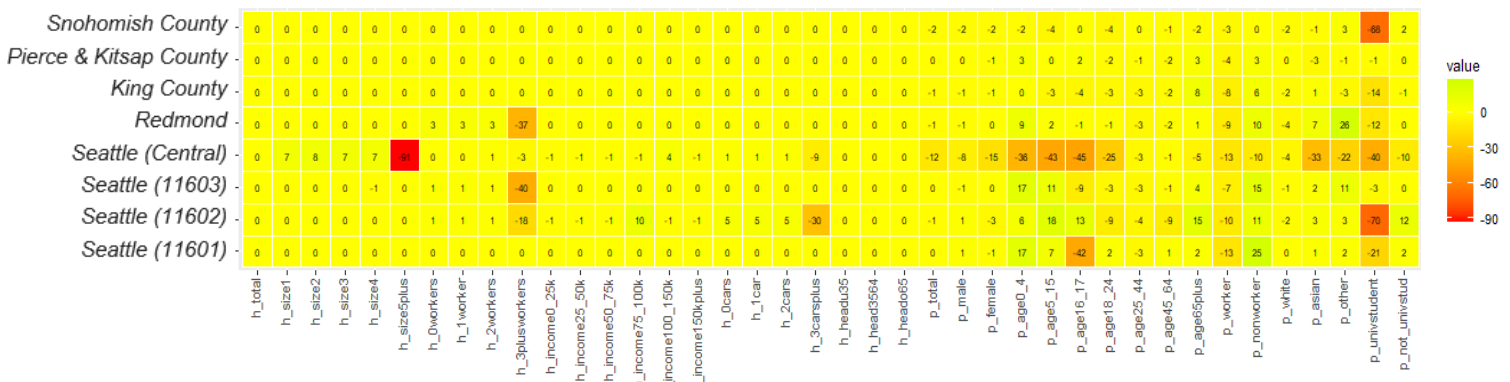
As a result of the IPF reweighting process by adjusted PUMA groupings, the household weights were created. The range of the household weights were from 2.65 to 13,126, with ~95% of the weights between 2.65 to 1,250. The mean household weight was 482.6 with the median weight at 46.5, evidence of the distribution of weights is right-skewed, as shown in Figure 11.

FIGURE 11: DISTRIBUTION OF FINAL HOUSEHOLDS WEIGHTS



After the household weights were created, the fit of each target variable was evaluated by plotting in an R heatmap (GGPlot2) output. As shown in Figure 12, each cell illustrates the percentage fit of the household weights multiplied by the sample size to match the target sum. For example, for the “h_total” variable (households total) the sum of weighted households is shown to have 0% difference for the target of WA State OFM 2017 households by the defined PUMA groupings.

FIGURE 12: PUMS-BASED TARGETS FOR EACH PUMA GROUP AND TARGET VARIABLE



6.5 | STEP 3. TRIP WEIGHTS AND TRIP CORRECTION FACTORS

The study collected travel diary data using rMove and the online travel diary. The final part of the weighting process involved comparing and adjusting trip rates based on detectable biases from the two data collection methods. RSG collected the data by smartphone using the rMove app and compared this to the data collected using the traditional diary recall method online or over the telephone. Typically, the smartphone-based data contain more days with travel and more trips per day and are used as the best



estimate of the true trip rates. The traditional diary-based data are adjusted so that the trip rates (and percentage of days with no trips) more closely match the smartphone-based data.

Table 11 shows the number of valid person-days of data collected as part of complete household-days—days on which complete data was collected for all household members. A total of 6,044 person-days are from rMove respondents, spread evenly across all seven days of the week. A total of 5,019 person-days are from the diary-based survey, which was administered for one travel day on a Tuesday, Wednesday, or Thursday. By study design, there were 697 households that used smartphone versus 2,580 that used travel diaries, so the multiday smartphone method yielded 8.50 valid person-days per household, compared to 1.95 person-days per household for the one-day diary method. (On average, the rMove households have 5.1 complete household-days of data.)

TABLE 11: NUMBER OF PERSON-DAYS AND AVERAGE LINKED TRIPS PER DAY, BY SURVEY METHOD AND DAY OF WEEK

	PERSON-DAYS OF DATA		AVERAGE TRIPS PER PERSON-DAY	
	rMove	Diary	rMove	Diary
TUE	960	1,545	4.02	3.50
WED	946	1,760	4.07	3.53
THU	873	1,714	4.16	3.42
FRI	854	--	4.67	--
SAT	760	--	4.73	--
SUN	834	--	3.89	--
MON	817	--	4.07	--
TOTAL	6,044	5,019	4.22	3.48

Table 11 shows that the rMove average linked trip rates for Monday, Tuesday, Wednesday, and Thursday are all similar—in the range 4.02 to 4.16, while the Friday trip rate is much higher at 4.67. This is due to more frequent evening activities on Fridays. For trip rate comparison and adjustment, Friday is excluded along with Saturday and Sunday. Only Monday-Thursday are used as these are stable and comparable to the Tuesday-Thursday period used for the diary method.

Table 12 contains the results of analyses to compare the travel patterns for the rMove and traditional diary-based data. RSG split the traditional diary households into four groups:

- “Opt-out”: All HH adults own smartphones, but the household opted out of using rMove.
- “NO-all”: All HH adults own smartphones, but the household was not given an option to use rMove.
- “NO-some”: Some HH adults own smartphones, so the HH was not given an option to use rMove.
- “NO-none”: No HH adults own smartphones, so the HH was not given an option to use rMove.

These were compared to the “Opt-in” group who opted to use rMove. Note that the “NO-all” group is likely to be most similar to the “Opt-in” group because all adults own smartphones and many of these households would have used rMove if they had been given the option. The “Opt-out” group, on the other

hand, chose not to use rMove, so may be different from the “Opt-in” group in ways that also influence travel behavior.

The first part of Table 12 shows the number of Monday-Thursday person-days of data in each group. In sum, 42% of the days are in the rMove group, while between 11% and 18% of the person-days are in each of the four diary-based groups. The average trips per day in the rMove Monday-Thursday person-days is 4.08. The average trip rate for the most similar diary-based group (NO-all) is 3.68, which is about 10% lower than for rMove. The other three diary-based groups have somewhat lower trip rates, but that is likely due to characteristics that are correlated to being in the opt-out and non-smartphone-owning groups (e.g., older, lower income)

The maximum number of trips in any of the diary-based person-days is 17, while the rMove person-days include as many as 64 trips, with multiple cases of over 20 trips. However, capping the number of rMove trips per day at a maximum of 20 for analysis purposes only reduces the mean rMove trips rate by 4.08 to 4.05—less than 1%. So, this analysis is not greatly affected by extreme cases, but it will be important to truncate the extreme cases for any regression analyses, which are much more sensitive to outlier effects.

For rMove surveys in the past, we have found that one of the main reasons for higher trip rates is that there are fewer “stay-at-home” days with zero trips as compared to diary-based data. Table 12 shows that this is true for the PSRC data, with only 6.1% zero-trip days in the rMove data compared to 10.5% in the two diary-based groups with high smartphone ownership, and about 18% in the two diary-based groups with partial or no smartphone ownership (which tend to be older, nonworking households). When the number of trips is averaged only across days with 1+ trips, the average trip rate for rMove person-days goes up to 4.38, while for the diary-based groups it is 4.11 for the NO-all group, so the difference is reduced from 10% to 6%. This result indicates that about half of the higher trip rate for rMove is due to a lower frequency of nontravel days, while the rest is due to a higher number of trips on days with travel.

The remaining sections of Table 12 investigate the differences across the groups in three ways: 1) by the number of work and school tours, the number of other home-based tours, and the number of intermediate stops person-day; 2) by the number of trips by mode; and 3) by the distance traveled by mode. (The distances are based on the GPS traces for rMove trips and from the Google API for diary-based trips. All trip distances were truncated at 100 miles to avoid undue effects of long trips. These values are calculated across all (Monday-Thursday) person-days, and then again across days with one or more trips only, excluding the “stay-at-home” days.

Some key observations based on the averages across all days include the following:

- When compared to the “Opt-out” and “NO-all” groups, the rMove group has a similar average number of work/school and other tours, but approximately 40% more non-home-based trips, meaning more intermediate stops on tours.
- When compared to the “Opt-out” and “NO-all” groups, the rMove group has a similar (or lower) number of walk/bike and “other mode” trips, but approximately 18% more car trips, and somewhat more transit trips.
- While the main discrepancy between the groups is in car trips, the average miles traveled by car per day is similar across the groups. This suggests that while rMove is capturing extra additional intermediate stops on auto tours, those stops are not adding much in terms of total auto distance



traveled, so these data may not be as critical in terms of transportation demand. If trip correction were done without taking this into account, it might “overcorrect” and create too much extra auto mileage in the diary-based trips.

- The average distance per day for walk/bike is higher in the rMove group, even though the average number of trips is not higher. This may be because rMove is better at capturing recreational “loop trips” by those modes, which may tend to be longer distance than other walk/bike trips. This difference may warrant further investigation before the data are used for modeling purposes, but it was not be a focus of the trip correction process.

Some key observations based on the averages across days with 1+ trips only include the following:

- Compared to the “Opt-out” and “NO-all” groups, the rMove group has a similar (or slightly lower) average number of work/school and other tours. It still has more non-home-based trips, but now the difference is only about 25% rather than 40% (1.65 NHB trips per day in the rMove group vs. 1.26 in the NO-all group).
- Compared to the “Opt-out” and “NO-all” groups, the rMove group has a similar (or lower) number of walk/bike and “other mode” trips. It still has more car trips, but the difference is approximately 12% instead of 18% (2.77 auto trips per day in the rMove group vs. 2.44 in the NO-all group).
- The average miles traveled by car per day is similar across the groups—and somewhat lower in the rMove group than in the other groups. (Some of the difference may be attributable to the way that the distance measures are obtained, but they should be comparable.) The average miles traveled across all modes is almost identical across the smartphone-owning groups.

TABLE 12: ANALYSIS OF TRIP RATES AND TRAVEL PATTERNS, BY RESPONDENT GROUP

LABEL	OPT-IN	OPT-OUT	NO-ALL	NO-SOME	NO-NONE	TOTAL
Survey method used	rMove	Diary	Diary	Diary	Diary	--
Offered rMove option?	Yes	Yes	No	No	No	--
HH adults own smartphones?	All	All	All	Some	None	--
Person-days of data (Mon-Thu)	3,596	1,531	1,452	1,096	940	8,615
% of person-days (Mon-Thu)	42%	18%	17%	13%	11%	100%
Average trips per day (Mon-Thu)	4.08	3.53	3.68	3.23	3.40	3.72
% of days with no trips	6.1%	10.5%	10.5%	17.3%	18.1%	10.4%
Average trips on days w/ 1+ trips	4.35	3.94	4.11	3.91	4.15	4.15
Avg. work & school tours	0.66	0.69	0.70	0.57	0.45	0.64
Avg. other home-based tours	0.63	0.59	0.62	0.62	0.74	0.63
Avg. non-home-based trips	1.54	1.05	1.13	0.91	1.05	1.25

LABEL	OPT-IN	OPT-OUT	NO-ALL	NO-SOME	NO-NONE	TOTAL
Avg. total tours	1.29	1.28	1.32	1.19	1.19	1.27
Avg. trips per tour	3.19	2.82	2.85	2.76	2.88	2.99
Avg. trips by car	2.60	2.16	2.19	2.17	2.06	2.34
Avg. trips by walk or bike	0.92	0.92	0.99	0.65	0.88	0.89
Avg. trips by transit	0.45	0.36	0.40	0.32	0.39	0.40
Avg. trips by other modes	0.11	0.09	0.11	0.08	0.06	0.10
Avg. miles by car	14.6	14.7	14.2	15.7	13.0	14.5
Avg. miles by walk or bike	1.3	0.8	0.8	0.6	0.7	0.9
Avg. miles by transit	3.0	2.5	2.8	2.6	2.5	2.8
Avg. miles by other modes	1.4	1.4	1.6	1.2	0.7	1.3
Avg. total miles	20.3	19.4	19.4	19.8	17.0	19.6
Only including days with 1+ trips						
Avg. work & school tours	0.70	0.77	0.79	0.69	0.55	0.71
Avg. other home-based tours	0.67	0.66	0.69	0.75	0.91	0.70
Avg. non-home-based trips	1.65	1.18	1.26	1.10	1.29	1.40
Avg. total tours	1.37	1.43	1.38	1.44	1.46	1.41
Avg. trips per tour	3.19	2.82	2.85	2.76	2.88	2.99
Avg. trips by car	2.77	2.42	2.44	2.62	2.52	2.61
Avg. trips by walk or bike	0.98	1.03	1.10	0.79	1.08	1.00
Avg. trips by transit	0.48	0.40	0.44	0.39	0.47	0.45
Avg. trips by other modes	0.12	0.10	0.12	0.10	0.08	0.11
Avg. miles by car	15.6	16.4	15.9	19.0	15.9	16.2
Avg. miles by walk or bike	1.3	0.9	0.9	0.7	0.9	1.1
Avg. miles by transit	3.2	2.8	3.1	2.8	3.2	3.1
Avg. miles by other modes	1.5	1.6	1.8	1.5	0.8	1.5
Avg. total miles	21.7	21.7	21.7	24.0	20.8	21.8



TRIP RATE ADJUSTMENT

The analysis described above indicates that the discrepancies in the trip rates between the rMove data and traditional diary-based data from comparable households arise from two main sources:

- A higher percentage of “stay-at-home” days in the self-reported traditional diary data, some of which may be “soft refusals” where respondents reported making no trips on days when they traveled.
- A higher number of non-home-based trips per day in the rMove data, mainly occurring on auto tours. These extra intermediate stops on auto tours mainly have the effect of splitting auto tours into additional, shorter auto trips, without significantly adding to the total auto distance traveled on the tours.

These findings are consistent with what RSG has found in similar comparative analyses from past surveys in other regions in the United States.

The standard trip rate adjustment process using GPS-based data is to weight the trip records directly, using different bias correction factors for different types of trips. The trip records in the data were cross-classified by three dimensions:

1. **Trip OD purpose:** (a) Home-based mandatory (work, school), (b) Home-based other, and (c) non-home-based.
2. **Trip mode type:** (a) Auto, (b) Walk/bike, and (c) Transit/other.
3. **Trip distance quartile:** (a) 0-1 miles, (b) 1-3 miles, (c) 3-8 miles, and (d) over 8 miles.

Based on an analysis of the distribution of different trip type combinations across the different respondent types, the trips were classified into six categories:

- Home-based mandatory—all modes and distances.
- Other OD purposes—walk/bike trips, all distances.
- Other OD purposes—transit/other trips, all distances.
- Other OD purposes—auto trips, 0-1 miles.
- Other OD purposes—auto trips, 1-8 miles.
- Other OD purposes—auto trips, over 8 miles.

The classification was determined by looking for groups of combinations with sufficient numbers of trips to make a valid comparison between data types and looking for combinations that showed different percentages of trips between the Opt-in rMove respondents and comparable smartphone-owning households. Table 13 shows that relative to the Opt-in group, the NO-all group has more home-based mandatory trips and fewer short auto trips for other purposes, with similar fractions for the other categories. (These values are weighted by the household-level weights.)

TABLE 13: PERCENTAGE OF TRIPS BY OD PURPOSE/MODE/DISTANCE COMBINATION AND RESPONDENT TYPE (DATA WEIGHTED BY HOUSEHOLD-LEVEL WEIGHTS)

LABEL	OPT-IN	OPT-OUT	NO-ALL	NO-SOME	NO-NONE	TOTAL
Survey method used	rMove	Diary	Diary	Diary	Diary	--
Offered rMove option?	Yes	Yes	No	No	No	--
HH adults own smartphones?	All	All	All	Some	None	--
HB Mandatory—all modes and distance	19.5%	33.0%	29.0%	29.2%	17.8%	24.9%
Other purposes—all walk and bike trips	9.4%	12.9%	10.4%	8.5%	15.4%	10.7%
Other purposes—all transit and other trips	3.2%	1.6%	3.1%	5.5%	6.3%	3.5%
Other purposes—Auto trips—0-1 miles	16.5%	8.9%	8.4%	13.9%	11.4%	12.7%
Other purposes—Auto trips—1-8 miles	37.5%	28.0%	35.9%	31.6%	38.6%	34.8%
Other purposes—Auto trips—over 8 miles	14.0%	15.6%	13.0%	11.3%	10.5%	13.5%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Next, the trips were aggregated by person-day across these same categories, to determine the number of trips per weekday person-day in each category, when weighted by the household-level weights. Table 14 shows the results. A comparison of the results for the Opt-in and NO-all groups indicates that the number of auto and transit trips for Other purposes should be weighted up—particularly for the short auto trips—enough to make up for the difference in trips between the Opt-in and NO-all groups. The adjustment factors and results after adjustment are shown in Table 15. The number of trips per day in the Opt-in and NO-all groups now match closely.



TABLE 14: AVERAGE TRIPS BY PERSON-DAY BY OD PURPOSE/MODE/DISTANCE COMBINATION AND RESPONDENT TYPE

LABEL	OPT-IN	OPT-OUT	NO-ALL	NO-SOME	NO-NONE	TOTAL
Survey method used	rMove	Diary	Diary	Diary	Diary	--
Offered rMove option?	Yes	Yes	No	No	No	--
HH adults own smartphones?	All	All	All	Some	None	--
HB Mandatory—all modes and distance	0.90	1.04	1.17	0.83	0.52	0.92
Other purposes—all walk and bike trips	0.44	0.41	0.42	0.24	0.45	0.40
Other purposes—all transit and other trips	0.15	0.05	0.12	0.16	0.18	0.13
Other purposes—Auto trips—0-1 miles	0.77	0.28	0.34	0.39	0.33	0.47
Other purposes—Auto trips—1-8 miles	1.74	0.88	1.45	0.90	1.12	1.29
Other purposes—Auto trips—over 8 miles	0.65	0.49	0.52	0.32	0.30	0.50
TOTAL	4.65	3.15	4.02	2.84	2.90	3.71

TABLE 15: AVERAGE TRIPS BY PERSON-DAY BY OD PURPOSE/MODE/DISTANCE COMBINATION AND RESPONDENT TYPE AFTER ADJUSTMENT

LABEL	OPT-IN	OPT-OUT	NO-ALL	NO-SOME	NO-NONE	TOTAL	ADJUSTMENT FACTOR-
Survey method used	rMove	Diary	Diary	Diary	Diary	--	--
Offered rMove option?	Yes	Yes	No	No	No	--	--
HH adults own smartphones?	All	All	All	Some	None	--	--
HB Mandatory—all modes and distance	0.90	1.04	1.17	0.83	0.52	0.92	1.00
Other purposes—all walk and bike trips	0.44	0.41	0.42	0.24	0.45	0.40	1.00
Other purposes—all transit and other trips	0.15	0.06	0.14	0.18	0.21	0.15	1.15
Other purposes—Auto trips—0-1 miles	0.77	0.56	0.68	0.79	0.66	0.94	2.00
Other purposes—Auto trips—1-8 miles	1.74	1.01	1.67	1.04	1.29	1.48	1.15
Other purposes—Auto trips—over 8 miles	0.65	0.57	0.60	0.37	0.35	0.57	1.15
TOTAL	4.65	3.65	4.67	3.44	3.47	4.47	--

6.6 | FINAL WEIGHTS AND RECOMMENDED USE

The weights provided with the 2017 PSRC household travel survey data are as follows:

- **hh_wt_final**: The resulting weights from the weighting to the ACS data. This weight should be used for household-level and person-level analyses.
- **hh_day_wt_final**: The same as hh_wt_final but divided by the number of complete weekdays of data (Monday-Thursday) for each household. This weight should be used for household-day and person-day-level analyses, as it represents an average weekday.
- **trip_wt_final**: The resulting weights from the trip correction factor process described in the previous section. This is equal to hh_day_wt_final multiplied by the trip correction factor in Table 15 for each trip type in the diary-based data.

The final round of updating and checking the weights excluded eight households whose trip data were determined to be invalid. Table 16 to Table 20 show the resulting unweighted and weighted totals for those final weights at household, person, person-day, and trip-level. In each case, the recommended weight to use is highlighted, so that the number of households or persons across the entire sample match the ACS-based targets. Separating out the rMove respondents by the number of weekdays of data shows how the hh_day_wt_final scales down the weights for the multiday households. This is appropriate for day-level and trip-level data, but not for household-level and person-level data. The number of trips per person-day in the diary-based data is still less than in the smartphone-based data even after correction because most of the difference is due to demographic differences between the samples using each method.

TABLE 16: NUMBERS OF HOUSEHOLDS, UNWEIGHTED AND WEIGHTED

HOUSEHOLDS	UNWEIGHTED	HH_WT_FINAL
Diary	2,580	1,332,898
smartphone-1 weekday	71	31,712
smartphone-2 weekdays	109	52,494
smartphone-3 weekdays	169	40,164
smartphone-4 weekdays	348	124,352
TOTAL	3,277	1,581,620

TABLE 17: NUMBERS OF PERSONS, UNWEIGHTED AND WEIGHTED

PERSONS	UNWEIGHTED	HH_WT_FINAL
Diary	5,019	3,309,037
smartphone-1 weekday	134	56,250
smartphone-2 weekdays	203	159,788
smartphone-3 weekdays	306	88,068
smartphone-4 weekdays	573	237,009
TOTAL	6,235	3,850,152

**TABLE 18: NUMBERS OF PERSON-DAYS, UNWEIGHTED AND WEIGHTED**

PERSON-DAYS	UNWEIGHTED	HH_DAY_WT_FINAL
Diary	5,019	3,309,037
smartphone-1 weekday	134	56,250
smartphone-2 weekdays	406	159,788
smartphone-3 weekdays	918	88,068
smartphone-4 weekdays	2,292	237,009
TOTAL	8,769	3,850,152

The data file includes 35,024 (Group 1) rMove trips, plus 17,469 diary-based trips (Group 2), for a total of 52,493 trips in the trip file. Of the rMove trips 8,756 were on incomplete household-days (one or more persons had an incomplete survey day), and 11,207 were on Fri-Sun, leaving 15,061 rMove trips on complete weekdays (Mon-Thu). Those 15,061 rMove trips (Group 1) have nonzero weights and are included in Table 19 and Table 20.

TABLE 19: NUMBERS OF WEEKDAY TRIPS, UNWEIGHTED AND WEIGHTED

TRIPS	UNWEIGHTED	TRIP_WT_FINAL
Diary	17,469	12,754,413
smartphone-1 weekday	591	273,024
smartphone-2 weekdays	1,734	806,231
smartphone-3 weekdays	3,710	415,356
smartphone-4 weekdays	9,026	1,183,296
TOTAL	32,530	15,432,320

TABLE 20: NUMBERS OF WEEKDAY TRIPS PER PERSON-DAY, UNWEIGHTED AND WEIGHTED

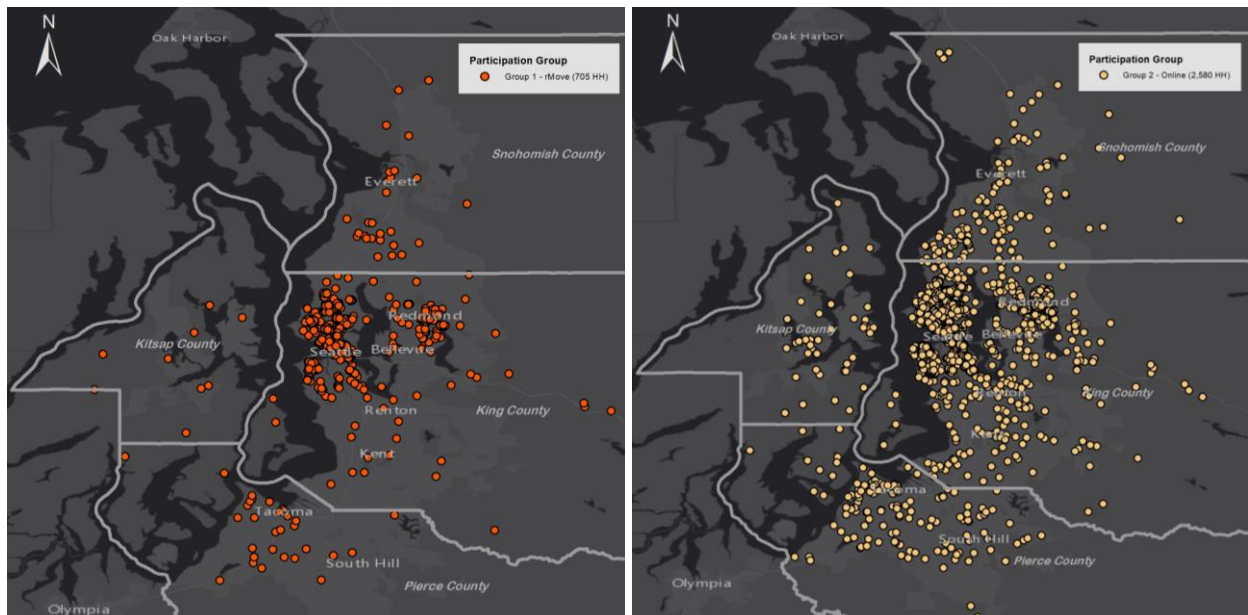
TRIPS PER PERSON-DAY	UNWEIGHTED	TRIP_WT_FINAL
Diary	3.48	3.85
smartphone-1 weekday	4.41	4.85
smartphone-2 weekdays	4.27	5.05
smartphone-3 weekdays	4.04	4.72
smartphone-4 weekdays	3.94	4.99
TOTAL	3.71	4.01

7.0 SURVEY RESULTS

7.1 | SURVEY RESPONSE RATES

The study exceeded its target of 3,100 households with 3,277 households who completed the study throughout the 4-county PSRC region. Figure 13 maps the home locations of participants for the rMove smartphone participants (Group 1) and the rSurvey online diary participants (Group 2) complete households.

FIGURE 13: PARTICIPANT HOME LOCATIONS, BY PARTICIPATION GROUP (RMOVE HOUSEHOLDS ON LEFT, RSURVEY HOUSEHOLDS ON RIGHT)



As is typical, PSRC is releasing a public version of their dataset on the agency website. The dataset contains 3,285 households. However, we note here that during the process of weighting (as noted in the section above) a very small number of households were excluded (and thus have weights of zero). These eight households are noted below by their ID as a reference. Again, the weighting section above and this section of the report are based on the final 3,277 households used in weighting.

- 17102275
- 17109128
- 17121270
- 17123255
- 17126685
- 17131745
- 17136275
- 17138989

As noted in the previous Survey Design section, Part 1 of the study included two questions about smartphone ownership. Participants over age 18 were asked to specify what type of smartphone they had (if any) and the phone's age. RSG then used this information to determine group assignments. Groups



were assigned after each household completed Part 1 (the demographic and household information section). The goal at the start of the study was to recruit approximately 20% of total households for Group 1. The result was 21.3% of complete households used rMove to collect data (Group 1), with 78.7% of completing via the online diary (Group 2) as seen in Table 21. Group 1 participants reported their travel for seven days using rMove, while Group 2 participants reported their travel for one-day online using rSurvey.

TABLE 21: HOUSEHOLDS BY PARTICIPATION GROUP

PARTICIPATION GROUP	UNWEIGHTED		WEIGHTED	
	COMPLETE HHs	PERCENT	FREQUENCY	PERCENT
Group 1: rMove only	697	21.3%	248,721	15.7%
Group 2: Online diary only	2,580	78.7%	1,332,898	84.3%
TOTAL	3,277	100.0%	1,581,620	100.0%

As noted in detail in the sampling section, RSG first established the target sample sizes for each region. This was done to achieve the sampling goals for each of the sponsoring agencies. The contracted sample sizes were determined within and by each agency based on long-term data needs. The primary sampling frame was the list of all households in the four-county study region (King, Kitsap, Pierce, and Snohomish counties). RSG used ABS to select and invite households to participate in the study. ABS involved drawing a random sample of addresses from all the residential addresses in each defined geography such that all households in each defined geography have an equal chance of selection for the sample. Table 22 and Table 23 show the results of the survey sampling plan with the number of invites per sample segment, with subsequent recruited households, complete households (by participation Group 1 rMove / Group 2 online diary), response rate and sample rate.

TABLE 22: SURVEY RESPONSE SUMMARY

SAMPLE SEGMENT	TOTAL HHs ACS 2011-15	INVITES	RECRUITED HHs	RECRUIT RATE	COMPLETE HHs	RESPONSE RATE
PSRC	1,353,823	19,150	1,224	6.4%	849	4.4%
City of Redmond	24,398	7,590	776	10.2%	571	7.5%
City of Seattle UVs	117,421	27,473	2,548	9.3%	1,857	6.8%
TOTAL	1,495,642	54,213	4,548	8.4%	3,277	6.0%

TABLE 23: HOUSEHOLD SURVEY RESPONSE BY SAMPLE SEGMENT

SAMPLE SEGMENT	TARGET SAMPLE SIZE	PREDICTED RESPONSE RATE	INVITES	RECRUITED HHs	COMPLETE HHs IN SAMPLE	RESPONSE RATE
PSRC:						
(01) low response rate	149	4.35%	3,440	182	136	3.95%
(02) med. response rate	255	5.70%	4,510	292	203	4.50%
(03) high response rate	252	7.60%	3,330	328	222	6.67%
(11) low response rate	244	4.35%	5,630	231	157	2.79%
(12) med. response rate	69	5.70%	1,220	95	66	5.41%
(13) high response rate	76	7.60%	1,020	96	65	6.37%
PSRC Total	1,046	--	19,150	1,224	849	4.43%
Redmond:						
(22) med. response rate	43	5.70%	750	72	60	8.00%
(23) high response rate	141	7.60%	1,860	198	141	7.58%
(31) low response rate	60	4.35%	1,390	121	75	5.40%
(32) med. response rate	37	5.70%	650	45	36	5.54%
(33) high response rate	48	7.60%	640	54	39	6.09%
(42) med. response rate	48	5.70%	660	90	71	10.76%
(43) high response rate	124	7.60%	1,640	196	149	9.09%
Redmond Total	500	--	7,590	776	571	7.52%
Seattle Urban Villages:						
(50) 10%	238	7.95%	3,000	281	218	7.27%
(51) 15%	339	6.85%	4,950	558	398	8.04%
(52) 20%	151	5.78%	2,620	243	177	6.76%
(53) 25%	95	4.32%	2,210	154	115	5.20%
(54) 30%	199	6.52%	3,060	291	194	6.34%
(55) 35%	196	4.77%	4,110	341	244	5.94%
(56) 50%	102	6.87%	1,490	160	120	8.05%
(57) 60%	92	4.76%	1,940	167	130	6.70%
(58) 75%	87	6.49%	1,350	109	74	5.48%
(59) 100%	141	5.11%	2,743	244	187	6.82%
Urban Village Total	1,640	--	27,473	2,548	1,857	6.76%
TOTAL (Households)	3,186	--	54,213	4,548	3,277	6.04%



7.2 | HOUSEHOLD RESULTS

The three most key household-level variables are household income, household size, and household vehicle ownership. Many of the results below are shown as percentages of the overall number of complete households (3,277). Because the participation group (rMove smartphone-based or rSurvey online travel diary) was a key factor in how the data were collected—in addition to being a newer and innovative data collection practice—some figures are segmented by participation group.

Results by household size are an important measure for HTS projects. Like the majority of household-level studies, this project’s participation was skewed toward smaller households. This is primarily due to the fact that it is less burden for smaller households to participate in and complete the study. RSG corrected this bias in the weighting process. Importantly, there were relatively few observed differences in household characteristics for households that used rMove (Group 1) and those that did not (Group 2).

Note also because time passed over the course of the project, an impact is that the original sample plan used 2011-2015 ACS data, whereas the weighted results below use the 2012-2016 ACS data.

TABLE 24: HOUSEHOLD SIZE, BY PARTICIPATION GROUP (UNWEIGHTED)

NUMBER OF PERSONS	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
1 person	328	47.1%	980	38.0%	1,308	39.9%
2 people	265	38.0%	1076	41.7%	1,341	40.9%
3 people	62	8.9%	275	10.7%	337	10.3%
4 people	39	5.6%	205	7.9%	244	7.4%
5 or more people	3	0.4%	44	1.7%	47	1.4%
TOTAL (Households)	697	100.0%	2,580	100.0%	3,277	100.0%

TABLE 25: HOUSEHOLD SIZE, BY PARTICIPATION GROUP (WEIGHTED)

NUMBER OF PERSONS	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
1 person	99,475	40.0%	343,233	25.8%	442,708	28.0%
2 people	78,668	31.6%	472,612	34.9%	551,280	34.9%
3 people	20,927	8.4%	229,967	15.9%	250,894	15.9%
4 people	38,014	15.3%	163,537	12.7%	201,552	12.7%
5 or more people	11,637	4.7%	123,549	9.3%	135,186	8.5%
TOTAL (Households)	248,721	100.0%	1,332,898	100.0%	1,581,620	100.0%

Next, the tables below present the unweighted and weighted summary of self-reported household income across participation groups. Higher-income households are more likely to own smartphones, therefore affecting study participation methods. Both groups show an underrepresentation of the lowest income

household group (under \$25,000) when comparing the survey unweighted to the weighted results. Notably between the groups, Group 2 online survey households were almost twice as likely as Group 1 rMove households to select prefer not to answer rather than report income (7.9% vs 4.2%)

TABLE 26: HOUSEHOLDS BY INCOME GROUP AND PARTICIPATION GROUP (UNWEIGHTED)

HOUSEHOLD INCOME	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
Under \$25,000	66	9.5%	284	11.0%	350	10.7%
\$25,000 to \$49,999	106	15.2%	392	15.2%	498	15.2%
\$50,000 to \$74,999	114	16.4%	367	14.2%	481	14.7%
\$75,000 to \$99,999	114	16.4%	304	11.8%	418	12.8%
\$100,000 or more	268	38.5%	1028	39.8%	1296	39.5%
Prefer Not to Answer	29	4.2%	205	7.9%	234	7.1%
TOTAL (Households)	697	100.0%	2,580	100.0%	3,277	100.0%

TABLE 27: HOUSEHOLDS BY INCOME GROUP AND PARTICIPATION GROUP WITH INCOME IMPUTATION (WEIGHTED)

HOUSEHOLD INCOME	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
Under \$25,000	35,894	14.4%	188,336	14.1%	224,229	14.2%
\$25,000 to \$49,999	45,332	18.2%	231,559	17.4%	276,891	17.5%
\$50,000 to \$74,999	46,363	18.6%	222,617	16.7%	268,980	17.0%
\$75,000 to \$99,999	42,379	17.0%	177,262	13.3%	219,640	13.9%
\$100,000 to \$149,999	16,791	6.8%	269,282	20.2%	286,073	18.1%
\$150,000 or more	61,963	24.9%	243,843	18.3%	305,806	19.3%
TOTAL (Households)	248,721	100.0%	1,332,898	100.0%	1,581,620	100.0%

Table 27 and 28 show the unweighted and weighted summary of household vehicle ownership, reflecting that 0-vehicle households were over-represented when comparing the survey unweighted to the weighted results for both groups. This is likely due to the higher sampling rates in the City of Seattle and the City of Redmond, where households are more likely to have no cars.

**TABLE 28: HOUSEHOLDS BY VEHICLES AND PARTICIPATION GROUP (UNWEIGHTED)**

HOUSEHOLD VEHICLES	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
0 (no vehicles)	139	19.9%	397	15.4%	536	16.4%
1 vehicle	361	51.8%	1228	47.6%	1589	48.5%
2 vehicles	160	23.0%	747	29.0%	907	27.7%
3 or more vehicles	37	5.3%	208	8.1%	245	7.5%
TOTAL (Households)	697	100.0%	2580	100.0%	3277	100.0%

TABLE 29: HOUSEHOLDS BY VEHICLES AND PARTICIPATION GROUP (WEIGHTED)

HOUSEHOLD VEHICLES	GROUP 1: RMOVE HHs	GROUP 1: RMOVE %	GROUP 2: ONLINE HHs	GROUP 2: ONLINE %	TOTAL: HHs	TOTAL: %
0 (no vehicles)	25,737	10.3%	104,709	7.9%	130,446	8.2%
1 vehicle	107,281	43.1%	389,993	29.3%	497,273	31.4%
2 vehicles	84,934	34.1%	508,560	38.2%	593,495	37.5%
3 or more vehicles	30,769	12.4%	329,636	24.7%	360,405	22.8%
TOTAL (Households)	248,721	100.0%	1,332,898	100.0%	1,581,620	100.0%

7.3 | PERSON RESULTS

Person-level data collected in the study included key elements like age, ethnicity, gender, employment, and educational enrollment. As a reminder, by design, some data were collected differently based on if the participant was a child or not. For example, ethnicity was not asked of children, only adults in the household. Table 30 presents the persons by age group and participation group. There are more younger people and fewer older people participating via smartphone than online/telephone, due to ownership and use of smartphones by these different age groups. There are few differences in gender between the participation groups and an almost equal match in male and female participation, as shown in Table 31.

TABLE 30: PERSONS BY AGE GROUP AND PARTICIPATION GROUP (UNWEIGHTED)

PERSONS	GROUP 1: RMOVE PERSONS	GROUP 1: RMOVE %	GROUP 2: ONLINE DIARY PERSONS	GROUP 2: ONLINE DIARY %	TOTAL: PERSONS	TOTAL: %
Under 5 years	69	5.7%	278	5.5%	347	5.6%
5-11 years	58	4.8%	249	5.0%	307	4.9%
12-15 years	20	1.6%	103	2.1%	123	2.0%
16-17 years	14	1.2%	60	1.2%	74	1.2%
18-24 years	85	7.0%	285	5.7%	370	5.9%
25-34 years	442	36.3%	1270	25.3%	1712	27.5%
35-44 years	245	20.1%	902	18.0%	1147	18.4%
45-54 years	137	11.3%	553	11.0%	690	11.1%
55-64 years	92	7.6%	582	11.6%	674	10.8%
65-74 years	50	4.1%	501	10.0%	551	8.8%
75-84 years	4	0.3%	198	3.9%	202	3.2%
85 years or older	0	0.0%	38	0.8%	38	0.6%
TOTAL (Persons)	1216	100.0%	5019	100.0%	6235	100.0%

TABLE 31: PERSONS BY GENDER AND PARTICIPATION GROUP (UNWEIGHTED)

GENDER GROUP	GROUP 1: RMOVE PERSONS	GROUP 1: RMOVE %	GROUP 2: ONLINE DIARY PERSONS	GROUP 2: ONLINE DIARY %	TOTAL: PERSONS	TOTAL: %
Male	600	49.3%	2409	48.0%	3009	48.3%
Female	600	49.3%	2487	49.6%	3087	49.5%
Another	3	0.2%	17	0.3%	20	0.3%
Prefer not to answer	13	1.1%	106	2.1%	119	1.9%
TOTAL (Persons)	1216	100.0%	5019	100.0%	6235	100.0%

There are a few notable differences in the participation by race/ethnicity, as presented in Table 32. Whites tended to participate at a higher rate in the rMove survey than in the online diary. This does not correlate directly with smartphone ownership in general, according to data for all adults in the U.S. from the Pew research center where 66% of whites own a smartphone, but 68% of blacks and 64% of Hispanic persons own a smartphone¹⁷. This same research shows a smartphone ownership of 30% for persons over 65 years of age, correlating with retired persons in Table 33, which shows a higher percentage of retired persons using the online diary than the smartphone application to participate in the study. Employed persons have a higher rate of using rMove, both for full-time and part-time work. Pew also

¹⁷ <http://www.pewinternet.org/2015/10/29/the-demographics-of-device-ownership/>



reports 81% for college or higher educational attainment, consistent with Table 34 that shows a higher number of people in the rMove participation group than in the online diary.

TABLE 32: PERSONS (ADULTS ONLY) BY RACE/ETHNICITY AND PARTICIPATION GROUP (UNWEIGHTED) – SELECT ALL THAT APPLY QUESTION

RACE GROUP	GROUP 1: RMOVE PERSONS	GROUP 1: RMOVE %	GROUP 2: ONLINE DIARY PERSONS	GROUP 2: ONLINE DIARY %	TOTAL: PERSONS	TOTAL: %
African American or Black	22	2.1%	129	3.0%	151	2.8%
American Indian or Alaska Native	12	1.1%	44	1.0%	56	1.0%
Asian	172	16.3%	764	17.6%	936	17.4%
Native Hawaiian or Pacific Islander	8	0.8%	32	0.7%	40	0.7%
Hispanic	52	4.9%	160	3.7%	212	3.9%
White	792	75.1%	2974	68.7%	3766	69.9%
Other	23	2.2%	90	2.1%	113	2.1%
Prefer not to answer	32	3.0%	371	8.6%	403	7.5%
TOTAL	1,113	105.5%	4,564	105.4%	5,677	105.4%
<i>Total Persons Age 18+</i>	1,055		4,329		5,384	
<i>Total Persons <Age 18 (Not Asked Question)</i>	161		690		851	

TABLE 33: PERSONS BY EMPLOYMENT STATUS AND PARTICIPATION GROUP (UNWEIGHTED)

EMPLOYMENT STATUS	GROUP 1: RMOVE PERSONS	GROUP 1: RMOVE %	GROUP 2: ONLINE DIARY PERSONS	GROUP 2: ONLINE DIARY %	TOTAL: PERSONS	TOTAL: %
Employed full-time (35+ hours/week, paid)	717	59.0%	2367	47.2%	3084	49.5%
Employed part-time (<35 hours/week, paid)	97	8.0%	342	6.8%	439	7.0%
Self-employed	69	5.7%	275	5.5%	344	5.5%
Unpaid volunteer or intern	10	0.8%	42	0.8%	52	0.8%
Homemaker	46	3.8%	229	4.6%	275	4.4%
Retired	52	4.3%	705	14.0%	757	12.1%
Not currently employed	64	5.3%	369	7.4%	433	6.9%
Under 18	161	13.2%	690	13.7%	851	13.6%
TOTAL (Persons)	1216	100.0%	5019	100.0%	6235	100.0%

TABLE 34: PERSONS BY STUDENT TYPE AND PARTICIPATION GROUP (UNWEIGHTED)

STUDENT STATUS	GROUP 1: RMOVE PERSONS	GROUP 1: RMOVE %	GROUP 2: ONLINE DIARY PERSONS	GROUP 2: ONLINE DIARY %	TOTAL: PERSONS	TOTAL: %
Daycare	14	1.2%	52	1.0%	66	1.1%
Preschool	25	2.1%	94	1.9%	119	1.9%
K-12 public school	68	5.6%	325	6.5%	393	6.3%
K-12 private school	17	1.4%	62	1.2%	79	1.3%
K-12 home school	3	0.2%	24	0.5%	27	0.4%
College, graduate, or professional school	97	8.0%	307	6.1%	404	6.5%
Vocational / technical school	7	0.6%	20	0.4%	27	0.4%
None	34	2.8%	141	2.8%	175	2.8%
Other	5	0.4%	32	0.6%	37	0.6%
Not a student	946	77.8%	3962	78.9%	4908	78.7%
TOTAL (Persons)	1216	100.0%	5019	100.0%	6235	100.0%

7.4 | TRIP RATES AND TRAVEL ANALYSIS RESULTS

For the 3,277 complete households with 6,235 persons in the PSRC 2017 data, there were 35,024 smartphone-based trips and 17,469 diary-based trips, for a total of 52,493 trips (Table 35). Of the smartphone-based trips (Group 1) 8,756 were incomplete household-days (one or more persons had an



incomplete survey day), and 11,207 were on Friday, Saturday, or Sunday, resulting in 15,061 smartphone-based trips on complete weekdays (Monday -Thursday). The 11,207 Friday, Saturday or Sunday trips remain in the trip dataset as zero-trip weight, with the 15,061 complete weekdays (Monday – Thursday) have nonzero weights.

TRIP RATES

TABLE 35: NUMBERS OF HOUSEHOLDS, PERSONS AND TRIPS BY PARTICIPANT GROUP (WEIGHTED).

PARTICIPATION GROUP	COMPLETE HHs	PERSONS	TRIPS	HHs WEIGHTED	WEEKDAY (MON.-THUR.) TRIPS WEIGHTED
Group 1: rMove only	697	1,216	35,024	248,721	2,677,907
Group 2: Online diary only	2,580	5,019	17,469	1,332,898	12,754,413
TOTAL	3,277	6,235	52,493	1,581,620	15,432,321

The PSRC 2017 dataset was compared to the previously published PSRC 2006 and 2014 dataset reports for weighted distributions. The 2017 weighted trip data had a slightly higher trip rate 9.76 trips per household with 4.01 trips per day as shown in Table 36, (“trip_wt_final” weight as described previously in Table 20). When separating out the data collection participations group households in the 2017 data the Group 1 households had 4.95 trips per day for Group 1 for 1 weekday and 3.85 trips per day for Group 2, again one weekday. Group 1 rMove smartphone households had the highest trip rate captured of all recent PSRC surveys at 10.77 trips/household, which is comparable to the GPS adjusted trip rate from 2006. The household size for the rMove participants (group 1) was lower than the comparative surveys, so the trips per person were slightly higher than any other survey. Due to the smartphone passive rMove data collection technology with seven days of travel, the Group 1 households participation method recorded active trips for nearly every person and households (<0.1%), while households and persons reporting no trips were almost entirely in the Group 2 online diary reporting (3.3% and 10.8%, respectively), compared to the 2006 and 2014 self-reported diary survey results.

TABLE 36: NUMBERS OF HOUSEHOLDS, PERSONS AND TRIPS BY SURVEY YEAR (WEIGHTED)

	2006 SURVEY	2006 WITH GPS-BASED ADJUSTMENT	2014 SURVEY	2017 SURVEY TOTAL	2017 SURVEY GROUP 1 REMOVE	2017 SURVEY GROUP 2 ONLINE DIARY
Households	1,375,702	1,375,702	1,462,107	1,581,620	248,721	1,332,898
Persons	3,267,043	3,267,043	3,537,800	3,850,151	541,115	3,309,037
Persons/HH	2.37	2.37	2.42	2.43	2.18	2.48
Trips	12,273,532	14,762,567	13,782,059	15,432,230	2,677,907	12,754,413
Trips/household	8.92	10.73	9.43	9.76	10.77	9.57
Trips/person	3.76	4.52	3.90	4.01	4.95	3.85
HH with no trips	6.0%		3.6%	3.3%	<0.1%	3.3%
Persons with no trips	10.7%		12.2%	10.8%	<0.1%	10.8%

Household weekday weighted trip rates were analyzed by household income and participation group. With increased household income, the trip rate continuously increased from 5.6 trips per day for the lowest income households (under \$25,000) to 14.6 trips per day for households in the highest income category (\$150,000 or more) (Table 37). Of the 3,277 complete households, 110 were found to have made zero trips, with nearly 100% (109 of these 110 households) in Group 2 (online survey). This is due to the GPS passive smartphone data collection aspect of Group 1 participation in which RSG’s rMove app leverages automatic capture of even the shortest of trips, which are routinely under-reported in self-report online travel surveys. Due to Group 1 having completed 7 days of travel participation, the 705 households of Group 1 provided 2,188 weekday (Monday – Thursday) complete travel days. The Group 1 households were only 20% of the target sample however, so the total trips collected were over double at 35,204 trips for Group 1 vs. 17,469 trips for Group 2 with only 1 day of travel.

TABLE 37: HOUSEHOLD WEEKDAY TRIP RATES BY INCOME

	HHs	HHs WEIGHTED	TOTAL TRIPS	WEEKDAY TRIPS	WEEKDAY TRIPS WEIGHTED	WEEKDAY HH TRIP RATE WEIGHTED
Under \$25,000	377	224,229	3,888	2,423	1,250,285	5.6
\$25,000 to \$49,999	551	276,891	6,639	4,220	2,285,233	8.3
\$50,000 to \$74,999	524	268,979	8,357	4,967	2,832,840	10.5
\$75,000 to \$99,999	418	219,640	7,746	4,868	2,147,652	9.8
\$100,000 to \$149,999	765	286,073	12,602	7,850	2,461,500	8.6
\$150,000 or more	642	305,805	13,261	8,202	4,454,811	14.6
TOTAL	3,277	1,581,620	52,493	32,530	15,432,320	9.76

Weighted trip rates by household size are shown in Table 38, with weighted trip rates by age group in Table 39 and employment status in Table 40.

**TABLE 38: HOUSEHOLD TRIP RATES BY HOUSEHOLD SIZE (GROUPS 1 & 2)**

	HHs	HHs WEIGHTED	TOTAL TRIPS	WEEKDAY TRIPS	TRIPS WEIGHTED	WEEKDAY HH TRIP RATE WEIGHTED
1 person	1,308	442,708	13,225	8,230	2,106,680	4.8
2 people	1,341	551,280	23,226	14,042	4,524,722	8.2
3 people	337	250,894	7,743	4,663	2,339,842	9.3
4 people	244	201,552	7,173	4,638	3,222,280	16.0
5 or more people	47	135,186	1,126	957	3,238,896	24.0
TOTAL	3,277	1,581,620	52,493	32,530	15,432,320	9.76

TABLE 39: PERSON TRIP RATES BY AGE GROUP

	PERSONS	PERSONS WEIGHTED	TOTAL TRIPS	WEEKDAY TRIPS	TRIPS WEIGHTED	WEEKDAY PERSON TRIP RATE
Under 5 years	347	245,257	2,151	1,284	1,139,200	4.64
5-11 years	307	354,152	1,991	1,273	1,408,117	3.98
12-15 years	123	176,759	696	484	491,940	2.78
16-17 years	74	95,591	376	266	250,821	2.62
18-24 years	370	275,843	3,300	1,816	828,898	3.00
25-34 years	1712	616,638	17,585	9,904	2,233,576	3.62
35-44 years	1147	526,274	10,702	6,580	2,378,996	4.52
45-54 years	690	517,750	6,452	4,044	2,251,484	4.35
55-64 years	674	506,070	5,153	3,510	2,249,596	4.45
65-74 years	551	443,974	3,247	2,558	1,861,862	4.19
75-84 years	202	75,980	755	726	291,358	3.83
85 years or older	38	15,862	86	85	46,472	2.93
TOTAL	6,235	3,850,152	52,493	32,530	15,432,320	4.01

TABLE 40: PERSON TRIP RATES BY EMPLOYMENT STATUS

	PERSONS	PERSONS WEIGHTED	TOTAL TRIPS	WEEKDAY TRIPS	TRIPS WEIGHTED	WEEKDAY PERSON TRIP RATE
Employed full-time (35+ hours/week, paid)	3,084	1,570,289	30,311	17,823	6,057,799	3.86
Employed part-time (fewer than 35 hours/week, paid)	439	322,733	4,413	2,572	1,258,755	3.90
Self-employed	344	115,621	3,208	2,160	491,087	4.25
Unpaid volunteer or intern	52	25,844	445	288	102,653	3.97
Homemaker	275	237,314	2,186	1,433	1,539,966	6.49
Retired	757	480,481	4,041	3,298	2,122,001	4.42
Not currently employed	433	226,109	2,675	1,649	569,982	2.52
Persons <Age 18	851	871,760	5,214	3,307	3,290,079	3.77
TOTAL (Persons)	6,235	3,850,152	52,493	32,530	15,432,321	4.01

AT HOME ACTIVITIES

The study asked questions about online shopping and telework for each day, which are analyzed in Figure 14 to Figure 17. Because these distributions are so heavily skewed to the low end of the spectrum, two charts are provided for each topic. The left-most charts show the percentage of people reporting no time doing these activities, while the right-most charts show the distribution for people reporting any time doing these activities. Additionally, these charts refer to the weighted data, and thus reflect activity on four-weekday days for Group 1 households (Monday-Thursday, Figure 14 and Figure 16) and three weekdays for Group 2 households (Tuesday-Thursday, Figure 15 and Figure 17).

15-34% of participants report some level of online shopping activity each weekday.

Across the Group 1 and Group 2 weekdays, 15-34% of participants report some level of online shopping activity. The distribution of online shopping time is similar across days with an overall decrease in time Monday through Thursday and a peak on Friday.



FIGURE 14: ONLINE SHOP TIME BY DAY OF WEEK, WEIGHTED (GROUP 1)

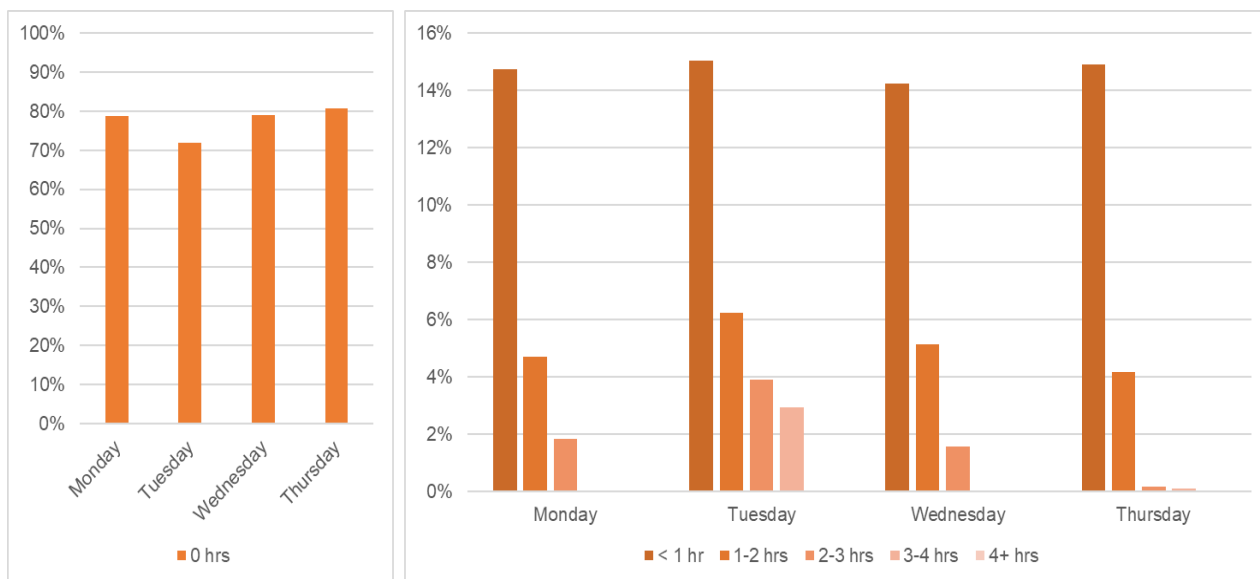
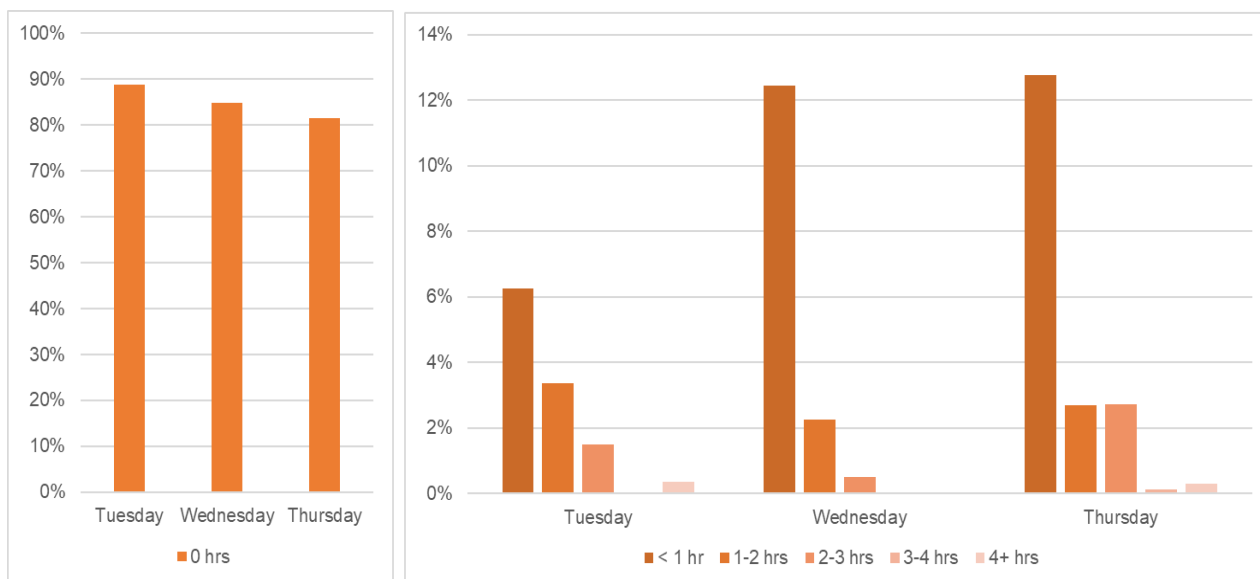


FIGURE 15: ONLINE SHOP TIME BY DAY OF WEEK, WEIGHTED (GROUP 2)



Across the Group 1 and Group 2 weekdays, 14-34% of participants reported some amount of teleworking. Among survey participants who reported teleworking, the most frequent telework days were Monday, Tuesday, and Wednesday for Group 1 households, and Wednesday for Group 2 households. Across all days, the most frequent lengths of telework time per day were short intervals (e.g., 15-120 minutes), full work days of eight hours, or 10+ hours (apparent in the Group 1 smartphone households).

14-34% of participants reported some amount of teleworking on weekdays

FIGURE 16: TELEWORK TIME BY DAY OF WEEK, WEIGHTED (GROUP 1)

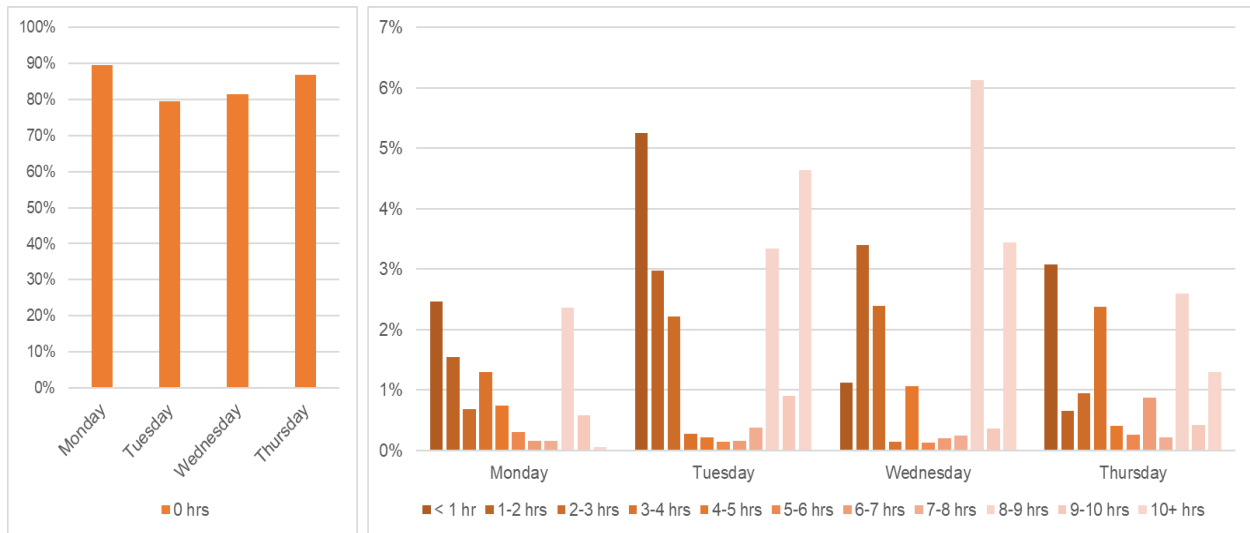
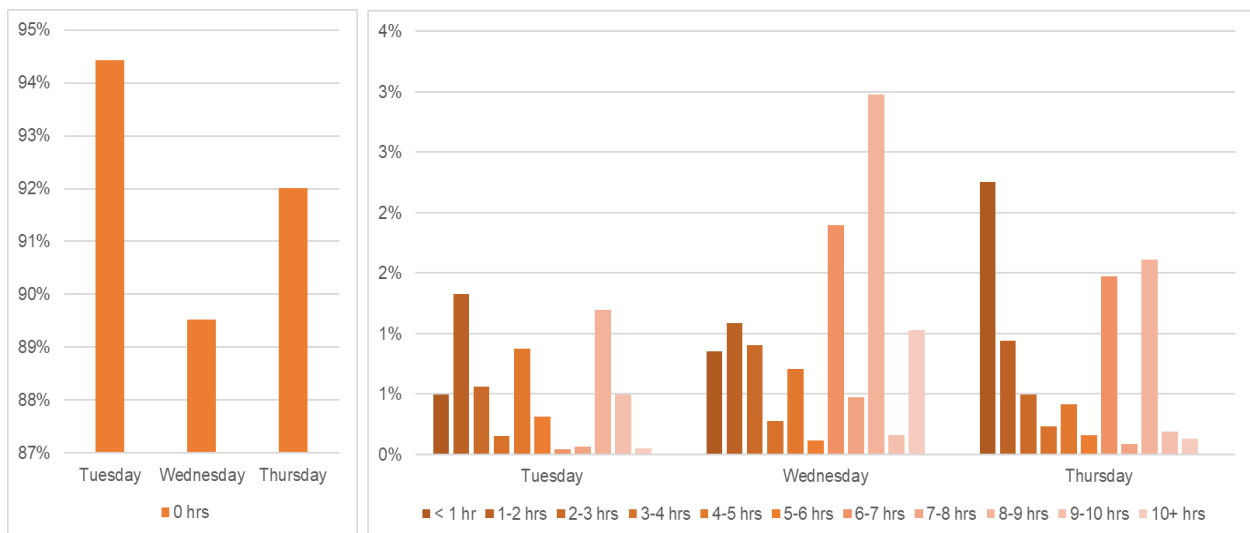


FIGURE 17: TELEWORK TIME BY DAY OF WEEK, WEIGHTED (GROUP 2)



TRAVEL ANALYSIS

The 2017 PSRC travel study resulted in several notable and consistent patterns across all trips (e.g., “Home” was the most common trip purpose and “Personal Vehicle” was the most common trip mode). Some patterns are only recognized when trips are categorized by household size, income, location, and other variables. The following sections demonstrate these high-level patterns. The results are weighted trip data for all complete household travel days (days for which there is with 100% complete data) by both participation modes (Group 1 and Group 2).

In addition, this dataset is a primary input to future transportation modeling at PSRC. Certain figures reported here, such as travel mode shares, may differ from future travel demand modeling scenarios. Transit and Taxi/ “TNC” ride share (i.e., “Uber”/ “Lyft”) mode shares are likely to be different between this report and future modeling scenarios. This dataset reflects the travel of residents of the Puget Sound



four-county region and does not necessarily reflect the travel of visitors or nonresidents. The most common trip destination purpose was to go home, with 34% of all trips overall (Figure 18), a finding that was consistent across household income levels (Figure 19). Outside of trips to home, “errand/other” were the most frequent trip types among most income brackets except for the lowest and highest income brackets (under \$24,999 or above \$150,000 household income), which had a higher share of “shopping” trips (Figure 19).

FIGURE 18: TRIP DESTINATION PURPOSE (WEIGHTED)

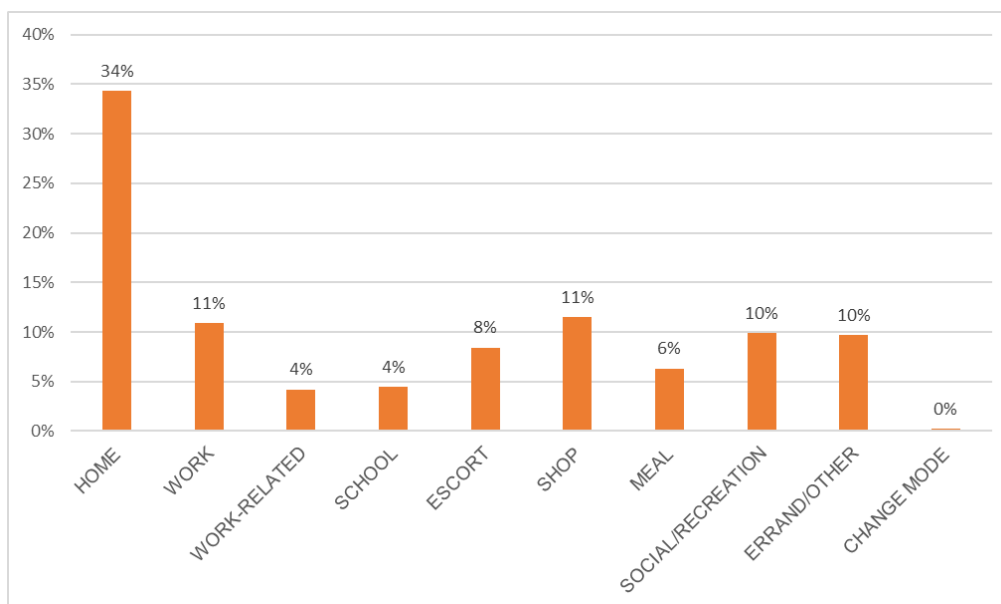
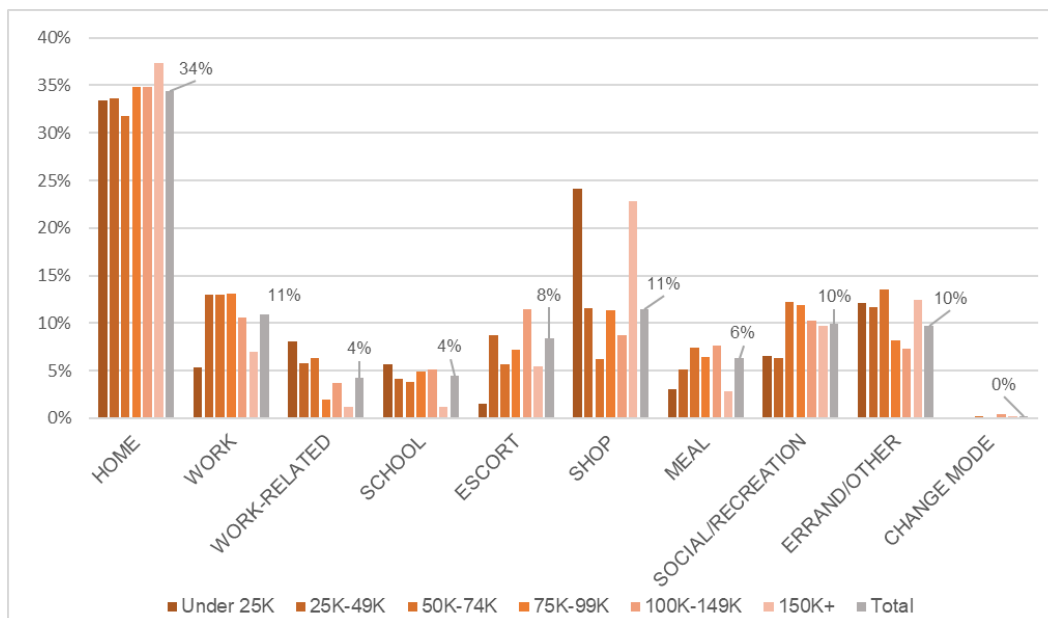


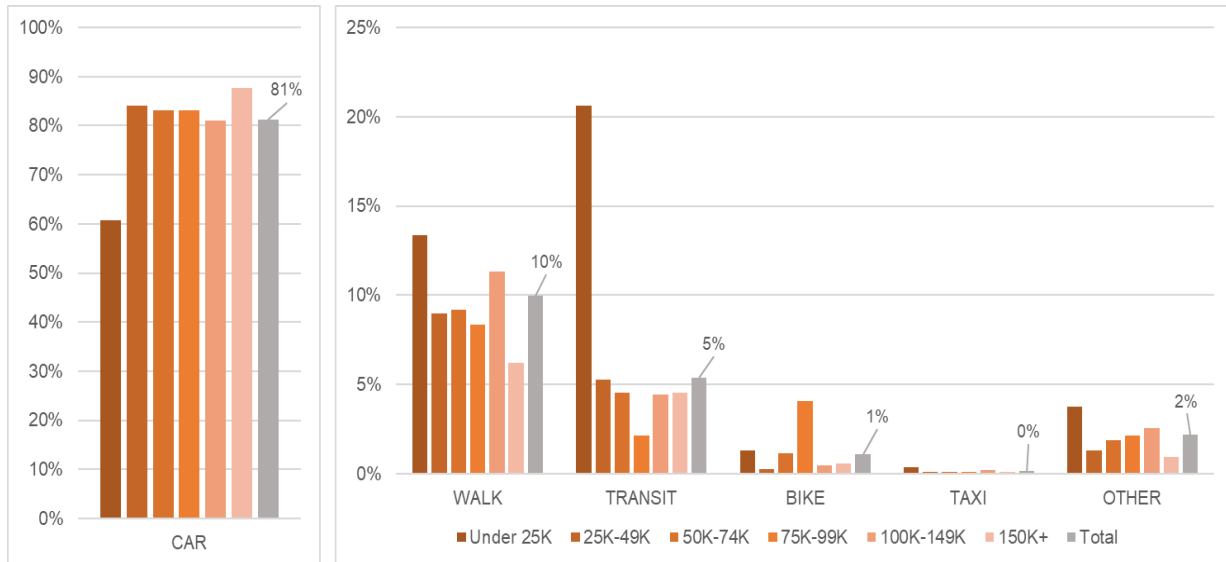
FIGURE 19: TRIP DESTINATION PURPOSE BY HOUSEHOLD INCOME (WEIGHTED)



Examining the trips by mode, car trips are the most frequent mode, with an 81% mode share overall, followed by walking (10%), transit (5.5%), and all other modes combined at roughly 3.5%. Looking at

variations by income, participants from low-income households (under \$24,999 in annual household income) were much more likely to walk and take transit than the overall population (Figure 20).

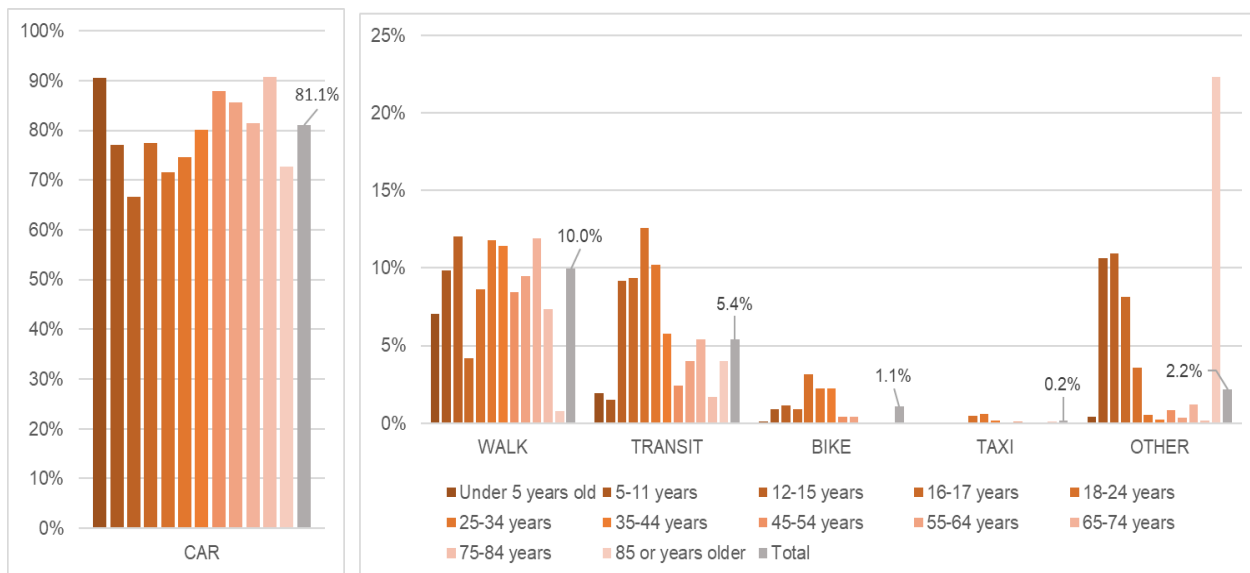
FIGURE 20: TRIP MODE BY HOUSEHOLD INCOME (WEIGHTED)



Trip mode shares vary slightly by age, with younger populations having fewer car trips. People 18-24 years old are slightly more likely to use transit and bike, with the largest gains coming from increased transit usage (Figure 21). Similarly, transit usage slightly spikes for older populations, to around 5% for those 65-74 and 85 years or older. Otherwise, car usage is mostly stable at around 80% across age groups. Taxi usage, while a small share overall at less than 1%, also shows a skewed age distribution toward the young. This is likely due to the fact that 86% of taxi trips used the relatively new smartphone-based ride-hailing services, such as Uber or Lyft, whose customer bases appear to be much younger than the overall population. The relatively high proportion of trips by other modes for children under 18 can be mostly accounted for by school bus trips, while the spike in other modes for trips taken by the over 85 years of age category is an anomaly due to a sample size of one and a high weight for this category. Since the over 85 years of age category is not typically used in planning or modeling studies as a separate category, this does not present an issue.



FIGURE 21: TRIP MODE BY AGE GROUP(WEIGHTED)



Analyzing trip purposes by departure time of the trip shows travel patterns daily life. As shown in Figure 22 of overall travel departure times by hour of day, there were two general peaks over the day of morning rush hour 8-11 a.m., and then evening 3-6 p.m. Figure 23 represents trips by purpose and hour of day. Some trip purposes are more evenly distributed throughout the daylight hours, while others followed more distinct or spiked travel patterns. Most work and school trips began early in the morning, whereas most home trips occurred in the afternoon and evening. “Escort” trips peaked in mornings and afternoons, presumably to accompany children or household companions to school or work trips. Shopping trips peaked in late morning, while errand/other trips had two peaks in the morning and afternoon.

FIGURE 22: TRIPS BY TIME OF DAY (WEIGHTED)

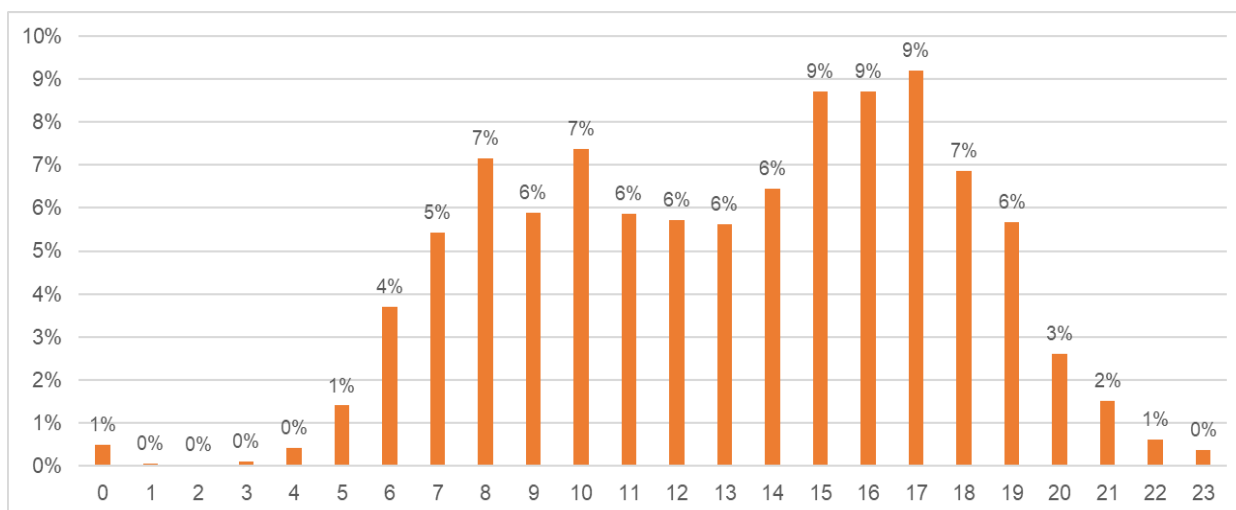
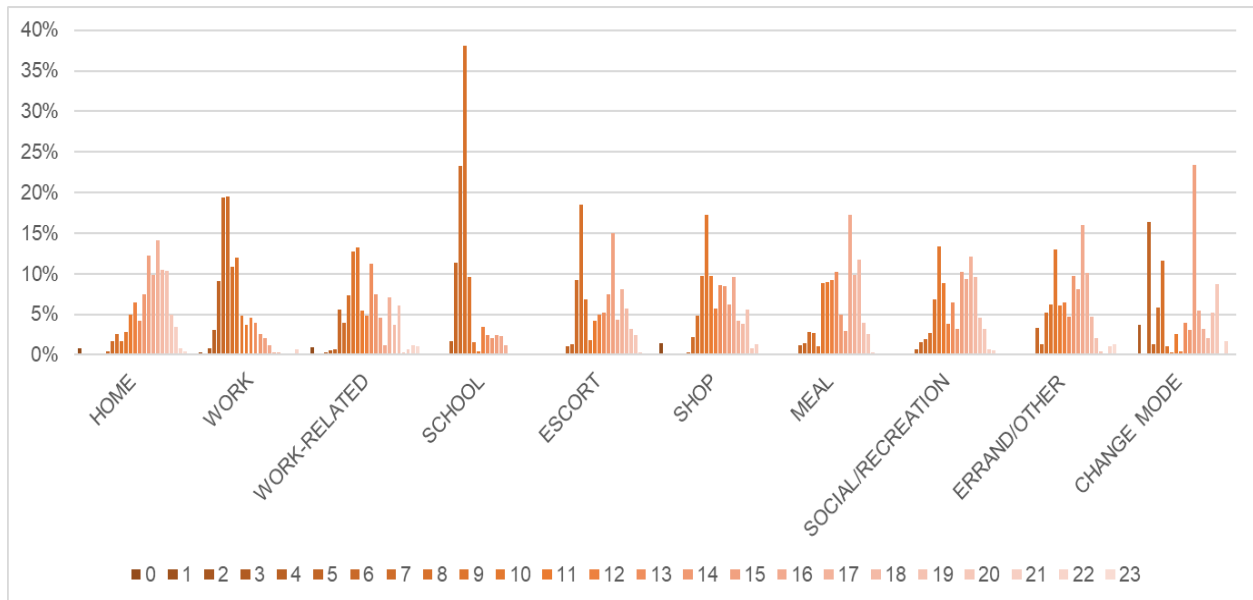


FIGURE 23: TRIPS BY TIME OF DAY AND DESTINATION PURPOSE (WEIGHTED)



Trip origins and destinations, and travel distances, were automatically recorded and calculated for the Group 1 rMove smartphone households. For the Group 2 online survey households, participants utilized a mapping interface to enter addresses or click on the map to enter locations, which were then calculated for all trip distances. In total for both participation modes, over 500,000 miles of trips were captured by the 3,277 complete households with most frequent trips under 1 mile (28%) and 11+ miles (17%) (Figure 24).

Over 500,000 miles of trips were captured in the 2017 PSRC travel study.

When segmented by trip mode, the distributions of trip duration and distance remain consistent across modes. “Walk” trips are one of the few exceptions in both cases, primarily because most individuals opted for another mode (other than walking) once the trip reached a certain distance. The disproportionate number of walk trips under one mile (86%) was also likely a result of many people walking to the location of their next mode (e.g., walking to a bus stop). Transit trips had a significant peak in 11+ miles trips (32%) due to long distance express bus and commuter rail service in the PSRC 4-county region (Figure 25).



FIGURE 24: TRIPS BY DISTANCE (WEIGHTED)

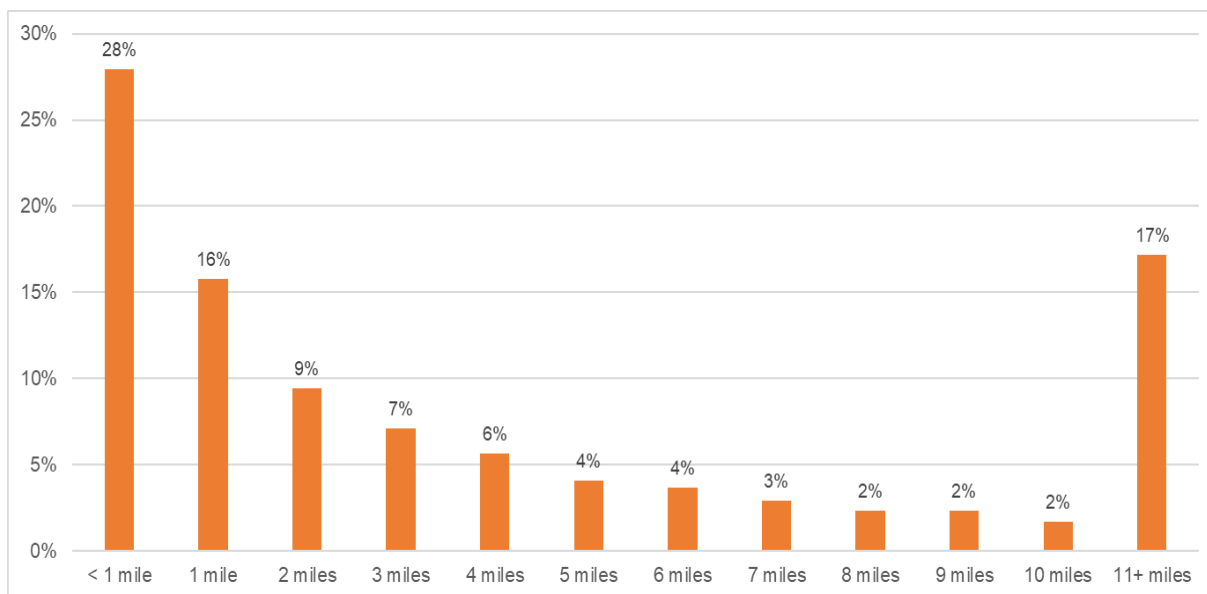
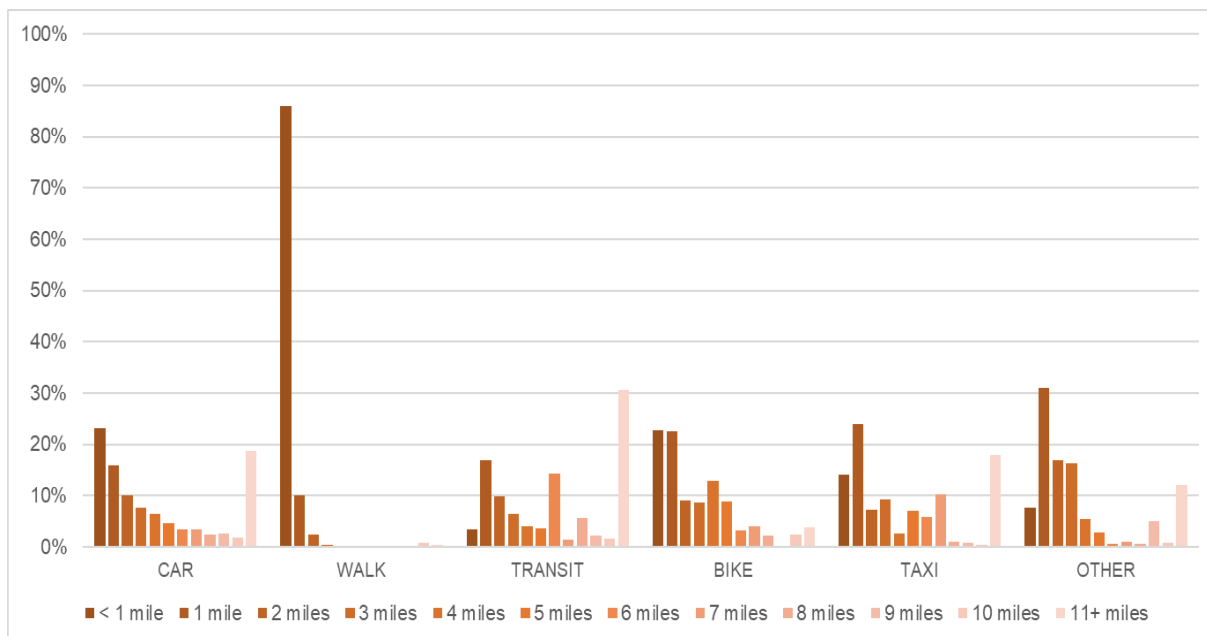


FIGURE 25: TRIPS BY DISTANCE AND TRIP MODE (WEIGHTED)



8.0 FUTURE CONSIDERATIONS

8.1 | SUMMARY

The study **obtained 3,277 complete households, exceeding the project goal of 3,100** complete households. These households completed 52,493 trips, totaling over 500,000 miles of travel.

The 2017 PSRC study yielding the 52,493 trips compares favorably to the 2014 study which yielded a similar volume of ~50,000 trips with an 85% larger sample size in 2014. With the inclusion of the Group 1 rMove passive seven-day smartphone participation sample, the 2017 dataset collected more than 4 million GPS points to detail the origins, destinations, and travel paths of trips. These Group 1 households were only 20% of the target sample for the 2017 travel study but the total trips collected were double for Group 1 with 7 days of travel (35,024 trips) compared to Group 2 with only 1 day of self-reported travel (17,469 trips).

Across multiple demographic measures, the data collected were representative after RSG applied a rigorous data weighting process using data from the ACS.

8.2 | FUTURE CONSIDERATIONS

As part of the project conclusion, PSRC and the cities of Seattle and Redmond met with RSG to discuss lessons learned. The three agencies planned to meet at key points in the future to further review data needs and planning elements of the travel survey program such as revisiting the “ideal” increment and size of each wave of data collection. Other lessons learned included interest in an earlier contract date, so that more than 1-2 months would be available to the project team prior to data collection. Smaller details such as question modifications and sample targets would be covered within any future contracts. Many of the themes related to lessons learned emerged from the fact that there is a growing set of stakeholders for the data and meeting those various needs can require additional planning and input over the course of the project.



9.0 APPENDICES

9.1 | QUESTIONNAIRES

(See separate PDF files.)

9.2 | INVITATION MATERIALS

(See separate PDF files.)