REGIONAL TRANSPORTATION COMMISSION
Metropolitan Planning • Public Transportation & Operations • Engineering & Construction
Metropolitan Planning Organization of Washoe County, Nevada

Regional Transportation Commission

Washoe County Regional Travel Characteristics Study
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NuStats, LLC
Contact: Vivian Daigler, Project Manager
PO Box 19304
Austin, TX 78760
Phone: 512-279-4153
Fax: 512-485-2835
E-mail: vdaigler@nustats.com

In Association with:
PlanTrans, LLC
Coulter & Associates
Kimley-Horn and Associates

Household Travel Survey

Final Report

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Table 1: List of Abbreviations and Acronyms

RTC	Regional Transportation Commission of Washoe County
ACS	American Community Survey
CASRO	Council of American Survey Research Organizations
CATI	Computer Assisted Telephone Interviewing
CM	Complete
CPH	Completes Per Hour
GPS	Global Positioning System
HH	Household
HHTS	Household Travel Survey/Study
MPO	Metropolitan Planning Organization
MSG	Marketing Systems Group
NTX	NuTripX™ – NuStats' proprietary real-time geocoding tool
RS	RouteScout – Smartphone application developed by NuStats for GPS data collection
LAT	Latitude
LONG	Longitude

1.0   Acknowledgements

NuStats and the Regional Transportation Commission of Washoe County (RTC) would like to acknowledge the many individuals who assisted with the planning, development, implementation, and execution of this project. Each party played an integral role in allowing this project to be a success.

The RTC team was led by Xuan Wang, who provided guidance and oversight throughout the project. Debra Goodwin, Amy Cummings and Judy Altoff were key members of the advisory team. Additional members of the advisory team were: Michael Dulude, Hao Xu, Jeremy Smith, Tina Wu, and Joseph Harrington. We are grateful for their contribution to this project.

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Kimley-Horn and Associates provided modeling expertise and local quality assurance. The individuals that performed these tasks were Tim Padgett and Molly O'Brien, and NuStats is thankful to them for their contributions to this project.

NuStats' data collection team worked tirelessly to recruit, retrieve, troubleshoot, and provide quality assurance, quality control, and sample management. Several of the NuStats team also performed the tasks of trip-purpose editing of the GPS and RouteScout data, fulfillment (postcards, survey packets, GPS devices, and mailing incentives) and downloading travel data from the GPS devices. These team members were instrumental in the successful completion of this project, and we are grateful to all of them for their contributions to this project.

Finally, without the survey participants, this project could not have been successful. It takes considerable effort to provide recruitment and travel data of all household members; for this, we are extremely grateful to these households that participated.

Additional individuals to be acknowledged for their contributions to this project:

Kris Castillo, Ceci Natal, and Christina Gomez	Data Collection Specialists
Brett Davis	Senior Software Developer
Sarah Griffith	CDF Administrator
Mike Hinojosa	Fulfillment Supervisor
Sujin Hong	Senior Data Analyst
Martin Kunzmann	President, NuStats
Cory Masterman	Post Trip Purpose Editing Lead
George Uribe	Data Collection Manager

2.0   Executive Summary

The Regional Transportation Commission (RTC) Washoe County Regional Travel Characteristics Study was a collaborative effort designed to collect household social economics data, travel diary data, and GPS data from 2,500 households in the RTC travel demand model region.

The RTC Household Travel Survey (HHTS) was designed to collect data utilizing Computer Assisted Telephone Interviewing (CATI), on-line, paper diary mailed back to NuStats, and two Global Positioning System (GPS) technologies: data logger and smartphone technology (RouteScout). A pilot survey was conducted in early summer of 2015 in which the survey instrument and methodology were tested. The pilot survey was conducted in English only; however the full study was conducted in both English and Spanish.

For both the pilot and the main survey, travel days were assigned during the school year on Tuesdays, Wednesdays, and Thursdays throughout data collection, with the exception of holidays. The travel period for non-GPS households was one 24 hour period beginning at 12:00 a.m. on the assigned travel day, and ending at 11:59 p.m. that same day. Households that participated in the GPS study were asked to carry their GPS device or smartphone for a seven day period, with the first day of the travel period being their assigned travel day. All participating households were recruited either via CATI, or online (self-recruitment). Travel information was retrieved via CATI, online (self-retrieval), or mailed back diaries.

There were 2,154 completed households, which includes 1,929 non-GPS households and 225 GPS + diary households. Of the GPS households 155 used GPS data logger and 70 used GPS RouteScout.

The overall recruit response rate for the main survey was 13.5 percent[1], which was higher by 3.4 percent than the pilot recruit response rate of 10.1 percent. The overall retrieval rate for the main survey was 63.7 percent, which was nearly 10 percent higher than the pilot retrieval response rate of 53.9 percent.

Presented in Table 2 in the next section are the average trip rates broken down by demographic characteristic. The lowest trip rate of 1.22 trips per household per day is reported by respondents of African American ethnicity. The highest trip rate of 16.17 trips per household per day is found in respondents residing in households with four or more household members. This was followed by households having 3 or more workers with an average trip rate of 13.65 trips per day. The average trip rate per household is 7.32 trips per day. The average trip rate per person is 3.43 trips per day.

Presented in Table 3 in the next section is a summary of trip statistics. Total trips include all household trips by all modes of travel. Auto trips include driver/passenger trips using household vehicles, carpool/vanpool, motorcycle, and rental car trips. Driver trips include household vehicle driver trips. Included in transit trips are private shuttle, RTC Ride, RTC Access, RTC Intercity, Sierra Spirit, RTC Rapid, RTC Vanpool, Amtrak, school bus, and other bus.

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[1] Based on the Council of American Survey Research Organization's (CASRO's) calculation of response rate, which includes all eligible and assumed eligible sampled households in the denominator

3.0   Key Statistics

Presented in Table 2 are the average trip rates broken down by demographic characteristic.

Table 2: Average Trip Rates by Demographic Characteristic (weighted and GPS factored)

Item	Trips per household/person per day
Household	7.32
Person	3.43
Household size	
1	3.05
2	5.64
3	9.14
4+	16.17
Household vehicles	
0	3.77
1	4.99
2	8.89
3+	9.56
Household workers	
0	3.40
1	7.00
2	11.02
3+	13.65
Household income	
Less than $25,000	4.87
$25,000 to less than $50,000	6.50
$50,000 to less than $75,000	8.93
$75,000 or less than $100,000	7.65
$100,000 or more	10.44
Refused to report income	4.65
Age	
<25 years old	3.11
25 – 34	3.31
35 – 44	4.58
45 – 54	3.87
55 – 64	3.62
65+	2.73
Hispanic Status	
Yes	3.45
No	3.43
Ethnicity	
White	3.53
African American	1.22
American Indian/Alaska Native	2.53
Asian	3.46
Native Hawaiian/Pacific Islander	2.12
Other	3.27
Refused to report ethnicity	3.20

Table 3 provides a summary of trip statistics.

Table 3: Key Household Travel Survey Trip Statistics (weighted and expanded)

	Total – 2015/2016
Total Household Trips	1,476,302
Total Household Auto Trips	1,281,136
Total Household Driver Trips	959,342
Total Transit Trips[2]	73,045
Avg. Daily Household Trips per Household	7.32
Avg. Daily Person Trips (Per Person)	3.43
Avg. Daily Driver Trips Per Household	5.83
Avg. Daily Transit Trips per Household	0.44
Avg. Trip Length (All Trips In minutes)	14.67
Avg. Trip Length (All Trips In miles)	8.02
Avg. Trip Length (In minutes, Home to Work Trips[1])	18.74
Avg. Trip Length (In miles, Home to Work Trips[1])	11.85
Avg. Vehicle Occupancy (private vehicle driver, passenger, carpool trips only)	1.72

[1]Home to Work Trips include unlinked trips between home and work place.

[2] Transit trips in 2016 survey includes RTC Ride, RTC Access (paratransit services), RTC Intercity, Sierra Spirit, RTC Rapid, RTC Vanpool, Amtrak, and Other Bus

Travel mode distribution is presented in Table 4.

Table 4: Travel Mode Distribution (weighted)

Mode	2015-2016 Mode Share
Non-Motorized Travel – walk, bike, wheelchair, other	7.9%
Private Vehicle – driver, passenger, carpool, motorcycle	86.2%
Private transit – taxi, rental, private shuttle, greyhound, airplane and other	1%
Public transit	4.5%
Total	100%

4.0   Introduction

The 2015-2016 RTC Travel Characteristics Survey was a multi-modal study of the demographic and travel behavior characteristics of residents throughout Washoe County, Nevada. Detailed travel behavior information was obtained from 2,154 households, using multiple data collection methods, including Computer Assisted Telephone Interviewing (CATI), online, mail surveys, wearable GPS devices, and a smartphone application. The survey sampling plan was designed to ensure an accurate representation of the entire RTC region.

4.1   Survey Objectives and Overall Approach

The main objective of the household travel study was to collect completed travel surveys from 2,500 households in the RTC region. The completed households are representative of the population of the 20 planning districts in Reno-Sparks. These 20 districts were disaggregated based on geographic and socioeconomic characteristics. Of particular interest to the RTC is the stratification of the resulting data into 2 two-dimensional categories: vehicles per household and number of workers per household and; household size and household income level. Ten percent of the responding households were selected to participate with GPS technology, either by wearing a GPS Data Logger (DL) or by utilizing RouteScout (NuStats' smartphone GPS tracking application). Participating households were required to complete a traditional travel diary. The GPS data serves to adjust unreported trips.

Assigned travel days were Tuesday through Thursday, except for holidays that fell on one of those days. During school breaks, data collection was suspended until school was back in session. With the approval of the RTC project manager, several travel days were added to the assigned travel day schedule in late fall 2015, and in early spring 2016.

A pilot study was conducted in early summer 2015 in order to assess respondent reaction to the survey and to confirm that the survey questions would yield the desired data. A summary of the pilot study is presented in Section 6.1. The pilot report provided recommendations for modifications that were implemented for the full study.

Figure 1 shows a map of the survey study area.

Figure 1: RTC MPO Map of the Household Travel Survey Study Area*
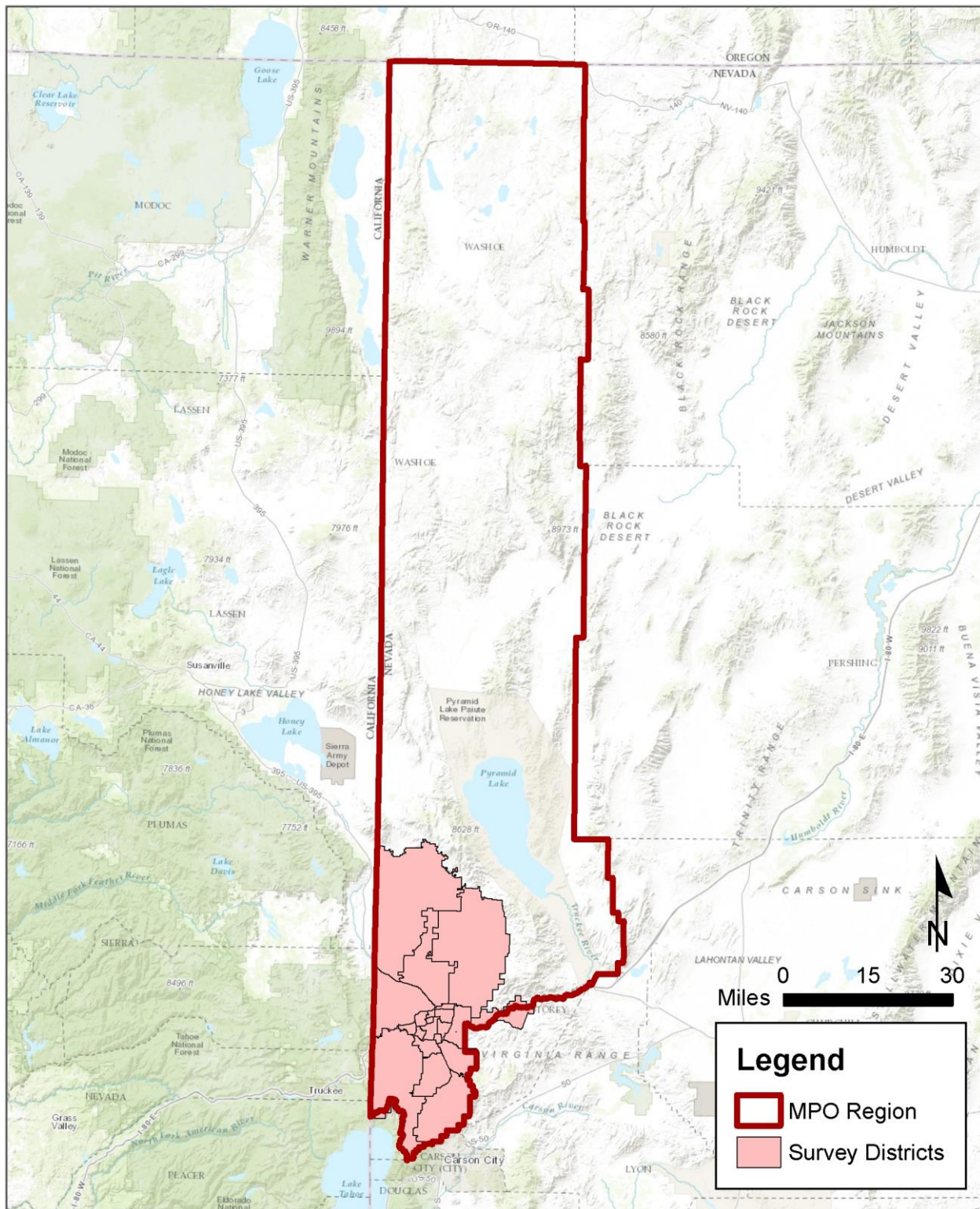
Source: http://www.rtcwashoe.com/mapwarehouse/RTC_MPO_Area.pdf

4.2   Description of the Survey Components

An overview of the key aspects of the RTC HHTS survey design is presented in Table 5. These three aspects, Sample Type, Household Type, and Survey Mode, are described as follows:

Sample Type: The sampling frame for the RTC HHTS was an address-based sample. Households whose addresses were sampled fell into two types—those for which there was a telephone number matched to the address (Matched Sample) and those without a matching telephone number (Unmatched Sample). In general, Matched Sample households have landline telephones, and Unmatched Sample households are those with no telephone, or cell phone numbers only.

Household Type: Households were recruited as: 1) those using Global Positioning System (GPS) technology (GPS Households) to augment their travel reporting and; 2) those not using GPS technology (Non-GPS). In the RTC HHTS design, GPS households were further recruited to use one of two different types of GPS technology:

- ✓ Wearable GPS
- ✓ RouteScout (Smartphone GPS tracking technology)

Survey Mode: To provide potential respondents with multiple ways to respond, there were different survey modes offered in the Recruitment and Retrieval phase of the survey. Recruitment was available to all Household Types through computer-assisted telephone interviewing (CATI) as well as on the Internet through the RTC Survey website. Retrieval of travel information was offered through CATI and Online, as well as by Mail for Non-GPS Households.

Table 5: RTC HHTS Survey Design Schematic

Sample Type	Household Type		Survey Mode				
			Recruitment		Retrieval		
			CATI	Online	CATI	Online	Mail
Matched or Unmatched Sample supplemented with targeted listed samples and targeted consumer cell sample	GPS Households	GPS					
		RouteScout					
	Non-GPS Households						

Traditionally, household travel surveys have two phases—recruitment, in which households are screened for participation; and retrieval, in which the detailed travel and activity information is collected. The recruitment phase contained a robust list of questions to collect person, household, vehicle, demographic, and habitual location information. The retrieval phase included the collection of detailed household travel information from all survey respondents. Additionally, any information that was refused during the recruitment interview was attempted to be collected during the retrieval interview.

4.3   Survey Schedule

NuStats was contracted on April 15th, 2015 to conduct the Regional Transportation Commission of Washoe County Travel Characteristics Study. Upon execution of the contract, NuStats began work on the tasks noted. Figure 2 provides the summary of the tasks performed, with the timeframe dedicated to each. As noted in

Section 4.1, several travel days were added to the original proposed schedule. This was due to participation levels being lower than originally predicted.

- Task 1 Research & Sampling – This task included: finalization of the Project Work and Management Plan; travel for the kick-off meeting; project management; finalization of the Sampling Plan; and obtaining and processing the study sample.

- Task 2 Survey Design – This task included finalization of the Public Awareness Plan; finalization of the diary and GPS survey methodologies; survey materials development; and programming.

- Task 3 Survey Instruments – This task included printing and fulfillment of the survey materials; postage; shipping; and business reply costs.

- Task 4 Public Outreach – This task was for all public outreach activities performed by our subconsultant, including time spent participating in meetings with regard to this project.

- Task 5 Conduct the Pilot – This task encompassed the activities necessary to administer the pilot study, analyze the results, prepare the data file and final report, and implement approved recommendations prior to beginning the full study.

- Task 6 Conduct the Main Survey – This task included: travel for trip purpose training; translation services; survey administration; weekly reporting; and management and cost of incentives.

- Task 7 Data Processing – This task encompassed the activities necessary for processing the retrieved data, and preparing it for delivery.

- Task 8 Analysis – All analysis activities are included in this task.

- Task 9 Final Reports – The activities involved to prepare the final technical report fall under this task.

Figure 2: Survey Schedule

	Task Name	Duration	Start	Finish
1	Household Travel Survey	287 days	4/15/15	5/19/16
11	Sample Design	29 days	4/16/15	5/26/15
16	Data Collection Methodology	86 days?	4/15/15	8/12/15
49	Initial Instrument Design	18 days	5/14/15	6/8/15
59	Pilot Survey	60 days	5/18/15	8/7/15
79	Final Instrument and Procedure Design	120 days	8/10/15	1/22/16
92	Full Survey Implementation	144 days	8/12/15	2/29/16
101	Data Deliveries	149 days	9/9/15	4/4/16
107	Data Weighting	250 days	5/12/15	4/25/16
112	Final Project Report	124 days	12/9/15	5/30/16

5.0   Survey Design

The RTC team and NuStats worked closely to finalize the design of the HHTS. A multimodal data collection menu was offered to participating households in order to maximize individual preference for survey administration. Households had the option of providing their completed travel information via mail, landline phone, cell phone, QR code, web, and other electronic means. The web-based recruitment and retrieval instruments were implemented using Voxco software and were accessible from the public website. With the postcard notification, each household received a unique Personal Identification Number (PIN) for login. The PIN allows for controlled and secured access to our survey instruments and was deactivated after a household completed their travel data. The web surveys followed the same format and flow as the CATI surveys that the interviewers used. Passive, high-resolution GPS data was collected via GPS DataLoggers (DL) and RouteScout (smartphone application) technology.

A public outreach plan was collaboratively designed between RTC, Coulter & Associates, and NuStats. The public outreach plan was implemented for the pilot survey, and was evaluated following the pilot for possible improvements that could be implemented for the full study.

Travel diary and GPS materials were processed for shipping to recruited households so that they would be received no later than the day before the assigned travel day.

Retrieval was completed in one of three modes: CATI, Online, or Mail. If responding households had not logged onto the survey website to complete their retrieval interview the day following their assigned travel day, retrieval calls were placed to collect the travel data.

5.1   Survey Instrument and Materials Design

5.1.1   Notification Postcards

Notification of the survey in the form or postcards was mailed to all unmatched sample. The postcards included an introduction to the survey, the purpose of the survey, a date to respond by, incentives being offered (to select households), a toll-free number to call with questions or to be recruited into the survey by a Computer Assisted Telephone Interviewing (CATI) interviewer, the URL for the survey website to self-recruit, and the respondent's PIN. For Spanish speaking participants, a line was placed on the front of the postcard saying: "Si desea esta información en español por favor llame a NuStats usando el número gratuito 1-877-221-7828." or "If you would like this information in Spanish please call NuStats using the toll free number 1-877-221-7828."

The postcards were modified a few times throughout the main study. The initial change was to enhance the call out window from saying "Your input is needed!" to "You can make a difference!" and adding a bubble showing "$25". Also for the second version, the respond by date was changed from 10 days to 14 days, the statement "Choose how you want to participate" was removed, and the paragraph stating "OR Call NuStats survey research firm, toll-free at 1-877-221-7828" was moved to the bottom of the postcard and reworded to say "Questions? Call NuStats survey research firm, toll-free at 1-877-221-7828." The reasons for these changes were to place focus on the incentive, and encourage web participation. Lastly, NuStats discontinued printing RouteScout specific postcards, and only mentioned GPS in the text of the postcard.

In its third iteration, the postcard evolved even further. NuStats created a QR code that took the respondent directly to the KOLO video interview, and a QR code that took the respondent directly to the survey website. With each mailing, approximately one-half of the households received the video link, and one half received

the survey link. It turned out more households that received the QR code with the survey link chose to recruit into the survey than did those that received the KOLO video interview QR code. Therefore, with the fourth iteration, we discontinued mailing postcards with the KOLO video QR code. Examples of the notification postcards may be found in Appendix A – Examples of the Notification Postcards.

5.1.2   Travel Day Assignment

Travel diary days were randomly assigned to households at the beginning of the recruitment interview for one 24-hour period on one weekday (Tuesday through Thursday) excluding any statutory holidays and school breaks and ensuring an even distribution of travel days. GPS data for GPS participants was collected for a continuous seven day (168 hour) time period. Distribution of travel days at the household level was monitored daily to ensure proper day-of-week distribution. The list of assigned travel days may be found in Appendix C – List of Assigned Travel Days.

5.1.3   Recruitment Survey Instrument

The recruitment survey for the RTC HHTS was developed collaboratively with RTC, NuStats, a modeling expert chosen by the RTC project manager, and with input from the technical advisory team. The recruitment survey was based on the RTC's travel modeling and analytical needs. The full CATI and online recruitment script may be found in Appendix B - CATI and Web Recruitment Script.

The key data elements identified and collected were as follows:

- **Household Characteristics –** main household characteristics collected were:
  a) Physical address, county of residence must be Washoe
  b) Household size
  c) Number of workers
  d) Use of public transportation
  e) Vehicle ownership, operational, and number of vehicles available to the household for regular use
  f) Bicycle ownership and number of bicycles available to the household for use
  g) Type of residence
  h) Home ownership status
  i) Number of years at current address
  j) Number of cell and landline phone numbers in household
  k) Household income

- **Person Characteristics -** Demographic information was collected for all household members to help explain the impact of household dynamics on personal travel in the region. The person-level data elements were:
  a) Name, Gender, Age
  b) Relationship among household members
  c) If any household members are of Hispanic, Latino or Spanish origin
  d) Ethnicity
  e) Vehicles driven by household members
  f) Number in household who possess a valid driver's license

g) Employment status, if more than one employer, location of employment, type of industry and occupation

h) Typical work days, number of hours worked per week, availability of working flexible hours, and mode of transportation to and from work location

i) If disabled, type of disability

j) Student status, grade level, home or on-line schooled, name and location of school, Mode of transportation to and from school location, level of education completed

k) Number of one-way transit trips in the past week, employer or school assistance with transit fare

l) Number of bicycle trips in the past week

- **Vehicle Characteristics -** The recruitment instrument included questions about the vehicles available to the household:

  a) Year, make, model, and body type

  b) Vehicle fuel type (hybrid, gasoline, diesel, etc.)

- **GPS Characteristics** – The recruitment instrument included questions specific to GPS households, both DL and RS households:

  a) Confirm all household members age 12 and over agree to participate

  b) Smartphone operating system, type of phone, phone number, and carrier

5.1.4 Retrieval Survey Instrument

The CATI and Online programs were set up to encourage respondents to answer every required question, and to terminate (with prior warning) the retrieval interview if respondents refused. The telephone representatives were trained on refusal rebuttals to minimize terminations. The CATI program also prompted interviewers to reference the same trips made by other household members. The retrieval questionnaire utilized in the CATI and online interviews is found in Appendix D – CATI and Web Retrieval Script. The non-GPS travel diary packet materials may be found in Appendix E – Non-GPS Survey Materials. Appendix F – GPS Survey Materials contains the GPS travel diary packet materials.

The travel diary for the RTC HHTS was developed collaboratively with RTC, NuStats, a modeling expert chosen by the RTC project manager, and with input from the technical advisory team. The travel diary was based on the RTC's travel modeling and analytical needs.

- The retrieval interview confirmed information, and collected missing information not completed in the recruitment interview:

  a) Physical address, location of employment, location of school

  b) Household size

  c) Name, age, and relationship

  d) Vehicle information

  e) DL or RS usage

- **Activities –** The retrieval interview collected information about each person's activities throughout their assigned travel period. These data elements included:

  a) Identify activity

  b) Activity start time/end time

- **Trip Data** – During the retrieval interview, trip data was collected for each household member, and included the following:
    a) Arrival and departure time
    b) Trip place name and address
    c) Trip mode
    d) Number of household members who traveled
    e) Vehicle(s) driven by each household member
    f) Parking type, cost, and how parking was paid for
    g) Use of transit, if so, which transit system and route or line number or name

5.1.5   Reminders

During the recruitment interview, respondents were given the opportunity to select their desired method of being reminded of their assigned travel day. One day prior to the assigned travel day, the respondent received a reminder via the method they chose, either via text message, email, or telephone call. At the time of reminder, the respondents are asked to verify they have received their travel materials and are provided any additional information necessary. The reminder script may be found in Appendix H – Reminder Script.

5.2   Sample Design

The purpose of the regional household travel survey was to gather statistically sound data that is detailed, reliable, and of high quality so as to be incorporated into the RTC's traffic demand model that better reflects the rapid population growth and travel demand increase in the area. Collected data would reflect the diversity of residents and their travel behavior throughout the region. The sampling plan was developed in close coordination between RTC and the NuStats team. The sampling plan outlined the procedures for yielding a statistically viable and reliable sampling strategy comprised of a geographically and socio-demographically representative draw of households in the region. Critical considerations for the strategic sample design were: identification of the survey universe, selection of the sampling frame, and a sampling method that included stratification scheme and determination of sample size. The following sections discuss each of these key issues.

5.2.1   Survey Universe

An address-based sampling frame approach was used. An address-based sample is a random sample of all residential addresses that receive U.S. Mail delivery. Its main advantage is its reach into population groups that typically participate at lower-than-average levels, largely due to coverage bias (such as households with no phones or cell-phone only households). For efficiency of data collection, NuStats matched addresses to telephone numbers that had a listed name of the household appended to the sampled mailing addresses. This sampling frame ensured coverage of all types of households irrespective of their telephone ownership status, including households with no telephones (estimated at between 3% and 4% of households in the United States.[2]).

In order to better target hard-to-reach groups, the address-based sample were supplemented with samples drawn from the listed residential frame that included listed telephone numbers from working blocks of numbers in the United States for which the name and address associated with the telephone number were known. The "targeted" listed residential sample, as available from the sampling vendor, included low-income

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[2] https://nces.ed.gov/statprog/handbook/nhes_dataquality.asp, accessed 3/9/2016.

listed sample, large-household listed sample, young population sample, and Spanish-surname sample. As expected, this sample was used to further strengthen the coverage of hard-to-reach households. The advantage of drawing sample from this frame is its efficiency in conducting the survey effort—being able to directly reach the hard-to-reach households and secure their participation in the survey in a direct and active approach. Both address and listed residential samples were procured from the sample provider – Marketing Systems Group (MSG) based in Fort Washington, PA.

The survey population represents all households residing in the Reno-Sparks MPO area. According to 2010 household and population data available from RTC*, the survey universe is comprised of 158,489 households and 404,609 residents. The whole region is geographically divided into 20 planning districts, as shown in Figure 3.

Figure 3: Reno-Sparks MPO 20 Planning Districts
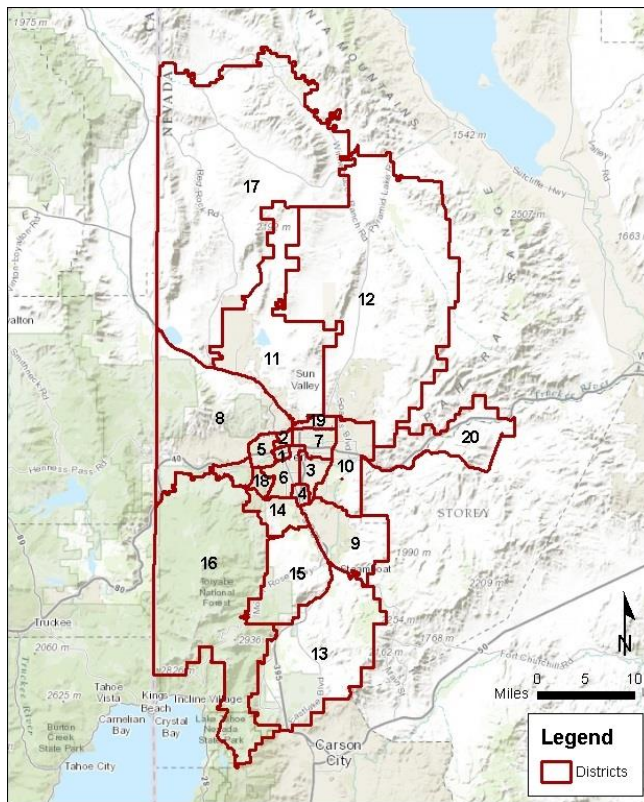
*Source: TAZ Shapefile from RTC Map Warehouse, accessible at http://www.rtcwashoe.com/planning-94

Table 6 provides the distribution of households among the 20 planning districts.

Table 6: Study Area and Survey Universe

District	District Name	Household	% of Total
1	Downtown	4,579	3%
2	University	3,385	2%
3	Airport	1,683	1%
4	Convention Center	3,724	2%
5	Reno Northwest	10,749	7%
6	Reno South	17,173	11%
7	Central Sparks	15,248	10%
8	Verdi-Mogul	16,332	10%
9	Huffaker Hills	10,522	7%
10	East Sparks	15,270	10%
11	North Valleys	17,494	11%
12	Pyramid Lake/Spanish Springs	17,184	11%
13	Washoe Southeast	3,264	2%
14	Anderson	5,529	3%
15	Rolling Hills	6,428	4%
16	Galena Creek Par	106	0%
17	Cold Springs	4,025	3%
18	Pyramid Lake	3,222	2%
19	North Sparks	2,563	2%
20	Washoe East	9	<1%
Total		**158,489**	**100%**

5.2.2 Sampling Design and Selection Methodology

NuStats employed a stratified probability sample of households for the RTC HHTS Full Study. Stratified sampling is a type of random or probability sampling, the methods of which are well grounded in statistical theory and the theory of probability. Specifically, stratified sampling is a probability sampling method where the survey universe is divided into smaller groups and a random sample is chosen within each group (i.e., every sampling unit has some non-zero probability of being selected into the sample). This method resulted in over-sampling for some strata ensuring NuStats captured the diversity of the population according to specific factors affecting travel behavior in the study area. Thus, within strata, households were selected with equal probabilities but the combined sample (across strata) comprised an unequal probability sample of households.

To ensure geographic representation, NuStats utilized a geographic stratification scheme, which ensured adequate representation of households throughout the study area. A stratified random sample that was disproportionate to the distribution of households by county of residence was drawn.

Sampling Frame

The sampling frame establishes population coverage as well as the efficiency of the sample (i.e., the extent to which screening is needed to weed out unusable or ineligible entries). Therefore, NuStats utilized an address–based frame to pull random samples of households in the region. One of the address-based frame's recognized strengths is its ability to reach into population groups, regardless of phone ownership, and provide comprehensive coverage. In addition, address-based sampling enabled NuStats to target Districts 1, 2, 3 and 7, which were lagging in participation.

For efficiency of data collection, addresses were matched to telephone numbers and had listed household names appended to the sampled mailing addresses. Samples without matched phone numbers were invited to the survey via mail with a notification postcard. As found in previous studies, the response rate for unmatched households is generally lower than matched households and this held true for the RTC HHTS. According to the National Health Statistics Reports (Issue No. 70), nearly 35 percent of adults aged 18 and over in the State of Nevada are estimated to live in cell-only households.

In the late fall, NuStats identified certain demographics that were lagging behind the average: young households (all members age 25 years or less); large households (more than 4 household members); and Hispanic households. In an attempt to increase participation from these groups, a sample of 500 households was drawn from this pool of available sample of Hispanic surname, large, and young households, which included matched, unmatched, GPS, and non-GPS sample; then the selected households were mailed a letter that contained a five dollar bill and a message asking them to participate in the study. An example of the letter is found in Appendix I – Pre-Paid Incentive Letter. Households in this sample that had not recruited into the study by January 7th, 2016, were sent a follow up letter that is included as Appendix I – Pre-Paid Incentive Letter and Follow up Letter.

Of the 500 households sent the pre-paid incentive letter:

- Thirty households enrolled online to participate in the study;
- One enrolled via CATI to participate in the study;
- Twenty-nine of the letters were returned as undeliverable;
- Overall, seven percent of this sample recruited into the study;
- A total of 19 households (four percent) completed both recruitment and retrieval
- This was one percent higher than the average for all other types of sample

Sampling Method and Proposed Sample Size

The selection of an appropriate sampling method is critical for an effective sample design that guards against unplanned selectiveness and produces a robust data set that is representative of the population in the region and captures diverse travel patterns and travel behaviors. NuStats targeted a total of 2,500 completed surveys for the main study that would result in a +/- 1.2 percent margin of sampling error at a 95 percent confidence interval. Of these, 500 completed surveys were targeted for the additional GPS component of the survey to track household travel patterns through GPS technologies. Due to overall participation rates being less than anticipated, the actual number of retrieved households reached to 2051, 82 percent of the original target with 1,683 non-GPS households, and 368 GPS/RS households retrieved.

Using a stratified probability sampling method, the survey universe was divided into smaller groups with a random sample chosen within each group. This method resulted in oversampling for some strata to ensure that the diversity of the population, according to specific factors affecting travel behavior, was captured in the study area. Thus, within strata, households were selected randomly (i.e., with equal probability of selection), but the combined sample (across strata) comprised an unequal probability sample of households.

Geographic Stratification

Stratifying the sample goal by district ensured a sound sample size per district. Table 7 presents the targeted and realized survey goals by district for non-GPS sample. As shown in the table, a minimum goal of 30 Non-

GPS households is allocated to every district except Galena Creek Park and Washoe East, where less than one percent of the total households are located. The geographic stratification for the targeted and realized survey goals for GPS households is found in Table 8.

Table 7: Non-GPS Sample Size by District

District	District Name	Total Households	% of Total*	Target Non-GPS Goal	% Sample Total*
1	Downtown	4,579	3%	56	3%
2	University	3,385	2%	41	2%
3	Airport	1,683	1%	30	2%
4	Convention Center	3,724	2%	44	2%
5	Reno Northwest	10,749	7%	135	7%
6	Reno South	17,173	11%	217	11%
7	Central Sparks	15,248	10%	192	10%
8	Verdi-Mogul	16,332	10%	206	10%
9	Huffaker Hills	10,522	7%	132	7%
10	East Sparks	15,270	10%	192	10%
11	North Valleys	17,494	11%	220	11%
12	Pyramid Lake/Spanish Springs	17,184	11%	216	11%
13	Washoe Southeast	3,264	2%	40	2%
14	Anderson	5,529	3%	70	4%
15	Rolling Hills	6,428	4%	81	4%
16	Galena Creek Park	106	<1%	8	0%
17	Cold Springs	4,025	3%	50	3%
18	Pyramid Lake	3,222	2%	40	2%
19	North Sparks	2,563	2%	30	2%
20	Washoe East	9	<1%	0	0%
Total		**158,489**	**100%**	**2,000**	**100%**

Totals may not add to 100% due to rounding

Table 8: GPS Goal by Area Type

District	District Name	GPS Sampling Strata	GPS Sampling Strata Name	% of Total HHs	Targeted GPS Ret. goal
1	Downtown				
2	University				
4	Convention Center				
5	Reno Northwest				
6	Reno South				
7	Central Sparks		High Density (>1000 HHs per sq. miles)		
18	Pyramid Lake	1		29%	184
3	Airport				
8	Verdi-Mogul				
9	Huffaker Hills				
10	East Sparks				
11	North Valleys				
14	Anderson		Medium Density (<1000 HHs and > 100 HHs per sq. miles)		
15	Rolling Hills				
19	North Sparks	2		50%	238
12	Pyramid Lake/Spanish Springs				
13	Washoe Southeast				
16	Galena Creek Par				
17	Cold Springs		Low Density (< 100 HHs per sq. miles)		
20	Washoe East	3		21%	78
Total				**100%**	**500**

A matrix of the sample goals by household vehicle and number of household workers is found in Table 9.

Table 9: Regionwide Household Distribution by Household Vehicle & Number of Household Workers

	1 worker	2 workers	3 workers	4+ workers	Total*
0 vehicle	5%	2%	1%	1%	9%
1 vehicle	18%	7%	3%	4%	32%
2 vehicles	5%	19%	6%	9%	39%
3+ vehicles	1%	7%	5%	8%	21%
Total	29%	35%	15%	22%	100%

Total may not add up to 100% due to rounding

The socioeconomic goal for each category is found in Table 10. [3]

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[3] Source: 2008-2012 American Community Survey 5-year Estimates for Reno-Sparks MSA region

Table 10: Socioeconomic Sample Goals by Household Vehicle & Number of Household Workers

	1 worker	2 workers	3 workers	4+ workers	Total
0 vehicle	106	90			**196**
1 vehicle	273	442	95		**810**
2 vehicles	179	354	400	136	**966**
3+ vehicles	206		217		**526**
Total	**621**	**1013**	**720**	**147**	**2,500**

Provided in Table 11 is the distribution of households by size and income in the RTC region.

Table 11: Regionwide Household Distribution by Household Size & Household Income

	1 person	2 persons	3 persons	4 or more persons	Total
Low income	10%	9%	4%	7%	30%
Mid income	9%	11%	5%	8%	33%
High income	9%	13%	6%	9%	37%
Total	28%	34%	15%	23%	100%

The target goal for the socioeconomic distribution by household size and household income for each stratum is shown in Table 12.

Table 12: Socioeconomic Sample Goals by Household Size & Household Income

	Target RET Goal
Low income - 1 person	242
Low income - 2 persons	232
Low income - 3 or more persons	270
Mid income - 1 person	233
Mid income - 2 persons	285
Mid income - 3 persons	131
Mid income - 4 or more persons	205
High income - 1 person	217
High income - 2 persons	329
High income - 3 persons	142
High income – 4 or more persons	214
Refused Income	-
Total	2,500

Listed households within one-quarter mile of a transit station (potential transit households) were drawn from the targeted census tracts. Figure 4 presents the transit oversampling area for the RTC HHTS.

Figure 4: Transit Oversampling area
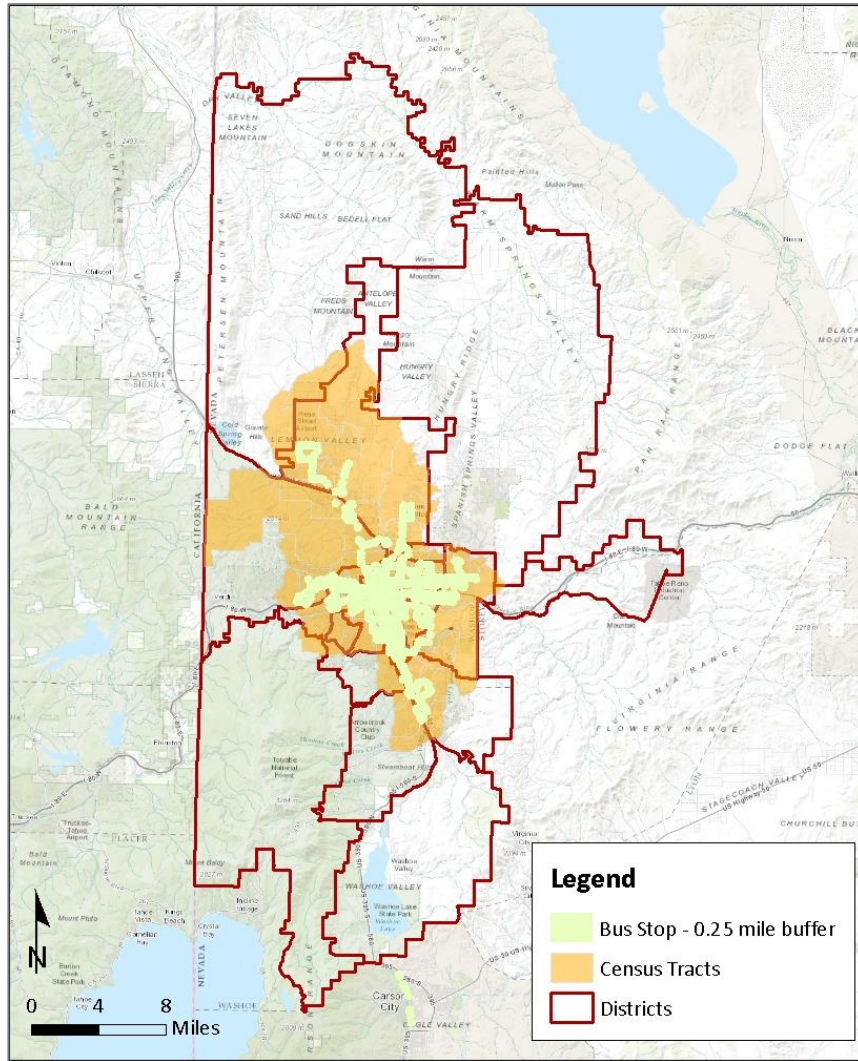
The targeted sociodemographic distribution for the study area may be found in Table 13.

Table 13: Sociodemographic Distribution for the Study Area

		Total Counts	% Counts
Household Size (ACS 2010-2014)	1	48,726	29.6%
	2	57,075	34.7%
	3	23,739	14.4%
	4 or more	34,921	21.2%
	Total	164,461	100.0%
Household Vehicle Ownership (ACS 2010-2014)	0	13,349	8.1%
	1	54,557	33.2%
	2	62,112	37.8%
	3 or more	34,443	20.9%
	Total	48,726	29.6%
Household Workers (ACS 2010-2014)	0	43,846	26.7%
	1	66,195	40.2%
	2	45,476	27.7%
	3 or more	8,944	5.4%
	Total	164,461	100.0%
Household Income (ACS 2010-2014)	<$25K	38,560	23.4%
	$25K-$50K	32,284	19.6%
	$50k-$75K	37,383	22.7%
	$75K-$100K	20,704	12.6%
	$100K+	35,530	21.6%
	Total	164,461	100.0%
Hispanic Status of Residents (ACS 2010-2014)	Hispanic	98671	22.9%
	Non-Hispanic	331314	77.1%
	Total	429,985	100.0%
Age of Residents (ACS 2010-2014)	<20 yrs	109,790	25.5%
	20 – 34 yrs	92,176	21.4%
	35 – 44 yrs	54,288	12.6%
	45 – 54 yrs	60,141	14.0%
	55 – 64 yrs	56,111	13.0%
	65+ yrs	57,479	13.4%
	Total	429,985	100.0%

6.0   Survey Methods

This section describes the main survey methods. Following a brief discussion of the changes made to the main survey as a result of the RTC HHTS pilot study, the final survey design is presented in detail. Discussions of the following specific aspects of the survey methods are then presented: proxy reporting, call backs, refusals, hotline, handling non-English speaking households, interviewer training, incentives, definition of a completed household, respondent burden, and sample management. Survey outreach to hard-to-reach populations and ongoing quality control complete the survey methods.

6.1   Survey Pilot

The pilot study was conducted from June 3rd to July 31st, prior to the full study, in order to assess respondent reaction to the survey and to confirm that the survey questions yielded the desired data. All households were mailed a postcard notifying them of the upcoming survey and offering some basic information about the survey, as well as information to complete the survey online. Respondents were offered two modes to complete the recruitment interview: CATI and web. Retrieval options were: mail back of diaries; web; or CATI. A toll-free hotline was available for respondents to call with questions about the survey. A technical support telephone number was provided for GPS and RouteScout participants to call if they required technical assistance. The pilot study was conducted in English only to effectively test the survey instruments prior to any translations.

The original pilot sampling plan targeted a total of 138 completes be collected. Of these, 100 were to be non-GPS, proportionately distributed among 20 geographic sampling strata. For the pilot study, there were no set goals by district or by socioeconomic characteristics of household. In addition, 28 percent of the sample, or 38 households throughout the whole study area, were selected to complete the pilot using either the smartphone GPS data collection app (19 households) or GPS data loggers (19 households). A total of 106 households completed both the recruitment and retrieval interviews: 76 non-GPS households; 17 GPS households; and 13 RouteScout households.

Participating households were required to complete a traditional travel diary, and had the opportunity to enter their travel information via the RTC Survey website, in lieu of completing a paper diary. The data collected for the 2015 RTC Washoe County Regional Travel Characteristics Pilot Study provided travel characteristics data for a typical weekday (Tuesday through Thursday) in the Washoe County Metropolitan Planning Area. The first assigned travel day was June 16th, and the last assigned travel day was July 2nd. This data collected also included information on household travel characteristics, demographics, and socioeconomic situations. NuStats' geocoding tool, NuTripX™ (NTX), was utilized for geocoding all trips. For households that reported their travel information to one of our interviewers via CATI, those interviewers entered the household's information into NTX real-time. Households that self-reported their travel information online used NTX as well. Households requiring assistance with NTX were able to call NuStats' toll-free hotline and one of our interviewers would provide assistance.

The processed pilot sample was divided into individual replicates by sample type (matched non-GPS, matched GPS, unmatched non-GPS, and unmatched GPS). Each replicate is designed to contain a random representation of the sample universe of the same sample type. For this purpose, sample replicates were designed to represent the various household types (matched vs. unmatched or GPS vs. Non-GPS households) and were loaded into the VOXCO system and released for dialing following the mailing of advance postcards. Given the short time-frame for the pilot survey (three weeks) and the low match rate (32 percent), NuStats opted to send advance postcards to all sample, not just the unmatched households.

Retrieval calls were placed to households the day following their assigned travel day. Retrieval calls were placed and reminder emails were sent every few days in an effort to reach households at various times of the day, and days of the week. Average retrieval rate for the pilot study was 54 percent.

Overall, the processes in place for the pilot study performed as expected. The flow of the questions worked well. Habitual location addresses were attempted in both recruitment and retrieval. The primary work address or nearest cross-streets was the highest ranked item of non-response.

Initially, a total of 2,760 records of address-based sample were randomly drawn throughout the study area and were expected to have a proportionate distribution to the number of households by district. Of the initial sample purchase, 23 percent of the matched records ended up being ineligible for the survey. As a result of the sample having a high percentage of ineligible records, a very low match rate (32 percent) and poor sample performance (with only a three percent recruitment rate) NuStats made the decision to purchase additional sample that was targeted for cell-phone only households. The additional 3,500 sample records helped NuStats reach 92 percent of the recruitment goal.

The non-GPS households retrieved at a rate of 58 percent, which was the highest of all three modes. Both GPS and RouteScout households were over-recruited showing an excess of 6 households recruited for GPS and 4 households above the goal for RouteScout and GPS. The retrieval rate for GPS households was 50 percent and for RouteScout households it was 42 percent. All retrieval rates were considerably lower than the anticipated 65 percent retrieval rate.

Recommendations:

- For the main study, we will add a cross-check to match employers with addresses in an effort to bring that item of non-response down to an acceptable range.

- A robust public awareness campaign will provide additional modes to ensure the public is provided multiple opportunities to be informed of the full study.

- Transit using households will be oversampled in order to ensure that the travel patterns of transit users are adequately represented.

- The capability of tracking the amount of time each household required to complete NuTripX™ was requested to be included for the main study; however this was not able to be implemented.

- Adding an over/under series of questions to ascertain a closer range of income for households refusing to provide this information.

- Two issues were identified within the retrieval database: household vehicle number was not stored correctly for some places; and, parking data was inadvertently not collected. Both of which were resolved for the main study.

- For the main study, monitoring of zero trip percentages by interviewer is to be performed to ensure the interviewers are appropriately gathering reported trip data, and probing when the respondent reports no travel.

Items to be implemented in the main study that were not in place for the pilot study are:

- Sample will be monitored as to appropriate district distribution
- Sample will be monitored to obtain adequate data in hard-to-reach population groups (Hispanic, large, head of household <25, low income household)

- Spanish language component will be implemented
- Incentives will be offered
- Notification postcards will be mailed in waves throughout the main study
- Unmatched sample will be required to provide contact information (either email or phone number)
- Definition of a completed household will be developed and followed
- An active public awareness campaign will be implemented

6.2 Final Survey Design

The RTC HHTS pilot yielded a few recommended revisions to the recruitment instrument and one minor revision to the retrieval instrument. Some changes did not yield the anticipated benefits, therefore, during the main survey data collection, there were changes made to increase recruitment and retrieval rates for particular populations, to encourage online responses, and to generally raise the overall level of response. This section presents the final survey design and documents the changes made.

6.2.1 Main Survey Data Collection Overview

The RTC HHTS collected travel data for one full day, or 24 hour time period, from 12:00 a.m. until 11:59 p.m. on their assigned travel day. Households that participated in the study utilizing GPS technology were tasked with continuing to use the GPS technology for an additional six days. Assigned travel days for both non-GPS and GPS households were Tuesday, Wednesday, or Thursday, except on government or school holidays.

The schedule for recruitment and retrieval CATI interviewing was mainly from 1:30 p.m. through 8:00 p.m. on weekdays, 1:30 p.m. through 7:00 p.m. on Fridays, and from 11:00 a.m. through 6:00 p.m. on Saturdays. In an effort to reach more respondents, CATI interviewing until 9:00 p.m. was implemented two evenings per week, and for the final few weeks of data collection, CATI interviewing occurred four evenings per week (Monday, Tuesday, Wednesday, and Thursday). On several occasions, call attempts were made beginning at 11:00 a.m. on weekdays.

Survey respondents were provided the option of completing the recruitment and retrieval surveys via a secure website. The online surveys followed the same general format and flow as the CATI programs used by the interviewers. The online portion was implemented using the same VOXCO software as was used for the CATI. Respondents accessed the online surveys from the public website, and gained access to the recruit and retrieval applications using a unique PIN provided in the notification postcard or to recruited households during the CATI interview.

The majority of households in the main survey were recruited through CATI, but more households were retrieved by mail, as may be seen in Table 14. The percentage of CATI recruitment and the percentage of mail retrievals were both significantly higher than anticipated, or budgeted. This resulted in a significant impact on the data collection resources.

Out of 2,083 preliminary completes, 2,049 passed the quality control procedure and met the definition of complete. The 2,049 completed surveys for the main study were combined with 105 from the pilot study, resulting in a total of 2,154 households. Of the original 397 GPS households that returned their devices and completed their diaries, only 225 of these had fully completed trip data and diary data. Those with fully completed diary data, but not GPS data, were included with the non-GPS household data.

Table 14: Pilot and Main Survey Recruitment and Retrieval Summary by Survey Mode

Survey Mode	Recruitment				Retrieval			
	Non-GPS Households	GPS Households	Total	Percent of Total	Non-GPS Households	GPS Households	Total	Percent of Total
CATI	2,409	603	3,012	88.6%	788	42	830	38.5%
Online	239	150	389	11.4%	213	53	266	12.3%
Mail					928	130	1,058	49.1%
Total	**2,648**	**765**	**3,401**	100.0%	**1,929**	**225**	**2,154**	100.0%

6.2.2 Survey Processes

The main survey followed the traditional two-step process of recruitment of a household for a prospective assigned travel day, followed by a separate retrieval effort to collect the detailed travel information. Figure 5 shows the survey process utilized for the RTC HHTS main survey.

Figure 5: RTC HHTS Survey Process
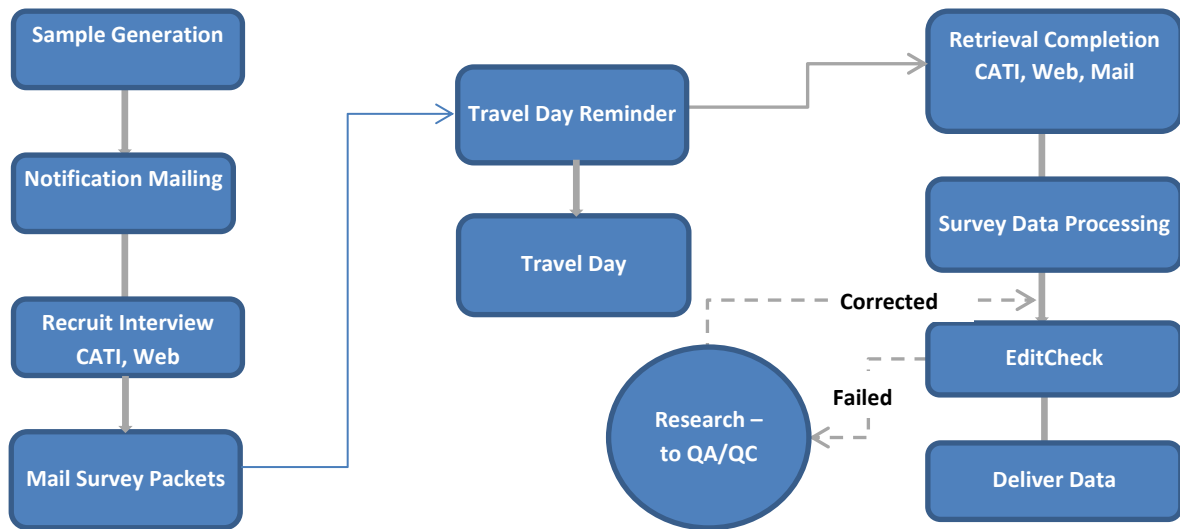
The sequential survey processes discussed below include:

- Notification Postcards
- Recruitment
- Survey Materials
- Reminder Contact
- Retrieval

Notification Postcards

Waves of notification postcards were mailed to unmatched sample on a weekly basis throughout the fall, with each wave consisting of approximately 5,000 postcards. The final wave of postcards was mailed December 29th, 2015. A total of 28,555 postcards were mailed. Of those, 3,263 (11 percent) were returned as undeliverable. After the first few waves of postcards were mailed, with approximately 1,000 of them returned as undeliverable, NuStats changed the approach to address all of the postcards to "Current Resident" rather than individual addressees. This improved the return rate slightly, but did not completely resolve the issue. The postcard itself went through several revisions in an effort to encourage more households to participate. Examples of these postcards may be found in Appendix A – Examples of the Notification Postcards.

All unmatched households in the first sample order were mailed postcards. There was a high rate of returned postcards, and a low rate of participation by households that were sent postcards. For the second sample order, NuStats drew sample from the lagging districts of 1, 2, 3, and 7 and mailed postcards to these groups in an effort to improve recruitment rates from those districts. The sample drawn from was unmatched sample, and resulted in a slight improvement in recruitment rates for all four of these lagging districts.

Recruitment

There were two modes for recruitment: CATI and online. Table 15 shows the start and end dates of recruitment, by mode and for each language used in the main survey. The Spanish language implementation lagged slightly behind the English as it was decided to wait until the English scripts were stable before undertaking translation in Spanish.

Table 15: Main Survey Recruitment Start and End Dates

Response Mode	START DATES		END DATE
	English	Spanish	
CATI	8/26/2015	9/23/2015	1/19/2016
Online	8/26/2015	9/23/2015	1/19/2016

Training for CATI interviewers took place in the afternoon of August 26th, 2015, immediately followed by conducting actual interviews that evening. To maximize response and reduce confusion among family members, during the recruitment interview, a household "reference" person was identified. This person was given the responsibility of ensuring that all members of the household completed a travel diary and, if applicable, used the GPS devices sent to them. At the end of the recruitment interview, this same person provided their contact information including a mailing address to have all the survey materials sent to them to distribute to other household members. This reference person was critical in ensuring all family members participated in the survey.

In order to ensure that the final demographic distribution was in line with the ACS data for the Reno/Sparks area, "termination" algorithms were included in the CATI recruitment to randomly disqualify the elderly as these households are disproportionately at home and reachable by telephone. Termination algorithms in the CATI and online program to randomly disqualify 80% (one of every five) of elderly (where the age was defined as all household members were 65 or above) for both GPS and non-GPS recruitment, were implemented in October, 2015.

The average length of the CATI recruitment interview was just over 19 minutes.

Survey Materials

Following recruitment, a packet of survey materials was custom assembled for each recruited household. For non-GPS households, the material contained either the English or Spanish versions of the following:

- A personalized survey cover letter, signed by the RTC project manager;
- Separate travel diaries for each member of the household, with the name and PIN on each diary;
- A postage-paid return envelope.

Examples of the non-GPS survey materials may be found in Appendix E – Non-GPS Survey Materials.

Recruited RouteScout households received the above materials, along with instructions on how to download and use RouteScout, and a daily record card to check off if they took their Smartphone with them everywhere they went each day for the seven days of the travel period. Examples of the RS survey materials may be found in Appendix G – RouteScout Survey Materials.

Recruited GPS households received a box containing all of the above, plus the relevant GPS equipment and instructions for use. The boxes were pre-labeled with a postage-paid label making it easy for respondents to return the equipment to NuStats. Households recruited for GPS also received a daily record card to check off if they took their GPS technology with them everywhere they went each day for the seven days of the travel period. Examples of the GPS survey materials may be found in Appendix F – GPS Survey Materials.

Only 28 households requested at the end of the recruitment interview to receive the Spanish version of the survey package. This is less than one percent of the recruited households, and indicates that the majority of Hispanic households in the RTC HHTS preferred the English versions.

Retrieval

There were three modes for a household to provide travel information: by CATI, online or by mailing back the completed diary and, for GPS households, the completed daily record card. Table 16 presents the start and end dates of retrieval for CATI and online, by language. The last day for receipt of mailed back diaries was February 27, 2016.

Table 16: Main Survey Retrieval Start and End Dates

Response Mode	START DATES		END DATE
	English	Spanish	
CATI	9/9/2015	11/4/2015	2/27/2016
Online	9/9/2015	11/4/2015	2/27/2016
Mail			2/27/2016

CATI retrieval of travel diary information began on the day following the assigned travel day. Households that had chosen to complete retrieval by web were not called the day following the travel day, but were allowed 2-3 days to complete by web. According to callback rules, this sample remained closed and was only released 2-3 days later if the household had not completed by web. These data were collected using a Voxco CATI program that is linked to NuTripX™—an interactive mapping program for online geocoding. All geocoding is performed in real-time via NuTripX™ (NTX) which is web-based and can be used by the respondent on the web or by a telephone interviewer (CATI). The screenshot shown in Figure 6 provides an example of interactive real-time geocoding with logical trip sequencing. All address data was geocoded to the current X-Y coordinates. Once the

locations were geocoded, the TAZ data was added in ArcGIS. The mailed-back diaries were entered via traditional data entry into the Voxco CATI program and NTX program by trained retrieval interviewers.

Figure 6: Example NuTripX™ Screen - Interactive Real-Time Geocoding with Trip Sequencing
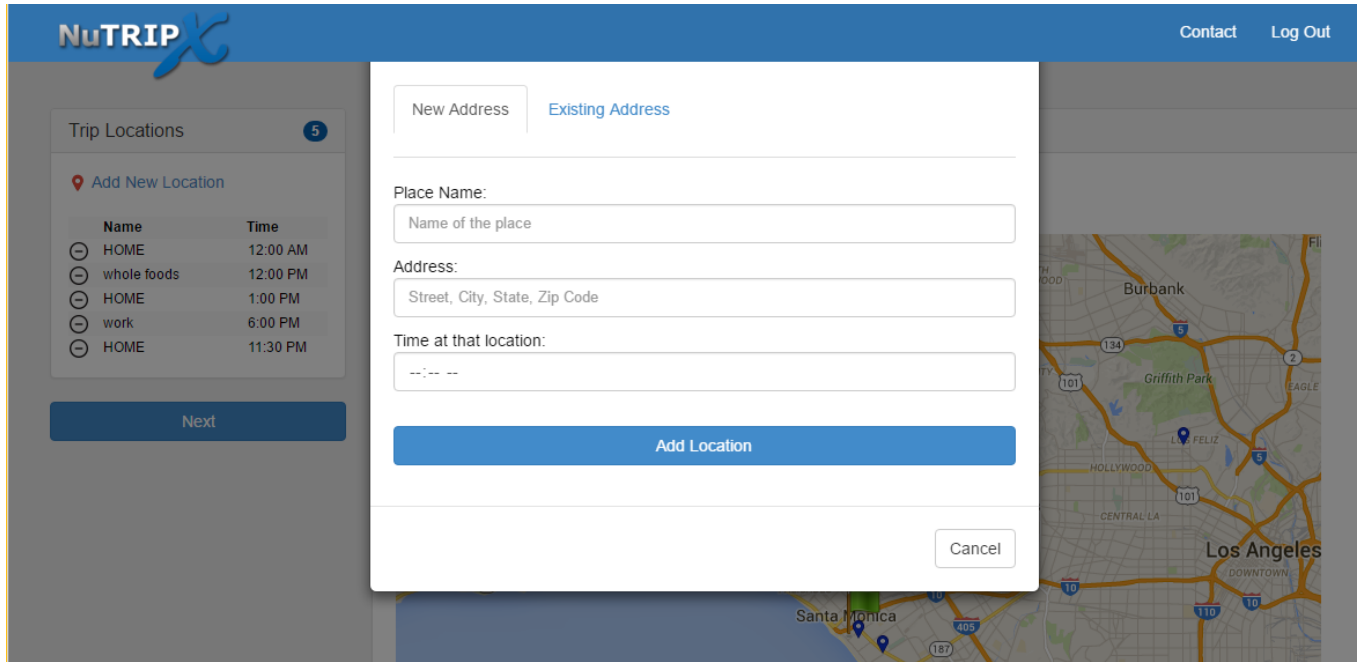
6.2.3 Proxy Reporting

It is generally accepted best practice for travel data to be collected from the person who performed the travel in as many cases as possible. Information that is provided by anther household member is referred to as "proxy" reporting.

In the RTC HHTS, the CATI interviewers were trained to speak to each person 16 years of age or older. Proxy reporting was permissible when the information for the missing adult existed in a completed travel log and another person was willing to read off the recorded information.

In this situation interviewers were required to make a minimum of three call attempts. Households with missing adult information were coded as Proxy Partials and follow up calls were made by the same interviewer when possible to maintain rapport and continuity with the household. At the beginning of the fourth day after the assigned travel day, if no contact had been made, the household was released for completion by proxy. This usually meant having the reference person report from memory the activities of the missing adult. In those instances when the missing travel information could no longer be obtained, the household was technically unresolved and it was coded as a Partially Completed Interview or a Partial Refusal.

6.2.4 Call Backs

Call backs were placed during the retrieval process to households that were missing key data elements, such as travel location information. These call backs were managed by the Voxco CATI software, which has a sophisticated sample management component that allows interviewers to schedule callbacks or types of contacts at the time requested by the respondent.

The next step in the survey process was an automated EditCheck system (described in Section 6.4). Households that did not pass the edit checks and needed additional corrections or follow-up were handled by the Quality Assurance research team. The research team conducted a thorough review of each record and initiated a follow-up or call back with the main respondent of the household to clarify any missing data or data discrepancy. If the research team was unable to reach the household, they left a message to call the hotline to confirm information about their reported travel. If an email address was provided, an email message was sent requesting the respondent call the research team to confirm information about their reported travel.

6.2.5   Refusals

Each respondent has a unique set of factors to consider when making the decision to participate in a survey. Some respondents are concerned with the legitimacy of the research, others want to make sure their privacy is protected, some want to make certain there is a clear benefit to participation (to themselves, their community, or society in general), and still others are concerned about the time and burden of the study. Regardless of their primary concern, all respondents are more likely to participate when contacted by a professional, persuasive, and engaging interviewer.

In addition to teaching interviewers to use the characteristics of their voices for sounding upbeat and engaging, the interviewer training focused on teaching interviewers to "read" respondents and tailor their replies to respondent questions and objections based on the undermining concerns. Remaining professional at all times as well as friendly and courteous are considered crucial elements at gaining and maintaining cooperation from respondents. Interviewers were always taught to be tactful, pleasant, sincere, and well prepared.

Interviewers were also trained to provide additional information about the study to handle a call where the respondent sounded insecure and showed a lack of understanding about the study even after an explanation was given. In addition to learning best practices, interviewers were trained to leave detailed interviewer notes in the records. It was critical that interviewers document the "facts" for full understanding of the situation in case the respondent was very difficult or threatening during the call and later wanted to complain about the study or the phone call.

Refusal avoidance and refusal turn around skills are more critical during the retrieval stage. At the retrieval stage, much time and effort had been spent in recruiting the household and in mailing them materials for their participation. This is why not just one but a series of refusal conversion attempts was made, each followed by a resting period. These attempts were often successful, especially when the calls were made by seasoned interviewers that had experience working with difficult cases.

6.2.6   Hotline

A toll-free hotline was maintained for the RTC HHTS. The hotline was available 24 hours a day, 7 days a week. This hotline was covered by one of NuStats interviewers that was specifically trained on all aspects of the RTC Travel Characteristics Survey and was dedicated to answer this line real-time from 4pm–8pm PST weekdays and 12pm–6pm PST Saturdays. Due to a few issues, the hotline was not always answered real-time during these time frames, and instead callers that left messages were called back as quickly as possible. A total of 454 calls were managed by our hotline team. The reasons for the calls may be found in Table 17.

Table 17: Hotline Call Summary

Reason for Call	Count	% of Total
Opting out	94	21%
Hung up	112	25%
Called to participate in survey	24	5%
Returned our call	64	14%
Needed on line help	18	4%
Had not received materials	8	2%
Wanted to be re-scheduled	18	4%
Called to report travel	4	1%
Help completing diary	31	7%
Has mailed completed diaries in	7	2%
Household will mail in diaries	1	0%
Called to provide missing information	1	0%
Incentive Questions	15	3%
Other	57	13%
Total Calls	454	100.0%

6.2.7   Non-English Speaking Households

The main survey was conducted in Spanish as well as in English. NuStats provided a team of experienced bilingual interviewers who were trained to conduct interviews in Spanish as requested by respondents. Households that requested the interviews be conducted in Spanish were either routed to one of the bilingual interviewers or, if one was not available, the household was coded as requiring a Spanish call back. Interviews in Spanish tended to be longer than those in English as interviewers had to explain concepts that sometimes were harder to relate to for some of these respondents. A team of bilingual supervisors was tasked with daily monitoring duties to ensure interviewing protocols were met in Spanish just as well as they were in the main English survey.

Households that were monolingual in languages other than English or Spanish were coded with a "Language Barrier" call disposition, thanked and not included in the survey. There were 108 such households in the main survey, as may be calculated from the recruitment sample disposition table (Table 40). This equates to less than one-half of one percent of all sampled households. This represents all languages other than English and Spanish, which in the Reno/Sparks area may include Chinese, Tagalog, Other Pacific Island languages, German, Korean, and many more.

6.2.8   Interviewer Training

All telephone interviewers and hotline staff were rigorously trained to ensure delivery of the highest quality data. The production and quality teams worked closely with the interviewers, the project manager and programming team to evaluate sample and interviewer performance, and implement changes where it was deemed necessary. These efforts resulted not only in high quality data, but also ensured all sample was adequately worked.

All RTC interviewers were trained according to Marketing Research Association (MRA) standards. The rigorous training program at NuStats included not only the technical aspects such as using the CATI interviewing programs and phone system, but also how to convey the importance and legitimacy of the survey, techniques for overcoming respondent's refusals, and maintaining professionalism at all times. In addition, RTC project-specific

training was provided, covering the specific details of the study such as the geography of the study area, colloquialisms, and subtle nuances about the study and/or particular region. The training program included:

- Details about the study including project purpose, objectives, and goals;
- Specific interviewing quotas (e.g., demographic items, residence location); and,
- A detailed project schedule.

Interviewers also underwent in-depth training on the CATI recruitment and retrieval programs, and NuTripX™. The training protocol covered the recruitment introductory script and each interviewer spent time familiarizing him/herself with the types of questions asked in the survey along with how to record the outcome results. Interviewers walked through each question along with choices and acceptable responses. Special attention was paid to not introduce any bias in the interviewing process, as this was a critical component of the training. Clarification of any question was discussed thoroughly with the team along with specific probing techniques particularly for open-ended questions. Bilingual interviewers were trained in English and Spanish to ensure they were familiar with both scripts.

6.2.9 Incentives

Households participating in the RTC household travel survey were offered an incentive for providing complete information for recruitment and retrieval via the online survey website. In addition, GPS households were eligible for the incentive when all devices were returned to NuStats. The incentive structure is shown in Table 18.

Table 18: Main Survey Incentive Structure for GPS and Non-GPS Households

TARGETED NON-GPS HOUSEHOLDS	Incentive Amount	
Online Recruitment **and** Retrieval	$25	
GPS and RouteScout	$25/Person	$25/Person ($75 maximum per Household)
Online Recruitment **and** Retrieval **and** GPS or RouteScout	$25 per Household/ $25 per Person	Maximum $100 per Household

The NuStats project manager utilized discretion in approving several households to receive incentives. A number of households returned their GPS devices where one of the devices was missing GPS information. The decision was made to approve an incentive for these households, as some of these participants were not aware the GPS devices weren't working. Other cases that required individual attention were households that had difficulty with the online survey, and needed assistance from one of our interviewers to complete their information.

The incentive process itself ran very smoothly. Amazon gift cards were offered to eligible households. No eligible households requested a check instead of the Amazon gift card, which NuStats would have provided for those cases. In general, incentives were processed within two weeks of receipt of completed travel data. The result of having this process run so well was that the volume of inquiries about incentives was very low.

NuStats continues to receive GPS devices; therefore, it's possible that not all of the incentives have been processed. Table 19 provides the current incentives summary, as of June 13, 2016. This table will be updated for the final report, if necessary.

Table 19: Incentives Summary

Household Type	Incentive type	Number of Households	Total Dollar Amount
Non-GPS	Online REC and RET	83	$2,050
GPS	GPS	143	$6,350
	RS	69	$3,025
	TOTAL	**295**	**$11,425**

6.2.10 Definition of a Completed Household

Working with the RTC team and their modeling consultant, the definition of a completed household was developed. The full definition of a completed household follows.

For the purposes of the RTC Household Travel Study, a household is defined as "those related or unrelated who live in a housing unit at least 5 days out of the week." For un-related households, data will be obtained for the person recruited and NuStats will make an attempt to recruit the other eligible members. The household will be considered "complete" if at least 50% of the eligible household members are recruited, fill out a travel diary and report their travel. For these un-related households, the household should be recorded in terms of size, vehicles, workers, etc. to match the Census. If all members in the un-related household do not report travel, then a flag needs to be set to indicate to anyone using the survey data that the trip data is not available for all HH members.

The following bullet points are with regard to all households, both GPS/RouteScout and non-GPS households, and are determined by RTC:

- Household members are not required to be related in order to qualify
- The household member (informant) who completed the recruitment survey may serve as a proxy to provide retrieval data in the following situations:
  - proxy interviews are required for household members age 16 and below
  - data should be collected in-person from each household member age 16+; proxy reporting allowed only IF the travel logs are used
  - For all surveys (regardless of age or reporting type), flags should be used to clearly indicate whether the data were reported in-person or by proxy, and whether the travel logs were used
  - a proxy interview completed by the informant will be allowed after four unsuccessful attempts to retrieve travel data, only if the travel log is used
  - proxy interviews completed by the informant will be allowed for elderly or disabled household members who are not able to provide their own travel data, only if travel log is used
  - For unrelated households, an informant may provide travel information for themselves and as many of the other members as possible if the following criteria are met:
    - Four unsuccessful attempts have been made to reach the individual
    - The informant has the travel log to refer to.
  - In cases where the informant possesses a completed travel diary for another household member, and the same other household member is not willing to come to the phone, we will allow this to be completed by the head of household as a proxy interview.
- Specify if details for special trips are expected. For example, collecting trips students make on campus when at school

- All locations visited must be 100% geocoded to either: full address, cross-streets, or place (single street or place centroid)
- No more than 5% missing and/or coded non-response data from a trip record, except for the data listed below for which every record needs to display valid information in order for the survey record to be considered complete:
  - origin zone
  - destination zone
  - trip purpose from
  - trip purpose to
  - arrival time
  - departure time
  - time spent at activity
  - origin and destination locations and place type
  - mode
- No more than 15% missing income
  - no more than 5% with no data at all (modeler requests an over/under option be included i.e. , "can you tell me if your income is above or below 75k", if below 75k, "can you tell me if it is above or below 35k")
- Exceptions for large households:
  - Households with 4+ persons -- no more than 10% will have travel missing for one person.
  - Households with 5+ persons -- no more than 10% will have travel missing for two persons.

The following points are specific to GPS and RouteScout (RS) households.

- GPS devices and diaries are provided for all household members aged 12 and above. Household members below the age of 12 are provided diaries only. Diaries are provided to all members of RS households. Household members aged 12 and above participate in the study using RS and will also complete a diary. Household members below the age of 12 will complete a diary only. The travel period for GPS/RS households is a full seven day period, with the first day of the travel period being the assigned travel day. A household is considered to be a GPS/RS/diary complete if:

  - Travel is reported for all household members by mail, web, or phone with complete information as specified above
  - GPS devices are used on the assigned travel day for at least two persons provided with GPS devices, and for only one person if only one GPS device provided
    - If travel was reported for a GPS person, then at least one GPS trip should have been captured by that person
    - If no travel was reported for a GPS person, then it is okay if there are no GPS trips captured on that day by that person
  - All devices are returned

6.2.11 Respondent Burden

Table 20 below presents the average length of time, in minutes, for a respondent to complete the recruitment and retrieval portions of the survey, by response mode. The mail response mode was estimated based on the amount of time our staff needed to enter the diaries for each household. Since our data entry staff is well versed in completing household travel diaries, it is likely the respondents themselves needed a few minutes more than 15, but we do not have a way to report that amount of time.

Table 20: Average Time in Minutes to Complete the Main Survey

RESPONSE MODE	RECRUITMENT	RETRIEVAL
CATI	19.2	25
Online	30	35
Mail		15

6.2.12 Sample Management

Sample management concerns those aspects of data collection management involving the availability and release of households (samples) in the project database to the appropriate next step in the survey process for that household. Much of the sample involves the management efforts of the data collection team. This included looking at the characteristics of the sample and making adjustments to maximize productivity and response, including review of live/non-final sample to determine how much new sample, relatively fresh sample (only a few call attempts), and older sample was available. It also included ensuring that all callbacks, including recruitment and retrieval programs and all specialized or target sample including GPS households, were properly loaded in Voxco and allocated to staff, including calls that may have been scheduled from online recruitment mode.

NuStats staff oversaw and facilitated quota management for all modes of data collection on an on-going, real-time basis through the Voxco Command Center program. Quotas and strata were constantly checked to ensure that they were filling proportionately. This aspect of the Voxco interviewing software is critical in launching complex, large household studies such as the RTC HHTS because it provides an efficient, low-risk method for centralized, timely tracking and adjustments of sample. When necessary, sample was assigned with priority to generate completes in lagging quota cells.

In addition to sample and quota management, the team closely tracked and managed productivity, production levels, and schedules on an hourly basis. If productivity was lagging, staff troubleshot project performance and worked quickly to identify the cause(s) and rectify the issue(s). Proper quota and production management for large studies such as the RTC HHTS are heavily reliant on real-time, constant sample management so production task leads were tracking, coordinating, and reporting on sample performance indicators with other key project team members on a regular basis.

Recruitment Sample Protocols

For the RTC household travel study, sample was divided into individual replicates of 500 samples each. Each replicate contained a random representation of the sample universe. The value of using replicates to manage sample was in having the ability to fully work through sample within each replicate before moving on to the next one. This allowed the data collection team to maximize sample performance before releasing new sample to the mix.

The RTC recruitment program contained standard call outcomes and some project specific codes as well. Interviewers were trained to follow specific protocols in coding call outcomes correctly. Each interviewer was assigned an interviewer identity number to access the program. This allowed for each call record to be tracked to the interviewer for review, feedback and coaching opportunities as needed. This was a valuable tool used to identify interviewers that needed help with refusal avoidance techniques or other areas that could be identified by running interviewer performance statistics.

A minimum of eight attempts to valid numbers resulting in a no contact were made before finalizing a sample record. This protocol was adjusted throughout the duration of the project, for example, to increase the level of effort in lagging areas. In some of the hard to reach areas sample was rested for a long period of time and re-attempted later in the project.

One other aspect of sample management was the "rest-and-recycle" technique for non-responsive households. After eight attempts without being able to contact a household, those samples were "rested" for a period of a few weeks and then were recycled back into the active sample pool for re-calling and re-contacting.

Retrieval Sample Protocol

A key element to consider when discussing sample management and the retrieval stage is the Production Schedule. The Production Schedule contained the list of all valid travel dates for the duration of the project. This schedule dictated when sample needed to be available for reminder calls and when it needed to be available for retrieval calls.

Sample management for retrieval was an on-going and hands on task that often times required supervisory and management staff to discuss sample segments or even specific households on the best approach to finalize the household. Some of the considerations taken into account included whether the household had been called during the day of the week and time of the day when the recruitment interview took place, whether calls had been spread out across times of the day and days of the week, whether any or too many messages had been left, or whether the household needed to be finalized as non-completed and needed to be replaced.

When email addresses were available, the NuStats team sent reminder email messages asking the participants to log onto the survey website to complete their travel information. These email messages were sent on a weekly basis to non-responsive households to whom several call attempts had been placed without contact, and that had not completed their travel information online, or had not refused to participate. An example of one of these reminder emails is shown in the text box below. The final two email reminders included a note that the deadline for receipt of travel information was February 27th, 2016.

SUBJECT LINE: RTC Household Travel Survey Reminder (DO NOT DELETE)

PIN: «PINNO»

Dear «RFNAM»,

Thank you for participating in the Regional Transportation Commission – Washoe County Household Travel Characteristics Survey! Our records indicate you have not yet submitted your travel information from your travel date of «TDAY». If you would like assistance with completing your diary/diaries, please contact NuStats toll-free at 877-221-7828 and one of our telephone representatives will be happy to assist you. If you would like to complete the survey online, please visit www.RTCSurvey.com and enter your PIN («PINNO») to report your travel.

Best Regards,

The RTC Travel Survey Team

On the same schedule as the reminder emails, text messages were sent to non-responsive households to whom several call attempts had been placed without making contact, and that had not completed their travel information online, or had not refused to participate. Due to the desire to limit the text message to be received in one message window, the text was kept under 110 characters. An example of one of these text messages is found in the following text box.

Please visit www.RTCSurvey.com and enter your PIN
«PINNO» to report your travel. NuStats - 877-221-7828.

The Strata and Quotas definition module in Voxco allowed NuStats to manage subsets of the sample and to open or close access to any stratum or subset as needed. It also allowed NuStats to apply goals or ceilings to monitor the number of completed interviews by stratum, and the rate at which they were attained.

This module was used for tracking goals and sample management by assisting in the release or withholding of specific sample segments. Many of the sample management activities already described were made possible by a specific strata definition that existed in the Quota Management module. The starting point of making this sample control tool work was to specify a set of criteria or strata, upon which sample controls were to be applied.

6.3   Public Awareness

The following strategies and activities were planned and implemented on behalf of the RTC Washoe County Travel Study:

Household Travel Survey

- Informational community outreach interviews were planned and aired on local ABC affiliate, KOLO-TV News (air times coincided with prime time news, in both the morning and evening, and also during the mid-day news).
- News releases and media advisories were researched, written and distributed in partnership with the RTC Public Information Team.
- NuStats team followed-up with all media contacts regarding the news release.
- Continuous media relations were conducted throughout the ongoing surveys and overall study.
- Mentions of the overall study appeared on all three main news networks (including ABC KOLO-TV, NBC KRVN-TV, and CBS KTVN-TV).
- Social media outreach was planned and implemented in conjunction with the RTC Public Information Team; including posting of the informational interviews that originally aired on ABC affiliated, KOLO-TV.
- Distribution of e-mail blasts to local Chambers of Commerce and selected community organizations.

6.4   Quality Control

The following quality control protocols were implemented for the RTC household travel study data collection team:

- A comprehensive Interviewer-training (specifically focused on understanding and proper delivery of the CATI questionnaire)
- Adherence to CASRO guidelines
- Expert program design input and detailed and redundant program testing
- Dedicated, tenured team of Managers, Trainers, Supervisors and Interviewers.
- On-site and off-site monitoring of interviewers' efforts by project-specific QC leaders. Monitoring capability used with options of providing instant messaging feedback during live calls.
- On-going, constant dual data reviews being conducted by data collection leaders and by NuStats data cleaning team throughout the entire data collection period.

- Electronic tracking of interviewers' performance – dialing statistics, completed interviews, refusals, non-contacts, average interview lengths.

Live, full monitoring of CATI interviews led by project-dedicated Quality Control Managers and Supervisors were conducted as the cornerstone of the QC process for this study. Full monitoring sessions, where a conversation between an interviewer and a respondent is not only heard but also viewed through remote visual monitoring, were the most efficient and reliable method for ensuring that Interviewers were reading scripts verbatim as well as accurately recording all data provided by respondents. Following industry guidelines, a minimum of 10% of all CATI completes were monitored or validated. Monitoring sessions were also used to provide on-going supplementary training to interviewers as well as to validate the accuracy of the real-time entry. For each monitoring session, interviewers were evaluated on the following criteria: dialing rate, effective use of time, professionalism, gaining cooperation, disposition coding, contact procedures, reading verbatim, neutral delivery, effective probing, pacing and focus, and accurate data entry. In addition, for retrieval the primary QC focus was on trip collection, probing for missed trips, and the accuracy of the collection of address details.

In addition, dual project data reviews were also a key part of the overall QC process. On a shift-by-shift basis, the NuStats QC team actively checked data within the dialing program for completeness on key criteria. This was followed by full-scale automated data checks by NuStats data staff to confirm that data met the required specifications. This dual system helped ensure that the NuStats QC team was able to quickly correct any potential data issues and to also administer immediate remedial training for specific Interviewers.

7.0   Global Positioning System (GPS) Subsample

7.1   Overview

The purpose of the GPS component of the RTC Travel Characteristics Study (RTCS) was to collect detailed information about all trips made by the GPS subsample and to estimate levels of trip underreporting in this subsample that can be applied to the larger, non-GPS sample. The following section summarizes the GPS data collection results for the GPS/Diary Complete households (as defined by the updated GPS and diary completion rules). All households that reported travel by January 26, 2016 are included. With a target goal of obtaining 500 GPS complete households, it was estimated that at least 800 households would need to be recruited. Recruitment for the study concluded on January 19, 2016. There were 602 households recruited into the GPS component of the study, which was below the target goal. A split design was implemented, with some households receiving dedicated wearable GPS devices (loggers) and other households receiving the RouteScout App to load on their own Smartphone. The GPS devices or RouteScout software were to be used for seven days, with the first day coinciding with the assigned diary travel day.

This split technology design allowed for the collection of seven days of highly accurate trip data with minimal respondent burden. Households selected for the GPS component were deployed for seven days, with all household members age 12 and above receiving GPS equipment. Local deployment personnel shipped and received returned equipment from/to their home. As GPS devices were returned by GPS households and data were received from the server for RouteScout households, the data were downloaded and posted to a secure portal for processing by PlanTrans.

PlanTrans, as a subcontractor to NuStats, was responsible for managing and processing the GPS component of this survey.

There are some interesting results from the GPS component that may be useful for the RTC for future planning of surveys and related issues. First, the average trip rates for households that were recruited for the GPS survey and eventually used in the matching are 5.31 trips per person on the diary day from the GPS devices/software and 4.86 trips per person on the diary day recorded in the diaries. However, there are differences between those who used the RouteScout software and those who used the GPS devices as shown in Table 21. Because both the diary and GPS for RouteScout participants show a higher trip rate, it appears that those who accepted the RouteScout software are more mobile than those who used the GPS loggers. Interestingly, the underreporting percentage is about half by RouteScout of that by GPS logger (5.2 percent compared to 11.6 percent).

Table 21: Trip Rates for the GPS and RouteScout Samples

Trip Rate Source	GPS Logger	RouteScout	Total
GPS	4.97	6.06	5.31
Diary	4.45	5.76	4.86

Table 22 shows the number of trips recorded by GPS by day of week, the number of days recorded, and the average trip rates by day of week. The table shows that the number of days recorded by day of week was least for Sundays and greatest for Thursdays. The trip rate is highest on Saturdays and lowest on Tuesdays, and among the weekdays, there is a rise from Tuesday through Friday, with Monday showing a marginally higher trip rate than Tuesday. The weekend days show the highest trip rates, with Saturday at 6.76 trips per person per day and Sunday at 5.37 trips per person per day.

Table 22: GPS Trips by Day of Week

Statistic	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Number of Trips recorded	1,563	1,393	1,722	2,148	2,455	2,183	2,198
Average Trip Rate	5.37	4.63	4.58	5.05	5.22	5.35	6.76
Number of Days	291	301	376	425	470	408	325

7.2   Deployment Methods and Results

PlanTrans provided the GPS devices and charging units to NuStats to manage deployment of these devices and chargers. Households were recruited into the travel survey at least 10 days prior to their assigned travel date.

7.2.1   Deployment Methods

Each household was shipped one box containing the GPS devices and chargers for each household member, a travel diary for each household member, instructions for using the device, a daily record card, a postage paid shipping label, and a cover letter (found in Appendix F – GPS Survey Materials). These instructions included a hotline phone number for the respondent to call for assistance with questions about installation and use of the devices. The instructions emphasized the need to use the diaries, or the survey website to record travel on the assigned travel date. A daily record card was provided on which the household members were asked to record if they used the devices, and if not, to list the reason(s) why.

A sticker was affixed to each GPS device with the first name of the household member printed on the sticker. Shipping was conducted via UPS and the United States Postal Service. The items listed at the beginning of this section were placed in a cardboard box and secured with packing material. The pre-paid shipping label was affixed to the front of the box. The box was then placed in a large envelope, labeled, and shipped. The equipment was scheduled to be delivered to the household two business days prior to the assigned travel day. After the assigned GPS data collection period, households were to place all of the equipment, travel diaries, and the daily record card in the box, seal it, and place it in the appropriate (UPS or USPS) outbound box. Outbound and return equipment packages were tracked on the UPS or USPS website.

After receiving the returned equipment, the deployment team downloaded the GPS raw data from the loggers and then cleared the device memory for redeployment. The downloaded, zipped GPS file was then posted to the secure portal for PlanTrans to have access to the data for GPS data processing. Deployment personnel were also responsible for maintaining a control sheet of the status of deployed, returned, and outstanding GPS equipment.

7.2.2   Deployment Results

Equipment was deployed to 333 households. An equipment retrieval management system was developed and used to coordinate follow up with all GPS households that did not immediately return their GPS equipment as instructed. First, a phone call was placed to the home telephone number for all households that did not return their GPS devices within one week after the last GPS travel date. When a person answered or an answering machine picked up, a message was delivered thanking the household for their participation and requesting that the GPS equipment be returned using the box provided. A toll-free call back number was left if the household had any questions. If no person or answering machine was reached, additional calls were attempted.

If equipment still had not been returned by two weeks after the last GPS travel day, email and text messages were sent to the household. Several rounds of email and text messages were sent on a weekly basis to all

outstanding households. Calls were also placed on a weekly basis. As of July 19th, 53 households had not returned the GPS equipment sent to them. This is a total of 105 unreturned devices.

The deployment outcomes are presented in Table 23.

Table 23: Deployment Statistics by GPS Household Sample Type

Sample Type	Recruited Households	Returned Deployed	Refused	Not Returned	Devices Not Deployed
GPS Devices and chargers	333	200	80	53	8

7.2.3   GPS Participation Results

The recruitment goal was to have an equal number of households recruited for each of the GPS loggers and the use of RouteScout software on their personal Smartphones. As shown in Table 24, at the outset, including the pilot sample, the goal was to recruit 782 households, split equally. However, in actuality, only 77 percent of this goal was achieved, and the numbers were unequal, with 269 households recruited for RouteScout and 333 for GPS loggers. As was found in the pilot survey, recruiting households to use the loggers was more successful than recruiting them to use their own Smartphones, a point that should be kept in mind for future surveys.

Of the recruited households, 200 (60%) that were recruited to use the GPS loggers actually complied with the request and returned loggers with useable data. For the RouteScout software on personal Smartphones, the actual compliance was by 112 (42%) of the recruited households. Again, the GPS loggers show superiority over Smartphones for compliance, as well as for recruitment. To be useful for the factoring exercise, households and the individuals within those households needed to complete their travel diaries on the start day of their GPS logger or RouteScout use. However, 44 households, plus 6 individuals in households that included some full respondents, did not complete diaries. Of these 44 households, 23 were provided with GPS loggers and 21 with the RouteScout software. In addition, 43 households, plus 19 individuals in households that included some full respondents, did not use their GPS logger or the RouteScout software on the diary day. Of these 43 households, 24 were supplied with the RouteScout software and 19 with GPS devices. Similarly, 5 individuals did not use their Smartphone on the diary day, and 14 did not use their GPS loggers. (It should be noted that we have included among the counts of complying households those households that reported no travel on the diary day.) Again, it is noteworthy for future surveys that the non-compliance rate for Smartphone households was higher than for GPS logger households, so that the final percentages of useable households for the factoring are 40 percent for the GPS logger and 18 percent for the Smartphone.

Table 24: Recruitment, Completion and Results by GPS Household Type

Sample Type	Recruit Total	Recruit Goal	Recruit % Complete	GPS/RS Complete	GPS/RS + Diary Complete	%Complete Goal
GPS	333	391	85	200	155	40
RS	269	391	69	112	70	18
Total	**602**	**782**	**77**	**312**	**225**	**29**

7.3 GPS/Diary Processing Methods and Results

7.3.1 Processing of Data from RouteScout and GPS Loggers

Processing of the GPS data was performed using the same software, irrespective of the method by which the GPS was collected, with the exception of the first step in the procedures, where the RouteScout data had to be conformed to a similar format as the GPS logger data. In both cases, the software used was a proprietary package of software tools developed by the University of Sydney, under the direction of Dr. Stopher over the past decade. A brief summary of the process is provided in this report and is shown in Figure 7.

Figure 7: Schematic of the GPS Data Processing Software
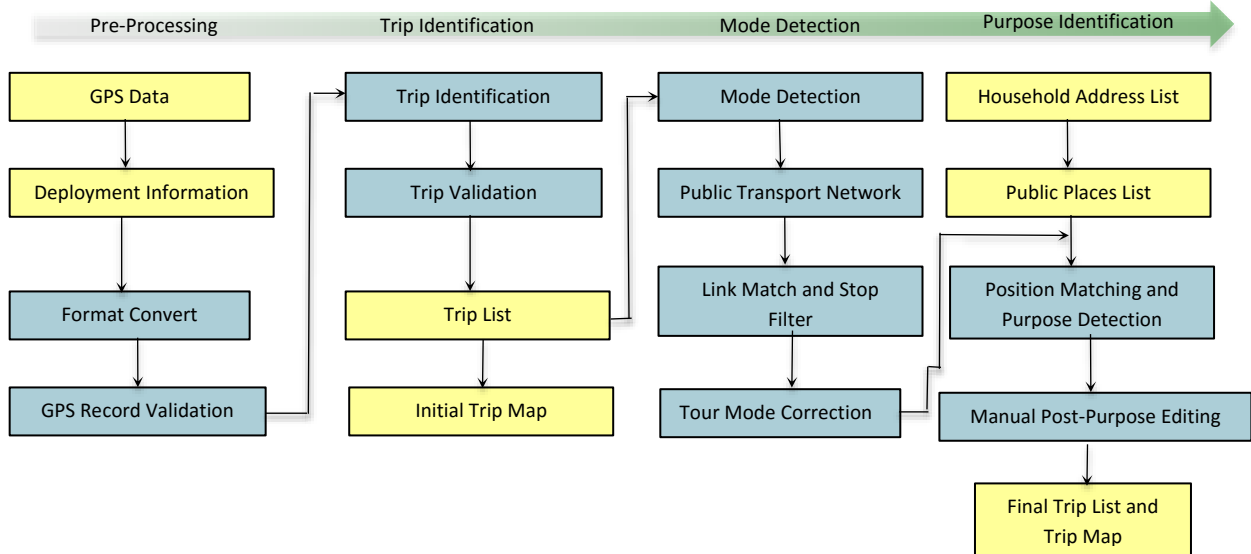
As shown in Figure 7, the first step in the process is to assemble the downloaded data, which are grouped into batches of approximately 10 households. In addition, deployment data (the start date for GPS recording for each household) is assembled. The next step is to convert the GPS data stream to the format expected by the G-TO-MAP software. For the dedicated GPS loggers, this is a minor step, because the data are already largely in the correct format. However, for the data from the Smartphones collected by RouteScout, it is necessary to rearrange the data and reformat some data items. In addition, the software uses the number of satellites in view and the Horizontal Dilution of Precision (HDOP) to determine if data points are valid. These data items are not collected in the data stream from RouteScout and have to be interpolated from the accuracy measure that RouteScout records, which is not used by G-TO-MAP. Table 25 shows how these values are interpolated from the accuracy. These values would generally mean that data points recorded by RouteScout as having an accuracy of greater than 100 meters would be rejected as invalid, while all others would be considered to be valid.

Table 25: Method of Interpolating HDOP and Satellites in View from the RouteScout Accuracy Measure

Accuracy	HDOP	Satellites
>100 meters	10	2
10.1-100 meters	5	3
5.1-10 meters	3	4
≤ 5 meters	1.5	6

G-TO-MAP then checks the data for validity. A common problem with all GPS devices (Smartphone or dedicated GPS device) is that there are occasional roll-backs in time of a few seconds in duration. These cause serious problems in the processing and so must be detected and corrected before the processing continues. Typically, roll-backs in time are on the order of 3 – 14 seconds, although occasionally a larger value may be encountered. GPS experts are unable to explain why this happens, but it is commonly found in any GPS data stream.

After the data have been checked for validity and any necessary corrections made, the data are then processed through a step called trip identification. This step uses a user-provided number of seconds to define the stop duration that is to define the end of a trip. In this project, a duration of 45 seconds was used to define the end of a trip, because it has been found that this provides close to optimal results in terms of a trade-off between the need to link through stops that are not real destinations, and the need to split trips where a short stop (such as a pick up or drop off) occurs. This step provides a preliminary trip table which is subjected to some validation tests, to ensure that such things as bus stops and train stations are correctly picked up, and then the initial trip list is output, together with first draft Google Earth maps. The trip list is now processed through a link matching process that uses information on the road network, public transport networks, bus stop and train station locations, and other relevant network information. This processing step provides a preliminary identification of mode, based on proximity of the path to the various networks, household ownership of bicycles, speed, acceleration, and other information to identify the probable mode of travel. The first mode to be identified is walk, because it is slowest, may not adhere to the networks, and has the lowest rates of acceleration and deceleration. Following this, public transport is identified, based on speed, acceleration, deceleration, and proximity to the public transportation networks. The remaining trips are then allocated to car and bicycle, although a check is made on bicycle ownership to determine if bicycle is likely. The home location is also used in this step to identify tours, which are defined as any sequence of trips that begins at home and eventually ends at home.

The output from this step is a trip list with mode identified, and this is then processed by a step called "tour mode correction". In this step, the sequence of mode use on a tour is determined and checked against a set of rules as to what sequences of mode use are considered possible. For example, a sequence such as car-car-bus-bicycle would be considered improbable, because one normally must return home with the car with which one left at the beginning of the tour. Therefore, the bus and bicycle legs would be changed to car. After these checks are made and corrections made to the mode identification, the data are fed to the final step of purpose identification. In this step, additional information is input on school, shop, and work locations, and purpose is imputed from the geographic information on shops, schools, work, and home, and from the duration of time spent at the destination location.

At this point, a manual step is introduced, called "post-purpose editing". At this step, a trained editor examines each trip and the information on mode and purpose, using both the trip list and the Google Earth maps. An examination may be made of the street view at the destination of the trip to determine if it is consistent with the imputed purpose. Also, each destination is checked to make sure it is a real destination, and not a traffic stop. The editing typically involves joining some trips together through traffic stops, splitting some trips to pick up very short stops, changing mode and changing purpose, where appropriate. A set of rules is used to guide the editing process, so that it is done objectively and is not subject to the whims of individual editors. The output at the end of this step is a final trip table from the GPS data, providing day, date, time start, time end, origin (with latitude and longitude), destination (also with latitude and longitude), duration of travel in time and distance, imputed mode, imputed purpose, and number of people travelling together. Subsequently, data from the Daily Record cards is added to each trip, indicating whether or not the respondent used the GOS device on each day. Any missed days in the middle or ends of the record are added, when possible, based on the Daily Record data, which may indicate certain days on which the person did not travel.

7.4   GPS and Diary Trip Matching Results

GPS data were requested from each respondent for seven days, with the first day of GPS data collection also being the designated diary day. As noted in section 6.2.3, in some cases, GPS respondents did not complete a diary. In other cases, respondents did not use their GPS device on the diary day, or completed their dairies but provided no GPS data at all. For the matching process, it is necessary that a respondent has both valid diary data and valid GPS data for the same day, and the numbers of households and individuals that provided such data were 225 households and 345 individuals, which includes both individuals who claimed not to have traveled on the diary day, and those who provided GPS data on a day that they claimed in the diary not to have traveled, or completed the diary with travel information on a day that their Daily Record showed was a day on which they did not leave home.

Table 30 shows the frequencies of numbers of days for which data were provided from the GPS participants (both Smartphone and GPS logger and Main and Pilot data combined). It can be seen that the largest percentage of people provided 7 days of data and, in fact, 38.1 percent provided 7 or more days of data. A total of 61.9 percent of people provided data for 5 or more days. This represents a high rate of compliance with the GPS task and indicates a substantial amount of data available.

Table 26: Frequencies of Number of Days for the GPS Sample

Number of Days	Frequency	Percentage
1	73	14.7%
2	43	8.7%
3	35	7.1%
4	38	7.7%
5	58	11.7%
6	60	12.1%
7	95	19.2%
8	50	10.1%
9	16	3.2%
10	15	3.0%
11	3	0.6%
12	2	0.4%
13	4	0.8%
14	1	0.2%
15	2	0.4%
18	1	0.2%
TOTAL	496	100.0%

The matching process involved matching the data from the diary day with data from the GPS record for the same day and then checking each trip to see if it really matched. An automated process was used initially to check for a match. This process indicated a match on start time or end time, if those times were within 10 minutes of each other. Similarly, a match was indicated if the latitude and longitude of the origin were within 0.002 degrees of each other, which represents approximately one tenth of a mile in each of longitude and latitude and allows for a combined difference of almost 0.2 miles if both latitude and longitude differ by up to 0.002 degrees. A check was also made on mode and purpose. However, because the diary data are much richer in both of these attributes than the imputed GPS data, these matches were not considered critical, but rather indicative. Even where the number of trips is the same in both the diary and the GPS (103 cases, apart from those where both show 0 trips), 17 of these cases show significant differences in some of the trips, with some trips recorded in the GPS and not

the diary, and vice versa. Thus, a careful matching was then undertaken on a trip-by-trip basis to determine which trips matched and which did not. If trips matched on origin and destination, then the trip was assumed to be the same trip, even if the times were not a match within 10 minutes. However, if the origin and/or destination did not match, the trip was considered not to be a match, even if the times did match within 10 minutes.

7.4.1   Matching Results

There are 14 respondents who reported both in the diary and the Daily Record that they did not travel on the diary day. This reduces the number of individuals available for matching on actual travel to 331. These outcomes affect 11 households. A further 30 individuals recorded trips either in the diary with no GPS trips (14) or on the GPS with no diary trips (16). These are more troublesome and indicate a problem, possibly that they completed the diary for a different day from the one requested, or that the GPS was not carried on the diary day. In 12 of these cases, the respondent had filled in their Daily Record Card to show that they carried their GPS with them all day on that day: in 5 cases, the respondent had no GPS trips, but reported diary trips; in the other 7 cases, the respondent had GPS trips recorded but indicated no travel in the diary. The numbers of trips recorded by GPS for the 16 persons whose diaries claimed no travel totaled 98, and varied from 2 to 17 trips. For the 14 persons who claimed on the GPS daily record not to have traveled on the diary day, there were 57 trips recorded in the diaries, ranging from 1 to 8 trips.

Table 27 shows the comparison of the trip frequency for those respondents who had matching data (including no travel days) between the Diary and the GPS. The table shows that the GPS captured a total of 1,840 trips compared to the 1,679 in the diaries. This, without further analysis, suggests that the diaries under-reported trips by almost 10 percent (161 trips difference against the 1,679 recorded in the diaries). However, this is not a correct assessment. Table 28 shows the results in terms of matching of trips and shows a far poorer picture of diary reporting than Table 27. In the GPS record, some start and end times are missing, where editing has interpolated a trip. Therefore, the correct count of trips that are only in the diary is that of the origins and destinations that are only in the diary, i.e., 425 trips. On the other hand, there are 586 trips that are in the GPS records only and not in the diaries. This latter suggests an under-reporting rate of 35 percent, based on the number of diary trips actually recorded (including the 425 that were not recorded by the GPS).

Table 27: Trip Frequencies for the Matched GPS Sample (Diary and GPS)

Trips (#)	GPS Record		Diary Record	
	Frequency	Percentage	Frequency	Percentage
0	28	1.50%	29	1.70%
1	319	17.30%	319	19.10%
2	316	17.20%	316	18.90%
3	261	14.20%	250	15.00%
4	222	12.10%	211	12.60%
5	174	9.50%	162	9.70%
6	135	7.30%	123	7.40%
7	101	5.50%	85	5.10%
8	79	4.30%	64	3.80%
9	61	3.30%	46	2.80%
10	48	2.60%	33	2.00%
11	33	1.80%	21	1.30%

Trips (#)	GPS Record		Diary Record	
	Frequency	Percentage	Frequency	Percentage
12	25	1.40%	12	0.70%
13	18	1.00%	8	0.50%
14	14	0.80%	7	0.40%
15	12	0.70%	5	0.30%
16	8	0.40%	4	0.20%
17	7	0.40%	3	0.20%
18	5	0.30%	2	0.10%
19	2	0.10%	1	0.10%
20	1	0.10%	0	0.00%
Totals	**1841**	**100%**	**1672**	**100%**

As indicated in Table 28, some trips show a complete match, at least within the tolerance limits permitted in this project. However, Table 28 also indicates that there are 419 trips that are recorded in the diary only and 588 that are recorded by the GPS only. The former will occur most probably if the GPS is left at home, or if the trip is very short, so that the GPS is unable to get a fix on position. The latter will occur when people forget to enter trips they have made into the diary, or intentionally omit them because of fatigue in answering, or forget that they have made the trips at all. Table 29 shows the frequencies of missed trips.

Table 28: Status of Matches between Diary and GPS

Match Status	Origin	Destination	Start Time	End Time
Matched within .1 mile or 10 minutes	1031	923	985	847
No Match	222	330	230	368
Diary Only	419	419	457	457
GPS Only	588	588	573	573
Both No Travel	14	14	29	29
TOTAL	2274	2274	2274	2274

Table 29: Trip Frequencies for the GPS Sample for the Main Survey

Missing Trips (#)	Missing GPS Frequency	Missing Diary Frequency
1	125	135
2	46	51
3	20	21
4	14	16
5	5	8
6	4	10

Missing Trips (#)	Missing GPS Frequency	Missing Diary Frequency
7	3	3
8	2	1
9	0	1
10	0	3
11	0	1
12	0	0
13	0	1
14	0	0
15	0	1
16	0	0
17	0	1
Totals	**219**	**253**

About 57 percent (125) of respondents with missing GPS trips have only a single trip missing, which is often a result of failure of the GPS to acquire position. A total of 171 respondents (78 percent) have 2 or fewer missing GPS trips. The maximum number of GPS missed trips is 8 and applies to just two respondents. A further 3 respondents have 7 missed trips and another 4 have 6 missed trips. For missed diary trips, 135 respondents (53 percent) missed 1 trip in their diary; while a further 51 (20 percent) missed 2 trips. One respondent missed 17 trips and 7 respondents missed 10 or more trips.

There are 23 respondents where nothing matches at all between the diary record and the GPS record. That is to say, for these respondents, no origins or destinations match, no times match, and generally mode and purpose do not match either. These are the most puzzling cases. There are a further three cases, where the origins and destinations do not match, but some or all of the times match. These 26 respondents recorded 129 trips on their GPS devices and 97 trips in their diaries. Two explanations for this situation are possible. On the one hand, the respondents could have handed their GPS devices to another person on the diary day and that is the travel that was recorded, while the respondent filled out the diary for what he or she actually did on the day. The other possibility is that the person filled out the diary for a different day from that for which he or she was instructed to use the diary. Unfortunately, time and resources for this project do not allow searching for a match to other days of the GPS record. It is noteworthy, however, that 15 households (whose data are not included in these statistics) completed their diaries apparently for a date that was 6 or more days before the beginning of the GPS period, or after the end of the GPS period and this was known to the survey team. It is, therefore, quite plausible that some respondents may have completed their diaries for a quite different date from the one on which they were expected to complete them, without this information being available to the survey team.

Starting from 345 individuals for whom both diary and GPS records (presumably for the same day) were available, including those who did not leave home on the diary day, 30 are lost from the analysis because either their GPS devices had no trips recorded on the diary day while trips were recorded in the diary, or the diary had no trips recorded while there were trips recorded by the GPS device. A further 26 are also lost, because nothing between their diary and the GPS record matches, so that it has to be assumed that these respondents have not recorded the same day of travel in their diaries as was measured by the GPS. This leaves 289 respondents whose

travel can be analyzed for factoring purposes. Also, from a starting point of 1,841 GPS trips and 1,672 diary trips, 227 GPS trips and 154 diary trips are lost from the analysis, leaving 1,614 GPS trips and 1,518 diary trips.

7.4.2   Matching Results – Summary Tables

Table 30: Summary Statistics – Comparison of GPS and Diary Records

Match Result	Origin	Destination	Start Time	End Time	Mode	Purpose
Diary and GPS Match	1045	937	1014	876	1020	481
No Match	222	330	230	368	249	787
Present in Diary only	419	419	457	457	418	419
Present in GPS only	588	588	573	573	587	587
Total	2274	2274	2274	2274	2274	2274

Table 31: Perfect Match Summary

Perfect Match Summary	Perfect Matches	Perfect Match %
Persons Instrumented	345	
Persons (All Perfect Matches)	80	23.2%
Persons (No GPS / No Travel Perfect Match)	14	4.0%

Table 32: Missing Trip Matching Summary

Missing Trip Summary	Count	Percent
GPS Missing Trips	419	22.7%
Diary Missing Trips	588	35.2%

Total Number of Reported and Captured Trips	Count
GPS Trips	1,841
Diary Trips	1,672

7.5   GPS Data Deliverables

The GPS data deliverable included several Excel Databases containing the data collected from complete households. In addition, Google Earth Files are provided for all trips for all days collected by the GPS devices. Tables included as part of the GPS data deliverables are:

HOUSEHOLDS contains one record for each responding household deployed with GPS equipment or software during the study period.

PERSONS contains one record for each responding person deployed with GPS equipment or software during the study period.

GPSTRIPS contains trip-level information for each valid GPS trip detected in the GPS point data collected by the sampled households during the assigned travel day.

MISSEDTRIPANALYSIS contains a comparison of diary reported trips and GPS captured trips by persons for complete households. This table contains only persons whose diary data could be matched to GPS data, or whose diary data confirmed no travel on the travel day.

DIARYGPSTM contains all diary reported trips by persons for all households. This table contains only persons whose diary data could be matched to GPS data, or whose diary data confirmed no travel on the travel day.

TRIPS_SORTED contains an integrated record of all trips, both diary reported and GPS captured trips, by persons for all complete households. This table contains only persons or vehicles whose diary data could be matched to GPS data, or whose diary data confirmed no travel on the travel day.

8.0   Assessment of Survey Quality

This section discusses the assessment of various aspects of the RTC HHTS quality. Overall, the data was subjected to rigorous data quality procedures ensuring quality data for the household travel study and fulfilling the definition of a completed household. The quality of the final main survey is demonstrated through the assessment of: Item non-response, expected value ranges and logical relationships between data elements, geographic and demographic coverage of participating households, and overall survey response rate.

8.1   Item Non-Response Analysis

One of the key indicators of survey quality is the amount of non-response to the individual items. The following is a summary of item non-response to the survey items within the final data files. The percentages indicated in each table are the proportion of responses that were "Don't Know" and/or "Refused".

Table 33 presents the one item that, at the household level, had a non-response level of two percent or greater. As may be seen, the question asking participants about their Household Income had the highest item non-response, with 9.6 percent of all households refusing to answer this question. Refusal of Household Income is typically a high non-response item in household travel surveys.

Table 33: Household Item Non-Response

Household File	% Non-Response
Household income	9.6%

Table 34 presents the items that experienced an item non-response of two percent or greater, at the person level.

Table 34: Person Item Non-Response

Person File	% Non-Response
Age	2.3%
Race/Ethnicity	2.0%
Work day	2.4%
Compressed work hours	4.2%
Primary job industry	2.2%
Primary job occupation	2.6%
Days for a secondary work	9.1%
School transit subsidy	9.2%
Grocery store name*	15.9%*

only collected for the main survey

In the vehicle file, only one item presented a high degree of refusal - higher than two percent: the question asking vehicle model. Two point four percent of respondents did not answer this question. It is possible that respondents simply did not know the answers to this question. See Table 35 Vehicle data collected was: year, make, model, body type, vehicle type, and fuel type.

Table 35: Vehicle Item Non-Response

Vehicle File	% Non-Response
Model	2.4%

The following is a summary of item non-response for the travel data elements asked during the retrieval interview. The data element with the highest non-response was time in minutes walking from parking location to destination (44.8 percent). The survey did not ask whether respondents parked a car or not, which may be a factor in the high non-response rate of the parking questions. See Table 36 for more information on the travel data elements that experienced item non-response at two percent or greater.

Table 36: Travel Behavior Item Non-Response

Place File	% Non-Response
Time(Mins) looking for parking	6.1%
Parking cross streets	33.4%*
Time(Mins) walking from Parking location to destination	44.8%*
Transit route	18.4%

8.2   Expected Value Ranges and Logical Relationships between Items

Another indicator of high data quality is that each data element contains the expected value ranges as shown in the survey recruitment and retrieval instruments. Where data elements should be skipped (i.e. a non-worker should not be asked the Occupation question), is the data for that person appropriately blank? Similarly, if there are two allowable categories for an item (i.e. Male and Female for the Gender item) does the data file contain only the appropriate choice codes? Logical relationships between items are also critical for a high quality data file. If a parent takes a child to school, does the child's place data also reflect the corresponding school trip? These quality assurance checks, and many more, were reviewed and flagged throughout data collection in NuStats' EditCheck module.

The EditCheck module is used by analysts to check data for consistency and accuracy, as well as to transform data to the final delivery format and perform summaries on the data. For the EditCheck section, there are a number of queries that are run to check for the quality of the data and update the status flags for any existing data and other queries. Table 37 details the quality assurance checks performed on the main survey data file.

In addition to the automated checks shown in the table below, access/egress trips from transit, intra-household travel, and spelling/consistency of open-ended responses were manually reviewed.

Table 37: Summary of Quality Assurance Checks

Message	Treatment	FILE
Arrival before departure (TRIP)	Check to see if TRPDUR>0, If not there is a time error between this row and the previous row	TRIP
Departure before arrival (TRIP)	Check to see if ACTDUR>0, If not there is a time error between ARRIVAL and DEPARTURE	TRIP
First place does not start at 0:00 (TRIP)	Check the ARRIVAL time of PLANO=1, it should be 0:00, if not, the first trip is may be missing or there is a reporting error	TRIP

Message	Treatment	FILE
Last place does not end at 23:59 (TRIP)	Check the DEPART time of the last trip, it should be 23:59, if not there is a numbering error between trips or the last trip has a reporting error	TRIP
Day Time Totals <> 1439 (TRIP)	One of the TRPDUR/ACTDUR's is false	TRIP
Need reason for no travel/filled in and should not be (PER)	Check NOGO/O_NOGO	PER
HHSIZ (HH) not equal to person count (PER)	Check PER data to see if everyone is a valid person then modify HHSIZ	HH/PER
HHVEH (HH) not equal to vehicle count (VEH)	Check VEH data to see if vehicle is a valid vehicle , then modify HHVEH	HH
VEHOP (HH) not equal to vehicle count (VEH)	Check VEH data to see if vehicle is a valid vehicle , then modify HHVEH	HH
HHWRK (HH) not equal to workers count (PER)	Check PER data to see if everyone AGE>15 has a valid EMPLY code, then modify HHWRK	HH/PER
HTRIPS (HH) does not match number of household trips (TRIP)	Validate total number of trips from NTX and update HTRIPS in HH table	HH/TRIP
INCOM is missing or is out of range (HH)	Check INCOM, look in REC data	HH
RESTY missing or is out of range (Including RESTO)	Check RESTY and O_RESTY, look in REC data	HH
HHSTU does not match number of Household students	Verity student status of each household member	HH
TRIP - Person Making Trips not in PER file (PER/TRIP)	Check Trip file or Person Roster for inconsistency	TRIP
TRIP-person traveling together (TRIP)	Manually review intra-household travel	TRIP
AGE and/or GENDER is missing or out of range (PER)	Check AGE and GENDER, one could be missing, RET (add per) and REC data	PER
PERSON not in HH file	There is no HH in the HH table corresponding to this PERSON, check REC and RET or send to RESEARCH and verify if PERSON is moved out of house or non-household member	HH/PER
Work trip address does not match WADDR (PER/TRIP)	Check WLOC, maybe 2 works. Also check ACTTYP	PER/TRIP
SCHOL is missing	Check PER school data, update from RET (add per) or send to research	PER
SCHOL is not null	Check PER school data, update from RET (add per) or send to research	PER
SNAME, SADDR is missing when SLOC is not home or vice versa	Check PER school data, update from RET (add per) or send to research	RES
School trip address does not match SADDR (PER/TRIP)	Check ACTTYP	PER/TRIP
Trip duration (TRPDU) is out of range or does not agree with PLANO (TRIP)	Check Arrival time of current place and departure time of previous place, PLANO=1 should have a null TRPDUR	TRIP
PTRIPS (PER) does not match number of person trips (TRIP)	Review TRIP and recompute PTRIPS	PER/TRIP
Home trip does not match HHADDR (HH/TRIP)	CHECK ACTTYP	HH/TRIP
Invalid mode	PLANO 1 should not have a mode, there should be a MODE for all other PLANO's	TRIP
Number of household members traveling together is larger than household size	Check HHMEM in TRIP if it is too large	TRIP
Wrong geocoding for work location- geocoded to the city	Need to collect addr or cross street	PER
Wrong geocoding school loc - geocoded to the city	Need to collect addr or cross street or SNAME with at least one street	PER
VEH YEAR is missing or is out of range (VEH)	Check rec data	VEH
PER - Employment Verification (EMPLY) - Part 1	Check REC and RET PER tables	PER
PER - WORKER (WLOC, OCCUP, INDUS) -	Check REC and RET PER tables	PER

Message	Treatment	FILE
Part 3		
PER - AGEB is NOT NULL	Update AGEB to NULL	PER
PER - DISAB is null or DTYPE,DSLIC,TWEXT is null	Check REC and RET PER tables	PER
PER - WKSTAT is null	Check Work Status	PER
PER - WKSTAT is not null	Check Work Status	PER
TRIP - PER1 is null and HHMEM > 0	Review TRIP	TRIP
PER - School-aged person not a student	Obtain school information, or reason not in school	PER
Look for home xy-coordinates in trip table or geocode haddr	Invalid home address. Locate and geocode home addr, else, send to research	HH/TRIP
Out of area household - Need Out of Area Addr and needs to be geocoded	Flagged for Research	RES
Speed is too fast(Place is wrongly geocoded or mode is wrong or travel time is wrong)	Review locations, times, and travel mode, else, send for research.	TRIP
NOGO is missing	Flagged for Research	TRIP
ACTIVITY STARTS BEFORE ARRIVAL TIME	Review Trip table and times, else, send for research.	ACTIVITY
ACTIVITY ENDS AFTER DEPARTURE TIME	Review Trip table and times, else, send for research.	ACTIVITY

8.3 Data Review – Kimley-Horn

The purpose of this section is to present information on the review of the draft data sets from the RTC Household Survey performed by Kimley-Horn. The following data submission files (Excel) from NuStats were reviewed:

- RTCHHTS_DataMatrix_Deliv_03252016_;
- HH_deliv_wgt;
- PER_deliv_wgt;
- PLACE_deliv_wgt;
- VEH_deliv_wgt.

A combined Excel file was created with a tab for each of the original survey submission files (HH, PER, PLACE, and VEH). These tabs, along with the DataMatrix file were reviewed as noted in the following sections.

8.3.1 File Review

Kimley-Horn and Associates reviewed the HH, PER, PLACE, and VEH files along with the DataMatrix file for accuracy and consistency and to make sure that these files were as "clean" as possible. Examples of data checks consisted of the following:

- Data fields where checked against those listed in Data Dictionary tab.
- Spelling was checked for consistency in all fields.
- Numbers stored as text.
- Multiple listings or duplicates.
- Consistency with possible answers from Data Dictionary tab.
- Consistency between related fields.
- Consistency between names in same field and across tabs
- Travel Date and Travel Day were checked for consistency.

- Consistency between addresses for same employer.
- Consistency between LAT/LONG for same employer/same address.
- Consistency between Employer City, Employer State and Employer Zip.
- Consistency between addresses for same person.
- Consistency between address, city, state, zip and LAT/LONG for each location.
- Logic check between fields.

A spreadsheet of issues found in the review was shared with RTC, NuStats, and the RTC's modeler. In addition to file review, all tabs were also edited where appropriate to correct errors.

Finally, in addition to the review items noted above, a GIS analysis of the data was also performed. First, all place locations were plotted and checked for consistency as well as errors. Second, all HH locations were also plotted. Four HH locations fell outside Washoe County. Two locations were located in Storey County which seems reasonable, but one household was located in Lyon County and another was located in Marin County, CA. These two HH locations were checked. Upon receipt of the data review from Kimley-Horn, NuStats made the necessary corrections and finalized the data file. Plots showing the place locations and home locations are provided in Figure 8 and Figure 9.

Figure 8: RTC Place Locations

Figure 9: RTC Home Locations

8.4 Geographic Coverage

Another indicator of high survey quality is the achievement of a final dataset that is representative of the full diversity of the surveyed population, including both the sociodemographic profile of residents of the region, as well as the full geographic coverage of residential addresses. Table 38 presents the geographic distribution of total households by strata, their percentage of all total households in the RTC area, and the geographic distribution and percentage of the final unweighted data file. Overall, the survey achieved a fairly equal geographic distribution as compared with Household Count by TAZ from the RTC Map Warehouse. The largest discrepancies were in the Central Sparks and Reno South districts, in which there were two percent fewer completed households in the final data than the overall percentage of households in that district, and in Downtown and Central Sparks with one percent fewer households in the final weighted dataset than expected.

Table 38: Geographic Distribution by Strata

District	District Name	Total Households	% of Total Households	Final Data File (Unweighted)	Percent of Final Data File (Weighted)
1	Downtown	4579	3%	2%	2%
2	University	3385	2%	2%	2%
3	Airport	1683	1%	1%	1%
4	Convention Center	3724	2%	2%	2%
5	Reno Northwest	10749	7%	6%	7%
6	Reno South	17173	11%	9%	11%
7	Central Sparks	15248	10%	8%	9%
8	Verdi-Mogul	16332	10%	9%	10%
9	Huffaker Hills	10522	7%	6%	7%
10	East Sparks	15270	10%	10%	10%
11	North Valleys	17494	11%	11%	11%
12	Pyramid Lake/ Spanish Springs	17184	11%	13%	11%
13	Washoe Southeast	3264	2%	3%	2%
14	Anderson	5529	3%	4%	4%
15	Rolling Hills	6428	4%	5%	4%
16	Galena Creek Park	106	<1%	1%	0%
17	Cold Springs	4025	3%	3%	3%
18	Pyramid Lake	3222	2%	3%	2%
19	North Sparks	2563	2%	2%	2%
20	Washoe East	9	<1%	0%	0%
Total		**158,489**	**100%**	**100%**	**100%**

8.5   Response Rate Summary

The final measure of survey quality is the response rate, which can be measured simply as the number of households sampled divided by the number of completes or by using one of the statistically accepted formulas. This report presents the simple and the Council of American Survey Research Organization's (CASRO's) calculation of response rate. The CASRO calculation includes all eligible and assumed eligible sampled households in the denominator. The CASRO method of response rate calculation formed the basis for the development of a standard for the calculation of response rates by the American Association for Public Opinion Research (AAPOR), which was then further refined by the Institute for Social and Economic Research (ISER). This calculation yields a more precise view of the overall percent of households from the original sample that end up completing the survey.[4]

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[4] For detailed information on response rate calculation visit http://www.quantitativeskills.com/sisa/calculations/resprhlp.htm

8.5.1 Total Sample Size

Presented in Table 39 is the summary of the sample count and type used for the full study. It should be noted that in the proposal stage for this project, we had initially estimated approximately 30,000 sample records would be necessary to collect completed surveys from 2,500 households. Due to a much lower than estimated response rate in the pilot study, and a low matched rate (<40 percent) of the purchased sample, the sampling plan was revised to estimate 84,150 sample records would be needed. Due to limited availability of sample in some of the specific districts, the total count of sample used for the full study was 73,802.

The voter registration list for the region was obtained from the Office of Nevada Secretary of State. This list contained 12,539 records that we were able to match phone numbers to the unmatched sample list. In addition, 682 records from the pilot address-based sampling frame were able to be recycled for the full study, as were 2,814 records from the pilot cell sample list.

Table 39: Summary of Used Sample Count by Sample Type for Main Study

Sampling Frame	Specific Sample Type	Total Counts Used for Full Study
Address–based Sampling Frame	Matched	17,738
	Unmatched	22,479
	Recycled pilot matched sample	682
	Unmatched sample matched to the phone number from the voter list	12,539
Cell	Matched	4,300
	Recycled pilot cell sample	2,814
Listed RDD Sampling Frame	Large household	3,814
	Low income household	1,500
	Young head of household	2,930
	Spanish surname household	2,506
	General listed household from near-transit-area	2,500
	Total	73,802

The RTC HHTS full study was conducted utilizing a two-stage approach. The first stage was the recruitment interview in which households provided information about their household, household members, vehicles, transit use, habitual locations, and demographic information. The second stage was the retrieval interview in which travel information from all household members of the recruited households was collected. During the retrieval interview, additional attempts were made to collect information missing or refused in the recruitment interview. The sample disposition for recruitment by sampling type for the full study is presented in Table 40. Based on eligible households in each sample type, the recruitment rate for listed sample outperformed the cell sample and the address-based sample, with six percent of all eligible listed households completing a recruitment interview. The cell sample showed five percent of eligible sample completed a recruitment interview. Address-based sample showed a four percent completion rate of eligible sample.

Table 40: Sample Disposition for Recruitment by Sampling Type for Main Study

Sample Type	Category	Dispositions	Count	% of Total Sample Type**
Address-based Sample	**Eligible**	Complete	2,063	4%
		Partial complete	520	1%
		Final refusal	1,629	3%
		Incomplete after starting the survey	30	0%
		Subtotal	**4,242**	**8%**
	Ineligible	Language barrier*	108	0%
		Disconnect	7,505	14%
		Business/government	601	1%
		Invalid phone number –fax/modem	347	1%
		Not qualified/terminated from qualification question/over quota	1,129	2%
		Subtotal	**9,690**	**18%**
	Unknown	Answering machine	8,604	16%
		Busy line	267	0%
		Call back	344	1%
		No answer/left message	2,186	4%
		Soft refusal to participate	2,498	5%
		Hang up	3,358	6%
		Unmatched sample contacted via mail and no response	22,028	41%
		Other	221	0%
		Subtotal	**39,506**	**74%**
		Total	**53,438**	**100%**
Listed	**Eligible**	Complete	768	6%
		Partial complete	218	2%
		Final refusal	550	4%
		Incomplete after starting the survey	7	0%
		Sub total	**1,543**	**12%**
	Ineligible	Language barrier*	63	0%
		Disconnect	2,275	17%
		Business/government	172	1%
		Invalid phone number –fax/modem	161	1%
		Not qualified/terminated from qualification question/over quota	307	2%
		Subtotal	**2,978**	**22%**
	Unknown	Answering machine	3,968	30%
		Busy line	143	1%
		Call back	333	3%
		No answer/left message	1,494	11%
		Soft refusal to participate	869	7%
		Hang up	1,797	14%
		Other	125	1%
		Subtotal	**8,729**	**66%**
		Total	**13,250**	**100%**

Sample Type	Category	Dispositions	Count	% of Total Sample Type**
Cell	**Eligible**	Complete	388	5%
		Partial complete	121	2%
		Final refusal	450	6%
		Incomplete after starting the survey	4	0%
		Sub total	**963**	**14%**
	Ineligible	Language barrier*	21	0%
		Disconnect	994	14%
		Business/government	84	1%
		Invalid phone number –fax/modem	14	0%
		Not qualified/terminated from qualification question/over quota	397	6%
		Subtotal	**1,510**	**21%**
	Unknown	Answering machine	2,520	35%
		Busy line	161	2%
		Call back	92	1%
		No answer/left message	442	6%
		Soft refusal to participate	437	6%
		Hang up	871	12%
		Other	118	2%
		Subtotal	**4,641**	**65%**
		Total	**7,114**	**100%**
		Total	**73,802**	

Language barrier refers to a language other than English or Spanish.
**Totals may not add to 100% due to rounding

8.5.2   CASRO Response Rate

Using the CASRO response rate calculation, which takes into account ineligible sample and call outcome unknown sample, the RTC main survey had an overall recruit response rate of 13.5 percent. By sample type, CASRO response rate of address-based sample was 12.7 percent. The CASRO response rate of the targeted listed landline sample and targeted consumer based cell sample was 17.0 percent and 13.5 percent respectively. Overall the retrieval rate was 63.7 percent.

8.5.3   Simple Response Rate

In order to compare recruitment and retrieval rates by sample type, the simple response rate calculations are presented in Table 41. As is frequently seen in household travel surveys, the unmatched address-based sample resulted in the lowest response rate (one percent) as compared with other sample types. With no telephone number associated with the household, these households would have had to self-recruit via the online survey or call in to the hotline and complete the recruitment questionnaire with an interviewer. Three sample types tied for next lowest response rate of two percent. The sample types were: address-based matched recycled pilot sample; young head of household sample from the listed RDD frame; and Spanish surname sample also from the listed RDD frame.

Table 41: Recruitment and Retrieval Rates and Response Rates by Sample Type for the Main Study

Sample Type	Specific Sample Type	Sampled HH (A)	Recruited HH (B)	Recruitment Rate (B)/(A)	Retrieved HH (C)	Retrieval Rate (C)/(B)	Response Rate (C)/(A)
Address-based	Matched	17,671	1,042	6%	731	70%	4%
	Unmatched	22,479	323	1%	202	63%	1%
	Recycled pilot matched sample	749	31	4%	14	45%	2%
	Unmatched sample matched to the phone number from the voter list	12,539	667	5%	379	57%	3%
Cell	Matched	3,763	213	6%	138	65%	4%
	Recycled pilot cell sample	3,351	175	5%	87	50%	3%
Listed RDD Sampling Frame	Large household	3,814	259	7%	166	64%	4%
	Low income household	1,500	112	7%	88	79%	6%
	Young head of household	2,930	118	4%	61	52%	2%
	Spanish surname household	2,506	71	3%	38	54%	2%
	General listed household from near-transit-area	2,500	208	8%	145	70%	6%
	Total	**73,802**	**3,219**	**4%**	**2,049**	**64%**	**3%**

The recruitment and retrieval rates and response rates by the districts identified as the sampling strata may be found in Table 42. The Galena Creek Park district had the lowest retrieval (5 percent) and response rates (<1 percent), with only one of the 19 recruited households carrying through and reporting their travel. The University, Airport, and Convention Center districts had the next lowest response rates of one percent each.

Table 42: Recruitment Rates and Response Rates by Sampling Strata for the Main Study

District	District Name	Sampled HH (A)	Recruited HH (B)	Recruitment Rate (B)/(A)	Retrieved HH (C)	Retrieval Rate (C)/(B)	Response Rate (C)/(A)
1	Downtown	2,993	70	2%	53	76%	2%
2	University	2,813	71	3%	34	48%	1%
3	Airport	1,855	38	2%	23	61%	1%
4	Convention Center	2,149	52	2%	26	50%	1%
5	Reno Northwest	4,334	193	4%	147	76%	3%
6	Reno South	6,699	290	4%	206	71%	3%
7	Central Sparks	8,815	257	3%	158	61%	2%
8	Verdi-Mogul	6,627	310	5%	203	65%	3%
9	Huffaker Hills	4,862	201	4%	120	60%	2%
10	East Sparks	6,058	305	5%	196	64%	3%
11	North Valleys	8,351	406	5%	223	55%	3%
12	Pyramid Lake/Spanish Springs	7,543	407	5%	312	77%	4%
13	Washoe Southeast	1,221	89	7%	65	73%	5%
14	Anderson	2,036	107	5%	87	81%	4%
15	Rolling Hills	2,742	148	5%	118	80%	4%
16	Galena Creek Park	335	19	6%	1	5%	<1%
17	Cold Springs	1,810	106	6%	72	68%	4%
18	Pyramid Lake	1,360	91	7%	72	79%	5%
19	North Sparks	1,199	59	5%	38	64%	3%

9.0 Survey Data Weighting and Expansion

From a finite population sampling theory perspective, analytic weights are needed to develop estimates of population parameters and, more generally, to draw inferences about the sampled population. Without the use of analytic weights, population estimates are subject to biases of unknown (and possibly large) magnitude. Consequently, analytic weights are crucial to obtain survey estimates with minimal bias.

The weighting approach utilized in this study accounts for the biases associated with sampling and robustness of the data collected. Specifically, the components of the analytic weights generated from method are as follows:

- Sampling weights
- Raking adjustment

Analytic weights are computed at the household and person levels. These weights adjust the relative importance of responses to reflect the different probabilities of selection by respondents, and align the sample distributions to population distributions. This section discusses the components of the household weight and person weight in detail.

9.1 Household Weight

The sampling weight reflects the probability of selection of an address or a telephone number from the sampling frame. Considering the multiple-sampling frame employed in this study, separate sampling weights are calculated for samples from each sample frame employed – address-based sampling frame, several targeted listed landline sampling frame and targeted consumer-based cellphone sample frame. Specifically, the sampling weight for a sampling unit j in the sampling frame (denoted as $W_{j,SampFr}$) from each sample draw, is simply the reciprocal of the selection probability of the sampling unit.

$$W_{j,SampFr} = \frac{1}{\text{Prob}_{j,SampFr}} \tag{1}$$

Where:

The sampling unit j is an address in the address-based sampling frame, a landline residential phone number in the targeted listed residential frames or a cell phone number in the targeted cell phone sample frame. Sampling frame $_{SampFr}$ is address-based sampling frame, targeted listed residential sampling frames or targeted cell phone sample frame.

The sampling weights help adjust for oversampling of specific geographies (e.g. potential transit user households live in ¼ mile radius from transit stations) or demographic groups of interest (e.g. hard to reach population such as large household, low income household etc.) for which we had implemented controls to ensure adequate observations in these groups. To illustrate, the sampling weight associated with an address-based sample is simply computed as the number of addresses (universe) in the address-based frame divided by number of sample pieces ordered from the frame for the study area for each sample order. For this study, samples (i.e. addresses) were drawn by district defined by RTC from address-based sampling frame, sampling weights was computed by district for the samples drawn from the address-based sampling frame. On the other hand, targeted listed samples (large households with 4 or more persons, low income households with annual income less than $25,000, young households with all members aged 25 or younger, Hispanic surnames) and cell samples were drawn randomly across the RTC study area from the respective sampling frames. In addition, general listed households within ¼ mile from the transit station (potential transit households) were drawn from the targeted

census tracts within one-quarter mile from the transit stations. Sampling weights were computed separately for samples drawn from each of the five targeted sampling groups and for the cell samples.

9.1.1 Raking Adjustment

Raking adjustments are used to improve the reliability of survey estimates. Raking adjustments are applied to the collected data when the distribution of key demographic variables do not match to those of the general population; hence, a raking adjustment was used to align the weighted sample with population statistics from the latest available census data - 2010-2014 5-year estimates, depending on selected raking control variables and base-geography. In particular, the aforementioned weights were adjusted so that the sums of the adjusted weights are equal to known population totals for certain subgroups of the population, defined by demographic characteristics and geographic variables. Variables and variable categories used for raking at the household level are as follows:

- Household size (1, 2, 3, 4 or more) distribution
- Household income (Less than $35,000, $35,000 - $100,000, over $100,000)
- Household vehicle & number of household workers in the household (0 vehicle & 0 worker, 0 vehicle & 1 or more worker, 1 vehicle & 0 worker, 1 vehicle & 1 or more worker, 2 vehicle & 0 worker, 2 vehicle & 1 worker, 2 vehicle & 2 or more worker, 3 + vehicle & 0 or 1 worker, 3+ vehicle & 2 or more worker)
- District of home location

These variables were chosen as raking variables as these are key variables that impact travel behaviors and it is important that the collected data are representative of general population geographically and socioeconomically. It is reasonable to expect that maximum bias reduction would be achieved using these variables on travel demand data calibration. It is important to note that the missing values in the raking variables were imputed to calculate the raking adjustments using the well-known hot deck method, in which a missing value is imputed using the data from other observations in the same dataset. Missing income was imputed before the household level raking procedure using a mean of household income for combination of four variables - OWN (home ownership), HHSIZ (household size), HHWRK (number of household workers) and HHVEH (number of household vehicles) variables. A mean of each combination was calculated and applied to the refused income values for the relevant category.

The raking procedure was based on an iterative proportional fitting procedure, and involves simultaneous ratio adjustments to two or more marginal distributions of population counts. The raking procedure was performed in a sequence of adjustments. First, base weights (sampling weights) were adjusted to one marginal distribution and then to the second marginal distribution, and so on. One sequence of adjustments to the marginal distributions was known as a cycle or iteration. The procedure was repeated until convergence was achieved.

Following the raking procedure, inordinately large weights or too small weights, a by-product of raking, ought to be capped in order to prevent samples with extremely large or small weight from skewing other variables that are not controlled by the weighting process and travel pattern. Weights that are over 3 or less than 0.25 were capped to be 3 and 0.25 respectively so that balanced raking results remain effective while removing outlying weights.

Table 43 shows the survey and population distributions by demographic and geographic raking variables for the study area. A comparison of the unweighted distribution and the weighted distribution of these raking variables indicates that the raking procedure has aligned the sample statistics to the population statistics.

Table 43: Raking Adjustment at Household Level

Key variables	Unweighted		Weighted		2010-2014		Difference (% points) Weighted-ACS
Household Size							
1	648	30.1%	664	30.8%	48,726	29.6%	1.2%
2	961	44.6%	772	35.9%	57,075	34.7%	1.2%
3	275	12.8%	314	14.6%	23,739	14.4%	0.2%
4 or more	270	12.5%	404	18.7%	34,921	21.2%	-2.5%
Total	**2154**	**100.0%**	**2,154**	**100.0%**	**164,461**	**100.00%**	0.0%
Income*							
Less than 35K	537	27.6%	645	33.3%	55,759	33.9%	-0.6%
35K-100K	939	48.2%	858	44.3%	73,172	44.5%	-0.2%
100K+	471	24.2%	432	22.3%	35,530	21.6%	0.7%
Total	**1947**	**100.0%**	**1,935**	**100.0%**	**164,461**	**100.00%**	0.0%
Number of Household Vehicles							
0 vehicle - 0 worker	91	4.2%	102	4.7%	7,737	4.7%	0.0%
0 vehicle - 1 or more worker	33	1.5%	60	2.8%	5,612	3.4%	-0.7%
1 vehicle - 0 worker	414	19.2%	292	13.6%	19,892	12.2%	1.4%
1 vehicle - 1 or more worker	331	15.4%	434	20.2%	34,665	21.2%	-1.1%
2 vehicle - 0 worker	263	12.2%	172	8.0%	11,737	7.2%	0.8%
2 vehicle - 1 worker	292	13.6%	304	14.1%	23,000	14.1%	0.0%
2 vehicle - 2 or more worker	403	18.7%	367	17.0%	27,375	16.8%	0.3%
3 + vehicle - 0 or 1 worker	138	6.4%	173	8.0%	13,965	8.6%	-0.5%
3+ vehicle - 2 or more worker	189	8.8%	250	11.6%	20,478	12.5%	-0.9%
Total	**2154**	**100.0%**	**2,154**	**100.0%**	**164,461**	**100.00%**	0.0%
District							
1	53	2.5%	58	2.7%	4,579	2.89%	-0.7%
2	34	1.6%	44	2.1%	3,385	2.14%	-0.1%
3	23	1.1%	24	1.1%	1,683	1.06%	-0.2%
4	26	1.2%	46	2.1%	3,724	2.35%	-0.4%
5	147	6.8%	148	6.9%	10,749	6.78%	0.1%
6	206	9.6%	238	11.0%	17,173	10.84%	0.2%
7	158	7.3%	196	9.1%	15,248	9.62%	-0.4%
8	203	9.4%	219	10.2%	16,332	10.31%	0.0%
9	120	5.6%	141	6.6%	10,522	6.64%	-0.1%
10	196	9.1%	210	9.7%	15,270	9.64%	0.2%
11	223	10.4%	223	10.4%	17,494	11.04%	0.1%

Key variables	Unweighted		Weighted		2010-2014		Difference (% points) Weighted-ACS
12	312	14.5%	244	11.3%	17,184	10.84%	0.4%
13	65	3.0%	49	2.3%	3,264	2.06%	0.2%
14	87	4.0%	82	3.8%	5,529	3.49%	0.1%
15	118	5.5%	93	4.3%	6,428	4.06%	0.3%
16	1	.0%	2	.1%	106	0.07%	0.1%
17	72	3.3%	57	2.7%	4,025	2.54%	0.1%
18	72	3.3%	43	2.0%	3,222	2.03%	-0.2%
19	38	1.8%	37	1.7%	2,563	1.62%	0.1%
	2154	100.00%	2154	100.00%	158,480*	100.00%	0.0%

*Source: RTC TAZ GIS shape file

Final Expanded Household Weight

The final analytic weight is simply the product of sampling weight and raking adjustment. Following the computation of this weight, an expansion procedure was undertaken to get the final 'expanded' analytic weight so that the weighted survey dataset can provide estimates for the total population in the study area. The expansion process simply takes the weighted total number of households and multiplies each household by a factor that, when applied, expands the data to represent the universe of households in the study area of Washoe County. The 2010-2014 ACS 5-year estimates were used to get the most recent estimates of total household counts in the area. To derive the expansion factor, a simple division was used: Expansion Factor = N(Universe)/N(Surveyed). This translates to a survey universe of 164,461 households.

The final expanded household weight was appended to the Household and Vehicle data files.

9.2   Person Weight

Person weight is a product of the final household weight and the person level raking weight. Person data weighted by "final household weight" was raked to align it to population statistics from the 2010-2014 5-Year American Community Survey estimates. Variables used for raking at the person level are as follows:

- Hispanic Status (Hispanic, Non-Hispanic)
- Ethnicity (White, African American, Asian, Native Hawaiian and Other Pacific Islander alone, Other)
- Age (less than 20 years, 20 –34 years, 35 – 54 years, 55 – 64 years, 65 years or older)
- Employment Status (Yes employed, Not-employed)

Before the raking procedure, any missing data for Hispanic status/race or age were imputed using hot–deck imputation method which is the most commonly used method for missing data imputation. With this method, a missing value is imputed from the selected similar records. To select similar records, other reference demographic variables known to have a strong correlation with the imputing variable are used to compute mean or mode – a statistical term for the number that appears most often – to replace the missing value. Imputation of these variables was carried out as follows:

- Hispanic status/race is a categorical variable. Hence, mode (a statistical term meaning the value that appears most often) was calculated and applied for the missing value. For race, mode by household

income category was computed and applied to race refusal records in the same household income category. For Hispanic status, mode of Hispanic status by combination of household income and race was computed and applied to missing or refusal values of the same household income and age group.

- Age is a scale variable. Hence, mean age for combination of education level, employment status, and student status was computed and applied to age refusals. If education level was refused or missing, a mean age of relevant work status and student status category was applied. If all the variables used for imputation are refusals, and the overall average age was applied.

Following the raking procedure, any very large weights were capped to equal a maximum of three times the mean weight to avoid side effect of very large weights, a by-product of raking procedure. Table 44 shows the survey and population distribution by the aforementioned raking variables.

Table 44: Survey and Population Distribution by Raking Variables

Key variables	Unweighted		Weighted		2010-2014 ACS		Difference (% points) Weighted-ACS
Hispanic Status							
Hispanic	368	8.1%	758	16.7%	98,671	22.9%	-6.2%
Non-Hispanic	4201	91.9%	3771	83.3%	331,314	77.1%	6.2%
Total	**4569**	**100.0%**	**4529**	**100.0%**	**429,985**	**100.0%**	**0.0%**
							Age
<20 years old	759	16.8%	1105	24.5%	109,790	25.5%	-1.0%
20-34	522	11.6%	866	19.2%	92,176	21.4%	-2.2%
35-54	1104	24.5%	1191	26.4%	114,429	26.6%	-0.2%
55 – 64	949	21.1%	662	14.7%	56,111	13.0%	1.6%
65+	1174	26.0%	687	15.2%	57,479	13.4%	1.9%
Total	**4508**	**100.0%**	**4510**	**100.0%**	**429,985**	**100.0%**	**0.0%**
Race							
White	4067	89.6%	3799	84.3%	350,364	81.5%	2.8%
Black or African American	57	1.3%	97	2.1%	10,202	2.4%	-0.2%
American Indian or Alaska Native	42	.9%	58	1.3%	6,771	1.6%	-0.3%
Asian	101	2.2%	195	4.3%	22,461	5.2%	-0.9%
Native Hawaiian and Other Pacific Islander alone	19	.4%	29	.6%	2,518	0.6%	0.0%
OTHER	253	5.6%	328	7.3%	37,669	8.8%	-1.5%
Total	**4539**	**100.0%**	**4505**	**100.0%**	**429,985**	**100.0%**	**0.0%**
Employment Status							
Yes	2041	44.4%	2150	46.8%	202,147	47.0%	-0.2%
No (Including 16 or under)	2554	55.6%	2445	53.2%	227,838	53.0%	0.2%
Total	**4595**	**100.0%**	**4595**	**100%**	**429,985**	**100.0%**	**0.0%**

9.2.1 Final Expanded Person Weight

Following computation of "final person weight", weights were then expanded to reflect the total 429,985 persons residing in the Washoe County. The final expanded person weight was appended to Person and Place data files.

9.3 Factoring Diary Trips from GPS Results

In a household travel survey, there are at least two critical issues in the accuracy of the resulting trip data: sample coverage and trip reporting accuracy. Sample coverage is dealt with elsewhere in this report, and has to do with such things as nonresponse and sample adherence. Trip reporting accuracy is the issue that is of concern in this section of the report. Unfortunately, in all household travel surveys that ask people to report their travel, the reported travel, whether provided in written diaries or through interviews, are subject to errors: omission due to memory issues, privacy concerns, fatigue in answering the questions, and other issues. Use of global positioning system (GPS) devices, either through Smartphones or dedicated GPS loggers, provides a method to increase the accuracy of trip reporting. However, GPS is by no means foolproof, but does provide a significantly higher accuracy of reporting.

In the RTC Washoe County Travel Characteristics Study, 225 households (11 percent) completed both GPS measurement for at least one household member and also provided diaries for the appointed diary day. Where both GPS data and diary data exist for the same day, it is possible to determine the level of correction that may be needed to diary data to bring it closer to true trip-making levels. While the percentage of households completing both GPS and diaries seems fairly reasonable, the actual number is too low to undertake detailed factoring. Statistical analysis of small samples is fraught with error, so caution must be used in determining how to correct diary trips.

Four types of trips can be identified in the sample:

- Matched trips (M) – trips that are found in both the diary trip table and the GPS trip table, as determined by examining the match of origin and destination coordinates (latitude and longitude);
- Underestimated trips (U) – trips that are found in the GPS trip table but are not in the diary trip table;
- Overestimated trips (O) – trips that are found in the diary trip table that are not present in the GPS trip table, except for instances where it can be determined that the diary trips were missed by the GPS device; and
- Additional trips (A) – trips that are found in the diary trip table that are not present in the GPS trip table and for which it can be determined that the GPS record is in error. These trips are of little further interest in this study.

Matched trips are defined more leniently than in the earlier comparison. If a trip is found in the diary that matches any part of a trip reported by the GPS device or Smartphone, it is counted as a match. For underestimated and overestimated trips, an example would be the case where the diary records a trip from home to work, while the GPS shows that the person dropped of someone at school on the way to work and then continued on to work. The GPS would show two trips in this case, which would be considered to be underestimated trips. The Diary would have reported a single home to work trip, which is considered to be an overestimated (not real) trip, because it should not have appeared in the diary. An additional trip might arise where a round trip to drop a child at school was not recorded by the GPS either because the GPS was left at home, or because the trip was too short for the GPS to gain position. Table 45 shows the numbers of these types of trips for the 289 respondents that remained after excluding those with trips on their GPS devices and no trips in the diary, no trips in the GPS device and trips in the diary, and those whose diary and GPS trips do not match.

Table 45: Distribution of Trips of Different Match Types

Match Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Overestimated Trips (O)	9	0.5%	9	0.5%
Additional Trips (A)	267	14.0%	276	14.5%
Matched Trips (M)	1,253	65.5%	1,529	80.0%
Underestimated Trips (U)	383	20.0%	1,912	100.0%

The Additional Trips should not be subject to factoring, because these are trips that have been correctly entered in the diaries, but for which there is no parallel GPS validation, because they arise from errors that respondents make in carrying their GPS devices, and sometimes from technical difficulties experienced by the GPS devices. Overestimated trips should not have been recorded in the diaries but were recorded through respondent error. The diary recorded trips (1,253 + 9 = 1,262), exclusive of the additional trips, are the base on which correction should be made, because 81.6 percent of respondents filled out their diaries without being equipped with a GPS device or Smartphone App. However, when looking at diary trips from those who did not carry a GPS, the total diary trip base for correction is the number of diary trips less the probable additional trips that the GPS would not have caught. Thus the base trips must be reduced by 14 percent from the total of all diary trips. These trips must be factored down by 0.5 percent for unreal trips that were recorded in their diaries, and factored up by 20 percent, representing the underestimation of diary trips, compared to the GPS.

The correct number of trips is (M+A+U) = 1903. The number of trips measured by the diaries is (M+O+A) = 1529. Therefore, the simple factor to apply is (M+A+U)/(M+A+O) = 1903/1529 = 1.245. In fact, the reporting of diary trips is quite variable in the population, with some respondents reporting exactly the same trips as were measured by the GPS, while others report very few of the trips measured by the GPS. Unfortunately, with only 225 households to work with in the Reno project, it is not possible to examine significant differences by household and trip-making characteristics. While probably not as accurate as one would like, application of a single factor is all that can be achieved in this project.

10.0 Overall Survey Results

This section contains the summary tables for weighted data and is based on unlinked trips. The results represent all households in the dataset. All trip-level results presented in this section and throughout the main report are based on unlinked trips.

An analysis was performed to look at the demographic characteristics of retrieved households specifically by: Income, Ethnicity, Household Size, Sample Type, and Race. As noted previously, household income was the highest item of non-response in the 2015-2016 study (9.6 percent).

The largest percentage of respondents that reported income and completed retrieval (21.9 percent) was the $100,000 or more household income group. The results amongst those households that reported income showed the $100,000 or more household income group with the highest percentage (27.8 percent) choosing to report travel via the web option. This group also chose to report their travel via mail back at 23.5 percent. The majority of households that chose to report travel via the telephone option (22.2 percent) reported household income as $25,000 to $50,000. The group that reported household income as less than $25,000 chose to report their travel via the web option at the lowest percentage (11.3 percent). The results are presented in Table 46.

Table 46: Household Income by Retrieval Mode

Household Income	Mail		CATI		Online		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Less than $25,000	137	12.9%	170	20.5%	30	11.3%	337	15.6%
$25,000 to $50,000	230	21.7%	184	22.2%	50	18.8%	464	21.5%
$50,000 to $75,000	187	17.7%	137	16.5%	65	24.4%	389	18.1%
$75,000 to $100,000	149	14.1%	100	12.0%	37	13.9%	286	13.3%
$100,000 or more	249	23.5%	148	17.8%	74	27.8%	471	21.9%
DK/RF	106	10.0%	91	11.0%	10	3.8%	207	9.6%
Total	**1,058**	**100.0%**	**830**	**100.0%**	**266**	**100.0%**	**2,154**	**100.0%**

Eight percent of respondents reported their ethnicity as Hispanic. This group chose to report their travel primarily via telephone at 9.9 percent. This group was the least likely to report their travel via mail back at 6.4 percent, as may be seen in Table 47.

Table 47: Hispanic Status by Retrieval Mode (Person)

Hispanic Status	Mail		CATI		Online		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Yes	148	6.4%	168	9.9%	52	8.7%	368	8.0%
No	2,138	93.0%	1525	90.0%	538	89.7%	4,201	91.4%
DK/RF	14	0.6%	2	0.1%	10	1.7%	26	0.6%
Total	**2,300**	**100.0%**	**1,695**	**100.0%**	**600**	**100.0%**	**4,595**	**100.0%**

In examining the retrieval data relative to household size, it is found that 2-person households were most likely to report travel via the mail back option (47.9 percent) and 4+-person households were the least likely to report travel via telephone. The results of retrieval mode by household size are presented in Table 48.

Table 48: Household Size by Retrieval Mode

Household Size	Mail		CATI		Online		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
1 person	282	26.7%	293	35.3%	73	27.4%	648	30.1%
2 persons	507	47.9%	338	40.7%	116	43.6%	961	44.6%
3 persons	129	12.2%	114	13.7%	32	12.0%	275	12.8%
4+ persons	140	13.2%	85	10.2%	45	16.9%	270	12.5%
Total	**1,058**	**100.0%**	**830**	**100.0%**	**266**	**100.0%**	**2,154**	**100.0%**

An analysis of retrieval mode by sample type may be found in Table 49. Of note, the sample type that showed the highest level of retrieval was the address-based matched sample type, and the sample type that showed the lowest level of retrieval was the Spanish surname targeted listed sample type. These results are consistent with other recent household travel studies performed by NuStats.

Table 49: Retrieval Modes by Sample type

Sample Type	Mail		CATI		Online		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Address-based matched	615	58.1%	473	57.0%	108	40.6%	1,196	55.5%
Address-based unmatched	81	7.7%	13	1.6%	88	33.1%	182	8.4%
Cell	120	11.3%	127	15.3%	31	11.7%	278	12.9%
Large household targeted listed	88	8.3%	59	7.1%	19	7.1%	166	7.7%
Low income targeted listed	34	3.2%	49	5.9%	5	1.9%	88	4.1%
Young household targeted listed	24	2.3%	29	3.5%	8	3.0%	61	2.8%
Spanish surname targeted listed	16	1.5%	19	2.3%	3	1.1%	38	1.8%
General listed household from near-transit-area	80	7.6%	61	7.3%	4	1.5%	145	6.7%
Total	**1,058**	**100.0%**	**830**	**100.0%**	**266**	**100.0%**	**2,154**	**100.0%**

Of the respondents who reported their ethnicity, the largest group who also provided travel was households where ethnicity was reported as White at 88.5 percent. This group also showed the largest percentage that reported travel via all three options with 89.8 percent of the mail respondents, 87.1 percent of the telephone respondents, and 87.3 percent of the web respondents identifying ethnicity in this category. The complete breakdown of retrieval mode by race may be seen in Table 50.

Table 50: Retrieval Mode by Race (Person)

Race	Mail		CATI		Online		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
White	2,066	89.8%	1,477	87.1%	524	87.3%	4,067	88.5%
Black or African American	20	.9%	30	1.8%	7	1.2%	57	1.2%
American Indian or Alaska Native	17	.7%	20	1.2%	5	.8%	42	.9%
Asian	48	2.1%	32	1.9%	21	3.5%	101	2.2%
Native Hawaiian and Other Pacific Islander alone	8	.3%	9	.5%	2	.3%	19	.4%
Other	117	5.1%	113	6.7%	23	3.8%	253	5.5%
DK/RF	24	1.0%	14	.8%	18	3.0%	56	1.2%
Total	**2,300**	**100.0%**	**1,695**	**100.0%**	**600**	**100.0%**	**4,595**	**100.0%**

10.1 Respondent/Household Summary (Weighted) DK/RF excluded

This section presents a summary of the respondents and households that participated in the RTC HHTS. Person and household data elements are summarized in the following tables and figures.

Travel days for the RTC HHTS were Tuesday, Wednesday, and Thursday excluding school holidays. The distribution of travel days across those three days of the week are presented in Figure 10. As may be seen, the fewest households were scheduled to record travel on Wednesday.

Figure 10: Distribution of Households by Day of Week

Tuesday	32.4%
Wednesday	29.8%
Thursday	37.7%
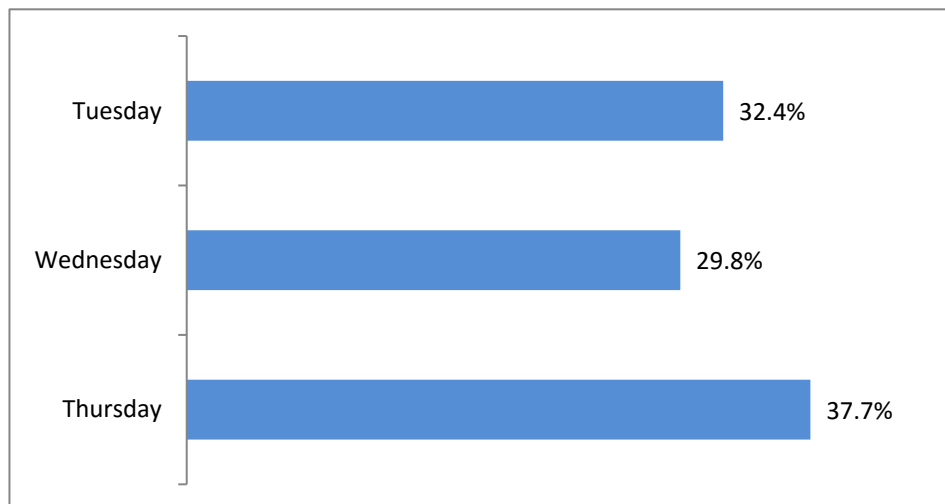
The results of the distribution of households by size may be viewed in Figure 11. Two-person households made up over 35 percent of the weighted data.

Figure 11: Household Size (Weighted)
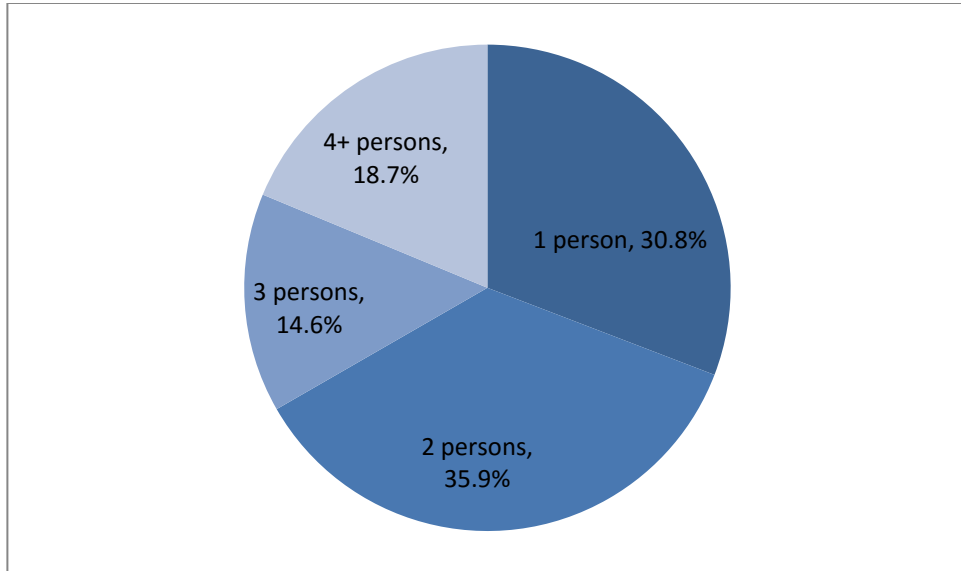
Presented in Figure 12 is a chart showing the reported number of household vehicles in the final, weighted dataset. The two-vehicle household group is the largest group represented in this chart.

Figure 12: Number of Household Vehicles (Weighted)
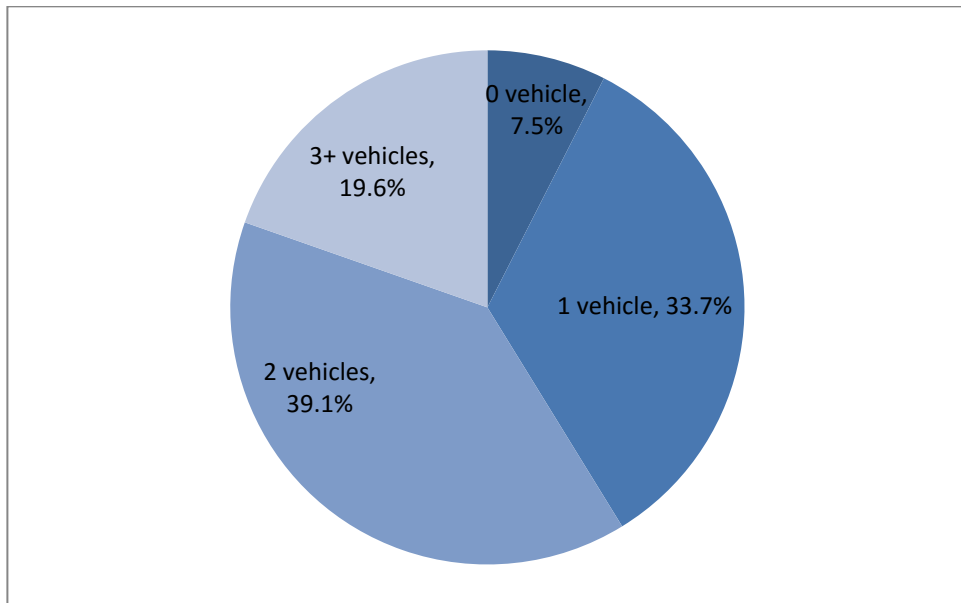
In looking at the vehicle fuel type reported by respondents, we received multiple responses from 70 households. The multiple fuel types reported were: gasoline and others, gasoline and natural gas, gasoline and electric, gasoline and biofuel, and diesel and biofuel. Gasoline is the reported vehicle fuel type for 94 percent of respondents. Only one respondent reported their vehicle utilized natural gas for fuel. The results are presented in Table 51.

Table 51: Vehicle Fuel Type

Fuel Type	Frequency	%
Gasoline	3,564	94.2%
Diesel	179	4.7%
Electric/Electric Battery	57	1.5%
CNG - Natural Gas	1	<1%
Biofuel, Ethanol, Biodiesel	21	<1%
Other (specify)	3	<1%
Don't Know	8	<1%
Refused	25	<1%
Total	**3,784**	**102.00%***

*Total is greater than 100 due to multiple responses allowed.

The distribution of ethnicity reported by respondents is shown in Figure 13. The highest percentage of respondents reported that they were white (84 percent). Just over two percent (2.1) of households reported they were Black or African American. These percentages are reflective of the US Census data for Washoe County.[5]

Figure 13: Ethnicity distribution (Weighted)

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[5] http://www.census.gov/quickfacts/table/PST045215/32031,00
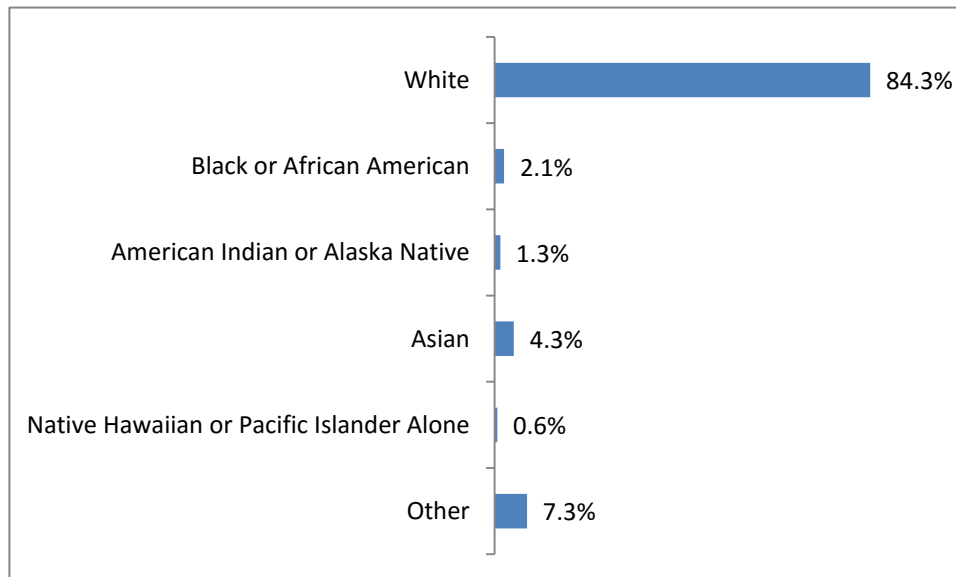
Participation by households reporting their ethnicity as Hispanic was 16.7 percent. This percentage is six percentage points lower than the information found on the US Census website (22.9 percent) for Washoe County.[6] The distribution is shown in Figure 14.

Figure 14: Proportion of Hispanic Household (Weighted)
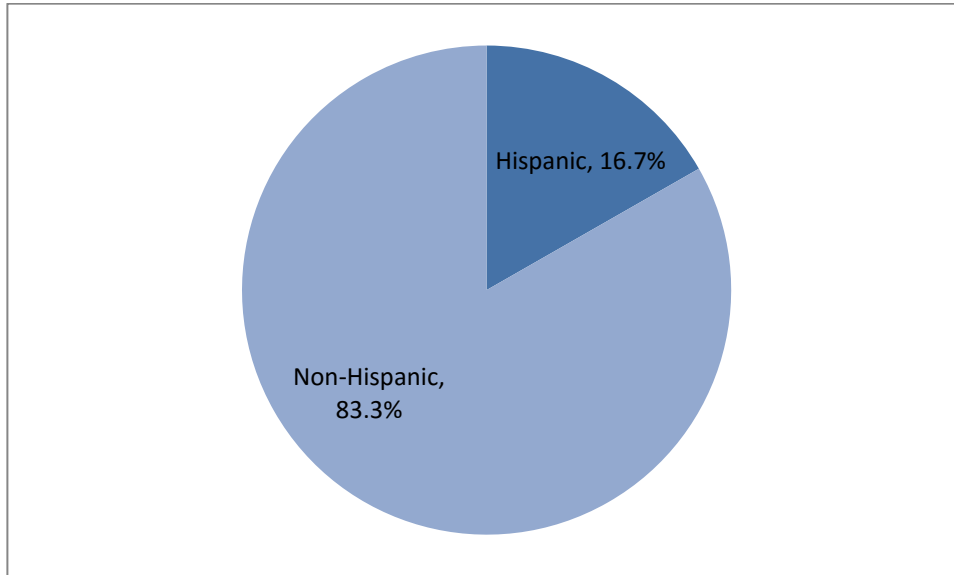
The homeownership rate in Nevada is 54.8 percent.[7] Respondents in the RTC HHTS report a home ownership rate of 76.8 percent, and a rental rate of 22.9 percent.

Figure 15: Ownership of Household Residence (Weighted)

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[6] http://www.census.gov/quickfacts/table/PST045215/32031,00
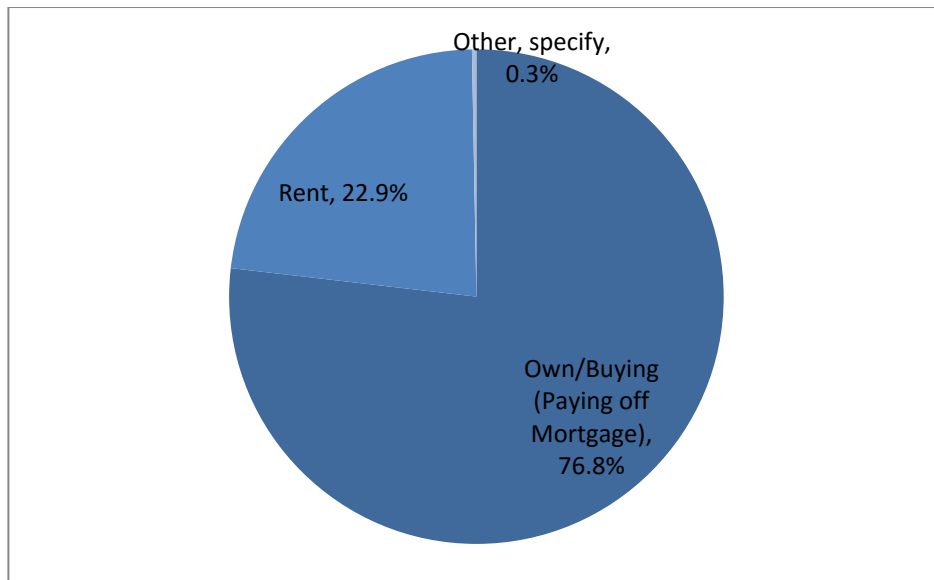
[7] https://research.stlouisfed.org/fred2/series/NVHOWN accessed 6/10/2016

The most recent report available with regard to state level wireless only phone ownership is the National Health Statistic Report, Number 70, issued December 18, 2013. As of December 2012, wireless only phone ownership in the state of Nevada for adults age 18 and up was 38.9 percent.[8] Approximately two percent of the population has no phone at all. Wireless only phone ownership in western United States is estimated to be 46.9 percent as of December 2014.[9] The data collected with regard to landline phone ownership for the RTC HHTS shows that nearly 80 percent of households in the RTC region own landline telephones. The results are presented in Table 52.

Table 52: Landlines in Household (Weighted)

Landlines in Household	Frequency	Percent
Yes	1,697	78.9%
No	453	21.1%
Total	**2,150**	**100.00%**

In looking at household annual income distribution, a total of five percent of households reported income in the range of less than $10,000. The income range of $50,000 to $74,999 is the largest with 17.5 percent of respondents reporting annual income in this range. The smallest percentage of households (1.2 percent) responded their annual income range was $200,000 to $249,000. Household income distribution is illustrated in Figure 16.

Figure 16: Illustrated Household Income* (Weighted)

Income Range	Percent
Less than $10,000	5.0%
$10,000 to $24,999	16.2%
$25,000 to $34,999	12.1%
$35,000 to $49,999	12.0%
$50,000 to $74,999	17.5%
$75,000 to $99,999	14.8%
$100,000 to $149,999	13.7%
$150,000 to $199,999	4.7%
$200,000 to $249,999	1.2%
$250,000 or more	2.7%
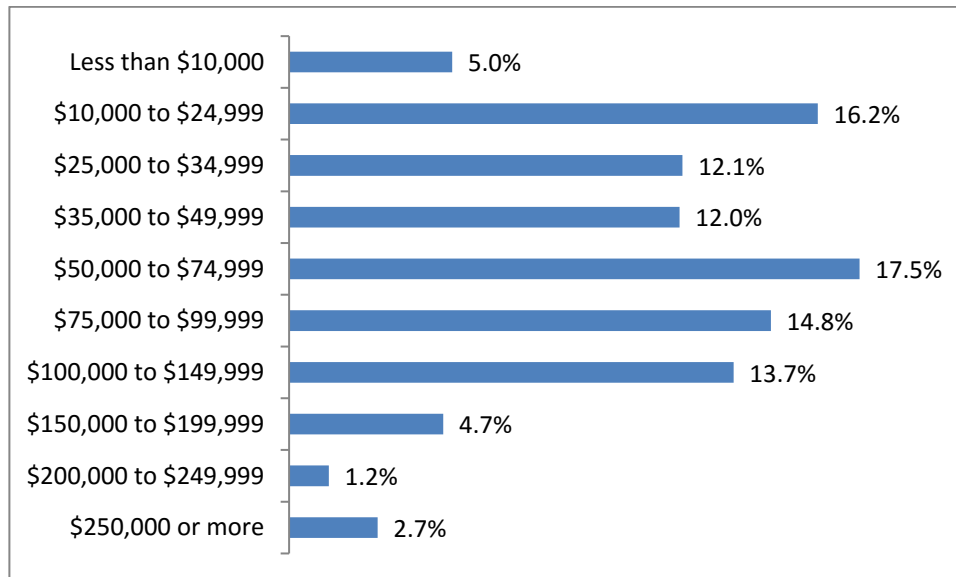
*Income distribution excludes DK/RF

Nearly three-quarters (69.8 percent) of the RTC HHTS households reported having no students. A small percentage (1.4 percent) reported having four or more students in their household. The distribution of the reported number of students by household is shown in Table 53.

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[8] http://www.cdc.gov/nchs/data/nhsr/nhsr070.pdf accessed 6/10/2016

[9] http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201506.pdf accessed 6/10/2016

Table 53: Number of Household Students (Weighted)

Number of Students	Frequency	Percent
No student	1,504	69.8%
1 student	342	15.9%
2 students	201	9.3%
3 students	78	3.6%
4 or more students	30	1.4%
Total	**2,154**	**100.00%**

The percentage of households that reported having one worker was 38.5 percent; 27.5 percent reported two workers; 29.6 percent reported having no workers in the household; and 4.3 percent reported three or more workers in the household.

Figure 17: Number of Household Workers (Weighted)
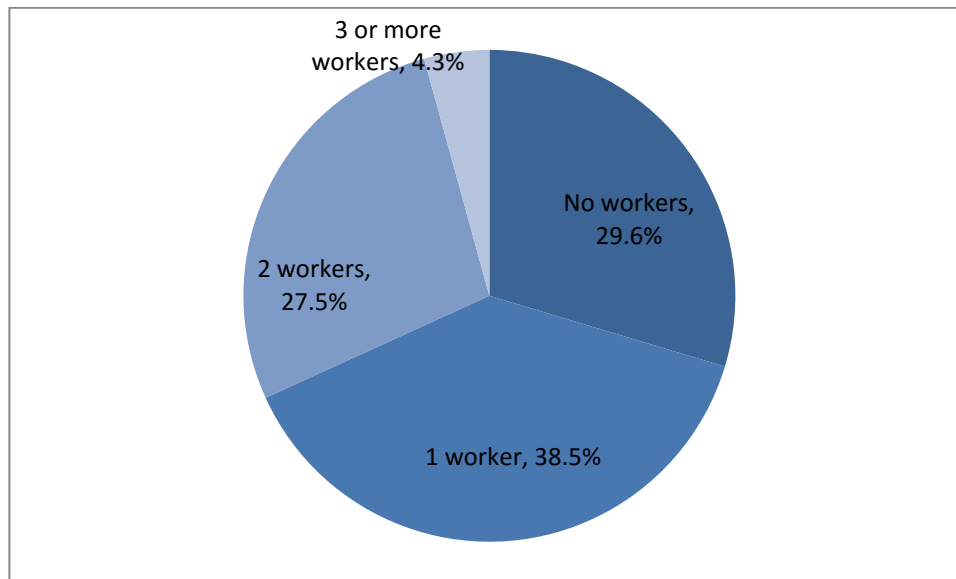
The results of the 2015-2016 study show 52.2 percent of respondents reported they are female, and 47.8 percent reported they are male for a difference of 4.6 percent. Per the US Census website, 50.8 percent of the residents of Washoe County are female.[10]

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[10] http://www.census.gov/quickfacts/table/PST045215/32031,00

Figure 18: Gender Participation (Weighted)

Female, 52.2%   Male, 47.8%
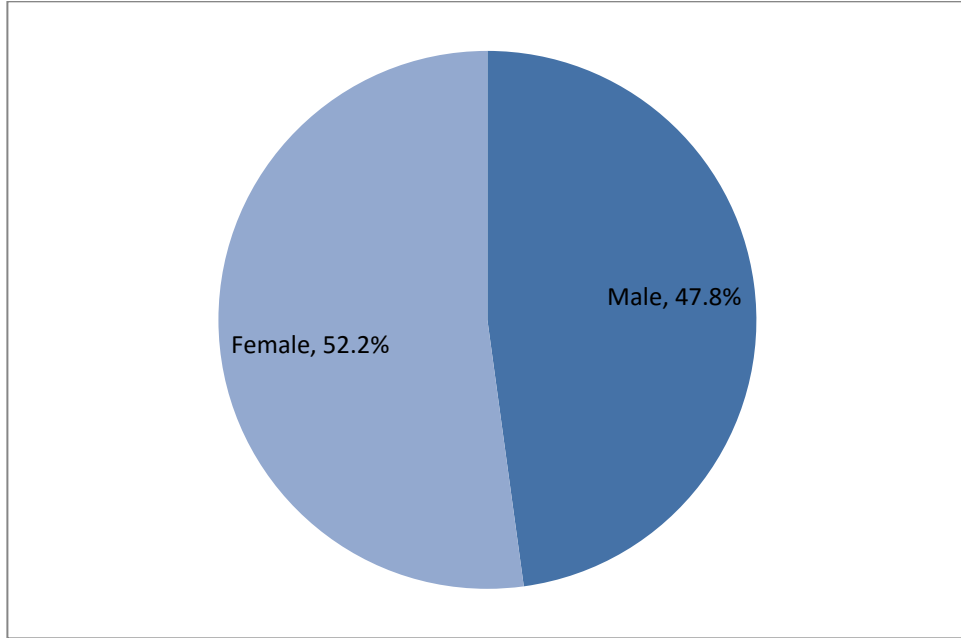
Respondent age was reported by the age distribution shown in Table 54.

Table 54: Respondent Age Distribution (Weighted)

Age Distribution	Frequency	Percent
<20 years old	1,105	24.49%
20-34	866	19.19%
35-54	1,191	26.41%
55 – 64	662	14.68%
65+	687	15.23%
Total	*4,510*	*100.00%*

The disability rate for the 2015-2016 study at eight percent was one percent higher than reported in the 2005 study.

Figure 19: Respondent Disability Status (Weighted)
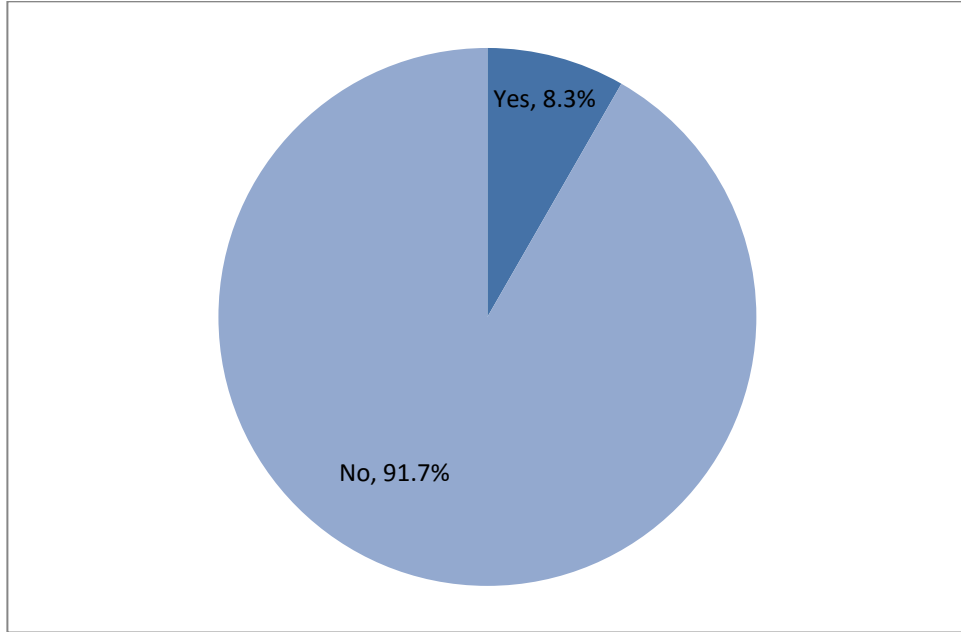
The 2015-2016 RTC HHTS asked respondents to provide their employment status in the capacity of full-time, and/or part-time paid employment. The questionnaire allowed for respondents to enter information about primary and secondary jobs. The results of the employment status question are presented in Figure 20.

Table 55 provides the information on the number of jobs, as reported by respondents. Most of the respondents (94 percent) reported having only one job.

Figure 20: Respondent Employment Status (Weighted)
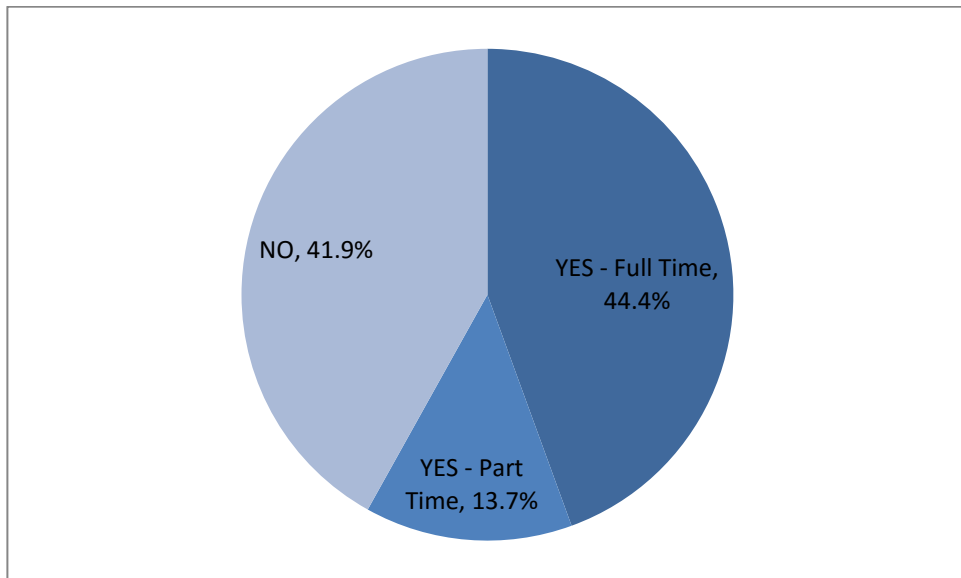
Table 55: Respondent Number of Jobs (Weighted)

Number of Jobs	Frequency	Percent
1	2,016	94.07%
2	110	5.15%
3	17	0.77%
Total	**2,143**	**100.00%**
Average	1.07	

10.2 Travel Behavior

This section presents an analysis of trip rates in relation to the demographic characteristics of the participating households. The analysis results in this section are adjusted with the GPS factors. The GPS factor is discussed later in the report to account for under-reported trips.

For households of four or more people with at least 1 worker, the average trip rate is highest among all respondents with 16.33 trips per household. Overall, the average trip rate of 16.17 was reported by households with four or more household members. Single person households with no workers reported the fewest trips (2.18 average).

The results of average trip rate by household size and employment status is presented in Table 56.

Table 56: Average Household Trips by Household Size and Employment Status [Weighted and GPS factored]

	Average Trips		
Household Size	**At Least 1 Worker Household**	**Non -Worker Household**	**Total**
1-Person	4.04	2.18	3.05
2-Persons	6.34	4.10	5.64
3--Persons	9.23	8.22	9.14
4 or more Persons	16.33	12.15	16.17
Total	8.98	3.40	7.32

For the 2015-2016 RTC HHTS, the overall average trip rate is highest among four or more person households. Large households with one household vehicle show the highest trip rate of nearly 21 trips on average. The lowest trip rate (2.14 average) was found in single person households, with no household vehicle.

Table 57: Average Household Trips by Household Size and Number of Household Vehicles [Weighted and GPS factored]

	Average Trips				
Household Vehicles	**1 – Person Household**	**2 - Persons Household**	**3- Persons Household**	**4 or More Persons Household**	**Total**
No Vehicle	2.14	5.64	13.48	8.95	3.77
1 – Vehicle	3.11	5.68	9.62	20.92	4.99
2 – Vehicles	3.93	5.61	9.36	17.84	8.89
3 or more Vehicles	3.07	5.69	8.55	14.02	9.56
Total	3.05	5.64	9.14	16.17	7.32

As has been the trend for the RTC HHTS, four or more person households report the highest average trip rate among all household size and household income strata. The highest average trip rate (18.2) was reported by households of four or more persons with a household income of $50,000 to $74,999. The next highest average trip rate (17.9) was found in households of four or more persons reporting an income of $100,000 or more.

Table 58: Average Household Trips by Household Size and Household Income [Weighted and GPS factored]

	Average Trips				
Household Income	**1 – Person Household**	**2 - Persons Household**	**3- Persons Household**	**4 or more Persons Household**	**Total**
Less than $25,000	2.59	5.13	12.41	14.05	4.87
$25,000 to $49,999	3.45	5.36	9.95	14.58	6.50
$50,000 to $74,999	4.19	6.49	9.28	18.20	8.93
$75,000 to $99,999	3.59	5.63	7.23	14.03	7.65
$100,000 or more	3.30	6.20	9.45	17.93	10.44
Don't know/refused	1.94	4.41	5.83	13.16	4.65
Total	3.05	5.64	9.14	16.17	7.32

Average trip rates by age group, gender, and age and gender, are presented in Table 59, Table 60, and Table 61.

Table 59: Average Trips per Person by Age Group [Weighted]

Age	**Person**	**Trip Count**	**Trip Rate**
<25 years old	1,336	4,151	3.11
25-34	634	2,097	3.31
35-54	1,191	5,000	4.20
55-64	662	2,398	3.62

Age	Person	Trip Count	Trip Rate
65 or older	687	1,872	2.73
Don't know/refused	85	258	3.04
Total	4,595	15,776	3.43

Table 60: Average Trips per Person by Gender [Weighted]

Age	Person	Trip Count	Trip Rate
Male	2,180	7,384	3.39
Female	2,378	8,214	3.45
DK/RF	37	178	4.82
Total	4,595	15,776	3.43

Table 61: Average Trips per Person by Age and Gender [Weighted]

Gender	Age	Person	Trip Count	Trip Rate
Male	<25 years old	657	2,028	3.09
	25-34	294	898	3.05
	35-54	580	2,376	4.10
	55-64	306	1,133	3.70
	65 or older	316	869	2.75
	Don't know/refused	27	80	2.94
	Total	2,180	7,384	3.39
Female	<25 years old	661	2,038	3.08
	25-34	340	1,200	3.53
	35-54	607	2,575	4.24
	55-64	356	1,265	3.56
	65 or older	371	1,003	2.71
	Don't know/refused	43	134	3.13
	Total	2,378	8,214	3.45
Gender Refused	<25 years old	18	85	4.65
	25-34	0	0	-
	35-54	4	49	12.94
	55-64	0	0	-
	65 or older	0	0	-
	Don't know/refused	15	44	2.98
	Total	37	178	4.82

10.3 Trip Characteristics

This section presents the characteristics of the trips themselves. Specific data elements collected were: main purpose of travel (activity); mode of travel; and travel times.

Respondents were asked to record the activity they participated in at each trip destination. Aside from activities at home/work/school that initiated the trips, routine shopping (8.6 percent), pick up/drop off passengers (8.1 percent), social/visit friends/relatives (4 percent), and eat meal restaurant/diner (3.8 percent) were the main other activities performed. Trip distribution by activity is shown in Table 62.

Table 62: Trip Distribution by Activity [weighted]

Activity	Trip Counts	Percent
At Home		
Personal activities (sleeping, personal care, leisure, chores, etc.)	4,401	27.9%
Preparing meals / eating	405	2.6%
Hosting visitors / entertaining guests	17	.1%
Exercise (with or without equipment) / playing sports	25	.2%
Study / schoolwork	105	.7%
Work for pay at home using telecommunications equipment	63	.4%
Using computer / telephone / cell or smartphone or other communications device for personal activities	116	.7%
All other activities at home	381	2.4%
At Work		
Work / job duties	1,927	12.2%
Training	24	.2%
Meals at work	15	.1%
Work sponsored social activities (holiday or birthday celebrations, etc.)	4	.0%
Non-work related activities (social clubs, etc.)	16	.1%
Exercise / sports	11	.1%
Volunteer work / activities	78	.5%
All other work-related activities	85	.5%
At School		
In School / classroom / laboratory	973	6.2%
Meals at school / college	3	.0%
After school or non-class-related sports / physical activity	50	.3%
All other after-school or non-class-related activities (library, band rehearsal, clubs, etc.)	77	.5%
Quick Stops / Trips		
Change of transportation / transfer	385	2.4%
Pickup / drop off passenger(s)	1,271	8.1%
Drive-through meals (snacks, coffee, etc.)	228	1.4%
Drive-through other (ATM, bank, etc.)	153	1.0%
At Other Places		
Work related (meeting, sales call, delivery)	197	1.2%
Service private vehicle (gas, oil, lube, repairs)	226	1.4%
Routine shopping (groceries, clothing, convenience store, household maintenance)	1,363	8.6%
Shopping for major purchases or specialty items (appliances, electronics, new vehicle, major	278	1.8%

Activity	Trip Counts	Percent
household repairs)		
Household errands (bank, dry cleaning, etc.)	129	.8%
Personal business (visit government office, attorney, accountant)	224	1.4%
Eat meal at restaurant / diner	596	3.8%
Health care (doctor, dentist, eye care, chiropractor, veterinarian)	437	2.8%
Civic/religious activities	169	1.1%
Outdoor exercise (sports, jogging, bicycling, walking, walking dog, etc.)	238	1.5%
Indoor exercise (gym, yoga, etc.)	246	1.6%
Entertainment (movies, watch sports, etc.)	231	1.5%
Social / visit friends / relatives	630	4.0%
Total	15,776	100.0%

10.3.1 Mode Choice

For each trip, respondents were asked to provide the mode of travel they used. The distribution of trips by mode collected from the survey is shown in Table 63. The most popular travel mode choice was Auto / Van / Truck Driver with 66.8 percent of trips made using this mode. The next most popular mode was Auto / Van / Truck Passenger with 19.5 percent of trips being made using this mode.

Table 63: Trip Distribution by Travel Mode [weighted and GPS factored]

Mode	Frequency	Percent
Walk	1,049	6.5%
Bike	178	1.1%
Wheelchair / Mobility Scooter	4	.0%
Other Non-Motorized (skateboard, etc.)	19	.1%
Auto / Van / Truck Driver	10,252	66.8%
Auto / Van / Truck Passenger	3,268	19.5%
Carpool / Vanpool (RTC Trip Match)	52	.4%
Motorcycle / Scooter / Moped	31	.2%
Taxi / Hired Car / Limo	11	.1%
Rental Car / Vehicle	88	.5%
Private Shuttle (Employer, Hotel, etc.)	22	.1%
Airplane	19	.1%
Other Private Transit	24	.1%
RTC Transit	363	2.14%
RTC Access (paratransit services)	21	.1%
RTC Vanpool	0	0.00%
Amtrak	0	0.00%
School Bus	363	2.1%
Other Bus	11	.1%
Total	15,776	100.0%

The results were distributed amongst four mode choices (Private Vehicle, Public Transit, Non-Motorized, and Other) as presented in Table 64.

Table 64: Mode Choice Comparison

Mode	2015-2016 Mode Share
Non-Motorized Travel – walk, bike, wheelchair, other	8.1%
Private Vehicle – driver, passenger, carpool, motorcycle	86.0%
Other - taxi, rental, private shuttle, greyhound, airplane	1.0 %
Public transit	4.9%
Total	**100%**

Trip duration varied by mode. Overall, the average trip duration was 14.4 minutes, with Other Non-Motorized trips being shortest taking 8.4 minutes on average. Greyhound Bus trips took the longest at 54 minutes. Figure 21 presents the results for average trip duration by mode and is based on the unlinked trips.

Figure 21: Average Travel Duration by Mode
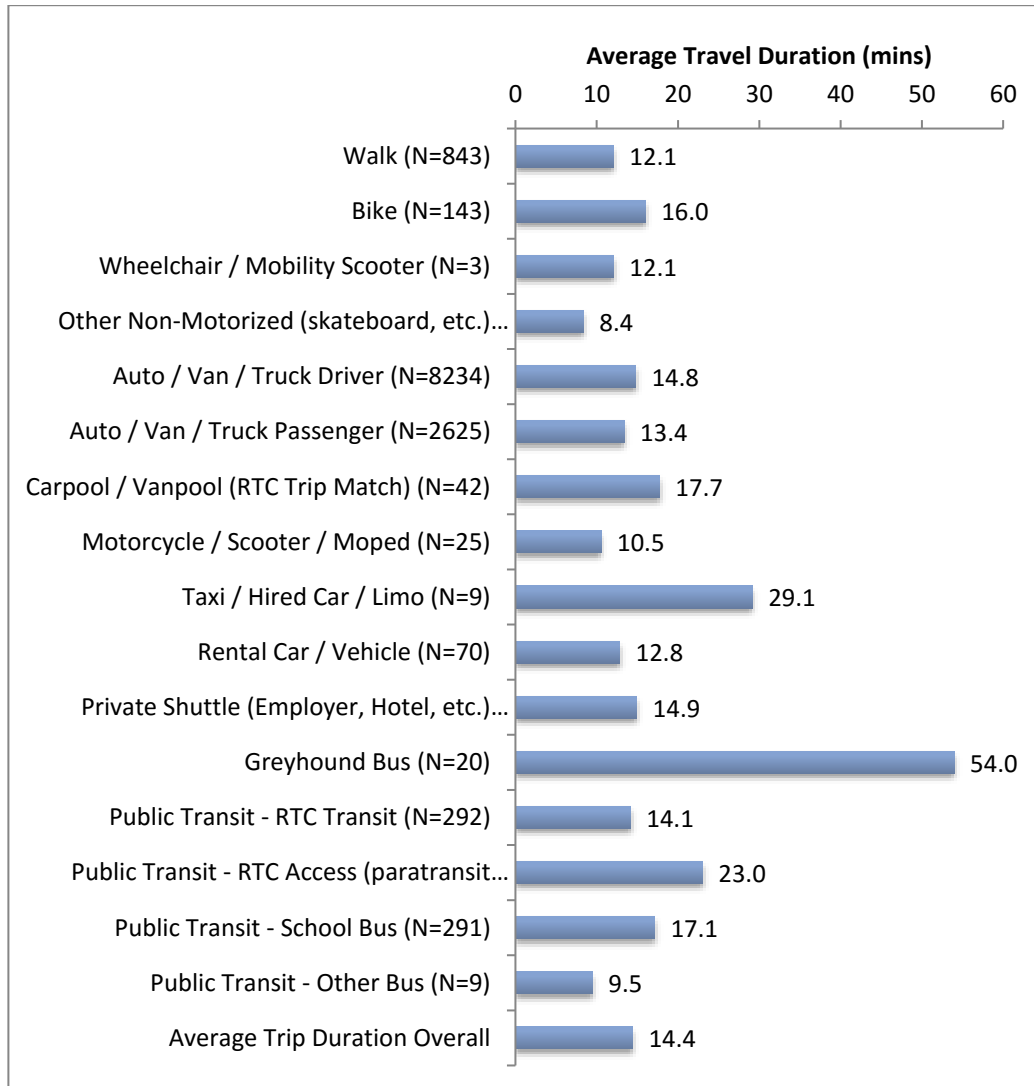
Looking at travel distance by travel mode in Figure 22, Wheelchair/mobility scooter trips were the shortest with the average trip length of 0.3 miles. The longest trips were made by Taxi/hired car/limo trips showing an average of 16.2 miles.

The average travel distance overall for the 2015-2016 survey was seven miles.

Figure 22: Average Travel Distance by Mode
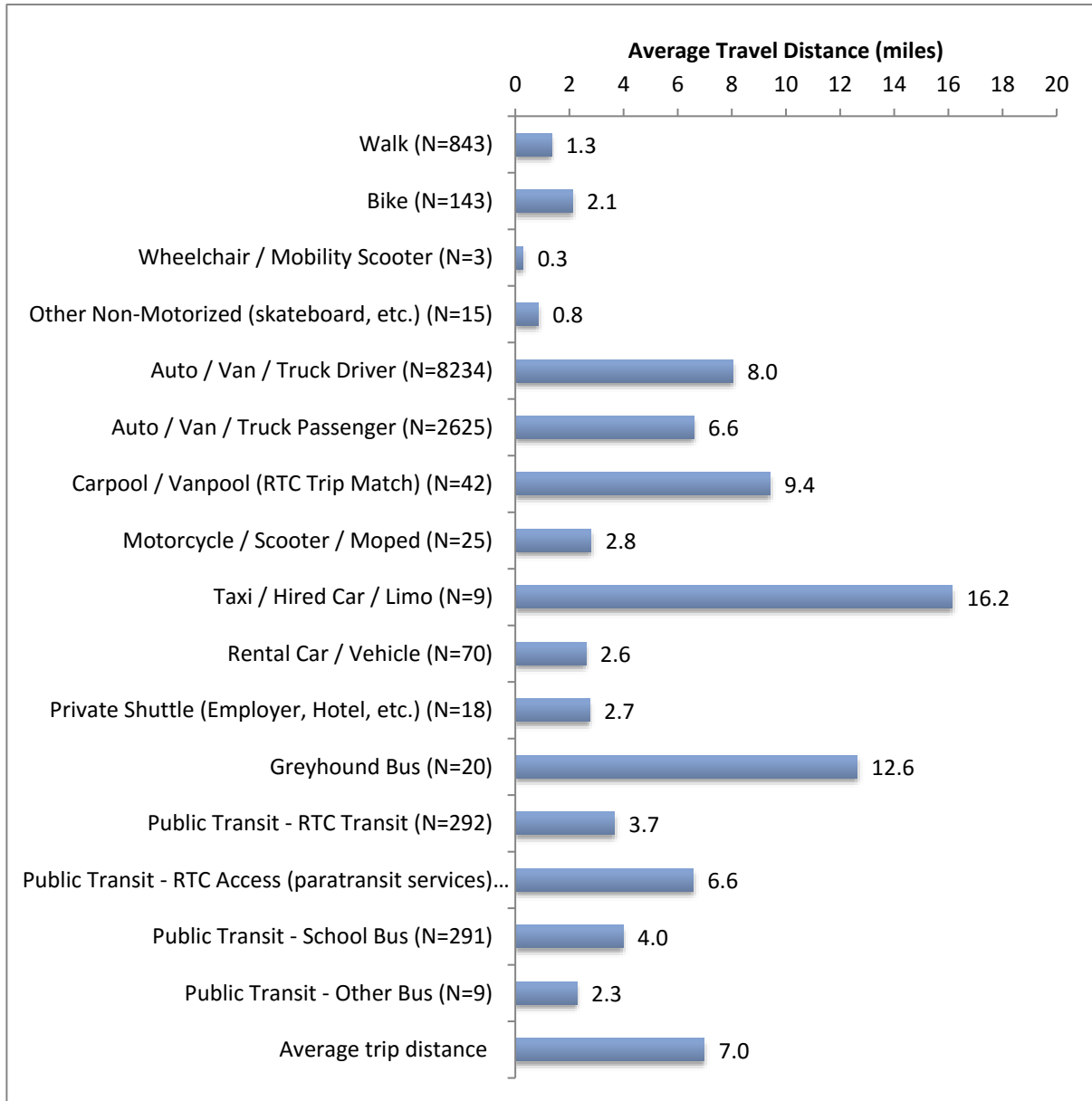
10.3.2 Travel Times

Departure times can be grouped into time slots, representing travel in the morning peak (6 a.m. to 9:59 a.m.), midday (10 a.m. to 2:59 p.m.), afternoon peak (3 p.m. to 7:59 p.m.), and night and early morning (8 p.m. to 5:59 a.m.). Figure 23 shows the distribution of trips based on these travel time categories. Slightly more than one third of all travel (36.5 percent) occurred during the afternoon peak, while 26.3 percent of all travel occurred during the morning peak, and nearly one third during the midday peak.

Figure 23: Trip Distribution by Time of Day Based on Departure Hour
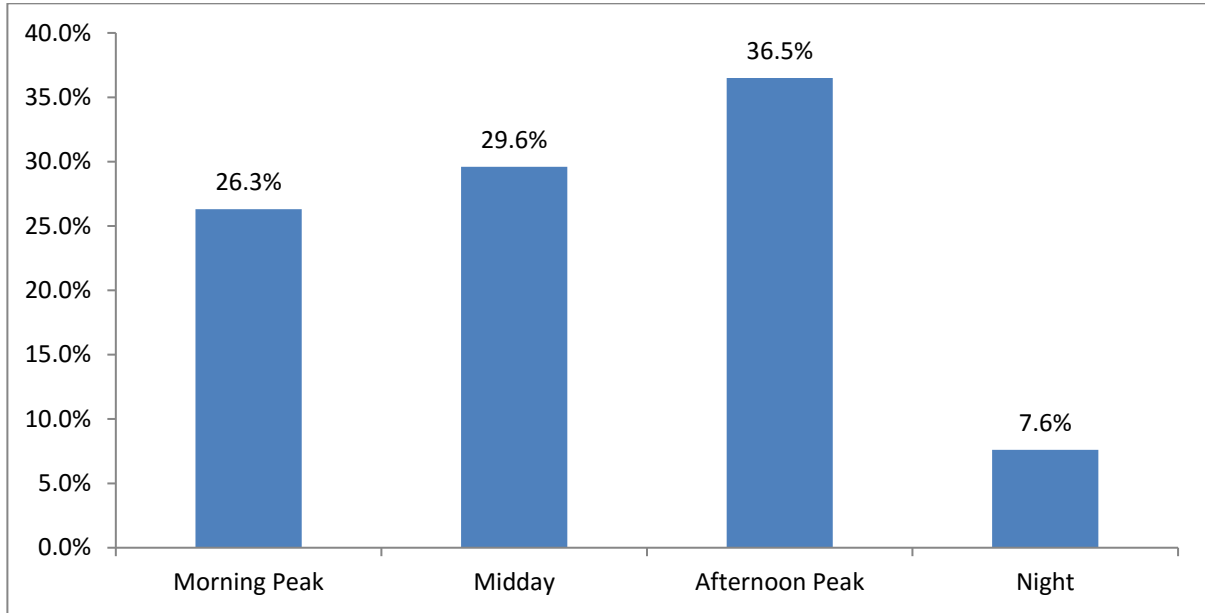
In examining hourly trip distribution, the highest peak hours of travel were 2 p.m. to 6 p.m. The hour between 3 p.m. and 4 p.m. shows the highest percentage of all trips with 9.2 percent of trips reported as falling in that time frame. These results are shown in Figure 24 utilizing a 24 hour time scale.

Figure 24: Hourly Trip Distribution by Departure Hours
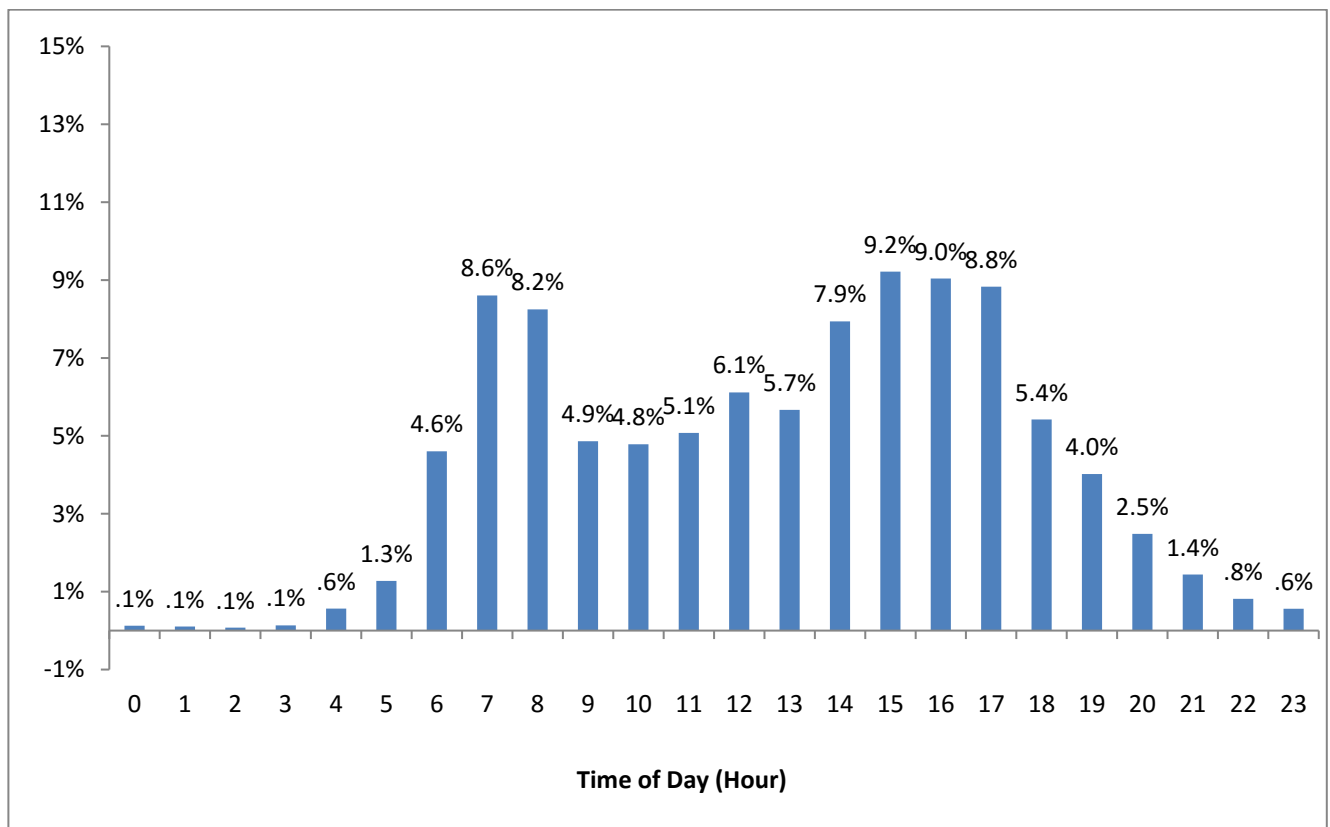
10.4 Activity-Based Survey Results

One activity was collected for each place visited. The number of activities by home, school, work and other are presented in Table 65.

Table 65: Number of Activities by Place Type (Home, Work, School, and Other)

Place Type	Counts	Percentages
Home	5,513	34.9%
Work	2,160	13.7%
School	1,104	7.0%
Other	7,000	44.4%
Total	15,776	100.0%

The average travel duration reported for the Training category was 56.62 minutes, which was the longest travel duration. Respondents reported 24.29 minutes average travel duration for the "Meals at work" category, which was the second longest travel duration. Overall, the average travel duration was 14.44 minutes. Table 66 presents the average travel duration by activity excluding airplane mode travel.

Table 66: Average Travel Duration by Activity [Weighted]

Activity at Visited Place	Mean	N
Personal activities (sleeping, personal care, leisure, chores)	14.20	4,400
Preparing meals/eating	13.38	405
Hosting visitors/entertaining guests	21.56	17
Exercise (with or without equipment)/playing sports	9.15	25
Study / schoolwork	13.59	105
Work for pay at home using telecommunications equipment	12.48	63
Using computer/telephone/cell or smart phone or other communications device for personal activities	12.94	116
All other activities at my home	13.65	381
Work/job duties	16.42	1,927
Training	56.62	24
Meals at work	24.29	15
Work-sponsored social activities (holiday or birthday celebrations, etc.)	16.65	4
Non-work related activities (social clubs, etc.)	11.69	16
Exercise/sports	12.40	11
Volunteer work/activities	9.56	78

Activity at Visited Place	Mean	N
All other work-related activities at my work	12.63	85
In school/classroom/laboratory	12.71	973
Meals at school/college	10.00	3
After school or non-class-related sports/physical activity	9.90	50
All other after school or non-class related activities (library, band rehearsal, clubs, etc.)	13.42	77
Change type of transportation/transfer (walk to bus, walk to/from parked car)	13.97	382
Pickup/drop off passenger(s)	15.23	1,271
Drive through meals (snacks, coffee, etc.)	13.27	228
Drive through other (ATM, bank)	12.31	153
Work-related (meeting, sales call, delivery)	14.40	195
Service private vehicle (gas, oil, lube, repairs)	14.44	226
Routine shopping (groceries, clothing, convenience store, hh maintenance)	14.55	1,363
Shopping for major purchases or specialty items (appliance, electronics, new vehicle, major hh repairs)	14.32	278
Household errands (bank, dry cleaning, etc.)	13.41	129
Personal business (visit government office, attorney, accountant)	14.04	224
Eat meal at restaurant/diner	12.80	596
Health care (doctor, dentist, eye care, chiropractor, veterinarian)	16.33	437
Civic/religious activities	10.03	169
Outdoor exercise (playing sports/jogging, bicycling, walking, walking the dog, etc.)	13.10	238
Indoor exercise (gym, yoga, etc.)	10.95	246
Entertainment (movies, watch sports, etc.)	22.17	231
Social/visit friends/relatives	14.29	617
Total	14.44	15,757

*Trips by airplane mode excluded

11.0 Limitations of the Survey

As with every survey and the resulting dataset and findings, the RTC HHTS experienced a few limitations. Each limitation is described in the following sections, and is presented in no particular order.

Sample Performance

When preparing a sampling plan, certain assumptions are made based on prior experience. For the RTC HHTS, the estimated overall recruitment response rate was six percent. The actual overall recruitment response rate for the RTC HHTS overall was four percent (see Table 41). When looking at the type of sample and its performance, matched address-based sample, matched cell sample, and the listed RDD sampling frame performed at or near the expected six percent response rate, while all others fell below the six percent expected response rate.

For retrieval, typically 65 to 67 percent of the recruited households will complete the retrieval questionnaire and report their travel. Overall, only 64 percent of recruited households for the RTC HHTS completed retrieval. This is significant because a large amount of effort is invested in recruiting households, shipping retrieval materials, and making repeated attempts to collect travel data. In addition to telephone calls, reminders were sent via email and text message on a weekly basis to households prompting them to report travel information.

The fact that both recruitment and retrieval failed to meet the expected goals impacted negatively on the budget and schedule, ultimately creating a shortfall in completed households.

Underrepresentation of Smartphone GPS Households

The sampling plan for the RTC HHTS had targeted an even split of GPS technologies with 50 percent of the GPS households utilizing GPS data loggers and the remaining 50 percent utilizing RouteScout (RS) to collect GPS data points over a seven day assigned travel period. The inequity of the split was monitored throughout data collection, with attempts to balance it made on several occasions. When the inequality was first identified, a portion of the sample flagged for GPS data logger was reflagged as RS in attempt to balance the two groups more equally. This method of reflagging a portion of the GPS data logger sample was repeated on a few occasions during data collection. The refusal rate of RS selected households was particularly high, and an evaluation was performed of the reasons for refusal. The primary explanation given by selected households for refusing to participate using the smartphone technology was they were concerned that downloading the smartphone app would provide a two-way portal to the personal data stored on their smartphones. The technology is too new for participants to research to find out that this is not possible with the app used for this particular study. The secondary explanation provided was that household members age 12 and up did not all own smartphones, therefore the entire household was not able to participate utilizing the smartphone technology. At the end of data collection, recruitment of households utilizing GPS data loggers was 16 percent greater than that of RS households; and retrieval showed an even greater gap with 36 percent more GPS data logger households completing retrieval.

Improving the communication about how the smartphone technology works is warranted for future studies in which this GPS technology will be used. Smartphone GPS technology is considered one of the most promising innovations for use in HHTS. The expectation is that more information about the limits of the research firm's ability to access participants' smartphones will be more accessible to the general public and will alleviate this fear.

12.0 Recommendations for Future Survey Improvement

Several recommendations are made with regard specifically to the retrieval module. For this survey, we utilized NuTripX, a proprietary real-time geocoding program built by NuStats. The suggestions included in the bullet-points below also include the reason for the modification when further clarification is needed.

- Embed NTX as a seamless transition from Voxco, and back again to reduce partial completes.
  - Respondents that self-reported had difficulty returning to Voxco after completing the travel information entry in NTX. NuStats assumes the respondents didn't understand they needed to return to Voxco to finish the survey. Our team is working on embedding the NTX survey questions in the Voxco survey in a way that will make it seamless for the respondents to transition from Voxco to NTX and back to Voxco.
- Modify instructions to make them more user friendly for less tech-savvy people.
  - A small percentage of respondents required assistance with completing the NTX portion of their surveys. Our team is working to develop more clearly defined instructions that should help those having difficulty navigating NTX to be able to do so without assistance.
- Enable respondents to plot Home/School/Work as available per household member prior to beginning the mapping portion, which would make the information available to reference during the travel data collection.
- Add the ability to move waypoints after they are plotted.
  - This is helpful when utilizing cross streets and verifying locations with respondents.
- Display trip lines from location to location.
  - This provides a visual for respondents to see their route.
- Add ability to correct the time without deleting the location.
  - Currently NTX does not allow a change in the time entered after location is entered and requires the location be removed and re-entered to modify the time.
- Allow one person to enter travel data for household members that traveled together, rather than on an individual basis.
  - Currently, the NTX program only allows completion of travel information on an individual basis. Our programming team is working to change this to allow travel to be entered for multiple household members for the occasions they travel together. This will reduce respondent burden.
- Allow entry of up to 3 activities at each stop; this matches the diary.
- Include an automatic QC check for trip duration and length so that it does not need to be done in post-processing and can be fixed by the respondent when an unrealistic speed is found.
- Modify screenflow to enter locations and answer location questions place by place to improve user experience and reduce error.
- Add question "Did you park a car?"
  - The questionnaire did not include this question, but asked several parking questions. By adding "Did you park a car?" to the retrieval questionnaire, respondents that answered "no" to this question would automatically skip all related parking questions.

The main survey was conducted in Spanish which involved translating all of the survey printed materials (diary and GPS) as well as the cover letters and CATI and online scripts into Spanish. Only 28 households requested at the end of the recruitment interview to receive the Spanish version of the survey package. This is less than one percent of the recruited households, and indicates that the majority of Hispanic households in the RTC HHTS preferred the English versions. For future surveys, it is recommended that bi-lingual interviewers be available to assist participants requiring the Spanish version of the survey. This will save the cost of printing materials, and programming the surveys in Spanish, but will still serve to collect data from Spanish speaking households.

Appendix A – Examples of the Notification Postcards

The images in Figure 25 are of the notification postcards that were sent to Non-GPS, RouteScout, and GPS households.

Figure 25: Notification GPS and Non-GPS Postcards

RTC Regional Household Travel
Survey c/o NuStats
4115 Freidrich Lane, Suite 200
Austin, TX 78744

Survey Conducted on behalf of:
RTC — Regional Transportation Commission
1105 Terminal Way Suite 211 | Reno, NV 89502
Tel: 775-332-9521

Your input is needed!

Earn $25

«RFNAM» «RLNAM»
«HADDR» «HSUIT»
«HCITY», «HSTAT» «HZIP»

Recruitment closes January 19, 2016. Enroll today!

Si desea esta información en español por favor llame a NuStats usando el número gratuito 1-877-221-7828.

Your input is appreciated!

Your household has been selected to utilize GPS technology to participate in the RTC Regional Household Travel Survey. This survey will collect data about where families go and how they get there. The RTC will use the information to plan projects such as new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads that enhance quality of life in the Truckee Meadows.

Go to www.RTCSurvey.com; Click "Start Survey" and enter PIN: «PINNO» OR scan and start survey

We are offering households that are selected to use GPS technology $25 per device once we receive travel information for all household members!

Your privacy is critical to the survey. Information will not be shared. Please provide candid responses to survey questions. All information provided will be held in strict confidence.

«SAMPN» «REP»

Questions? Call NuStats survey research firm, toll-free at 1-877-221-7828

RTC Regional Household Travel
Survey c/o NuStats
4115 Freidrich Lane, Suite 200
Austin, TX 78744

Survey Conducted on behalf of:
RTC — Regional Transportation Commission
1105 Terminal Way Suite 211 | Reno, NV 89502
Tel: 775-332-9521

You can make a difference!

Earn $25

«RFNAM» «RLNAM»
«HADDR» «HSUIT»
«HCITY», «HSTAT» «HZIP»

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Si desea esta información en español por favor llame a NuStats usando el número gratuito 1-877-221-7828.

Your input is appreciated!

Your household has been selected to participate in the RTC Regional Household Travel Survey. This survey will collect data about where families go and how they get there. The RTC will use the information to plan projects such as new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads that enhance quality of life in the Truckee Meadows.

Go to www.RTCSurvey.com; Click "Start Survey" and enter PIN: «PINNO» OR scan and start survey

If you complete both Step 1 (enroll in the survey) AND Step 2 (report travel) ONLINE AND your entire household reports complete travel information in Step 2, you earn a $25 Amazon gift card!

Your privacy is critical to the survey. Information will not be shared. Please provide candid responses to survey questions. All information provided will be held in strict confidence.

«SAMPN» «REP»

Questions? Call NuStats survey research firm, toll-free at 1-877-221-7828

Appendix B - CATI and Web Recruitment Script

NOTE: Capital letters indicate [Do not read]

INT01.

Hi - my name is _____ and I'm calling on behalf of Regional Transportation Commission, the metropolitan planning organization in Washoe County.

Am I speaking to an adult head of the household (or someone age 18 or older)?

We're interviewing families about their daily travel. This study will benefit your community by providing information about residents travel patterns for transportation planning and identification of transportation improvements.

IF NEEDED: The survey will take an average of 15-20 minutes.

IF REFUSING: We really need your help to identify ways of improving local transportation.

PRIVACY CONCERN: All the information that you provide will be held in strict confidence and will be used only to benefit your community.

       CONTINUE
       WILL COMPLETE ONLINE
       CALLBACK, GENERAL
       CALLBACK, SPECIFIC
       CALLBACK ON LANDLINE
       NEW NUMBER
       NO ANSWER
       ANSWERING MACHINE
       LEFT MESSAGE
       BUSY
       CALLER ID
       SPANISH CALLBACK, GENERAL
       SPANISH CALLBACK, SPECIFIC
       SPANISH NO ANSWER
       SPANISH ANSWERING MACHINE
       SPANISH BUSY
       BUSINESS/GOVERNMENT
       LANGUAGE BARRIER (OTHER), DEAF/TTY
       LANGUAGE BARRIER, ASIAN LANGUAGE
       LANGUAGE BARRIER, OTHER LANGUAGE
       DISCONNECT
       FAX/MODEM
       HANG UP
       1ST REFUSAL
       FINAL REFUSAL
       REFUSES TO CONTINUE ON CELL-PHONE

CKFIP. Do you live in Washoe County?

       1. YES

2. NO

8. DK

9. RF

IF NEEDED: We ask for this information because we want to make sure that households from across the Reno/Sparks region participate in the survey. We certainly understand your reluctance to provide this information, but you can be assured that your information will be held in the strictest of confidence and used for transportation planning purposes only. If you do not feel comfortable providing your county of residence, we will have to end the survey.

[IF CKFIP=2]

Moved out of Study Area

INT09. Thank you for your time, but we are only attempting to survey households who currently live in the Washoe County. Have a nice day.

QM. MOVED OUT OF WASHOE COUNTY

[IF CKFIP=1]

PREVIEW.   The study is purely a research effort, and your answers will be completely confidential. For the first part of the study, we ask some questions about your household. These questions are important in making sure that everyone in Washoe County is properly represented in the study.

For the second part of this study, we're asking households to record their travel for a 24-hour period. The travel details help us to understand how and when people travel. We will send you logs to use to record your trip information.

In order to prepare those logs, I need to get some information about each person in your household.

Again, I want to assure you that this information is for research purposes only and will be held in strict confidence. This phone call should take between 15 and 30 minutes.

FOR WEB RECRUITMENT ONLY

To thank you for participating in this important survey, your household will receive an Amazon gift card as long as all household members fully complete Step 1 (this survey) AND Step 2 (report travel) online.

1. CONTINUE

CADDR. Before we get started, please verify your address is still

STREET:

SUITE/APT #:

CITY:

STATE:

ZIP:

YES, THIS IS MY ADDRESS

NO, THIS IS NOT MY CURRENT ADDRESS

IF NEEDED: We ask for this information because we want to make sure that households from across the Reno/Sparks region participate in the survey. We certainly understand your reluctance to provide this information, but you can be assured that your information will be held in the strictest of confidence and used for transportation planning purposes only. If you do not feel comfortable providing your address, we will have to end the survey.

[IF NO]

What is your current physical address?

NO P.O. BOXES ALLOWED

Street Address:

Suite/Apt #:

City:

State:

Zip Code:

[IF YES]

HHSIZ. Before we begin the survey, we would like to ask you some general information about your household. This information will help us make sure we include all types of households in the county.

How many people, including yourself, live in your home?

IF NEEDED: This information will help us to be sure that we include all types of households in your area. We understand your concerns regarding this question, but this information helps transportation planners understand the relationship between the number of people in a household and the number of trips they make. Without this information, your household will not be eligible to participate in this survey.

INCLUDE: FOSTER CHILDREN, ROOMMATES, HOUSEMATES, AND PEOPLE LIVING HERE MOST OF THE TIME WHILE WORKING, EVEN IF THEY HAVE ANOTHER PLACE TO LIVE.

DO NOT INCLUDE: COLLEGE STUDENTS LIVING AWAY WHILE ATTENDING COLLEGE OR PEOPLE WHO LIVE AT ANOTHER PLACE MOST OF THE TIME.

> 98. DK
> 99. RF

HHWRK.   And of these, how many are employed full-time or part-time in paid working positions?

> 98. DK
> 99. RF

RIBUS. Do you or any members of your household use transit at least once a week?

> 1. YES
> 2. NO
> 9. DK
> 8. RF

HHVEH. How many motor vehicles are owned, leased, or available for regular use by the people who currently live in your household? Please be sure to include motorcycles, mopeds, and RVs.

> [Range 0-99]
> 98. DK
> 99. RF

VEHOP. How many of these vehicles are operational and used regularly during the week?

> [Range 0-99]
> 98. DK
> 99. RF

HHBIC. And how many bicycles in working condition are available to people in your household?

> 98. DK
> 99. RF

INT10. Thank you.

We asked these questions to help us to make sure we are talking with all types of households.

An important part of this study is to understand why, when, and where people travel in Washoe County.

To do this, we're asking households to write down their travel for a 24-hour period.

If you could help us with this study, we'll ask you some more questions about your household today.

Then we'll ask for some details about each person in your household so we can print a personal travel diary for each person.

We will mail the diaries to you so everyone can record where they went and how they got there for the assigned travel period.

Everything asked will be used for travel, fuel use and air quality research purposes only and will be held in strict confidence.

IF REFUSED: We are sorry that you are not able to continue with the survey. Your participation is very important to improving transportation planning in your area.

Thanks very much for your time.

> OK. CONTINUE
>
> R2. REFUSED (ADD INT)

CARS.   Now I'd like to get some information about each of your [two] operational vehicles.

Let's start with the vehicle that you drive the most.

> 1. CONTINUE

START VEHICLE ROSTER

YEAR.   What is the year of vehicle [number one], the one that is driven the most?

ENTER YEAR OF VEHICLE:

NOTE: FOUR DIGITS FOR YEAR

> 9998. DK
>
> 9999. RF

VEHICLE 01

MAKEX. What is the make or manufacturer of this vehicle?

(e.g. Honda)

[Options will show from the scroll-down bar]

VEHICLE 01

MODLX.   What is the model of this vehicle?

[Options will show from the scroll-down bar]

VEHICLE 01

BODY.   What is the body type of this vehicle?

> 01. SEDAN(4-DOOR)
>
> 02. SUV
>
> 03. PICK-UP TRUCK
>
> 04. COUPE(2-DOOR)
>
> 05. CONVERTIBLE
>
> 06. HATCHBACK
>
> 07. WAGON
>
> 08. MINIVAN
>
> 09. VAN
>
> 10. OTHER KIND OF TRUCK
>
> 11. RECREATIONAL VEHICLE
>
> 12. MOTORCYCLE
>
> 13. MOPED/SCOOTER (e.g. VESPA)

97. OTHER, SPECIFY (WATERCRAFT, CROSSOVER, ETC)

98. DK

99. RF

VEHICLE 01

VEHT.   Is this vehicle:

1. Hybrid Vehicle

2. Gasoline Only Vehicle

3. Diesel Only Vehicle

4. Plug In Hybrid Electric Vehicle

5. CNG

6. Electric Only

7. OTHER

VEHICLE 01

FUELT.   What type(s) of fuel does this vehicle use?

READ ALL. SELECT ALL THAT APPLY

1. Gasoline

2. Diesel

3. Electric / Electric Battery

4. CNG - Natural Gas

5. Biofuel, Ethanol, Biodiesel

7. OTHER, SPECIFY

8. DK

9. RF

END OF VEHICLE ROSTER

RESTY.   Which of the following best describes your home?

01. Single family house not attached to any other house

02. Single family house attached to one or more houses (townhouse, duplex, triplex) each with separate entry

03. A mobile home

04. Building with 2-4 apartments/ condos / studios /rooms

05. Building with 5-19 apartments/ condos / studios / rooms

06. Building with 20 or more apartments/ condos / studios / rooms (NOTE TO   INTERVIEWERS: includes dorms, etc.)

07. Boat, RV, Van, etc.

97. OTHER, SPECIFY

98. DK

99. RF

OWN.   Do you own or rent your home?

1. OWN/BUYING

2. RENT

7. OTHER, SPECIFY

8. DK

9. RF

TEN.	How many years have you lived at your current residence?

NOTE: IF LESS THAN 1, ENTER 1

        98. DK

        99. RF

START PERSON ROSTER

PERSON 1

FNAME.	Now we'll ask you to answer a few questions about each household member, including yourself.

Earlier you said there are [two people] in your household.

Let's begin with you.

What is your first name?

PERSON 1

LNAME.	What last name should we use for your household when mailing the materials?

PERSON 1:

GEND.	INTERVIEWER NOTE: BY OBSERVATION

And what is your gender?

        1. MALE

        2. FEMALE

        9. RF

PERSON 1

RELAT.	What is this person's relationship to you?

        01. SELF

        02. SPOUSE/PARTNER

        03. CHILD/DAUGHTER/SON/ADOPTED CHILD/STEPCHILD/SON-IN-LAW/DAUGHTER-IN-LAW

        04. PARENT/PARENT-IN-LAW/STEP-PARENT

        05. BROTHER OR SISTER (STEPBROTHER/STEPSISTER)

        06. GRANDPARENT

        07. GRANDCHILD

        08. OTHER RELATIVE

        09. NO RELATION/HOUSEMATE/ROOMMATE/FOSTER CHILD

        99. RF

PERSON 1:

AGE.	What is your age?

IF A CHILD IS UNDER 1 YEARS OLD THEN ENTER AS 1

IF GREATER THAN 99, ENTER 99

        998. DK

        999. RF

[IF DK/RF]

AGEB: I understand your reluctance to provide your age. However, age is a very important factor. As we age, our travel needs and patterns change dramatically.

Can you tell me if you are between 16 and 75?

1. LESS THAN 16 OR OVER 75

2. BETWEEN 16 AND 75

8. DK

9. RF

PERSON 1:

HISP.   Are you of Hispanic, Latino, or Spanish origin?

      1. YES

      2. NO

      8. DK

      9. RF

PERSON 1:

RACE.   What is your ethnicity?

      01. White

      02. Black or African American

      03. American Indian or Alaska Native

      04. Asian (Asian Indian, Japanese, Chinese, Korean, Filipino, Vietnamese)

      05. Native Hawaiian or Pacific Islander (Guamanian, Samoan, Fijian)

      97. Other (please specify)

      98. DK

      99. RF

LIC: Do you have a valid driver's license?

      1. YES

      2. NO

      8. DK

      9. RF

[IF MORE THAN ONE VEHICLE]

PERSON 1:

USER.   Which vehicle is driven most by you?

      98. DK

      99. RF

PERSON 1:

EMPLY. Are/Is you employed, either full-time or part-time?

      1. YES, FULL TIME

      2. YES, PART TIME

      3. NO

      8. DK

      9. RF

PERSON 1:

JOBS.   How many jobs do you have?

Please include all paid positions that you work on a regular basis.

      98. DK

      99. RF

[IF MORE THAN ONE JOB]

PERSON 1:

WLOC. Let's talk about your primary job. Is your primary work address fixed, is it your home, or does it vary from day to day or week to week?

IF NEEDED: This is the work location where you spend the most time.

    1. Fixed

    2. Home

    3. No fixed workplace, varies (e.g. construction)

    8. DK

    9. RF

PERSON 1:

WNAME.   What is the name of your primary employer?

CWADD.   Do you know the exact street address or the nearest cross streets?

Street Address:

Suite/Apt #

CITY:

STATE:

ZIP

What are the nearest cross streets of this primary job?

PERSON 1:

WDAY. What days of the week do you typically work at this primary job?

SELECT ALL THAT APPLY

    08. MONDAY - FRIDAY

    01. MONDAY

    02. TUESDAY

    03. WEDNESDAY

    04. THURSDAY

    05. FRIDAY

    06. SATURDAY

    07. SUNDAY

    98. DK

    99. RF

PERSON 1:

HOURS. How many hours per week do you typically work at this primary job?

    998. DK

    999. RF

PERSON 1:

WSCHED.   Which of the following statements best describes your work schedule:

    1. I have no flexibility in my work schedule.

    2. I have some flexibility in my work schedule.

    3. I'm free to adjust my schedule as I like.

    8. DK

    9. RF

PERSON 1:

COMPR.   Does your primary employer offer alternative work schedule options such as a compressed work week?

IF NEEDED: A compressed work week is working 40 hours in less than 5 days.

1. YES
2. NO
8. DK
9. RF

PERSON 1:

WMODE.   How do you normally get to this primary job?

[IF NEEDED: That is, the method of travel used for the longest distance.

NON-MOTORIZED:

01. WALK

02. BIKE

03. WHEELCHAIR/MOBILITY SCOOTER

04. OTHER NON-MOTORIZED (Skateboard, etc.)

PRIVATE VEHICLE:

05. AUTO/VAN/TRUCK DRIVER

06. AUTO/VAN/TRUCK PASSENGER

07. CARPOOL/VANPOOL (RTC TRIP MATCH)

08. MOTORCYLE/SCOOTER/MOPED

PRIVATE TRANSIT:

09. TAXI/HIRED CAR/LIMO

10. RENTAL CAR / VEHICLE

11. PRIVATE SHUTTLE (employer, hotel, etc.)

12. GREYHOUND BUS

13. AIRPLANE

14. OTHER PRIVATE TRANSIT

PUBLIC TRANSIT:

BUS:

15. RTC RIDE

16. RTC ACCESS (Paratransit Service)

17. RTC INTERCITY

18. SIERRA SPIRIT

19. RTC RAPID

20. RTC VANPOOL

21. TART

22. AMTRAK

23. SCHOOL BUS

24. OTHER BUS

INDUS. What type of business or company do you work for in your primary job?

AGRICULTURE, FARMING, FORESTRY, FISHING, HUNTING

MINING

UTILITIES

CONSTRUCTION

MANUFACTURING

WHOLESALE TRADE

RETAIL TRADE

TRANSPORTATION AND WAREHOUSING

INFORMATION

FINANCE AND INSURANCE

REAL ESTATE AND RENTAL AND LEASING

PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

MANAGEMENT OF COMPANIES AND ENTERPRISES

ADMINISTRATIVE AND SUPPORT ANDWASTE MANAGEMENT

EDUCATIONAL SERVICES

HEALTH CARE AND SOCIAL ASSISTANCE

ARTS, ENTERTAINMENT AND RECREATION

ACCOMMODATION AND FOOD SERVICES

OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

CENTRAL ADMINISTRATIVE OFFICE ACTIVITY

OTHER: [SPECIFY]

DK

RF

PERSON 1:

OCCUP. What kind of work do you do at that company / business?

MANAGEMENT, BUSINESS AND FINANCIAL OCCUPATIONS

COMPUTER, ENGINEERING AND SCIENCE OCCUPATIONS

EDUCATION, LEGAL, COMMUNITY SERVICE, ARTS, AND MEDIA OCCUPATIONS

HEALTHCARE PRACTITIONERS AND TECHNICAL OCCUPATIONS

SERVICE OCCUPATIONS

SALES AND OFFICE OCCUPATIONS

OFFICE AND ADMINISTRATIVE SUPPORT OCCUPATIONS

FARMING, FISHING, AND FORESTRY OCCUPATIONS

CONSTRUCTION AND EXTRACTION OCCUPATIONS

INSTALLATION, MAINTENANCE, AND REPAIR OCCUPATIONS

PRODUCTION OCCUPATIONS

TRANSPORTATION AND MATERIAL MOVING OCCUPATIONS

MILITARY SPECIFIC OCCUPATIONS

OTHER: [SPECIFY]

DK

RF

PERSON 1:

WLOC2. Now let's talk about your secondary job.

Is your secondary work address fixed, is it your home, or does it vary from day to day or week to week?

IF NEEDED: This is the work location where you spend the second most time.

1. FIXED

2. HOME

3. VARIES

8. DK

9. RF

PERSON 1:

WNAME.   What is the name of this employer?

CWADD.   Do you know the exact street address or the nearest cross streets?

Street Address:

Suite/Apt #

CITY:

STATE:

ZIP

What are the nearest cross streets of this job?

WDAYS2.   How many days a week do you typically go to work at this address?

PERSON 1:

GROCNAME.   What is the name of the primary grocery store where you shop most frequently?

GROCADD.   Do you know the exact street address or the nearest cross streets?

Street Address:

Suite/Apt #

CITY:

STATE:

ZIP

What are the nearest cross streets of this grocery store?

PERSON 1:

DISAB. Do you have a temporary or permanent physical condition or disability that makes it difficult to travel outside of the home?

    1. YES

    2. NO

    8. DK

    9. RF

[IF YES]

PERSON 1:

DTYPE. Can you tell me which of the following conditions you/this person has:

READ LIST MARK ALL THAT APPLY

    01. Hearing impaired / deaf (serious difficulty hearing)

    02. Sight impaired / blind (includes serious difficulty seeing even when wearing glasses)

    03. Cognitive impaired, such as serious difficulty concentrating, remembering, or making decisions

    04. Balance or respiratory impairment, such as difficulty walking or climbing stairs without difficulty

    05. Difficulty dressing or bathing

    06. Difficulty doing errands alone, such as visiting a doctor's office or shopping

    97. Other condition that makes it difficult to travel outside your home

    98. DK

    99. RF

PERSON 1:

STUDE. Are you currently enrolled in any type of school, including daycare, technical school, or university as part time or full time?

1. YES - FULL TIME

2. YES - PART TIME

3. No

8. DK

9. RF

SCHOL. What school grade or level do you attend?

INTERVIEWER NOTE: CHECK AGE OF PERSON BEFORE ASKING CHOICES 1-4

01. DAYCARE

02. NURSERY SCHOOL, PRESCHOOL

03. KINDERGARTEN TO GRADE 8

04. GRADE 9 TO 12

05. TECHNICAL/VOCATIONAL SCHOOL

06. 2-YEAR COLLEGE (COMMUNITY COLLEGE)

07. 4-YEAR COLLEGE OR UNIVERSITY

08. GRADUATE SCHOOL/PROFESSIONAL

97. OTHER, SPECIFY

98. DK

99. RF

[IF 01-03]

And is he/she home schooled?

1. YES

2. No

8. DK

9. RF

PERSON 1:

SONLN. Please tell me which of the following best describes where you attend school:

1. On campus only

2. Online only

3. Both on campus and online

8. DK

9. RF

PERSON 1:

SNAME.   What is the name of your school?

CSADD. What is the address of your school?

Please enter the address of this school.

Street Address:

Suite/Apt #

What is the city, state, and zip of this school.

CITY:

STATE:

ZIP

PERSON 1:

SMODE.　　How do you normally get to school?

IF NEEDED: That is, the method of travel used for most of the distance.

NON-MOTORIZED:

      01. WALK

      02. BIKE

      03. WHEELCHAIR/MOBILITY SCOOTER

      04. OTHER NON-MOTORIZED (Skateboard, etc.)

PRIVATE VEHICLE:

      05. AUTO/VAN/TRUCK DRIVER

      06. AUTO/VAN/TRUCK PASSENGER

      07. CARPOOL/VANPOOL (RTC TRIP MATCH)

      08. MOTORCYLE/SCOOTER/MOPED

PRIVATE TRANSIT:

      09. TAXI/HIRED CAR/LIMO

      10. RENTAL CAR / VEHICLE

      11. PRIVATE SHUTTLE (employer, hotel, etc.)

      12. GREYHOUND BUS

      13. AIRPLANE

      14. OTHER PRIVATE TRANSIT

PUBLIC TRANSIT:

BUS:

      15. RTC RIDE

      16. RTC ACCESS (Paratransit Service)

      17. RTC INTERCITY

      18. SIERRA SPIRIT

      19. RTC RAPID

      20. RTC VANPOOL

      21. TART

      22. AMTRAK

      23. SCHOOL BUS

      24. OTHER BUS

PERSON 1:

EDUCA. What is the highest degree or level of school you have completed?

      1. NOT A HIGH SCHOOL GRADUATE, 12 GRADE OR LESS (THIS　　INCLUDES VERY YOUNG CHILDREN TOO)

      2. HIGH SCHOOL GRADUATE (HIGH SCHOOL DIPLOMA OR GED)

      3. SOME COLLEGE CREDIT BUT NO DEGREE

      4. ASSOCIATE OR TECHNICAL SCHOOL DEGREE

      5. BACHELOR'S OR UNDERGRADUATE DEGREE

      6. GRADUATE DEGREE (INCLUDES PROFESSIONAL DEGREE LIKE MD,　　DDS, JD)

      7. OTHER, SPECIFY

      8. DK

      9. RF

PERSON 1:

TTRIP.   How many one-way trips (if any) using transit did you make in the past week?

A round trip counts as two one-way trips.

ENTER NUMBER

      00. NONE

      98. DK

      99. RF

PERSON 1:

TRNSUBE.   Does your employer pay for all or any part of your transit fare?

      1. YES

      2. NO

      8. DK

      9. RF

PERSON 1:

TRNSUBS.   Does your school pay for all or any part of your transit fare?

      1. YES

      2. NO

      8. DK

      9. RF

BTRIP.   How many trips (if any) using a bicycle did you make in the past week?

ENTER NUMBER

      00. NONE

      98. DK

      99. RF

INCOM. Household income not only allows us to verify that we are including all types of households in the region, but it also has been found to be related to the types of trips households typically make. With this in mind, please tell me which category represents your total household income (total incomes for all persons living in the household) for last year.

IF NEEDED: We ask for this information because we want to make sure that all types of households participate in the survey. We certainly understand your reluctance to provide this information, but you can be assured that your information will be held in the strictest of confidence and used for transportation planning purposes only.

IF REFUSED: I appreciate your concerns about providing this information, but I only need to properly identify your household as belonging to one of the following categories: [READ APPROPRIATE RANGES]

      01. $0 to $9,999

      02. $10,000 to $24,999

      03. $25,000 to $34,999

      04. $35,000 to $49,999

      05. $50,000 to $74,999

      06. $75,000 to $99,999

      07. $100,000 to $149,999

08. $150,000 to $199,999

09. $200,000 to $249,999

10. $250,000 or more

98. DK

99. RF

NON GPS MODULE

ASSN. Understanding your household's travel and activities is very important for improving transportation in your area.

We will send you a diary for each member of your household to keep track of your travel and activities for 24 hours on your assigned travel day.

It is important for your household to record your travel on your assigned travel day. {IF THEY SAY THEY CANNOT RECORD THEIR TRAVEL THAT DAY, OFFER THE NEXT AVAILABLE DATE]

GPS MODULE

WRGPS

Your household is qualified to participate in the GPS portion of this study. We are asking you and everyone in the household who is at least 12 years old to <<[GFLAG -GPS] wear a GPS device>> <<[GFLAG-RS] carry a smartphone with the RouteScout application activated>> for 7 days in a row, starting on your assigned travel day. GPS technology allows us to collect information not only about where people travel, but also the actual path taken. This is very useful in transportation planning.

FOR GPS: To thank you for participating in this important survey, your household will receive an Amazon gift card in the amount of <<INAMT>> as long as all household members fully complete their travel information and all GPS units are returned.]

IF NEEDED FOR GPS: We will ask you to wear or carry your GPS units with you when you travel. They collect details of your travel routes during your travel days. It is very important to the survey that households like yours participate. The GPS units are small and easy to carry (you can clip them onto your belt, backpack, or purse).

IF NEEDED FOR ROUTESCOUT: The RouteScout application is a free application that you will download on your Smartphone. This application uses your phone's location services. We will ask you to wear or carry your Smartphone with the RouteScout application activated with you when you travel. It will collect details of your travel routes during your travel days. It is very important to the survey that households like yours participate.

Yes

No

[IF YES for GFLAG-GPS CONFIRM ALL HH MEMBERS ARE AT LEAST 12 YEARS OLD AND WILL CARRY GPS].

[IF YES FOR GFLAG-RS CONFIRM ALL HH MEMBERS ARE AT LEAST 12 YEARS OLD AND WILL CARRY SMARTPHONE; COLLECT PHONE NUMBER; PHONE MODEL; CARRIER AND OPERATING SYSTEM OF EACH RS PARTICIPANT'S SMARTPHONE. PARTICIPANTS MUST POSSESS A SMARTPHONE. PLEASE NOTE ROUTESCOUT IS NOT COMPATIBLE WITH IPHONES OLDER THAN IPHONE 5.]

<GPS ROSTER>

GSGPS

Will <gsname> use one of our gps devices to participate in the survey?

1. Yes

2. No (flag as diary person)

<SMARTPHONE ROSTER>

GSSMART

Will <gsname> use a smartphone to participate in the survey?

1. Yes
2. No (flag as diary person)

GSSMART2

What is the operating system for <gsname>'s phone?

98. Specify

GSSMART3

What is <gsname>'s type of phone?

98. Specify

GSSMART4

What is <gsname>'s phone number?

98. Specify

GSSMART5

What is <gsname>'s phone service carrier?

98. Specify

FOR RS: To thank you for participating in this important survey, your household will receive an Amazon gift card in the amount of $<<INAMT>> as long as all household members fully complete their travel information.]

[IF NO]

Your household may still participate in the study by providing travel information in the diaries we will send you.

1. CONTINUE AS DIARY HOUSEHOLD

2. AGREED TO PARTICIPATE IN GPS PORTION

3. REFUSED SURVEY

WASSN

Understanding your household's travel and activities is very important for improving transportation in your area.

GFLAG-GPS We will send a GPS device for each person who is 12 years of age or older for your household to keep track of your travel and activities.

GFLAG-RS, We will send instructions to download and use RouteScout for each person who is 12 years of age or older for your household to keep track of your travel and activities.

We ask that each person carry their smartphone with the RouteScout app activated for seven (7) consecutive days starting on your assigned travel day.

It is important for your household to record your travel on your assigned travel day. {IF THEY SAY THEY CANNOT RECORD THEIR TRAVEL THAT DAY, OFFER THE NEXT AVAILABLE DATE]

TRAVEL DAYS WILL BE UPDATED TO CORRECT DATES.

CATSI.

After your travel day, we will ask you to report details about the places you visited. Would you prefer to report them by telephone interview or via the website?

1. Telephone Interview
2. Web Interview
3. Mail back

[IF WEB]

WEBRC.We are glad you decided to participate in the final phase of the survey using our project website.

The purpose of this study is to understand how, why, and when people travel. This information will help transportation planners improve car, bus, and train travel options, as well as air quality.

We will mail travel diaries for each household member to record your travel and activities on your assigned travel day.

Once you have completed your travel diaries, you can provide your travel information online, by phone, or by mailing back the completed travel diaries and log.

The project website is _____

Your household's PIN is:_____

      1. CONTINUE

[IF PHONE OR MAIL]

MAILING ADDRESS

CMADD.

In order to mail the survey materials to you, I need to confirm your mailing address.

Is it...

ADDRESS:

SUITE#/APPT#:

CITY:

STATE:

ZIP CODE:

IF NO OR IF ANYTHING IS BLANK, YOU WILL GO BACK TO TRY AGAIN

      1. YES

      2. NO

To whom should we address the envelope?

FIRST NAME:

LAST NAME:

INTERVIEWER NOTE: CONFIRM SPELLING AND READ BACK

NOT ALLOWED TO HAVE MR., MRS. OR UNKNOWN

INITIALS ARE OKAY IF RESPONDENT NOT WILLING TO GIVE FULL NAME

SLANG. In which language should I send your diary materials?

      1. ENGLISH

      2. SPANISH

FOR WEB RECRUITMENT ONLY

Question added: PRN75 "Thank you for participating in the RTC Washoe County Travel Characteristics Study! In the event some of your information needs clarification, we may need to contact you. Please provide a phone number, or email address we may use to contact you." REQUIRED RESPONSE

Phone field added TEL03

Email field added EMAIL

REMN1.

Please note that we will contact you on the day before your travel day to remind you about your travel day and to provide you with additional instructions about your participation. Reminders can be made by a telephone call, by text message or by email. Which would you prefer?

IF RESPONDENT REFUSES, SELECT 1=PHONE

     1. PHONE

     2. TEXT

     3. EMAIL

[IF PHONE]

TEL02.

Can we confirm this telephone number as the number to call?

PHONE #:

IF NO: What is the best telephone number that we can call for the reminder call?

FORMAT:999-999-9999

[IF TEXT]

RMTXT.

What cell phone number should we use for reminder text messages?

FORMAT:999-999-9999

[IF EMAIL]

RMEML.   What email address should we use to send reminder email messages?

FORMAT EXAMPLE: vdiagler@nustats.com

CBACK. When we call back to collect your travel and activities, we will not ask to speak with anyone under 16 years old, but we would like to ask about their travel. We will speak with one of the adults in the household.

     1. Continue

THANK.

Thank you for participating in this first part of the RTC Washoe County Travel Characteristics Study. Please tell the other members of your household how important their participation is for the success of the study.

We look forward to talking with you again. If you have any questions or comments, I have a toll free number where you can reach us.

Would you like that number?

IF THEY WANT NUMBER: 1-877-221-7828.

Thank you and have a good afternoon/evening

Appendix C – List of Assigned Travel Days

Table 67: List of Assigned Travel Days

DOW	Date	
Tuesday	9/8/2015	Week 1
Wednesday	9/9/2015	
Thursday	9/10/2015	
Tuesday	9/15/2015	Week 2
Wednesday	9/16/2015	
Thursday	9/17/2015	
Tuesday	9/22/2015	Week 3
Wednesday	9/23/2015	
Thursday	9/24/2015	
Tuesday	9/29/2015	Week 4
Wednesday	9/30/2015	
Thursday	10/1/2015	
Tuesday	10/6/2015	Week 5
Wednesday	10/7/2015	
Thursday	10/8/2015	
Tuesday	10/13/2015	Week 6
Wednesday	10/14/2015	
Thursday	10/15/2015	
Tuesday	10/20/2015	Week 7
Wednesday	10/21/2015	
Thursday	10/22/2015	
Tuesday	10/27/2015	
Wednesday	10/28/2015	No School
Thursday	10/29/2015	
Tuesday	11/3/2015	Week 8
Wednesday	11/4/2015	
Thursday	11/5/2015	
Tuesday	11/10/2015	Week 9
Wednesday	11/11/2015	Veteran's Day
Thursday	11/12/2015	Week 9
Tuesday	11/17/2015	Week 10
Wednesday	11/18/2015	
Thursday	11/19/2015	
Tuesday	11/24/2015	Week 11
Wednesday	11/25/2015	
Thursday	11/26/2015	Thanksgiving
Tuesday	12/1/2015	Week 12
Wednesday	12/2/2015	
Thursday	12/3/2015	
Tuesday	12/8/2015	Week 13
Wednesday	12/9/2015	UNR Closed

DOW	Date	
Thursday	12/10/2015	Week 13
Tuesday	12/15/2015	Week 14
Wednesday	12/16/2015	
Thursday	12/17/2015	
Tuesday	12/22/2015	
Wednesday	12/23/2015	
Thursday	12/24/2015	
Tuesday	12/29/2015	Winter break
Wednesday	12/30/2015	
Thursday	12/31/2015	
Tuesday	1/5/2016	
Wednesday	1/6/2016	
Thursday	1/7/2016	
Tuesday	1/12/2016	Week 15
Wednesday	1/13/2016	
Thursday	1/14/2016	
Tuesday	1/19/2016	Week 16
Wednesday	1/20/2016	
Thursday	1/21/2016	
Tuesday	1/26/2016	Week 17
Wednesday	1/27/2016	
Thursday	1/28/2016	

indicates no travel day
Indicates travel day added after study began

Appendix D – CATI and Web Retrieval Script

Hi, this is _____ calling about the Washoe County Travel Characteristics Study conducted on behalf of the Regional Transportation Commission. We recently spoke with <RESPF> <RESPL> and are calling back to conduct the interview he/she agreed to complete a few days ago.
May I please speak with <RESPF>?

CONTINUE	OK
NO ANSWER	NA
BUSY	BZ
LEFT MESSAGE	LM
ANSWER MACHINE	AM
COMPUTER/FAX MACHINE	IM
BUSINESS/GOVERNMENT	IG
DISCONNECT	ID
CALLER ID	PM
SOFT REFUSAL	R1
HUNG UP (W/O A WORD)	RH
Final Refusal	RF
WRONG NUMBER, NEED TO RESEARCH	IW
RESPONDENT HAS MOVED	MV
RESP WILL CM ONLINE	WC
RESCHEDULE, CALLBACK	RT
RESCHEDULE, REMAIL(allow 12 days for mail out)	RM
Scheduled Callback	KB
Soft Callback	KH
Partial Complete	CP
Will Mail Completed Surveys	WM
Have Mailed Completed Surveys	HM

VASSN (104)

Last week, we spoke with you about the travel survey and asked you to record your travel on <ASSN><WASSN>. We would like to collect your trip information now.

   1. Continue
VGPS (105)
My records show that your household agreed to participate in the survey using <FLGSD> technology. Did your household use <FLGSD> technology during your travel day?

1. Yes, continue
2. No, did not get GPS Devices (CHOOSE A NEW DATE) ==> ASSNM
3. No, did not download RouteScout (CHOOSE A NEW DATE) ==> ASSNM
4. Forgot to use GPS or RS (CHOOSE A NEW DATE) ==> ASSNM

ASSNM (103)

CURRENT ASSN IS: <ASSN ><WASSN>

SELECT NEW ASSIGNMENT FOR RESENDING DIARY PACKET

15167	Tuesday, June 16
15168	Wednesday, June 17
15169	Thursday, June 18
15174	Tuesday, June 23
15175	Wednesday, June 24
15176	Thursday, June 25
15181	Tuesday, June 30
15182	Wednesday, July 01
15183	Thursday, July 02

VADD (106)

Let's start by verifying the address where you live. Our records show that your address is:

Name: <FNAME> <LNAME>

Address: <HADDR>

Apt #:   <HSUIT>

City: <HCITY>

State: <HSTAT>

Zip: <HZIP>

1. Yes, address is correct
2. No, address is wrong

HHSIZ (134)

Our records show that there is/are<OHSIZ> person/s living in your household. Is this correct?

I have listed:

<PERSON1>

<PERSON2>

<PERSON3> …

If this is not correct, please indicate the new number of people living in your household below.

Note: Please include in this number Foster Children, Roomers, Housemates, and/or people living in your home most of time, even if they have another place to live.

We understand you may have concerns regarding this question, however, transportation planners need to know if there is a relationship between the number of people in a household and the number of trips they make.

One

Two

Three

Four

Five

Six

Seven

Eight or more

SUMMARY (355)

Before I continue let me verify <PRN15>information....

Name: <Fname>

Age: <age>

Relationship: <RELAT>

Employed: <EMPLY>

Work Location: <WLOC>

Work Name: <WNAME>

Work Address : <WADDR>

Work Cross Streets: <WXST1> and <WXST2>

Suite Number: <WSUIT>

City: <WCITY>

State: <WSTAT>

Student: <STUDE>

School Location: <SONLN>

School Name: <SNAME>

School Address: <SADDR>

School Cross Streets: <SXST1> and <SXST2>

Suite Number: <SSUIT>

City: <SCITY>

State: <SSTAT>

1. INFORMATION IS CORRECT, CONTINUE
2. CORRECT WORK INFORMATION
3. CORRECT SCHOOL INFORMATION
4. CORRECT AGE AND NAME

VSUMMARY (376)

Our records indicate that you have <VEHOP> vehicle/s available to your household. Please let me verify your vehicle information before I continue.

<VEHICLE1>

<VEHICLE2>

<VEHICLE3>…

PRESS CONTINUE IF EVERYTHING IS CORRECT AND NO CHANGES ARE NEEDED

PRESS CORRECTION IF A VEHICLE NEEDS TO BE ADDED OR CORRECTED

SELECT VEHICLE NUMBER BELOW TO DELETE ANY VEHICLE THE HOUSEHOLD DOES NOT LONGER OWN

SELECT NO VEHICLE IF THE HOUSEHOLD DOES NOT OWN ANY VEHICLES

1. Continue, information is correct
2. Correction needed
3. Household has no vehicles
4. Delete Vehicle One
5. Delete Vehicle Two
6. Delete Vehicle Three…

CMPLG (503)

Your household should have received travel diaries to record your travel information.

Did <YOU3> complete a travel diary?

NOTE: IF THEY HAVE A COMPLETED DIARY PLEASE ASK TO HAVE IT AVAILABLE TO REFER TO IT WHEN REPORTING TRAVEL INFO

1. Yes - completed
2. No - not completed
3. Did not receive materials
8. Not Sure
9. Prefer not to answer

GPSP (505)

My records show that you agreed to receive a GPS device to use during your travel day to record your trip patterns.

Did <YOU3> use the GPS device we sent?

1. Yes - used GPS device during travel day
2. No - forgot to use the GPS device

SMARTP (506)

<you4> agreed to use <his> smartphone during the traval day.

Did <you3> use <his> smartphone to track <his> travel information?

1. Yes - used Smartphone during travel day
2. No - forgot to use Smartphone

TBBUT (528)

Next, we will ask you to provide details about the trip and activity information that your household recorded for your travel day. The link below will launch the online travel diary.

To enter the secure site, you will be prompted to enter your PIN number: <PINNO>

After you are done reporting travel information, please return to this page and press 'DONE WITH TRAVEL DATA' to continue and exit the survey.

CLICK HERE TO LAUNCH ONLINE TRAVEL DIARY

2. DONE WITH TRAVEL DATA, CONTINUE

L1X (606)

Please remember to keep wearing your GPS devices each day and mail them back on <ASSN7> using the pre-paid envelope provided in your packaging.

Please press 'Next' to continue.

L2 (607)

Have you returned your GPS equipment yet?

If not, please package it using the pre-paid envelope provided and drop it any USPS drop box.

INT99 (627)

This completes the survey. We appreciate you taking your valuable time to participate and share your travel details with the Regional Transportation Commission of Washoe County. Your participation will help better serve the transportation needs of your community for years to come.

If you have any questions or comments, the phone number where you may reach us at is 1-877-221-7828.

Thank you.

Appendix E – Non-GPS Survey Materials

This letter was sent with the diary materials to non-GPS households that had recruited online and would be eligible to receive an incentive if they also reported their travel online. All letters were formatted to fit on one page, and were printed on RTC letterhead. The diary, mailing envelope, and return mailing envelope follow the letters. A similar letter was sent to non-GPS households that were recruited via CATI, and not eligible for an incentive.

«RFNAM» «RLNAM»   MMDDYYYY
«HADDR» «HUNIT»
«HCITY», «HSTAT» «HZIP»

Thank you for participating in the RTC Regional Household Travel Survey! The information you provide will help the RTC to plan transportation projects. This includes new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads that improve safety and enhance quality of life in the Truckee Meadows. This information also helps the RTC to program funding for transportation projects. We value your input, no matter how much or how little you travel. Earn up to $25! Since your household completed Step 1 (enroll in the survey) online, if you also complete Step 2 (report travel) online **AND** your entire household reports complete travel information in Step 2, you earn a $25 Amazon gift card!

Step 1   **Complete the questionnaire enrolling your household in the travel survey.**

Next   **Record travel information in your Travel Diary:**

> For 24 hours on **«TDAY»**.
> Enclosed is a Travel Diary for each person in your household. Each person should carry their Travel Diary for the assigned 24-hour period to record details about their travel and activities. We ask that an adult help anyone under age 16 fill out their Travel Diary.

Step 2   **Report your travel information in ONE of the following ways:**

> **To be eligible for the incentive - Online**: Go to **www.RTCSurvey.com**. Click "Report Travel" and **enter PIN: «PINNO»**
> Each person should enter his/her own travel information. An adult can enter information for anyone under age 16.

> **Mail**: Use the enclosed postage-paid envelope to return your completed travel diaries. If you choose this option, we may call you to clarify or collect any missing information.

> **Phone**: NuStats will call after your travel day to collect your household's travel information.
> Or, call toll-free 1-877-221-7828 to provide the information at your convenience.

The survey is being conducted for the RTC by NuStats, a professional survey firm. **All information collected will not be shared, will be held strictly confidential** and used only in combination with information provided from other participating households to the RTC.

If you have questions about the survey or how to participate, visit **www.RTCSurvey.com**, or call our toll-free survey hotline at 1-877-221-7828 (4pm–8pm PST weekdays and 12pm–6pm PST Saturdays).

Thank you again for providing the details that will help improve transportation choices for the region.

Sincerely,

Xuan Wang
RTC Project Manager
www.rtcwashoe.com

The mailing envelope and BRM are found below.

RTC

c/o NuStats LLC
4115 Freidrich Ln., Suite 200
Austin, Texas 78744-9907

YOUR PERSONALIZED
TRAVEL DIARIES ARE ENCLOSED!

nustats
research solutions

4115 Freidrich Lane
Bldg L Suite 200
Austin, TX 78744

«RFNAM» «RLNAM»
«HADDR» «HUNIT»
«HCITY», «HSTAT» «HZIP»

MH_RTC_DiaryEnv_7.5x10.indd   1   6/4/2015   12:29:45 PM

«HCITY», «HSTAT» «HZIP»
«BARSAMP»
«PROJECT»-«SAMPN»-«NDIARIES»-
«ASSN»

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL   PERMIT NO. 420   AUSTIN, TX

POSTAGE WILL BE PAID BY ADDRESSEE

RTC REGIONAL HOUSEHOLD TRAVEL SURVEY
NUSTATS
4115 FREIDRICH LN STE 200
AUSTIN TX 78744-9907

Decoded IMb : 00708901278914000000787449907   Mailpiece Size : 7.5 X 12.0 Flat
Do not modify the size or change the placement of either the FIM or IMb.
QBRM pieces that are non-automation compatible and/or contain the incorrect ZIP+4 code are
ineligible for QBRM prices and will be charged the non-QBRM High Volume postage and fees.

The full diary is found below and on the following pages.

Travel Diary for:

Name: «RFNAM» «RLNAM»

Your Travel Day is: «TDAY»

Your PIN# is: «PINNO»

Household Members:

P1: «PERSON1»	**P5**: «PERSON5»
P2: «PERSON2»	**P6**: «PERSON6»
P3: «PERSON3»	**P7**: «PERSON7»
P4: «PERSON4»	**P8**: «PERSON8»

1a. What is the name and address of your regular workplace (primary job)?

☐ Not employed
☐ Work at home (for pay)
☐ Self-employed

Name of Workplace (primary job):

Street Address or Nearest Cross-streets:

City:

State:

Zip Code:

1b. Did you go to work today? ☐ Yes ☐ No Why not

2a. What is the name and address of your school?

☐ Not a student
☐ Home school

Name of School

Street Address or Nearest Cross-streets:

City:

State:

Zip Code:

2b. Did you go to school today? ☐ Yes ☐ No Why not

Continue inside

DIARY INSTRUCTIONS

Use this diary to record information about ALL the PLACES you visit on your travel day. Begin at 12 a.m. on your travel day and end at 11:59 p.m. the same day.

We ask that a parent or guardian fill out the travel diaries for children under age 16.

A PLACE IS: Any location you travel to, no matter how long you are there.

Examples: • stopping for gas • a drive-through window • dropping off or picking up someone • walking to lunch • driving to a meeting during your workday • biking to the park • attending a sporting event, etc.

A place can be a transfer point such as a transit stop or a parking location.

Please provide the following information:

✓ **PLACES** you visit. Record one place per page.
The place name, exact address or nearest cross streets, city, state, and the zip code are critical for analyzing areas with traffic congestion.

Some points to remember...

Trips to nearby states:	If you travel to the Lake Tahoe area or to places in other states, please record full addresses or cross-streets.
Trips out of the country:	If you travel to Canada or Mexico, please record the province or colonia.
Work-related trips:	If you drive as part of your job duties, only record those trips made if the vehicle you drive is owned by you or serves as your personal vehicle.
Parking locations:	If you park your car and walk more than 5 minutes to your destination, record the parking location as a separate place.

✓ **EXACT TIMES** you arrive and leave each place.

✓ How you **TRAVEL** to each place. Write the code from **LIST 1 - Method of Travel** (codes are on the flap of the back cover). We are interested in all types of travel: by auto, walking, biking, transit, etc.

✓ **ACTIVITIES** or what you do at each place and the starting and ending times for each activity. Write the code from **LIST 2 - Activities** (codes are on the flap).

Once you have completed your travel diary, follow the instructions for providing your

Questions? Call the toll-free survey hotline: 1-877-221-7828

Example PLACE

A What time did you ARRIVE at this place? *(Record exact time)* 7 : 32 (am)/ pm

B **WHAT is this PLACE?**

○ My Home
○ My Primary Job
○ My School
○ My Second Job
○ Transit Stop (bus or rail)
✗ Other Place

Name of Place:
Happy Kids Daycare

Street Address or Nearest Cross-streets:
901 Main Street

City (Colonia): Anytown   State: CA   Zip Code: 99999

C **HOW did you TRAVEL there?** *(Write code from **LIST 1**)* 5

How many other people traveled with you? *(Don't Include yourself)* 2

Of those, how many were household members? 2

Which household members? *(Use person #s from label)* ○ P1 ○ P3 ✗ P5 ○ P7   ✗ P2 ○ P4 ○ P6 ○ P8

D **If you traveled by PRIVATE VEHICLE:**

Which household vehicle did you use?
(Year / Make / Model): 2008 Honda Accord

○ Did not use a household vehicle

If you parked at this location, where did you park?
○ Did not park   ○ Street
✗ Parking lot   ○ Driveway / Personal garage
○ Parking garage   ○ Other: _____

What are the nearest cross-streets to this parking location?
Main St & 1st St

How much did you pay to park?
$ _____ per _____   ✗ Did not pay

How did you pay for parking?
○ Cash / credit / debit card
○ Pre-paid parking pass
○ Employer provided parking pass
○ Other: _____

How much did you pay out-of-pocket to park that was not reimbursed by your employer? $ _____

If you traveled by PUBLIC TRANSIT:

What transit system did you use?
_____ →

What was the route or line number or name?
_____

E **What ACTIVITIES did you do there?** *(Write up to 3 codes from **LIST 2** on the flap of the back cover and the start and end times.)*

Code: Specify if code "38":

	Code	Start	End
Activity 1:	22	7 : 32 (am)/ pm	7 : 36 (am)/ pm
Activity 2:		: am / pm	: am / pm
Activity 3:		: am / pm	: am / pm

F **What TIME did you LEAVE this place?** *(Please record exact time)* 7 : 36 (am)/ pm → **Move on to the next PLACE**

○ I didn't leave this place → **You are DONE. Thank You!**

PLACE 1

BEGIN RECORDING YOUR TRAVEL HERE

Your travel day begins with Place 1 at 12 a.m. Most people are home asleep at this time. If this is the case with you, check "My Home," then record your activities at this place and the exact time you leave.

REMEMBER!
A **PLACE** can be a transfer point such as a transit stop or a parking location.

A WHERE were you at 12 a.m. on your travel day?

☐ My Home
☐ My Primary Job
☐ My School
☐ My Second Job
☐ Transit Stop (bus or rail)
☐ Other Place

Name of Place:

Street Address or Nearest Cross-streets:

City (Colonia):   State: Zip Code:

B What ACTIVITIES did you do there?   (Write up to 3 codes from **LIST 2** on the flap of the back cover and the start and end times.)

Code: Specify if code "38":

Activity 1:   Start: :   am / pm   End: :   am / pm
Activity 2:   Start: :   am / pm   End: :   am / pm
Activity 3:   Start: :   am / pm   End: :   am / pm

C What TIME did you LEAVE?   :   am / pm   ➝ Move on to next PLACE
(Please record exact time)
☐ I didn't leave this place today   ➝ Answer D Below

D What is the MAIN reason you didn't leave this place today?

☐ I was sick   ☐ Not scheduled to work
☐ Vacation or personal day   ☐ Worked around home (not for pay)
☐ Child was sick   ☐ No transportation available
☐ Other household member was sick ☐ Weather
☐ I am home-bound, elderly, or disabled ☐ No reason to travel
☐ Worked at home (for pay)   ☐ Other:

*If you didn't leave this place today and you did more than three activities, please record the codes and start and end times for each activity on a separate sheet of paper.

IF YOU DIDN'T LEAVE THIS PLACE TODAY: You are done. Thank you!

PLACE 2

A ▸ **What time did you ARRIVE at this place?** *(Record exact time)* ⬚ : ⬚ am / pm

B ▸ **WHAT is this PLACE?**

☐ My Home
☐ My Primary Job
☐ My School
☐ My Second Job
☐ Transit Stop (bus or rail)
☐ Other Place

Name of Place:
⬚

Street Address or Nearest Cross-streets:
⬚

City (Colonia): ⬚   State: ⬚   Zip Code: ⬚

C ▸ **HOW did you TRAVEL there?** *(Write code from LIST 1)* ⬚

Of those, how many were household members? ⬚

How many other people traveled with you? *(Don't Include yourself)* ⬚

Which household members? ☐ P1 ☐ P3 ☐ P5 ☐ P7
(Use person #s from label) ☐ P2 ☐ P4 ☐ P6 ☐ P8

D ▸ **If you traveled by PRIVATE VEHICLE:**

Which household vehicle did you use?
(Year / Make / Model): ⬚
☐ Did not use a household vehicle

If you parked at this location, where did you park?
☐ Did not park   ☐ Street
☐ Parking lot   ☐ Driveway / Personal garage
☐ Parking garage   ☐ Other: ⬚

What are the nearest cross-streets to this parking location?
⬚

How much did you pay to park?
$ ⬚ per ⬚   ☐ Did not pay

How did you pay for parking?
☐ Cash / credit / debit card
☐ Pre-paid parking pass
☐ Employer provided parking pass
☐ Other: ⬚

How much did you pay out-of-pocket to park that was not reimbursed by your employer? $ ⬚

If you traveled by PUBLIC TRANSIT:

What transit system did you use?
⬚ →

What was the route or line number or name?
⬚

E ▸ **What ACTIVITIES did you do there?** *(Write up to 3 codes from LIST 2 on the flap of the back cover and the start and end times.)*

Code: Specify if code "38":

	Code		Start		End	
Activity 1:	⬚	Start:	⬚ : ⬚ am / pm	End:	⬚ : ⬚ am / pm	
Activity 2:	⬚	Start:	⬚ : ⬚ am / pm	End:	⬚ : ⬚ am / pm	
Activity 3:	⬚	Start:	⬚ : ⬚ am / pm	End:	⬚ : ⬚ am / pm	

F ▸ **What TIME did you LEAVE this place?** *(Please record exact time)* ⬚ : ⬚ am / pm → **Move on to the next PLACE**

☐ I didn't leave this place → **You are DONE. Thank You!**

PLACE 3

A ▶ **What time did you ARRIVE at this place?** *(Record exact time)* [___ : ___] am / pm

B ▶ **WHAT is this PLACE?**

- ☐ My Home
- ☐ My Primary Job
- ☐ My School
- ☐ My Second Job
- ☐ Transit Stop (bus or rail)
- ☐ Other Place

Name of Place: [_____]

Street Address or Nearest Cross-streets: [_____]

City (Colonia): [_____] State: [___] Zip Code: [___]

C ▶ **HOW did you TRAVEL there?** *(Write code from LIST 1)* [___]

Of those, how many were household members? [___]

How many other people traveled with you? *(Don't Include yourself)* [___]

Which household members? *(Use person #s from label)* ☐ P1 ☐ P3 ☐ P5 ☐ P7   ☐ P2 ☐ P4 ☐ P6 ☐ P8

D ▶ **If you traveled by PRIVATE VEHICLE:**

Which household vehicle did you use?
(Year / Make / Model): [_____]
☐ Did not use a household vehicle

If you parked at this location, where did you park?
- ☐ Did not park
- ☐ Parking lot
- ☐ Parking garage
- ☐ Street
- ☐ Driveway / Personal garage
- ☐ Other: [_____]

What are the nearest cross-streets to this parking location?
[_____]

How much did you pay to park?
$ [_____] per [_____]   ☐ Did not pay

How did you pay for parking?
- ☐ Cash / credit / debit card
- ☐ Pre-paid parking pass
- ☐ Employer provided parking pass
- ☐ Other: [_____]

How much did you pay out-of-pocket to park that was not reimbursed by your employer? $ [___]

If you traveled by PUBLIC TRANSIT:

What transit system did you use?
[_____] →

What was the route or line number or name?
[_____]

E ▶ **What ACTIVITIES did you do there?** *(Write up to 3 codes from LIST 2 on the flap of the back cover and the start and end times.)*

Code: Specify if code "38":

		Start:	End:
Activity 1:	[___][_____]	[___ : ___] am / pm	[___ : ___] am / pm
Activity 2:	[___][_____]	[___ : ___] am / pm	[___ : ___] am / pm
Activity 3:	[___][_____]	[___ : ___] am / pm	[___ : ___] am / pm

F ▶ **What TIME did you LEAVE this place?** *(Please record exact time)* [___ : ___] am / pm → **Move on to the next PLACE**

☐ I didn't leave this place → **You are DONE. Thank You!**

PLACE 11

A ▸ What time did you ARRIVE at this place? *(Record exact time)* _____ : _____ am / pm

B ▸ WHAT is this PLACE?

○ My Home
○ My Primary Job
○ My School
○ My Second Job
○ Transit Stop
  (bus or rail)
○ Other Place

Name of Place:
_____

Street Address or Nearest Cross-streets:
_____

City (Colonia): _____ State: _____ Zip Code: _____

C ▸ HOW did you TRAVEL there?
(Write code from LIST 1) _____

How many other people traveled
with you? *(Don't Include yourself)* _____

Of those, how many were
household members? _____

Which household members? ○ P1 ○ P3 ○ P5 ○ P7
(Use person #s from label) ○ P2 ○ P4 ○ P6 ○ P8

D ▸ If you traveled by PRIVATE VEHICLE:

Which household vehicle did you use?
(Year / Make / Model): _____

○ Did not use a household vehicle

If you parked at this location, where did you park?
○ Did not park   ○ Street
○ Parking lot   ○ Driveway / Personal garage
○ Parking garage   ○ Other: _____

What are the nearest cross-streets to this
parking location?
_____

How much did you pay to park?

$ _____ per _____   ○ Did not pay

How did you pay for parking?
○ Cash / credit / debit card
○ Pre-paid parking pass
○ Employer provided parking pass
○ Other: _____

How much did you pay out-of-pocket to park that
was not reimbursed by your employer? $ _____

If you traveled by PUBLIC TRANSIT:

What transit system did you use?
_____ →

What was the route or line number or name?
_____

E ▸ What ACTIVITIES did you do there? *(Write up to 3 codes from LIST 2 on the flap of the back cover and the start and end times.)*

Code: Specify if code "38":

Activity 1: _____ Start: ____ : ____ am / pm   End: ____ : ____ am / pm
Activity 2: _____ Start: ____ : ____ am / pm   End: ____ : ____ am / pm
Activity 3: _____ Start: ____ : ____ am / pm   End: ____ : ____ am / pm

F ▸ What TIME did you LEAVE this place?
(Please record exact time) ____ : ____ am / pm → **Move on to the next PLACE**

○ I didn't leave this place → **You are DONE. Thank You!**

EXTRA PLACES

If you used all of the previous pages, use the chart below to write information about the other places you visited. Don't forget to record your exact times!

PLACE #	A What TIME did you ARRIVE? (record exact times)	B WHAT is this PLACE? WHAT is the NAME and ADDRESS?	C HOW did you TRAVEL? (use LIST 1)	E What ACTIVITES? (use LIST 2)	F What TIME did you LEAVE? (record exact times)
12	: am / pm				: am / pm
13	: am / pm				: am / pm
14	: am / pm				: am / pm
15	: am / pm				: am / pm
16	: am / pm				: am / pm
17	: am / pm				: am / pm
18	: am / pm				: am / pm
19	: am / pm				: am / pm
20	: am / pm				: am / pm
21	: am / pm				: am / pm

LIST 1 - METHOD OF TRAVEL

NON-MOTORIZED TRAVEL:

1 Walk
2 Bike
3 Wheelchair / Mobility Scooter
4 Other Non-Motorized (skateboard, etc.)

PRIVATE VEHICLE:

5 Auto / Van / Truck Driver
6 Auto / Van / Truck Passenger
7 Carpool / Vanpool (RTC Trip Match)
8 Motorcycle / Scooter / Moped

PRIVATE TRANSIT:

9 Taxi / Hired Car / Limo
10 Rental Car / Vehicle
11 Private Shuttle (employer, hotel, etc.)
12 Greyhound Bus
13 Airplane
14 Other Private Transit

PUBLIC TRANSIT:

Bus:
15 RTC Ride
16 RTC Access (paratransit services)
17 RTC Intercity
18 Sierra Spirit
19 RTC Rapid
20 RTC Vanpool
21 TART
22 Amtrak
23 School Bus
24 Other Bus

STOP Did you remember to record...

✓ Each place you went, even short walks, quick stops, and places you went in the evening?

✓ Complete place names and addresses?

✓ Activities you did at each place along with the start and end times?

✓ Exact accurate arrival and departure times?

Privacy Policy

We take your privacy very seriously. All information collected will be held strictly confidential and used only in combination with information provided from other participating households.

LIST 2 is inside flap

LIST 2 - ACTIVITIES

AT MY HOME:

1 Personal activities (*sleeping, personal care, leisure, chores, etc.*)
2 Preparing meals / eating
3 Hosting visitors / entertaining guests
4 Exercise (*with or without equipment*) / playing sports
5 Study / schoolwork
6 Work for pay at home using telecommunications equipment
7 Using computer / telephone / cell or smartphone or other communications device for personal activities
8 All other activities at my home

AT MY WORK OR VOLUNTEER LOCATION:

9 Work / job duties
10 Training
11 Meals at work
12 Work-sponsored social activities (*holiday or birthday celebrations, etc.*)
13 Non-work related activities (*social clubs, etc.*)
14 Exercise / sports
15 Volunteer work / activities
16 All other work-related activities at my work

AT MY SCHOOL (Preschool, K-12, College, etc.):

17 In school / classroom / laboratory
18 Meals at school / college
19 After school or non-class-related sports / physical activity
20 All other after school or non-class-related activities (*library, band rehearsal, clubs, etc.*)

QUICK STOPS / TRIPS:

21 Change type of transportation / transfer
22 Pickup / drop off passenger(s)
23 Drive-through meals (*snacks, coffee, etc.*)
24 Drive-through other (*ATM, bank, etc.*)

AT OTHER PLACES:

25 Work-related (*meeting, sales call, delivery*)
26 Service private vehicle (*gas, oil, lube, repairs*)
27 Routine shopping (*groceries, clothing, convenience store, household maintenance*)
28 Shopping for major purchases or specialty items (*appliance, electronics, new vehicle, major household repairs*)
29 Household errands (*bank, dry cleaning, etc.*)
30 Personal business (*visit government office, attorney, accountant*)
31 Eat meal at restaurant / diner
32 Health care (*doctor, dentist, eye care, chiropractor, veterinarian*)
33 Civic / Religious activities
34 Outdoor exercise (*sports, jogging, bicycling, walking, walking dog, etc.*)
35 Indoor exercise (*gym, yoga, etc.*)
36 Entertainment (*movies, watch sports, etc.*)
37 Social / Visit friends / relatives
38 Other (*write code and specify*)

LIST 1 is outside flap

QUESTIONS?

Visit the survey website:
www.RTCSurvey.com
or
Call the toll-free survey hotline:
1-877-221-7828

How Do I Provide My Travel Information?

Online
Enter your information online at:
www.RTCSurvey.com
Use the PIN# on the front of this diary.

OR

Mail
Return your completed diaries in the postage-paid envelope provided in your packet.
Please note that we may need to call you to clarify or to collect any missing information.

OR

Phone
Keep your completed diaries by the phone and we will call you to collect the information.
Or, you can call our toll-free survey hotline (1-877-221-7828) to provide your information.

For more information, visit the survey website at:

www.RTCSurvey.com

For questions or help filling out your Travel Diary:

Call the toll-free survey hotline
1-877-221-7828

Thank you for your participation!

Survey conducted by NuStats on behalf of:

Your RTC. Our Community.

REGIONAL TRANSPORTATION COMMISSION
Planning · Streets and Highways · Public Transportation
Metropolitan Planning Organization

Appendix F – GPS Survey Materials

This appendix includes the cover letter and other materials GPS households received with their diaries, GPS devices and chargers, and shipping materials. Letters were printed on RTC letterhead. Each GPS HH received these items packed carefully in a small box, in which a return mail address label was affixed. The box was then placed inside of a large Tyvek envelope with the household's mailing label affixed to it.

«RFNAM» «RLNAM»   MMDDYYYY
«HADDR» «HUNIT»
«HCITY», «HSTAT» «HZIP»

Thank you for participating in the RTC Regional Household Travel Survey! The information you provide will help the RTC to plan transportation projects. This includes new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads that improve safety and enhance quality of life in the Truckee Meadows area. This information also helps the RTC to program funding for transportation projects. We value your input, no matter how much or how little you travel. We are offering households that are selected to use GPS devices $25 per device (up to a maximum of three devices, or $75) once we receive travel information for **all** household members! All GPS units and chargers must also be returned; this incentive is in the form of an Amazon gift card.

Step 1 Complete the questionnaire enrolling your household in the travel survey – this is complete.

Next Record travel information in your Travel Diary:

> For 24 hours on **«dow»**, **«TDAY»**.
Enclosed is a Travel Diary for each person in your household. Each person should carry their Travel Diary for the assigned 24-hour period to record details about their travel and activities. We ask that an adult help anyone under age 16 fill out their Travel Diary.

> **GPS devices**: Use your GPS devices from **«TDAY»** to **«LastTravelDay»** as instructed in the enclosed "GPS Device Instructions for Use." Please return the GPS equipment (in the pre-paid package) immediately after your travel period. Remember, you also need to complete **Step 2** to report your travel in order to receive your gift card!

Report your travel information in ONE of the following ways:

Step 2
> **Online**: Go to **www.RTCSurvey.com**. Click "Report Travel" and **enter PIN: «PINNO»**
Each person should enter his/her own travel information. An adult can enter information for anyone under age 16.

> **Mail**: Use the postage-paid package to return your completed travel diaries with your GPS equipment. If you choose this option, we may call you to clarify or collect any missing information.

> **Phone**: NuStats will call after your travel day to collect your household's travel information. Or, call toll-free 1-877-221-7828 to provide the information at your convenience.

The survey is being conducted for the RTC by NuStats, a professional survey firm. **All information collected will not be shared, will be held strictly confidential** and used only in combination with information provided from other participating households to the RTC.

If you have questions about the survey or how to participate, visit **www.RTCSurvey.com**, or call our toll-free survey hotline at 1-877-221-7828 (4pm–8pm PST weekdays and 12pm–6pm PST Saturdays).

Thank you again for providing the details that will help improve transportation choices for the region.

Sincerely,

Xuan Wang
RTC Project Manager
www.rtcwashoe.com

Each GPS household received an instruction sheet with their materials.

GPS Instruction Sheet

Thank you for taking part in the **Washoe County Regional Travel Characteristics Study**. This page has basic information on how to use the GPS devices. The reverse side also contains information on using the device, such as how to turn the volume down.

If you have any questions regarding the survey, please call **NuStats at 877-221-7828 (toll-free call)** and ask for **Vivian Daigler**.

PLEASE TAKE THE GPS DEVICE WITH YOU WHEREVER YOU GO!
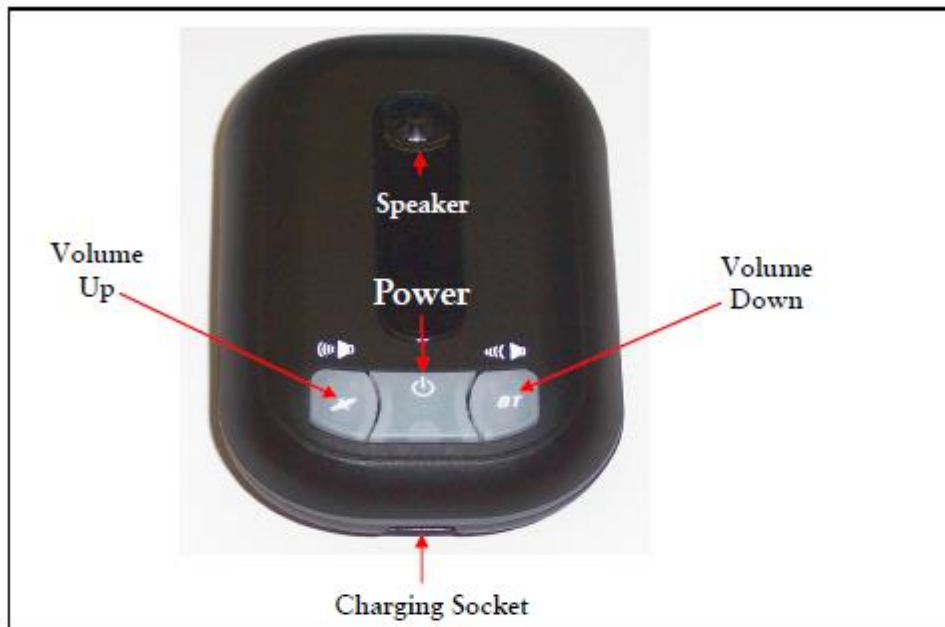
1. TURN ON: To turn on, hold down the ⬜ button for 3 seconds. You will hear a voice say "*FINDING POSITION*", unless the volume is at zero.

2. LOCATING POSITION: When the device finds its location, you will hear a voice say "*POSITION FOUND*". The ⬜ button will flash RED. Please wait until this happens before leaving your current position.

Note: • This could take a few minutes, especially if you are indoors.
   • This will happen faster in a spot with a clear view of the sky.
   • If the device loses signal again, you will hear a voice say "*FINDING POSITION*".

3. TURN OFF: To turn off, hold down the ⬜ button for 3 seconds. You will hear a short shrill sound before it turns off .

4. STANDBY: To save battery, the device will go on standby if it is not moved for 3 minutes. All lights will switch off. It will switch on again when it is moved.

5. CHARGING: If the power is low, you will hear a voice say "*BATTERY LOW*", and the ⬜ button will start to flash GREEN three times. Please recharge the device using the charger provided. The ⬜ button will flash twice while the device is charging.

Note: • Charging should take less than 4 hours. You cannot overcharge the device.
   • The device will need to be turned on again after charging – follow step 1.

Following completion of your seven-day travel period, please return the device and device charger, using the pre-paid postage materials provided in your package. If you cannot find your mailing materials, please contact a NuStats representative at 877-221-7828.

Troubleshooting

1: MY DEVICE IS TOO LOUD! CAN I TURN IT DOWN?

Yes, press the 'Volume down' `BT` button. Pressing the `BT` button three times will turn the sound off completely. If the sound is turned off you will not be able to hear any of the instructions from the device. To increase the volume, press the 'Volume up' button.

2: MY DEVICE DOES NOT SEEM TO RECORD! WHY NOT?

When a journey starts, the GPS device must "lock on" to enough satellites to record its position. To do this it needs to receive a signal from four GPS satellites. These signals can be blocked by walls, buildings, overhangs and even trees! When the device starts to record data a RED light will start flashing.

It can take up to a minute for the device to lock on to the satellites, especially if it has been turned off recently. To help make sure your device is recording data, it is best to stand under open sky before starting your journey. We appreciate your diligence, but this may not always be possible! The device may lose signal when passing through a tunnel, or through a built up urban area. The red light will then stop flashing. It should pick it up again when it has passed through.

3: MY DEVICE HAS STOPPED FLASHING! WHY?

There are three reasons why the GREEN light on your device may have stopped flashing.

- *The device may be in 'sleep mode':* The device will go on 'sleep mode' when the device isn't moved for 3 minutes in order to save battery power. The device has a sensor to detect movement, so when it is moved again it will wake up and try to re-find its position.
- *The device may be turned off:* If you move the device and the GREEN light still does not come on, the device may be turned off. To turn it back on, hold the 'Power' button down for 3 seconds.
- *The battery may have run out:* If the device still does not come on, the battery may have run out, and you will need to charge the device. You may have to turn it on while it is plugged in to the charger.

4: THERE ARE LIGHTS FLASHING ON MY DEVICE! WHAT DO THEY MEAN?

- The GREEN light flashes beneath the 'Power' button when the device is ON. It gives a double flash when the device is charging and a triple flash when the battery is low. In this case you will need to charge it – see the instruction sheet.
- The RED light flashes beneath the 'Volume up' button when the device is recording its position. An ORANGE light may flash as well. Hopefully, the red light will flash when you are travelling, as this means your trip information is being captured.

5: THERE ARE NON-FLASHING LIGHTS ON MY DEVICE. WHAT SHOULD I DO?

- If the RED light beneath the 'Volume up' button is permanently on, and isn't flashing, the device may have frozen. You will need to turn it off and back on again. To turn it off hold the 'Power' button for three seconds. Repeat this to turn it back on.
- If the BLUE light beneath the 'Volume down' `BT` button is permanently on, the device will still work properly but use a bit more battery power than normal. If this is a problem for you, call 877-221-7828 (toll-free call) and ask for Vivian Daigler for further instructions.

6: I HAVE LOST OR BROKEN MY DEVICE! IS THIS A PROBLEM?

The devices are valuable, and we hope that you will take good care of them. But we do realize that accidents happen, so the devices are fully insured. The devices can be damaged by exposure to heat (> 140°F) or water.

If you happen to lose a device, or think it has been damaged, please call NuStats at 877-221-7828 (toll-free call) and ask for Vivian Daigler as soon as possible. The sooner we can act to fix things the better! YOU WILL NOT BE LIABLE FOR ANY DAMAGE OR LOSS.

A daily record sheet was included with the GPS and RS materials.

<SAMPN>

Daily Record
Name: <RFNAM>

1. Please fill in this form for each date for **SEVEN (7)** consecutive days from the day you started the survey. For example, if the day you started the survey is October 6th, 2015, then the seventh day would be October 12th, 2015.
2. Fill out details for each day, even if you did not travel or use the device on that day, but make sure the date matches the day for which you are filling in the details.
3. Fill in Question 1 by ticking the option that best describes what happened on that day.
4. Fill in question 2 by ticking N/A if the battery did not run out or filling in the time of day when you noticed that the battery ran out.

QUESTION 1

	<ASSN>	<ASSN> +1	<ASSN> +2	<ASSN> +3	<ASSN> +4	<ASSN> +5	<ASSN> +6	<ASSN> +7	<ASSN> +8	<ASSN> +9

I didn't go out all day
Oops! I forgot to take my GPS with me today
I took the GPS with me for PART of the day
I took the GPS with me all day

QUESTION 2

The battery ran out today at approximately this hour...
(please write in just the hour and tick am or pm if the battery ran out)

N/A am pm (repeated for each day)

QUESTION 3

There was no car available for me to use today

No Car / Car (repeated for each day)

<SAMPN>

Daily Record
Name: <RFNAM>

1. Please fill in this form for each date for **SEVEN (7)** consecutive days from the day you started the survey. For example, if the day you started the survey is October 6th, 2015, then the seventh day would be October 12th, 2015.
2. Fill out details for each day, even if you did not travel or use the device on that day, but make sure the date matches the day for which you are filling in the details.
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Oops! I forgot to take my GPS with me today
I took the GPS with me for PART of the day
I took the GPS with me all day

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The battery ran out today at approximately this hour...
(please write in just the hour and tick am or pm if the battery ran out)

N/A am pm (repeated for each day)

QUESTION 3

There was no car available for me to use today

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Name: <RFNAM>

1. Please fill in this form for each date for **SEVEN (7)** consecutive days from the day you started the survey. For example, if the day you started the survey is October 6th, 2015, then the seventh day would be October 12th, 2015.
2. Fill out details for each day, even if you did not travel or use the device on that day, but make sure the date matches the day for which you are filling in the details.
3. Fill in Question 1 by ticking the option that best describes what happened on that day.
4. Fill in question 2 by ticking N/A if the battery did not run out or filling in the time of day when you noticed that the battery ran out.

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	<ASSN>	<ASSN> +1	<ASSN> +2	<ASSN> +3	<ASSN> +4	<ASSN> +5	<ASSN> +6	<ASSN> +7	<ASSN> +8	<ASSN> +9

I didn't go out all day
Oops! I forgot to take my GPS with me today
I took the GPS with me for PART of the day
I took the GPS with me all day

QUESTION 2

The battery ran out today at approximately this hour...
(please write in just the hour and tick am or pm if the battery ran out)

N/A am pm (repeated for each day)

QUESTION 3

There was no car available for me to use today

No Car / Car (repeated for each day)

Households that recruited via web and were GPS households, would be eligible for an additional $25 if they completed all steps of the survey as directed. This flyer was placed in with the GPS materials.

Since your household completed Step 1 (enroll in the survey) online, if you also complete Step 2 (report travel) online **AND** your entire household reports complete travel information in Step 2, you earn a $25 Amazon gift card, in addition to your GPS incentive!
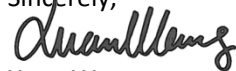
To be eligible for the full incentive: Go to **www.RTCSurvey.com**. Click "Report Travel" and **enter PIN: «PINNO»**
Each person should enter his/her own travel information. An adult can enter information for anyone under age 16.

As long as all household members report complete travel information and all GPS devices are returned, you will be eligible to receive the full incentive.

**Thank you for participating in the RTC Regional Household Travel Survey!**

Appendix G – RouteScout Survey Materials

RouteScout participating households were mailed a packet that included a cover letter, RouteScout instructions, a diary for each household member (found in Appendix E), daily record sheet (found in Appendix F), and a BRM (found in Appendix E). The cover letters were printed on RTC letterhead.

«RFNAM» «RLNAM»   MMDDYYYY
«HADDR» «HUNIT»
«HCITY», «HSTAT» «HZIP»

Thank you for participating in the RTC Regional Household Travel Survey! The information you provide will help the RTC to plan transportation projects. This includes new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads that improve safety and enhance quality of life in the Truckee Meadows area. This information also helps the RTC to program funding for transportation projects. We are offering households that are selected to use RouteScout $25 per smartphone (up to a maximum of three smartphones, or $75) once we receive travel information for **all** household members. This incentive is in the form of an Amazon gift card.

Step 1   **Complete the questionnaire enrolling your household in the travel survey.**

Next   **Record travel information in your Travel Diary:**

> For 24 hours on **«dow»**, **«TDAY»**.
> Enclosed is a Travel Diary for each person in your household. Each person should carry their Travel Diary for the assigned 24-hour period to record details about their travel and activities. We ask that an adult help anyone under age 16 fill out their Travel Diary.
> **RouteScout**: Use your smartphone with the RouteScout application turned on from **«TDAY» to «LastTravelDay»** as instructed in the enclosed "RouteScout Instructions." In order to keep your phone's battery from running out of power, please keep your phone plugged in whenever you have a power source available. **Remember, you also need to complete Step 2 to report your travel to receive your gift card!**

Step 2   **Report your travel information in ONE of the following ways:**

> **Online**: Go to **www.RTCSurvey.com**. Click "Report Travel" and **enter PIN: «PINNO»**
> Each person should enter his/her own travel information. An adult can enter information for anyone under age 16.
> **Mail**: Use the enclosed postage-paid envelope to return your completed travel diaries. If you choose this option, we may call you to clarify or collect any missing information.
> **Phone**: NuStats will call after your travel day to collect your household's travel information. Or, call toll-free 1-877-221-7828 to provide the information at your convenience.

The survey is being conducted for the RTC by NuStats, a professional survey firm. **All information collected will not be shared, will be held strictly confidential** and used only in combination with information provided from other participating households to the RTC.

If you have questions about the survey or how to participate, visit **www.RTCSurvey.com**, or call our toll-free survey hotline at 1-877-221-7828 (4pm–8pm PST weekdays and 12pm–6pm PST Saturdays).

Thank you again for providing the details that will help improve transportation choices for the region.

Sincerely,

Xuan Wang
RTC Project Manager
www.rtcwashoe.com

Households that recruited via web and were RS households, would be eligible for an additional $25 if they completed all steps of the survey as directed. This flyer was placed in with the RS materials.

REGIONAL TRANSPORTATION COMMISSION
Metropolitan Planning • Public Transportation & Operations • Engineering & Construction
Metropolitan Planning Organization of Washoe County, Nevada

Since your household completed Step 1 (enroll in the survey) online, if you also complete Step 2 (report travel) online **AND** your entire household reports complete travel information in Step 2, you earn a $25 Amazon gift card, in addition to your RouteScout incentive!

To be eligible for the full incentive: Go to <u>www.RTCSurvey.com</u>. Click "Report Travel" and **enter PIN: «PINNO»**
Each person should enter his/her own travel information. An adult can enter information for anyone under age 16.

As long as all household members report complete travel information, you will be eligible to receive the full incentive.

Thank you for participating in the RTC Regional Household Travel Survey!

Households participating utilizing RouteScout technology were mailed a instruction sheets for both iOS and Android devices as part of their materials. Presented here is the iOS instruction sheet.

Instructions for Download and Use of RouteScout – iOS Devices

1) Open the app store on your phone.

2) Search for "routescout". This is not case sensitive, but be sure to use one word instead of two. When you find the RouteScout application by NuStats, LLC, press the GET button and tap the button again to INSTALL the application.
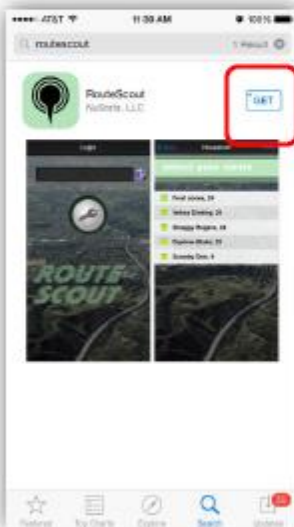
3) The RouteScout icon should now be on the last page of your home screen. Open the RouteScout app.

4) You will see a message that reads "Allow 'RouteScout' to access your location even when you are not using the app? Your location is needed for this app." In order for your travel data to be collected for the survey, you will need to allow this. Select "Allow"
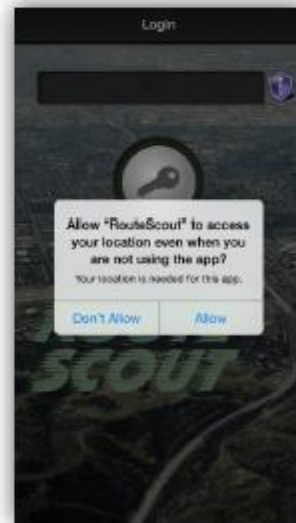
5) Enter the PIN that you were given and press the circular key button to log in.

6) Select your name from a list of your household members and press the "Enter" button at the top right corner of the screen.

7) Press the green circle to begin recording your travel data.

8) While recording, you will see a blue dot that represents your current location and a blue line that represents your travel history. Please leave the application on in the background during your entire assigned travel period (seven days). If you accidentally close the application, please reopen the app, log in, and resume recording your travel data by following steps 3-7.

9) At the end of your travel period, please stop recording by pressing the "Stop" button at the top of the map page. When prompted, press "Stop Trip". This will ensure that the rest of your travel data is sent to the surveyors.
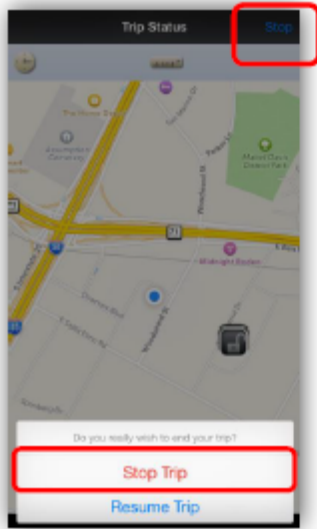
For assistance with these instructions, please contact:

Brett Davis
bdavis@nustats.com

For immediate support please text, then call after one hour if you do not receive a response:
512-695-8141

Appendix H – Reminder Script

Hi, this is _____ with the Washoe County Travel Characteristics Study. May I speak to ?

IF RESPONDENT ON PHONE:

I am calling to remind you that your household will be participating in the Washoe County Travel Characteristics Study and also to see if you had any questions about the study.

Please keep in mind that each member of your household must record all their trips and activities on_____ This will help improve transportation in your area.

Did you get the materials [if gps: including the gps devices] we sent you?

[IF YES] Do you have any questions for me?

[IF NO and DIARY OR RS]

Your participation is very important, could you download your travel diaries and from the project website?

The site address is: www.rtcsurvey.com

NOTE 1: IF RESPONDENT CAN'T DOWNLOAD FROM WEBSITE: We suggest jotting down the places you go that day, including complete addresses, and accurate arrival and departure times, as well as how you got there and the activities you did when you arrived .

NOTE 2: REMAIL MATERIALS IF NEEDED

IF REFUSE: Let me assure you that your information is confidential and used only for research purposes.

IF NEEDED: We would really like to include your household in this important project.

[IF NO and GPS]

RESCHEDULE TRAVEL DAY AND MAIL ANOTHER GPS PACKAGE.

This is a reminder to report your travel information the day after your travel day. And you have the option to report the information by phone or web. Again, the project website is rtcsurvey.com

Your pin number is _____

Have a nice day.

Reminder Message

Hello, my name is ___ and I'm calling with the Washoe County Travel Characteristics Study, regarding the Travel Survey your household is participating in on _____ .

I am calling to remind you that tomorrow is the day that each member of your household will record their trips in the travel logs we sent. If you have any questions please call 1-877-221-7828.

Appendix I – Pre-Paid Incentive Letter and Follow up Letter

REGIONAL TRANSPORTATION COMMISSION
Metropolitan Planning • Public Transportation & Operations • Engineering & Construction
Metropolitan Planning Organization of Washoe County, Nevada

December 17, 2015

«RFNAM» «RLNAM»
«HADDR» «HSUIT»
«HCITY», «HSTAT» «HZIP»

Dear «RFNAM»,

Your household has been selected to participate in the RTC Regional Household Travel Survey! This survey will collect data about where families go and how they get there. Your RTC will use the information to plan projects such as new roads, transit services, bike lanes, sidewalks, and maintenance on existing roads to enhance quality of life in the Truckee Meadows.

Participation is easy and only takes about 15 minutes! Enclosed is a $5.00 bill to thank you and your family for participating. Households that have been selected to participate utilizing GPS technology, or households that choose to complete the steps of enrolling in the study and reporting travel via web, may be eligible for additional incentives. We value your input, no matter how much or how little you travel! To enroll in the survey, please choose one of the following options:

- Go to www.RTCSurvey.com; Select "Enroll in the Survey", enter your PIN: «PINNO», then click "Start Survey"
- Scan the QR code; tap the Menu icon ☰ , select "Enroll in the Survey", enter your PIN: «PINNO», then tap "Start Survey"

- **OR** Call NuStats at (877) 221-7828 to speak with a telephone interviewer, who will enroll your household in the survey over the phone

RTC is reaching out to all types of households in the region to better meet the needs of our community. Your household's participation is very important. Your voice is necessary to help us meet our community's transportation needs! Please provide candid responses to survey questions. **Your privacy is critical to the survey. Your information will not be shared. All information provided will be held in strict confidence.**

View a TV interview about the survey with Joe Harrington, RTC Public Information Officer.

For more information about incentives, the study, or participation in the survey, please call (877) 221-7828.

Sincerely,

Xuan Wang
RTC Project Manager
www.rtcwashoe.com

REGIONAL TRANSPORTATION COMMISSION

Metropolitan Planning • Public Transportation & Operations • Engineering & Construction

Metropolitan Planning Organization of Washoe County, Nevada

January 7, 2016

«RFNAM» «RLNAM»
«HADDR» «HSUIT»
«HCITY», «HSTAT» «HZIP»

Dear «RFNAM»,

A few weeks ago, your household was notified you had been selected to participate in the RTC Regional Household Travel Survey. This letter was accompanied by a $5.00 bill to thank you and your family in advance for participating. We will continue to enroll households through January 19th, but after that date will not be enrolling further households. Please follow the instructions below to enroll prior to January 19, 2016!

Participation is easy and only takes about 15 minutes! Households that have been selected to participate utilizing GPS technology, or households that choose to complete the steps of enrolling in the study and reporting travel via web, may be eligible for additional incentives. We value your input, no matter how much or how little you travel. To enroll in the survey, please choose one of the following options:

- Go to www.RTCSurvey.com; Select "Enroll in the Survey", enter your PIN: «PINNO», then click "Start Survey"
- Scan the QR code; tap the Menu icon ☰ , select "Enroll in the Survey", enter your PIN: «PINNO», then tap "Start Survey"

- **OR** Call NuStats at (877) 221-7828 to speak with a telephone interviewer, who will enroll your household in the survey over the phone

RTC is reaching out to all types of households in the region to better meet the needs of our community. Your household's participation is very important. Your voice is necessary to help us meet our community's transportation needs! Please provide candid responses to survey questions. **Your privacy is critical to the survey. Your information will not be shared. All information provided will be held in strict confidence.**

View a TV interview about the survey with Joe Harrington, RTC Public Information Officer.

For more information about incentives, the study, or participation in the survey, please call (877) 221-7828.

Sincerely,

Xuan Wang
RTC Project Manager
www.rtcwashoe.com

Visitor Survey

Final Report

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As may be seen in Table 1, a total of 421 interviews were conducted. Of these, 354 were completed by short-term visitors and 67 were completed by long-term visitors (staying 7 or more days in the area). Table 1: Survey Outcomes by Length of Visit 2

1.0   Introduction

This report documents the design, implementation, and results of the Washoe County Travel Characteristics Study - Visitor Travel Survey, sponsored by the Regional Transportation Commission (RTC), which serves as the Metropolitan Planning Organization for the Reno/Sparks, Nevada region. The RTC Visitor Survey was intended to capture accurate and reliable travel behaviors of visitors, who stayed overnight, in the Reno/Sparks area. The visitor survey data collection combined with Kimley Horn's familiarity with travel modeling provided RTC with the necessary data to support the visitor travel component of RTC's Travel Demand Model.

According to the Reno/Sparks Convention and Visitors Authority, an estimated 4.6 million visitors traveled to the Reno/Sparks and Washoe County area in 2014. The importance of the Visitor Survey provided insight into visitors of the region and described who they were, what motivated them to travel to the region, and their activity-based travel patterns throughout the area.

The Visitor Travel Survey was conducted in February and October 2016, and it complements a Household Travel Behavior Survey and On-Board Transit Survey. RTC contracted with NuStats for the design and implementation of the suite of travel surveys. Subcontractors to NuStats for the Visitor Travel Survey included Reno-based firm Coulter & Associates, Kimley Horn and Associates, and temporary local field staff provided through A+ Staffing.

1.1   Purpose of the Survey

The purpose of the Visitor Travel Survey was to obtain accurate information on regional travel characteristics in order to develop and calibrate the regional travel demand model. The survey focused on travel by visitors staying at least 24 hours in the area and with at least one overnight stay.

1.2   Survey Design

The Visitor Travel Survey was conducted as an interviewer-mediated intercept survey utilizing NuStats' tablet application.

Visitors were interviewed at local venues, including hotels, casinos, resorts, and other activity centers. In total, 13 survey sites were selected, representing a range of locations that would be frequented by visitors to the area. Sites were surveyed at various hours, dependent upon the hours of operation at the location. Interviews were conducted with visitors, residing outside Washoe County and that had been in the region for at least 24 hours. Only one person per traveling party was eligible to respond. The data elements included characteristics of the visit, of the traveling party, of trips taken while visiting the study area, and an estimate of how much money the respondent anticipated spending while in the study area. Because the sample was a "choice" sample and not probability sample, the resulting data set was neither weighted nor expanded to reflect population parameters.

1.3   Survey Summary Outcomes

As may be seen in Table 1, a total of 421 interviews were conducted. Of these, 354 were completed by short-term visitors and 67 were completed by long-term visitors (staying 7 or more days in the area). Table 1: Survey Outcomes by Length of Visit

Length of Visit	Count	Percentage	Average (days)
Short-term (1-6 days)	354	84.1%	3.1
Long-term (7+ days)	67	15.9%	26.2
Total	421	100.0%	6.8

2.0 Survey Methods

2.1 Survey Content

The tablet program utilized for the RTC Visitor Travel Survey is a maps-based intercept survey that geocodes all locations as they are entered. It allowed for real-time data review with the respondents to validate their data. To improve the efficiency and quality of data collected, a drop-down menu of the local hotels was programmed to make input of the lodging data easy and consistent. Additionally, the program utilized text box pop-ups to provide additional information when needed.

The average completion time for the RTC Visitor Travel Survey was ten minutes. During the interview process, 100 percent of the spatial data were reviewed by a highly trained interviewer to detect issues with the data. This real-time quality control allowed the interviewer to document atypical travel behavior, which provided RTC with accurate and model-ready data. The application collected the following key variables:

- Respondent characteristics (gender, household income, age, and home location);
- Length of visit;
- Visit purpose;
- Traveling party size and characteristics;
- Lodging location and type;
- Travel modes to Washoe County;
- Primary travel mode while visiting Washoe County;
- Geocoding of all locations (home, lodging, and all destinations);
- Anticipated amount of money to be spent while in the region; and
- Trip characteristics for one day (including destinations, activities, activity durations, and mode).

The complete Visitor Travel Survey questionnaire may be found in Appendix A - Visitor Survey Questionnaire.

2.2 Tablet Interviewing Application

The visitor survey application is NuStats' proprietary application that was developed in-house, and modified specific to the needs of the RTC Visitor Survey. The application was programmed with a random generator in which the surveyor keyed in the number of possible interviewees and instructed the surveyor which visitor to approach to conduct the survey. The application is capable of performing real-time geocoding so that locations were collected and validated by the visitor while they were being interviewed.

The application was rigorously tested throughout development following the items found in the next section. Some points of note are:

- **Rapid data collection** – Use of the tablet platform enabled faster and more efficient survey completion, significantly boosting the number of completes per hour.
- **Offline data collection** – All operations of the survey application were fully functional while offline. The application incorporated an internal database system capable of collecting unlimited surveys while offline for later uploading once data connection was restored.

- **Custom client branding** – The application was customized with RTC's branding and identity information, ensuring that respondents were at ease knowing their answers were given in service of the local community.
- **Sophisticated survey logic** – The system was developed to support the needs of sophisticated modern survey methodologies, including branching and skip logic.

An example of the screen with the drop down menu of Reno area hotels is presented in Figure 1.

Figure 1: Drop Down Menu Screen
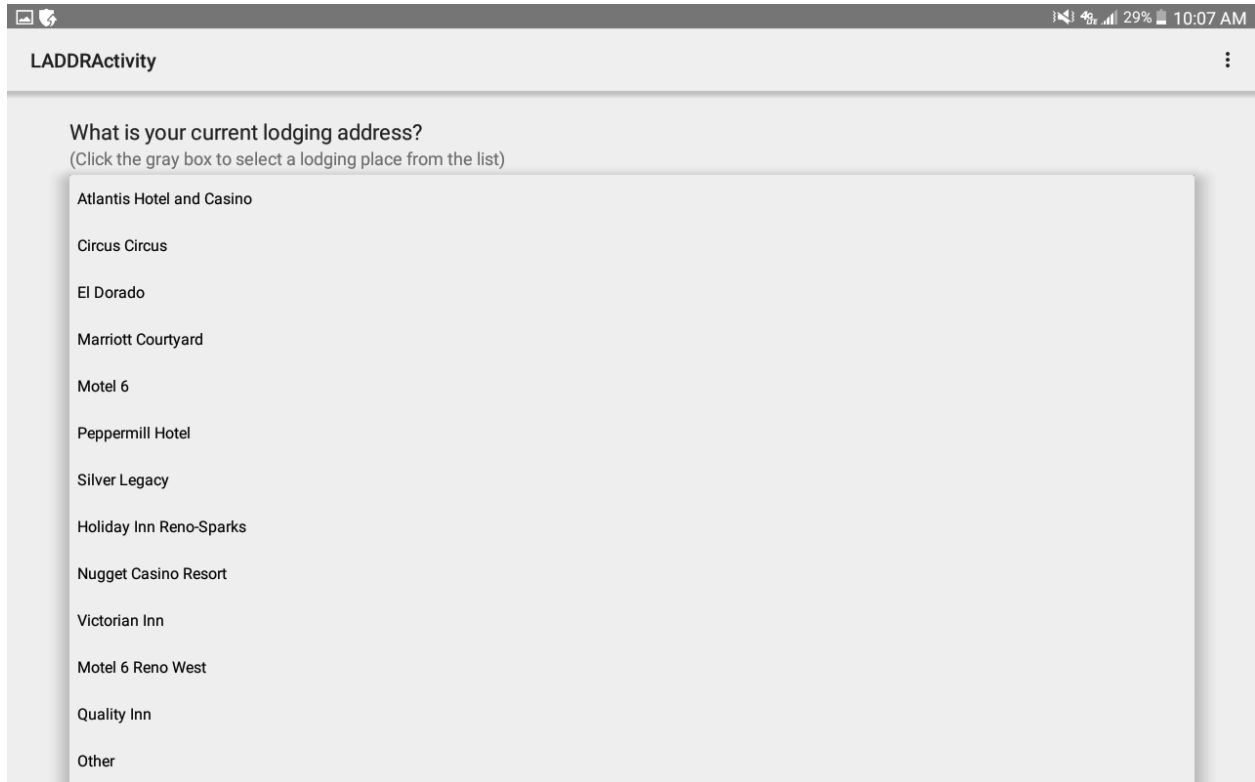
2.3   Item Response

Item nonresponse refers to the failure of respondents to answer individual survey questions. The level of item nonresponse provides a measure of survey data quality. Table 2 presents the level of response for each questionnaire item in the Visitor Survey. The base represents the total number of interviews conducted or, for the last 5 items, the total number of trips recorded. The item of highest nonresponse was "trip arrival times", at 74 percent of respondents proving an answer to this item.

Table 2: Key Survey Item Response Rate

Question Description	Base	Frequency	Response Rate
Respondent Gender	421	420	100%
Respondent Age	421	409	97%
Household Income	421	349	83%
Home State	421	405	96%
Length of Visit	421	421	100%
Visit Purpose	421	421	100%
Planned Spending During Visit	421	348	83%
Lodging Location*	421	364	86%
Travel Mode to County	421	421	100%
Mode of Travel to Lodging Site	421	421	100%
Trip Arrival Times	744	547	74%
Trip Departure Times	744	702	94%
Activities at Locations	744	662	89%
Travel Mode	744	676	91%
Number in Traveling Party	744	659	89%

*Includes only lodging locations with a confirmed, geocodeable address*

2.4   Sample Design

The Visitor Travel Survey involved interviews at 13 sites in Washoe County. NuStats selected the interviewing sites with input from subcontractor Coulter & Associates and RTC. Following site selection, Bobbi Coulter (Coulter & Associates) secured the permission to survey and made other necessary arrangements for the site-specific survey activities. Table 3 displays the survey site locations, and Figure 2 shows a map of those locations.

Table 3: Interviewing Sites

Site	Timeframe Surveyed
Atlantis Hotel & Casino	Spring 2016
Best Western Airport Plaza Hotel	Spring 2016
Circus Circus	Spring 2016
The Diamond Casino	Fall 2016
El Dorado	Spring 2016
Grand Sierra Resort	Fall 2016
Harrah's	Fall 2016
Marriott Courtyard	Spring 2016
National Automobile Museum	Fall 2016
Nugget Casino Resort	Spring 2016
Sands Regency	Fall 2016
Silver Legacy	Spring 2016
Whitney Peak Hotel - PILOT SURVEY	Spring 2016

Figure 2: Survey Locations
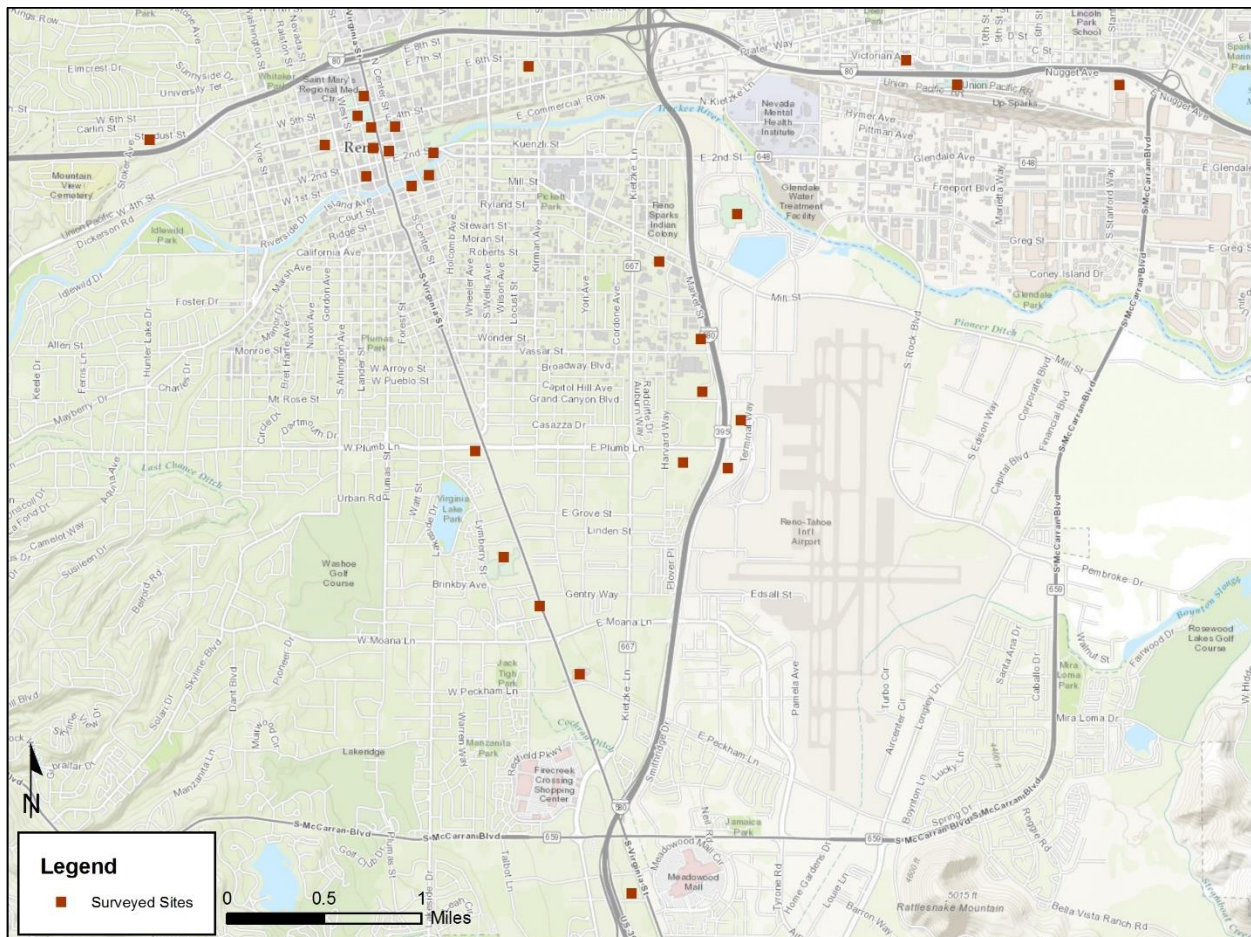
2.5 Data Collection Procedures

The primary focus of the survey was to capture information about visitors to the county, the characteristics of their visit, and the characteristics of their travel while in the county. Respondents were eligible to be interviewed if they had been in the county for at least 24 hours, and were at least 18 years of age. Multiple screening questions were used to assess respondent eligibility:

• Have you been in the Reno area for at least 24 hours?
• Are you 18 or older?

Visitors were asked general questions about their visit to the county. Then, they were asked about the places that they traveled to in the previous 24 hours. Interviewers captured all locations reported by respondents.

The interviews were conducted using surveyors from A+ Staffing and NuStats. NuStats conducted an in-depth training session with surveyors assigned to the project prior to them entering the field. The surveyor training session involved advising surveyors of the study purpose, fully acquainting them with the survey instrument (review of all questions and intended responses), and instructing them in how to enter data using the application. Survey data was uploaded data daily from the tablets through an FTP site. Uploaded records were reviewed by a NuStats analyst for completeness and then run through rigorous data editing and cleaning processes.

2.6 Data Editing and Cleaning

Once surveying has been completed, the dataset is exported from the project website to be verified. This process begins with reviewing all surveys to ensure the proper data were collected. Range and spelling queries are executed on the entire file. The interview data are then committed into a master database. The master database is then reviewed, edited, and corrected using manual and automated edit checks. When conducting the checks, outlying values that are illogical were identified, and inconsistent data corrected when possible.

2.7 Geocoding

Visited locations were geocoded to coordinates in real time as the survey was taking place. The surveyor was able to either enter a place name or address and search for the location on the map page, which incorporated the Google Maps API, or they could touch the location on the map to get the coordinates. NuStats utilized the tablet application to collect the spatial data. This program improved the efficiency and quality of collected activity data because it allows for the data to be reviewed in real-time with the respondent to validate their places. During the interview process, 100 percent of the spatial data was reviewed by a highly trained tablet interviewer to detect issues with the data, such as unreasonable walking distances or illogical arrival times for next locations.

The address collection pages of the application used the Google Maps API to search for and geocode a location. The place name, cross-streets, or address can be entered into the search bar, and as the surveyor types, a list of suggested entries pops up below the search bar for the surveyor to select. These suggestions are based on the physical location of the tablet and list closest matching entries at the top so as to reduce

selection of incorrect out-of-area places with the same name. Once selected, the location's name, address, and coordinates are recorded. Recorded address details include:

- address
  - street number
  - street prefix
  - street pre-type
  - street name
  - street suffix
- suite
- city
- state
- zip code

3.0   Results

This section provides the results of 421 interviews with visitors to the Reno/Sparks region conducted in February and October of 2016. Many of these results utilize the terms short-term visitors and long-term visitors. Short-term visitors were defined as those persons staying a minimum of 24 hours up to six days in Washoe County, and long-term visitors were defined as those staying from seven or more days.
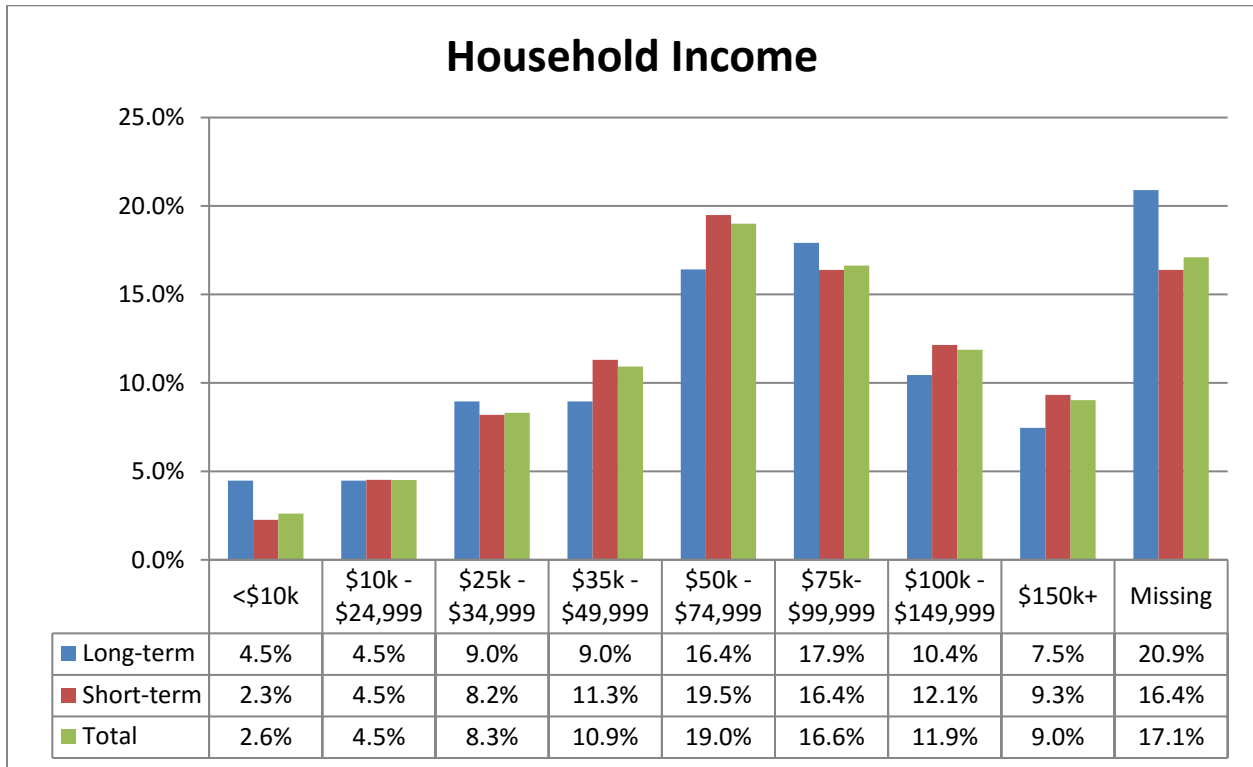
3.1   Visitor Characteristics

Presented in Table 4 are the results from the age and gender questions in the survey. Of the 421 completed surveys, 58 percent (244) reported their gender as male. The group that completed the most surveys was male in the 45-54 year old age group.

Table 4: Visitor – Age and Gender

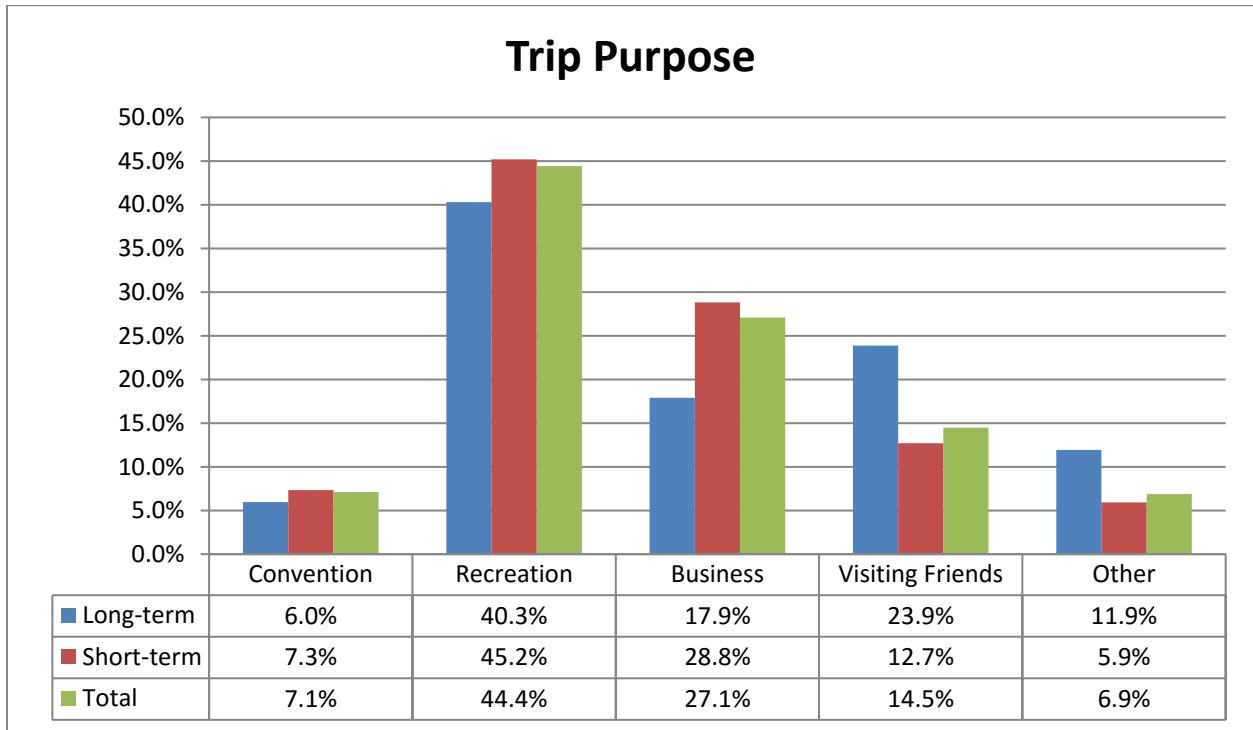| Age	Count Male 2016	Count Female 2016	Refused Gender
Less than 18	0	0	0
18 – 24	9	14	0
25 – 34	43	27	0
35 – 44	48	37	0
45 – 54	50	47	0
55 – 64	49	22	0
65 and over	39	23	1
Refused Age	6	6	0
Total	244	176	1
Grand Total	421		

Household income is one of the most challenging questions to gain a response from during an interview. The average household income of respondents that answered this question was reported as being in the $50,000 to $74,999 range. Seventeen percent of respondents did not answer this question. The results are displayed in Figure 3.

Figure 3: Visitor - Household Income

Household Income

	<$10k	$10k - $24,999	$25k - $34,999	$35k - $49,999	$50k - $74,999	$75k- $99,999	$100k - $149,999	$150k+	Missing
■ Long-term	4.5%	4.5%	9.0%	9.0%	16.4%	17.9%	10.4%	7.5%	20.9%
■ Short-term	2.3%	4.5%	8.2%	11.3%	19.5%	16.4%	12.1%	9.3%	16.4%
■ Total	2.6%	4.5%	8.3%	10.9%	19.0%	16.6%	11.9%	9.0%	17.1%

As is shown in Figure 4, 44 percent of visitors interviewed traveled to the Reno/Sparks region for recreation. The trip purpose reported the least was "Other", which showed slightly less than seven percent of those interviewed traveled to the Reno/Sparks region for purposes other than Convention, Recreation, Business, or Visiting Friends.

Figure 4: Visitor - Trip Purpose

Trip Purpose

	Convention	Recreation	Business	Visiting Friends	Other
Long-term	6.0%	40.3%	17.9%	23.9%	11.9%
Short-term	7.3%	45.2%	28.8%	12.7%	5.9%
Total	7.1%	44.4%	27.1%	14.5%	6.9%

With regard to travel party size, a total of 791 individuals were counted in the travel parties of the 317 interviews that provided the data. Of these, 747 were age 18 or older, and the remaining 44 were less than 18 years of age. Business travelers were not asked how many individuals below the age of 18 were in their traveling party. The average travel party size was 2.5 persons. The results are shown in Table 5.

Table 5: Visitor Travel Party Members

Type	Count – Age 18 and above	Count – Under Age 18	Percent – Under Age 18
Business	296	0*	0%
Family	451	44	10%
Total	747	44	6%

Question not asked of business travelers

As shown in Table 6, all of the visitor's home residences were in the United States. Of all U.S.-based visitors interviewed, most were from California (nearly 46 percent), Nevada (8 percent) or Texas (6 percent). A total of 41 states were represented among the visitor sample.

Table 6: Visitor Home State

State	Short-term		Long-term		Total	
	Freq.	%	Freq.	%	Freq.	%
California	152	45.6%	19	31.1%	171	43.4%
Nevada	25	7.5%	3	4.9%	28	7.1%
Texas	21	6.3%	1	1.6%	22	5.6%
Oregon	15	4.5%	3	4.9%	18	4.6%
Washington	12	3.6%	5	8.2%	17	4.3%
Utah	12	3.6%	2	3.3%	14	3.6%
Colorado	13	3.9%	1	1.6%	14	3.6%
Illinois	9	2.7%	1	1.6%	10	2.5%
Arizona	6	1.8%	3	4.9%	9	2.3%
Florida	2	0.6%	5	8.2%	7	1.8%
Idaho	6	1.8%	0	0.0%	6	1.5%
Missouri	6	1.8%	0	0.0%	6	1.5%
New York	6	1.8%	0	0.0%	6	1.5%
Nebraska	5	1.5%	0	0.0%	5	1.3%
Virginia	3	0.9%	2	3.3%	5	1.3%
Ohio	2	0.6%	2	3.3%	4	1.0%
Pennsylvania	2	0.6%	2	3.3%	4	1.0%
Kansas	2	0.6%	2	3.3%	4	1.0%
Arkansas	3	0.9%	0	0.0%	3	0.8%
Georgia	2	0.6%	1	1.6%	3	0.8%
Iowa	3	0.9%	0	0.0%	3	0.8%
Louisiana	2	0.6%	1	1.6%	3	0.8%
Massachusetts	3	0.9%	0	0.0%	3	0.8%
Michigan	3	0.9%	0	0.0%	3	0.8%
Oklahoma	3	0.9%	0	0.0%	3	0.8%
Not-stated*	1	0.3%	1	1.6%	2	0.5%
Alaska	1	0.3%	1	1.6%	2	0.5%
Kentucky	2	0.6%	0	0.0%	2	0.5%
North Carolina	2	0.6%	0	0.0%	2	0.5%

State	Short-term		Long-term		Total	
	Freq.	%	Freq.	%	Freq.	%
New Jersey	1	0.3%	1	1.6%	2	0.5%
Wisconsin	1	0.3%	1	1.6%	2	0.5%
West Virginia	1	0.3%	1	1.6%	2	0.5%
Alabama	1	0.3%	0	0.0%	1	0.3%
Hawaii	0	0.0%	1	1.6%	1	0.3%
Indiana	0	0.0%	1	1.6%	1	0.3%
Minnesota	1	0.3%	0	0.0%	1	0.3%
New Mexico	0	0.0%	1	1.6%	1	0.3%
South Carolina	1	0.3%	0	0.0%	1	0.3%
South Dakota	1	0.3%	0	0.0%	1	0.3%
Vermont	1	0.3%	0	0.0%	1	0.3%
Wyoming	1	0.3%	0	0.0%	1	0.3%
District of Columbia					1	0.3%
Florida					6	1.6%
Mississippi					1	0.3%
Montana					2	0.5%
New Hampshire					1	0.3%
Tennessee					2	0.5%
Total**	333	100.0%	61	100.0%	394	100.0%

A full home address was not obtained from two respondents

**Totals may not be exact due to rounding*

When asked where visitors stayed while in the Reno/Sparks region, a total of 37 different lodging names were reported. Hotels and casino resorts were the most common choice of lodging among respondents. Of 382 responses, 62 (16%) respondents stayed at the Peppermill Resort Hotel. Other popular choices were Circus Circus Reno Hotel & Casino (14 percent), and Whitney Peak Hotel (9 percent). The breakdown by lodging site name is shown in Table 7.

Table 7: Visitor Lodging Location

Lodging Site Name	Frequency	Percentage
Atlantis Casino Resort Spa	34	8.9%
Best Western Airport	2	0.5%
Circus Circus Reno Hotel & Casino	52	13.6%
Condo Rental	1	0.3%
Econo Lodge	1	0.3%
El Dorado	21	5.5%
Family/Friends	12	3.1%
Gold Ranch RV Resort	1	0.3%
Grand Sierra Resort And Casino	9	2.4%
Harrah's Reno Hotel & Casino	22	5.8%
Holiday Inn Express	3	0.8%
Holiday Inn Reno-Sparks	5	1.3%
Hotel El Cortez	1	0.3%
Hyatt Place	9	2.4%
La Quinta	3	0.8%
Marriott	1	0.3%
Marriott Courtyard	18	4.7%
Motel 6	13	3.4%
Nugget Casino Resort	31	8.1%
Peppermill Resort Hotel	62	16.2%
Quality Inn	2	0.5%
Ramada	1	0.3%
Sands Regency	12	3.1%
Siegel Suites	1	0.3%
Siena Hotel	1	0.3%
Silver Legacy Resort & Casino	23	6.0%
Thunderbird Timeshare	1	0.3%
University Of Nevada Reno	2	0.5%
Vagabond Inn	1	0.3%
Victorian Inn	1	0.3%
Whitney Peak Hotel	36	9.4%
Total	**382**	**100.0%**

The majority of visitors to the Reno/Sparks region stay two to three days. Of the 421 respondents, 113 reported they stayed for two days, and 93 reported they stayed for three days. Visitors reporting they stayed longer than seven days totaled 41. The length of stay results are shown in Table 8.

Table 8: Visitor Length of Stay

Number of Days	Count	Percentage
1	27	6.4%
2	113	26.8%
3	93	22.1%
4	58	13.8%
5	47	11.2%
6	16	3.8%
7	26	6.2%
8	3	0.7%
9	1	0.2%
10	4	1.0%
12	3	0.7%
14	13	3.1%
15	1	0.2%
15	1	0.2%
>=20	16	3.6%
Total	421	100%

3.2 Travel Behavior To and Within the Reno/Sparks Region

The most popular mode of travel to the Reno/Sparks region was air travel. More than 40 percent of all visitors who were surveyed used air travel as their mode of transportation to Reno/Sparks. The next most popular mode was as the driver of an auto, van, or truck, followed by passenger of an auto, van, or truck. The least popular mode of travel to the Reno/Sparks region was walking, which only one respondent indicated walking as their mode of travel. These results are presented in Table 9.

Table 9: Mode of Travel to Reno/Sparks Region

Mode	Count	Percentage
Walk	1	0.2%
Auto/Van/Truck Driver	121	28.7%
Auto/Van/Truck Passenger	60	14.3%
Carpool/Vanpool	20	4.8%
Motorcycle/Scooter/Moped	3	0.7%
Taxi/Hired Car/Limo	3	0.7%
Rental Car/Vehicle	12	2.9%
Private shuttle (SuperShuttle, employer, hotel, etc.)	2	0.5%
Greyhound Bus	12	2.9%

Airplane	172	40.9%
Amtrak	15	3.6%
Total	421	100.0%

When asked what mode of travel was used to arrive at their lodging site, 39 percent of respondents answered they traveled by auto, van, or truck as the driver, with an additional 12 percent of respondents stating they traveled by auto, van or truck as the passenger. Table 10 presents the breakdown of travel mode to lodging site.

Table 10: Mode of Travel to Lodging Site

Mode	Count	Percentage
Walk	20	4.8%
Auto/Van/Truck Driver	166	39.4%
Auto/Van/Truck Passenger	51	12.1%
Carpool/Vanpool	25	5.9%
Motorcycle/Scooter/Moped	3	0.7%
Taxi/Hired Car/Limo	45	10.7%
Rental Car/Vehicle	57	13.5%
Private shuttle (SuperShuttle, employer, hotel, etc.)	31	7.4%
Greyhound Bus	3	0.7%
Airplane	1	0.2%
Other Private Transit, please specify	4	1.0%
RTC Ride	4	1.0%
Amtrak	2	0.5%
Other	10	2.4%
Total	**421**	**100%**

One element that the RTC was interested in collecting for 2016 was an estimate of how much money visitors expected to spend on their trip to the region. Seventeen percent of those surveyed answered either that they didn't know how much they would spend, or they refused to answer the question. Of the remaining 83 percent that answered the question, 29 percent expected to spend between $0 and $499, and 25 percent expected to spend between $500 and $999. A total of 29 percent of respondents reported they expected to spend $1,000 or more. The results are shown in Figure 5.

Figure 5: Expected Spending During Visit

Expected Spending During Visit

	$0 - $499	$500 - $999	$1,000 - $2,499	$2,500 - $4,999	$5,000 - $9,999	$10k - $24,999	$25k - $49,999	$50k - $74,999	Don't Know/ Refused
Long-term	14.9%	14.9%	9.0%	11.9%	11.9%	3.0%	1.5%	0.0%	32.8%
Short-term	31.6%	27.1%	19.2%	5.1%	1.4%	0.6%	0.3%	0.3%	14.4%
Total	29.0%	25.2%	17.6%	6.2%	3.1%	1.0%	0.5%	0.2%	17.3%
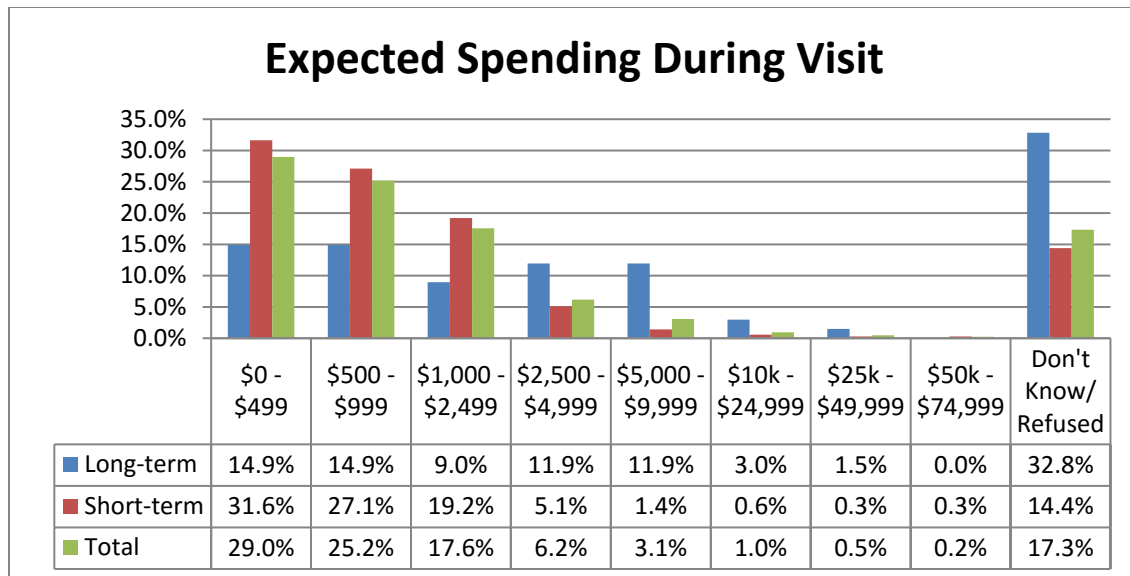
When asked to name the places that were visited by respondents within the previous 24 hours, a total of 638 responses were collected. Only the top 35 places (385 responses) were included in the analysis. Places named as being visited by less than four respondents were not included. Table 11 presents the results of the top 35 places reported as being visited in the previous 24 hours. Casino resort hotels were the most popular destination with a total of 35 percent of respondents reporting having visited one in the previous 24 hours. Places recognized as casino resort hotels are shaded in light blue in the table.

On an individual basis, the Silver Legacy Resort & Casino is shown as the place having the highest number of visits.

Table 11: Places Visited in Previous 24 Hours

Place Name	Frequency	Percentage
Silver Legacy Resort & Casino	65	10.2%
Atlantis Casino Resort Spa	33	5.20%
Circus Circus Reno Hotel & Casino	22	3.40%
Peppermill Resort Spa Casino Hotel	22	3.40%
Grand Sierra Resort And Casino	21	3.30%
Eldorado Resort Casino	17	2.70%
Harrah's Reno Hotel & Casino	17	2.70%
University Of Nevada Reno	16	2.50%
Nugget Casino Resort	14	2.20%
Meadowood Mall	13	2.00%
Automobile Museum	10	1.60%
Century Riverside	10	1.60%
Reno-Sparks Convention Center	10	1.60%

Place Name	Frequency	Percentage
Sparks Marina	10	1.60%
Cargo : Whitney Peak Hotel	8	1.30%
Club Cal Neva Hotel and Casino	8	1.30%
Reno Events Center	8	1.30%
The Outlets At Sparks	8	1.30%
McDonald's	7	1.10%
Reno Ballroom	7	1.10%
Renown Regional Medical Center	7	1.10%
Residential	6	0.90%
Nevada Discovery Museum	5	0.80%
Nevada Museum Of Art	5	0.80%
Great Basin Brewing Company	4	0.60%
Petco	4	0.60%
Reno Koa At Boomtown	4	0.60%
Sands Regency	4	0.60%
Sparks Marina Park	4	0.60%
Starbucks	4	0.60%
Toque De Mexico	4	0.60%
VA Medical Ctr-Sierra	4	0.60%
Walmart	4	0.60%
Total	385	60.30%

Includes only the top 35 locations of the 638 trips recorded with a valid location name.

The following maps present the places visited in progressively larger scales.

Figure 6: Places Visited Overview

Figure 7: Places Visited 1:10 Scale
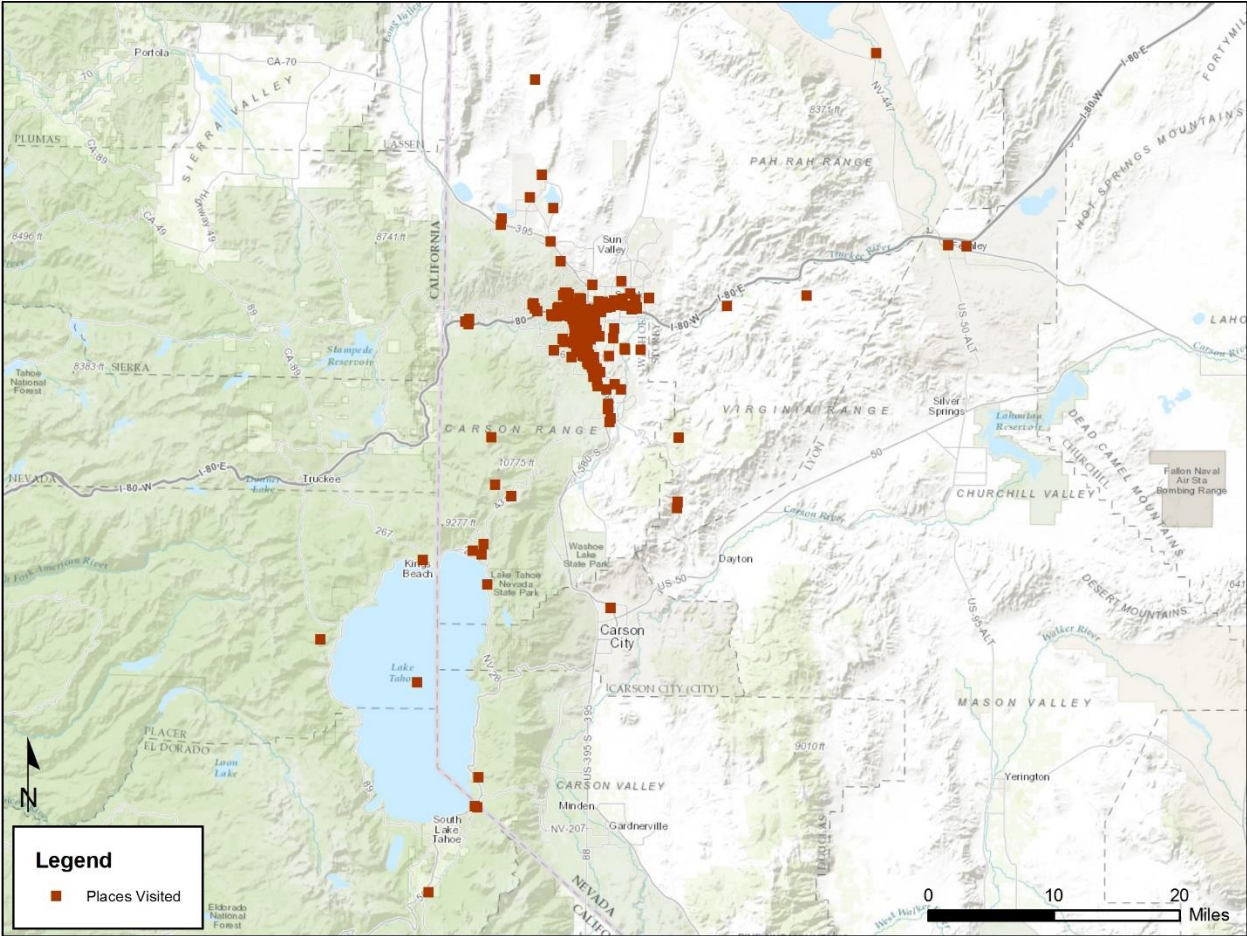
Figure 8: Places Visited 1:1.5 Scale
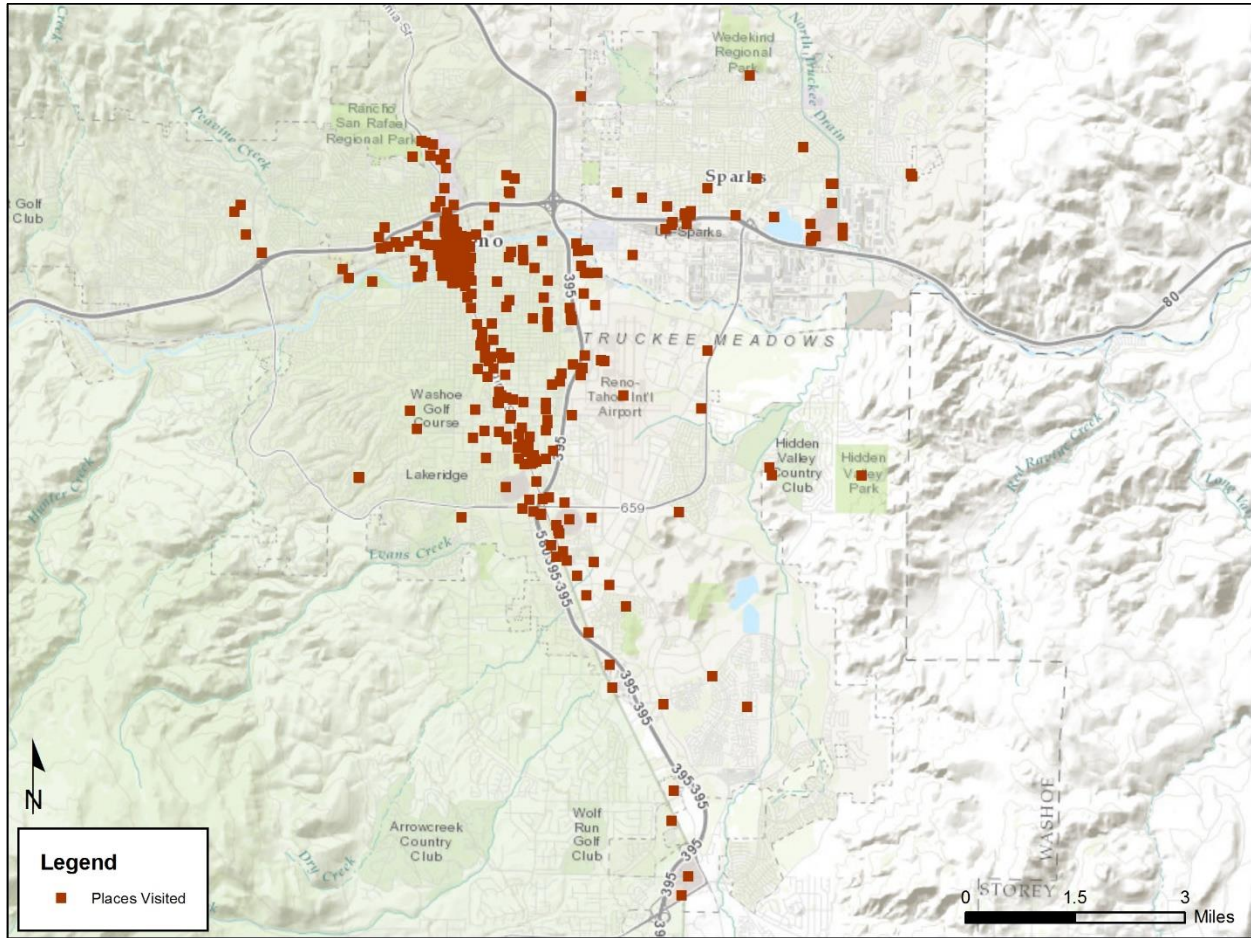
Figure 9: Places Visited 1:.5 Scale
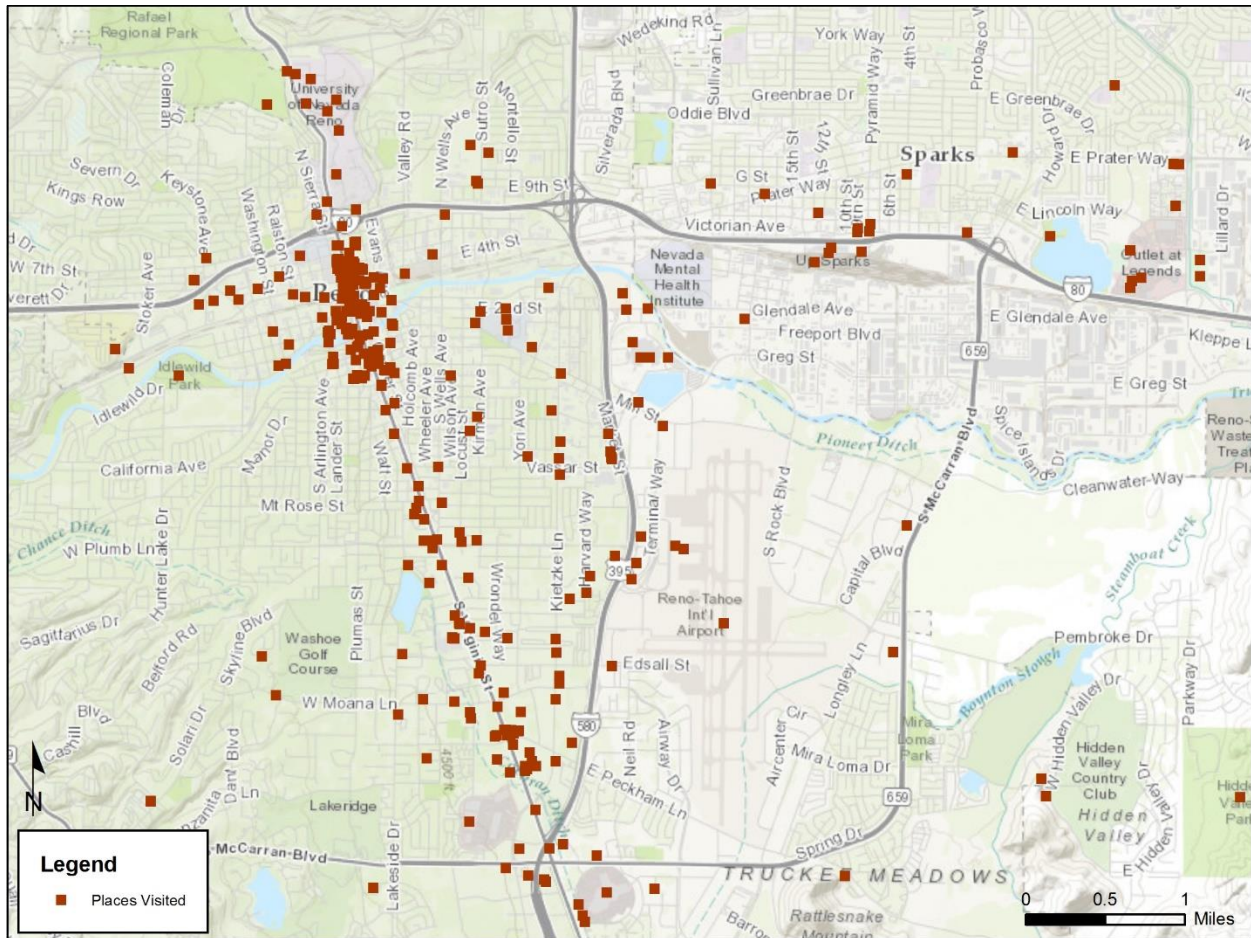
With each place respondents reported having visited in the previous 24 hours, the arrival and departure times were recorded. In Figure 10 the arrival times are displayed. The peak arrival hours are 10 a.m. (13.7 percent), 12 p.m. (11.5 percent), and 11 a.m. (11.3 percent). Arrival times between 1:00 a.m. and 6:00 a.m. are the lowest volume hours.

Figure 10: Arrival Time to Places Visited

Arrival Time of Places Visited
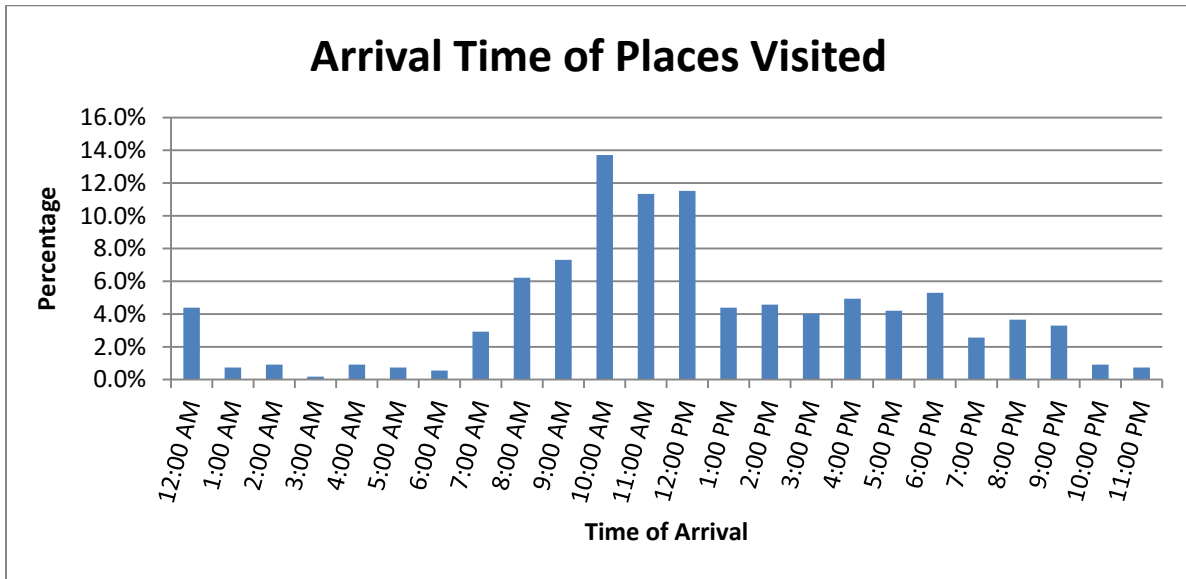
Departure times from each visited place show the volume between 1:00 a.m. and 7:00 a.m. is fairly low. There are several peak hours observed: 3:00 p.m. (7.4 percent); 4:00 p.m. (7.3 percent); 5:00 p.m. (7.7 percent); 7:00 p.m. (7.4 percent); and 8:00 p.m. (7.7 percent). The full results of departure times may be seen in Figure 11.

Figure 11: Departure Time from Places Visited

Departure Time of Places Visited

When asked what mode of transportation was used to get to and from places visited, multiple modes were allowed. Of the 638 places reported by respondents, 674 modes of travel were reported. Auto, Van,

Truck driver was the mode reported at the largest percentage (28 percent). The mode reported by the next highest percentage was walking at 24 percent. The results are displayed in Table 12.

Table 12: Mode of Transportation for Places Visited

Mode	Count	Percentage
Walk	161	23.9%
Bike	3	0.4%
Wheelchair/Mobility Scooter	1	0.1%
Auto/Van/Truck Driver	191	28.3%
Auto/Van/Truck Passenger	81	12.0%
Carpool/Vanpool	48	7.1%
Motorcycle/Scooter/Moped	4	0.6%
Taxi/Hired Car/Limo	49	7.3%
Rental Car/Vehicle	82	12.2%
Private shuttle (SuperShuttle, employer, hotel, etc.)	10	1.5%
Other Private Transit, please specify	7	1.0%
RTC Transit	22	3.3%
Other	15	2.2%
Total	674	100.0%

The most common activity while visiting Reno/Sparks was Entertainment or Cultural Activity. Thirty-eight percent of respondents reported the reason for the places visited was for this activity. The next largest category was for Other Activity. A table of these verbatim responses may be found in Appendix B – Verbatim Responses to all "Other – please specify" Questions. Table 13 presents the reported activity at places visited.

Table 13: Activity Purpose at Places Visited

Activity	Count	Percentage
Home/Lodging	22	3.3%
Work	48	7.3%
Work-related or business meeting	44	6.7%
School, including day-care or pre-school	6	0.9%
Visiting friends or relatives	42	6.4%
Medical or health services	14	2.1%
Shopping	71	10.8%
Entertainment or cultural activity	252	38.2%
Sports, nature activity, hiking, stroll	36	5.5%

Activity	Count	Percentage
Passenger drop-off or pick-up, accompanying other	7	1.1%
Transfer of travel mode or transit line	1	0.2%
Other, please specify	117	17.7%
Total	660	100.0%

Overall, more than half (55 percent) of the visitors to the region and that were interviewed, traveled with one other person to at least one place they visited. Slightly less than one-quarter (23 percent) reported they traveled with two other people. Please see Figure 12 for these results.

Figure 12: Overall Number of People Accompanying Traveler

Number of People Accompanying Traveler

	1	2	3	4	5	6	7	8	10	19	22	29
Percent	54.7%	23.2%	12.3%	4.0%	2.4%	1.2%	1.4%	0.2%	0.2%	0.2%	0.2%	0.2%
# Responses	276	117	62	20	12	6	7	1	1	1	1	1

Number of People
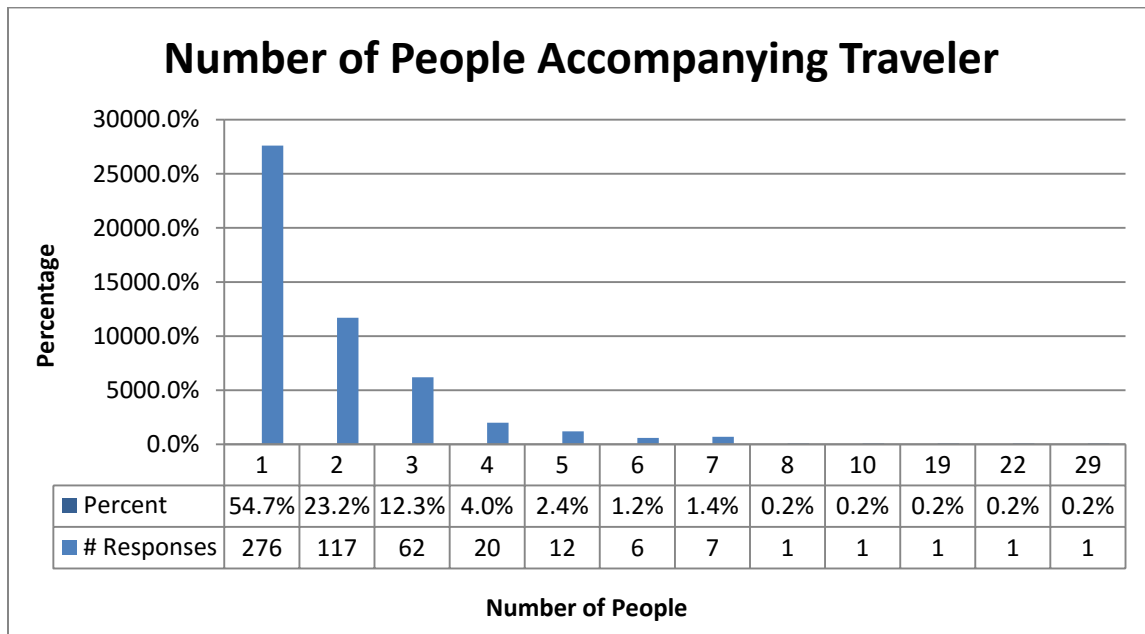
When collecting this information, respondents that identified the reason for their visit as "business" were asked how many colleagues were accompanying them. Respondents that indicated they were traveling alone are not included in the following tables. Fifty-one percent of convention and business travelers reported they were accompanied by one colleague. The results of this question are presented in Table 14.

Table 14: Number of Colleagues Accompanying Traveler

Number of Colleagues	Purpose of Visit				Total	
	Convention		Business			
	Count	%	Count	%	Count	%
1	15	65.2%	37	46.8%	52	51.0%
2	1	4.3%	23	29.1%	24	23.5%
3	1	4.3%	8	10.1%	9	8.8%

4	1	4.3%	2	2.5%	3	2.9%
5	1	4.3%	2	2.5%	3	2.9%
7	1	4.3%	0	0.0%	1	1.0%
8	0	0.0%	1	1.3%	1	1.0%
9	1	4.3%	1	1.3%	2	2.0%
>=10	2	8.6%	5	6.4%	7	6.9%
Total	23	100.0%	79	100.0%	102	100.0%

Respondents that identified the reason for their visit as all reasons other than convention or business were asked how many family members above the age of 18 were accompanying them and how many family members age 18 and below were accompanying them. These results are displayed in Table 15 and Table 16.

Table 15: Number of Family Members age 18 and Above Accompanying Traveler

Number of Family Members Above 18 yrs old	Purpose of Visit				Total	
	Recreation		Visiting Friends			
	Count	%	Count	%	Count	%
1	69	41.8%	19	38.8%	88	41.1%
2	70	42.4%	20	40.8%	90	42.1%
3	16	9.7%	5	10.2%	21	9.8%
4	4	2.4%	4	8.2%	8	3.7%
>=5	6	3.7%	1	2.0%	7	3.3%
Total	165	100.0%	49	100.0%	214	100.0%

Table 16: Number of Family Members 18 and Under Accompanying Traveler

Number of Family Members Under 18 yrs old	Purpose of Visit				Total	
	Recreation		Visiting Friends			
	Count	%	Count	%	Count	%
1	16	61.5%	3	60.0%	19	61.3%
2	9	34.6%	2	40.0%	11	35.5%
3	1	3.8%	0	0.0%	1	3.2%
Total	26	100.0%	5	100.0%	31	100.0%

4.0   Conclusions and Recommendations for Future Surveys

There was considerable difficulty in obtaining permission from some of the hotels, resorts, and casinos in the Reno/Sparks region to conduct the visitor survey. In addition, there were stringent controls at to the

day of week and time of day that the survey could be conducted. As a result, in the fall of 2016, NuStats made a concerted effort to collect as many surveys as possible. The requirement to survey only on weekdays was lifted to allow surveys to be conducted on weekends as well.

NuStats recommends that future visitor surveys be conducted in several waves, and to allow weekend surveying. Additionally, it is important for the area businesses to have a relationship with the RTC with the thought they may more readily agree to allow surveying in their businesses in the future.

Exploration of potential data expansion options is suggested for future surveys. Obtaining hotel occupancy during the survey period may assist in expansion of the dataset to represent all visitors to the region.

The questionnaire worked as expected. Revising of the wording of questions is typically recommended when developing future surveys. Technology will have significantly advanced at that time, as well. There are surveys conducted utilizing kiosks fitted with tablets. The possibility exists that this technology will be improved to the point it may be used to supplement the in-person intercept surveyors.

Appendix A - Visitor Survey Questionnaire

"How many people are available to interview?"
"Start with passenger #: " + (getRando + 1)
"The Regional Transportation Commission of Washoe County is conducting a brief Visitor survey to gain a better understanding of how visitors travel in the region and to assist with planning for the future. Are you a Resident of Washoe County (see SCREEN variable)?"
* "Yes"
* "No"
"Would you like to participate in the survey?"
* "Yes, I would like to take the Visitor Survey"
* "No, I would not like to take the Visitor Survey"
"Have you been in the Reno area for at least 24 hours?"
* "Yes"
* "No"
"What is your age?   "
1 "Less than 18"
2 "18-24"
3 "25-34"
4 "35-44"
5 "45-54"
6 "55-64"
7 "65+"
8 "Refused"
"What is your gender?"
1 "Male"
2 "Female"
9 "Refused"
"Including all sources, what was your annual household income in 2014?"
1 "$0 - $9,999"
2 "$10,000 - $24,999"
3 "$25,000 - $34,999"
4 "$35,000 - $49,999"
5 "$50,000 - $74,999"
6 "$75,000 - $99,999"
7 "$100,000 - $149,999"
8 "$150,000 - $199,999"
9 "$200,000 - $249,999"
10 "$250,000 or more"
98 "Don't Know"
99 "Refused"
"What is the main purpose of your visit?"
1 "Convention"
2 "Recreation"
3 "Business"
4 "Visiting Friends"

5 "Other (Specify)"

(If business:)
"How many colleagues are in your travel party?"
(If Family:)
"How many family members in your travel party are above the age of 18?"
"How many family members in your travel party are under the age of 18?"
"What is your current home address?"
"What is your current lodging address?"
"(Click the gray box to select a lodging place from the list)"
"What is the length of your stay in Washoe County? (In days)"
"How did you travel to the region?"
1 "Walk"
2 "Bike"
3 "Wheelchair/Mobility Scooter"
4 "Auto/Van/Truck Driver"
5 "Auto/Van/Truck Passenger"
6 "Carpool/Vanpool"
7 "Motorcycle/Scooter/Moped"
8 "Taxi/Hired Car/Limo"
9 "Rental Car/Vehicle"
10 "Private shuttle (SuperShuttle, employer, hotel, etc.)"
11 "Greyhound Bus"
12 "Airplane"
13 "Amtrak"
14 "Other, specify"
"How did you travel to your lodging site?"
1 "Walk"
2 "Bike"
3 "Wheelchair/Mobility Scooter"
4 "Other Non-Motorized (please specify)"
5 "Auto/Van/Truck Driver"
6 "Auto/Van/Truck Passenger"
7 "Carpool/Vanpool"
8 "Motorcycle/Scooter/Moped"
9 "Taxi/Hired Car/Limo"
10 "Rental Car/Vehicle"
11 "Private shuttle (SuperShuttle, employer, hotel, etc.)"
12 "Greyhound Bus"
13 "Airplane"
14 "Other Private Transit (please specify)"
15 "RTC Ride"
16 "RTC Access (Paratransit Service)"
17 "RTC Intercity"
18 "Sierra Spirit"
19 "RTC Rapid"
20 "RTC Vanpool"
21 "TART"

22 "Amtrak"
24 "Other, specify"

"What is the amount of money you intend on spending during your stay in Washoe County? (In U.S. currency)"
1 "$0 - $499"
2 "$500 - $999"
3 "$1,000 - $2,499"
4 "$2,500 - $4,999"
5 "$5,000 - $9,999"
6 "$10,000 - $24,999"
7 "$25,000 - $49,999"
8 "$50,000 - $74,999"
9 "$75,000 - $99,999"
10 "$100,000 - $249,999"
11 "$250,000 or more"
12 "Don't Know"
13 "Refused"
 (Repeat below:)
"Thinking about the last 24 hours, please tell me all the places you visited yesterday."
"What time did you arrive at this place?"
"What time did you depart this place?"
"What mode of transportation did you use to get there?"
1 "Walk"
2 "Bike"
3 "Wheelchair/Mobility Scooter"
4 "Other Non-Motorized (please specify)"
5 "Auto/Van/Truck Driver"
6 "Auto/Van/Truck Passenger"
7 "Carpool/Vanpool"
8 "Motorcycle/Scooter/Moped"
9 "Taxi/Hired Car/Limo"
10 "Rental Car/Vehicle"
11 "Private shuttle (SuperShuttle, employer, hotel, etc.)"
12 "Greyhound Bus"
13 "Airplane"
14 "Other Private Transit (please specify)"
15 "RTC Ride"
16 "RTC Access (Paratransit Service)"
17 "RTC Intercity"
18 "Sierra Spirit"
19 "RTC Rapid"
20 "RTC Vanpool"
21 "TART"
22 "Amtrak"
24 "Other, specify"
"What was the activity purpose?"
1 "Home/Lodging"

2 "Work"
3 "Work-related or business meeting"
4 "School, including day-care or pre-school"
5 "Visiting friends or relatives"
6 "Medical or health services"
7 "Shopping"
8 "Entertainment or cultural activity"
9 "Sports, nature activity, hiking, stroll"
10 "Passenger drop-off or pick-up, accompanying other"
11 "Transfer of travel mode or transit line"
12 "Parking"
13 "Other, specify"
"How many others traveled with you?"

"Thank you for participating in the Visitor Survey. Have a nice day!"

"End Survey and Start New Survey"

Appendix B – Verbatim Responses to all "Other – please specify" Questions

Table 17: Other – Specify Responses

Question	Responses	Count
How did you travel to the region?	train	1
How did you travel to your lodging site?	Bus but they don't remember which	1
	Flew here then took taxi	1
	Friend	3
	Harrah's bus	1
	Shuttle	2
	Tour bus	1
	Uber	5
For all places - What mode of transportation did you use to get there?	Friend	1
	Uber	11
	Corporate Transportation/Chauffer	5
For all activity purposes - What was the activity purpose?	Dining	84
	Banking	1
	Get car washed	1
	Getting gas	3
	Hotel and dining	1
	Job interview	2
	Looking at real estate	1
	Pay respects	1
	Picking up a car	1
	Realtor visit	1
	Storage unit	1
	Petco corporate meeting drove there via company shuttle	1
	Skateboard. With brother	1
	Like bowling wanted to check it out	1
	Check out a casino for first time!	1
	Entertainment and lodging	1
	Swimming	1
	Crashed there this night	1
	For fun and food	1
	Mystery shop evaluation	2
	Lunch and hanging out with girlfriend	1
	Met with prospective manager of Petco	1
	Back to hotel for lunch	1

On-to-off and Onboard Surveys

Final Report

Table of Contents

List of Tables and Figures

1 Executive Summary

This report documents the activities and findings for the Regional Transportation Commission (RTC) – Washoe County Onboard and On-to-Off surveys conducted by NuStats and A+ Staffing. The pilot survey was conducted beginning in the fall of 2015, followed by the main survey. Data collection concluded in February, 2016. NuStats, in collaboration with RTC, designed a sampling plan targeting to collect a sample of 1,200 completed Onboard surveys and 1,200 completed On-to-Off surveys that would be representative of bus riders in the region. The most recent ridership numbers available were from 2014, which were utilized as a guide to develop the sampling plan.

The survey approach for both the On-to-Off and Onboard surveys was grounded in two main principles: 1.) reduce respondent burden while increasing participation; and 2.) enhance the quality of the data. The Onboard survey was conducted utilizing TransiTap, NuStats' tablet technology. During the interview process, data were subjected to real-time geocoding, and quality control procedures to ensure that respondents provided accurate information and to identify and correct illogical trips. For the On-to-Off survey, cards were handed to boarding passengers, and then collected from them as they alighted. Further detail about methodology and survey instruments is found in subsequent sections of this report.

Data collection for both the Onboard and On-to-Off surveys was conducted on all routes as determined in collaboration with RTC, NuStats, and RTC's modeler.

2 Key Findings

The completed project yielded 1,209 Onboard surveys. The objectives of the full study were two-fold: 1) examine and confirm the travel behavior characteristics of RTC bus passengers; and 2) obtain the socio-economic characteristics of RTC bus passengers. The data weighting and expansion provide an appropriate representation of the RTC system.

Important findings from the analysis of the RTC bus system ridership are presented below:

- Fifty-three percent of RTC bus passengers are from households with an annual income of less than $25,000.

- Fifty-five percent of RTC bus passengers are transit-captive riders (i.e., they are from households that did not have a vehicle available to complete their one-way trip).

- Fifty-eight percent of RTC bus passengers are employed, with 38 percent employed full-time.

- Nearly two-thirds (61 percent) of RTC bus passengers do not possess a valid driver's license.

- Almost the entire group (99.7 percent) of RTC bus passengers took the survey in English with less than one-half of one percent taking the survey in Spanish.

- Fifty-six percent of RTC bus passengers are between the ages of 18 and 44.

- Thirty-seven percent of RTC bus passengers reported paying their fare with cash while 26 percent used a PrePurchase – 31 day pass.

- Travel behavior characteristics of RTC bus passengers indicate that home and work are the most prevalent trip origins and destinations.

  - ✓ Nearly one half (49 percent) of trips originate from home, 22 percent of trips originate from work, both school categories (K-12 and College/University) account for 3 percent of origin trip purposes.

  - ✓ The final destination for 34 percent of trips is home, whereas 22 percent end at work. Other common destination trip attractions are Social or Recreational, which represent 17 percent of all destinations, and shopping (11 percent).

- Overall, 93 percent of RTC bus passengers reported walk as their mode of access and/or egress.

3 Introduction

The 2015 RTC Washoe Country Regional Travel Characteristics Study conducted two separate transit related studies to provide supplemental data to update and calibrate the transit sub-model within the RTC Travel Demand Model. Two survey instruments were developed: one to collect travel behavior information from a large sample of RTC riders (On-to-Off study); and one to administer a more complex survey to a smaller sample of RTC riders (Onboard study).

In recent years, the Federal Transit Administration (FTA) has introduced stricter guidelines for conducting O/D onboard studies, including FTA New Starts/Small Starts requirements. As a result, NuStats utilized updated methodologies and newly developed ones to meet these requirements. NuStats targeted to collect, at a minimum, five percent of the total ridership or approximately 1,200 clean and usable surveys for updating the RTC Travel Demand Model.

NuStats teamed with Coulter and Associates, a local Public Relations firm, in development of a strategic plan to notify the public of their opportunity to participate in the On-to-Off and Transit Onboard surveys.

A high level review of the 2015 RTC operations and vehicle schedule was performed during the design phase in order to develop an understanding of how RTC conducts business with regards to the dispatch, operators, riders, and overall transit system. This was helpful in order to understand the idiosyncrasies of the schedules of each individual vehicle at the block, work run, or trip level. Additional meetings with key staff were held to ensure all parties understood the goals and mechanisms of the On-to-Off and Onboard Transit Surveys. General Transit Feed Specification (GTFS) and other pertinent data were requested to assist in this review.

4 Survey Methods

4.1 Survey Design

Based on initial guidance from RTC and review of the project objectives, the sampling design for all projects was based on a collaborative effort between RTC and NuStats to identify routes, sites, and corridors of interest throughout Washoe County. The steps undertaken to implement this design follow:

- A review was performed of current RTC transit operation data and the transit sub-model of RTC's Travel Demand Model;
- A public outreach plan was developed that served to inform the public about the survey effort;
- A geographically stratified sampling plan was developed to ensure that the collected data appropriately reflected travel patterns and demographic information about the transit users in Washoe County, optimizing the statistical representativeness and randomness;
- An intercept approach was utilized for data collection to reduce respondent burden and capture accurate transit patterns that through weighting is representative of the RTC system.

The study population for the On-to-Off survey consisted of all RTC riders who utilize RTC's fixed route system. Infants and children were counted, but they were not distributed an On-to-Off card.

The study population for the Onboard survey was riders who board a surveyed vehicle age 16 and above.

At project kick-off NuStats requested several pieces of information from RTC. These items were:

- Average daily ridership by year or month (preferably Spring or Fall ridership);
- Points of Interest (POI) list (if available) – based on individual routes listed on website;
- GTFS feed;
- Notice of any projected schedule changes due to realignment or construction; and
- Projections RTC uses to produce any GIS products (e.g., WGS 84).

NuStats' strategy to collect the most accurate and reliable data was to conduct the On-to-Off survey in conjunction with the Onboard Transit Survey in the following fashion:

- During a given week, the On-to-Off survey would focus on a segment of routes to collect the necessary data to instruct the Onboard Transit Survey where to anticipate riders.

- The following week resulted in a targeted sample approach to ensure an accurate representation of ridership patterns was captured in the Onboard Transit Survey.

4.1.1 Public Outreach Plan

NuStats and Coulter and Associates developed a public outreach plan that distributed news releases to local and regional media announcing the start of the surveys, and also any updates. Each news release was researched, written, and distributed to local area media. Follow-up with each media contact was conducted and carried out to ensure receipt of news releases and possible placement. Media announcements and outreach included television, radio and online venues. Media outlets included:

- Reno Gazette Journal

- Sparks Tribune
- Nevada Appeal
- The Bonanza (and affiliate newspapers)
- KOLO-TV / ABC Affiliate (Channel 8)
- KTVN-TV / CBS Affiliate (Channel 2)
- KRNV-TV / NBC Affiliate (Channel 4)
- KKOH Radio

Media relations were conducted in an ongoing manner of following-up and updating contacts. Social media outreach was implemented by working in conjunction with the RTC Public Information team. Updates were developed and then submitted to them to post survey updates on the social media pages.

In addition to the overall public outreach campaign conducted on behalf of the Onboard Survey, "public notice" place cards were designed, written, and printed to be placed in each of the RTC buses and/or at each of the bus stops. These place cards were developed in consultation with the RTC, Coulter and Associates, and NuStats. These place cards featured information about the importance of participation in the onboard survey, incentives being offered, and also thanked riders for participating.

4.2 Sampling Plan

NuStats made the recommendation of collecting a minimum sample size that would be statistically valid at the system level at the 95 percent confidence interval ± 2.8 percent. The On-to-Off data collection effort targeted collecting at least 1,200 cards and provided insight for RTC and NuStats to determine how best to distribute the sample allocation amongst the entire RTC transit network. The target of completed onboard surveys was also 1,200. In addition, the On-to-Off dataset served to assist in the weighting process by expanding the collected data to the entire RTC transit universe.

NuStats, in conjunction with RTC, worked to refine sample sizes based on average daily ridership by route as described in Table 1. Routes for which the average weekday ridership is relatively low poses a challenge in collecting enough completed surveys to achieve a minimum standard error. In these situations, clustering multiple routes can be used to bring the group to a more statistically significant level as opposed to a small sample size for an individual route. Clustering can be conducted in various ways, including grouping by geography, service type, or similar travel patterns.

For efficiency, the sampling methodology was implemented based on three principles: stratification, variability, and clustering. The sampling method recommended was a stratification of vehicle trips with cluster sampling, which is the method that NuStats has successfully applied in nearly all prior onboard surveys. The universe of bus trips was stratified to ensure that data for specific lines would be adequate for line analysis and planning, with the exception of low ridership routes where sample sizes were significantly smaller and potentially clustered. The strata was based upon the following parameters:

- Line
- Direction (e.g., inbound, outbound, E, W, N, S, loop)
- Time of Day (A.M. Peak, Mid-day, P.M. Peak, and Evening/Early Morning)

Table 1: RTC On-to-Off & Onboard Sample Sizes

Route	Average	Percent of Total	Sample - OO	Sample - OB
RAPD	3,792	13.4%	193	193
1	1,997	7.0%	91	91
2	1,968	6.9%	94	94
2S	430	1.5%	19	19
3CC	183	0.6%	8	8
3CL	866	3.1%	33	33
4	726	2.6%	31	31
5	1,699	6.0%	71	71
6	697	2.5%	30	30
7	1,824	6.4%	72	72
9	1,246	4.4%	53	53
11	2,366	8.4%	98	98
12	2,198	7.8%	64	64
13	626	2.2%	28	28
14	1,000	3.5%	38	38
15	1,200	4.2%	56	56
16	440	1.6%	18	18
17	488	1.7%	22	22
18	1,195	4.2%	43	43
18X	75	0.3%	3	3
19	315	1.1%	13	13
21	470	1.7%	19	19
25	304	1.1%	12	12
26	311	1.1%	13	13
54	435	1.5%	22	22
56	742	2.6%	28	28
INT C	149	0.5%	6	6
SS	589	2.1%	22	22
TOTAL	28,330	100.0%	1,200	1,200

The definition of a completed survey was developed collaboratively with RTC, the FTA, the modeling firm PB World, and NuStats. The process of defining a completed survey was two-fold: 1) review the previous travel demand model inputs and 2) work with RTC and the FTA to finalize a set of data and activity elements that would be needed for the 2015 model update. By applying a definition of a complete to each individual survey, it provides RTC the confidence to update their Travel Demand Model.

4.2.1 Approach to Sampling Bus Trips

NuStats prepared a plan to sample weekday bus trips based on the average daily ridership from FY 2014 as was provided by RTC. It was geared to capture five percent of passengers at the system level. The individual route goals are contained in Table 1, and found in the columns headed "Sample – OO" and "Sample- OB". The proposed sample plan was based on three main factors:

- First, the plan ensured that the sample adequately met data needs at the global level.

- Second, the plan ensured the collection of adequate samples at the various times of day. Times of day (TOD) are defined as AM Peak (6:00 a.m.–9:00 a.m.), Mid-day (9:01 a.m.–2:59 p.m.), PM Peak (3:00 p.m.–7:00 p.m.), and Evening/Early Morning (7:01 p.m.–3:00 a.m.).

- Third, the plan ensured that staff would have the ability to segment the sample on key variables, such as route, day of the week, time of day, and direction.

4.2.2 Bus Trip Selection

The number of sampled trips was calculated by assuming an average response rate of five percent, depending on service type and service period, of typical passenger loads by trip. Thus, a route that had an average load of 500 passengers and made 10 trips a day was determined to have an average passenger load of 50 passengers per trip. Assuming the route had a sample goal of 50 valid questionnaires, it was determined that 20 bus trips would need to be sampled to meet the requirements at an estimated five percent response rate (500/10 = 50 x .05 = 2.5; 50/2.5 = 20). The number of trips sampled was rounded up to the nearest whole number for trip selection purposes.

4.2.3 Surveyor Assignments

The final sampling task was uploading the sampled bus trips to a Web-based field management system to create surveyor assignment sheets. Trips were selected for assignments based on the following criteria:

- Consecutive trips within the same block/run

- Trips starting and ending at the same location

- An equal number of AM Peak Period trips as PM Peak Period trips (when possible)

Surveyor assignment sheets were printed from the Web-based management system and included the organized trips to be sampled, along with the division address from which the assignment originated. The assignment sheets were also bar-coded to link them to the field management system.

4.3 On-to-Off and Onboard Survey Instruments

NuStats and RTC worked together to develop two instruments for the purposes of this study: 1) an On-to-Off survey card that was easy to administer, easy to comprehend, and, collected data that supports the travel demand model, and 2) the Onboard Transit survey capturing origins and destinations, transfer locations, access and egress modes, and other demographic information.

Based on similar data collection efforts and input received from RTC and FTA as a tool in the development of these instruments, NuStats developed a draft version of the survey instruments for RTC to review. This process allowed RTC to review and collaborate with NuStats on the instruments, while ensuring sufficient time and attention in preparing, programming, and printing the survey instruments for survey administration. In addition to capturing critical data elements in the study, focus of survey instrument design is placed on the respondent. The survey instruments were designed to clearly and concisely convey project information in a respondent-friendly and straightforward manner.

The On-to-Off Survey card was designed to collect On-to-Off information at the rider level. For riders that were not proficient in reading English or Spanish, graphic instructions displayed the surveying steps. The cards were serialized so that they can be traced back to the On-to-Off location. Each card was serialized, barcoded, and packaged in bundles of 50 for ease of handling and tracking by the surveyors. Once the On-to-Off survey cards were finalized, they were sent for printing.

The Onboard Survey instrument was programmed utilizing NuStats' proprietary app, TransiTap. The questions were developed collaboratively between NuStats and RTC. Where appropriate, drop down menus were provided. By allowing surveyors to select items from a drop down menu, rather than manually entering data, the resulting data is cleaner and more consistent.

The On-to-Off Survey card is found in Appendix A: Survey Card.

Onboard Transit Survey - A pre-programmed tablet was utilized for the Onboard Transit Survey. NuStats proprietary app TransiTap was modified specific to the RTC region and was programmed in the tablets used by the surveyors. Using a survey instrument displayed on a tablet allowed the surveyors to collect all of the activity based data with the ability to display the rider's one-way trip information to verify all data was captured accurately. This approach minimized self-reported errors and provided the transit community to see the transparent process in an effort to maximize rider participation. Additionally, by using our technological capabilities NuStats was able to efficiently combine the data entry and verification process resulting in streamlining these two necessary data processing steps.

Table 2 provides the data elements that were captured, and the method of capture.

Table 2: Data Elements and Capture Method

QUEST	VARIABLE	DESCRIPTION	CODESET
1	SAMPN	Unique Sample Number	QR code
2	DATE	Calendar date	Automatically captured
3	TOD	Time of day	Automatically captured
4	ROUTE	Route surveyed	Automatically captured
5	DIRECTION	Direction surveyed	Automatically captured
6	BOARD	Boarding location	Automatically captured
7	B_GPS	Boarding X&Y cords	Automatically captured
8	ALIGHT	Alighting location	Automatically captured
9	A_GPS	Alighting X&Y cords	Automatically captured

4.4 Survey Procedures

Prior to the Onboard Survey, internal staff load the data (transit network and tablet survey) into our management software. Using this software, we have the ability to set up and monitor specific goals using lines, sample type, demographic criteria, and/or other predetermined targets provided by RTC. Given the current sample management software in place and protocols we have developed, we were able to ensure strategic release of sample allocation based upon the On-to-Off Survey results. This level of sample management — which includes prioritization, daily assignments, and goal stratification — enabled us to collect trip information according to the most representative distribution of actual ridership.

Expected levels of productivity were closely monitored throughout the data collection portion of the study. NuStats team members worked side-by-side with interviewer staff and shift leaders to ensure efficiency, data quality, and survey knowledge. Weekly reports were developed by the NuStats Production Manager and submitted to RTC for review prior to weekly/bi-weekly meetings. These reports included a breakdown of daily and weekly productivity levels, a full sample report, and a table outlining daily completed survey distribution by goal.

Validate, Adjust and Edit the Data - At this point, the dataset is exported from the project website to be verified. The image of the activity data is run through our GIS software to validate correct responses, with QC checks following. This process begins with reviewing the interview data to ensure the proper data were collected. Range and spelling queries are executed on the entire file. The interview data are then committed into a database, and the images are archived in PDF format.

The database was then reviewed, edited, and corrected using manual and automated edit checks. The results of the data processing were linked to the field management system so that an accurate accounting of survey progress and status was maintained throughout data collection.

Data were checked for integrity as the database was being created. Various edit routines were programmed to check the consistency of data and to identify reporting, scanning, or entry errors. Data edit checks were performed to examine survey responses for reasonableness and consistency across items. Routine checks included such items as:

- Spatial analysis on all activity-based data
- Response code range checks (e.g., only valid response category codes were captured)
- Checks for high frequency of item non-response or missing data

When conducting the checks, outlying values that are illogical were identified, and inconsistent data corrected when possible.

4.4.1 Labor Recruitment and Training

Engaging riders while conducting an Onboard Transit Survey not only improves the quality of the data collected, but also has a positive impact on the response rates. This occurs when trained surveyors are able to work directly with the rider and explain the importance of the survey and why it is necessary. Our highly skilled staff was able to conduct the survey in English and Spanish. NuStats worked with RTC to understand which routes have a linguistically isolated population and assigned Spanish speaking surveyors on those specific routes.

Local data collection labor was recruited through A+ Staffing. To ensure the highest quality, staff and supervisors attended training sessions designed by NuStats. The training sessions were held at RTC's headquarters to allow for RTC staff to participate, at will. The training covered the survey objectives, counting and surveying procedures, protocols for riding RTC vehicles, and addressed safety concerns and procedures to mitigate potential problems. These training sessions incorporated training on use of the appropriate technology to be used on the studies; RideTrack for the On-to-Off counts, and TransiTap for the Onboard survey.

4.4.2 On-to-Off Study

Serialized barcoded cards were used to collect all participating rider On-to-Off surveys. This process requires minimal burden to passengers. Riders were handed a card upon boarding the vehicle and then returned the card to the onboard surveyors as they alighted the vehicle. Surveyors scanned each card before distribution to riders boarding the vehicle and then scanned each card again as the rider alighted. This methodology of scanning the card, allows NuStats to accurately capture the On-to-Off data. NuStats' proprietary application, RideTrack, was utilized to capture data such as: On-to-Off location and time points, other time points for schedule adherence, direction and time of day.

This methodology requires three staff members (the surveyor, the collector, and the counter) to facilitate data collection. Each of the staff are equipped with a smartphone containing the RideTrack application. The

surveyor is charged with scanning and distributing the cards to all boarding passengers, while the collector is charged with scanning and collecting the cards from all the alighting passengers. The counter is tasked with maintaining all of the boarding and alighting activity at the vehicle stop level. Screen shots of the RideTrack application may be found in Appendix B: RideTrack Application.

With the proper trip and stop selected, the surveyor scans the barcode of the first card and proceeds handing cards to all of the boarding passengers at the first stop (that is identified by a GPS component and verified by the surveyor by selecting the physical bus stop). In addition to handing out cards, the surveyor records the number of passengers who refuse to take the card. Once all passengers board the vehicle, the surveyor enters the number of "boarding refusals" into the smartphone. This process is continued at each subsequent stop on the trip. Because the first card is scanned prior to distribution for each stop, a range of cards distributed for each stop is produced in the smartphone.

The collector selects the proper trip and stop as the vehicle arrives at a stop. Positioned next to the exit door, the collector retrieves all of the cards from alighting passengers. In addition to the surveyor, the counter also maintains the number of passengers who do not return a card and enters the total "alighting refusals" for each specific station. At that point, the collector scans the barcode for all the cards collected at that stop. If a large number of passengers alight at a single location, then the first card is scanned and the remaining cards are bound to the first card so that they can be scanned at a later time.

Results for the On-to-Off Board survey are found in Section 7: Summary of Results – On-to-Off Board.

4.4.3 Survey Administration

Survey Administration – The survey administration team was comprised of a data collection manager, a field coordinator, surveyors, counters, and collectors. Onboard surveying teams were deployed on assignments ranging between 6–9 hours per shift. Additionally, protocols were established on how the team would conduct surveys when the vehicles experience a crush load or is 100 percent full.

As assignments were handed out, information was updated in the Web-based field management system. When teams returned from an assignment, the field coordinator(s) checked the assignment results (i.e., quickly reviewed the cards to spot performance issues) and downloaded the passenger count data from the smartphone devices. Feedback and additional training were provided when errors were found in the data. If errors persisted, staff would be removed from the survey. The field coordinator updated the assignment status in the Web-based field management system (Figure 2) and then handed out the next assignment. Once the completed assignments were reviewed, the cards went through the in-field editing process for inspection and coding prior to being scanned.

The Web-based management system tracks data progress and surveyor effectiveness for the onboard survey. On a daily basis, with only a 24-hour lag, assignments completed were available for the RTC team to review. Additionally, the Web-based management system tracks the trips surveyed, date and shift time, number of cards distributed, and number of cards refused. Any trips missed are documented and reassigned on the site. On a weekly basis, the daily reports are summarized, and the initial completes for those shifts are captured and optically scanned, creating a database.

Riders were randomly selected as they boarded the vehicle through an automated process conducted by the surveyor. Surveyors keyed in the total number of boarding passengers and then a random selector, programmed on the tablet, randomly selected a number. The number selected by the tablet corresponded with the passenger to be approached to participate in the onboard survey. If this individual refused to

participate, the tablet randomly generated another number for the next corresponding passenger to be surveyed. An example of the website assignment tool may be found in Figure 1.

Figure 1: Website Assignment Tool

4.4.4 Status Reporting

As previously noted NuStats uses a transparent project-specific Website to monitor all phases of our data collection efforts. This critical management tool also allows NuStats to share progress with RTC regarding line-level response rates, percentage of route goals completed, and surveyor-level response rates. The system integrates barcode technology to track each returned card with the specific "control file" information regarding a trip (boarding and alighting, route, direction, and time of day). The system also provides a means to track assignment completion to avoid unintentional over- or under-sampling of lines; this has proven to be a very effective schedule and cost-control mechanism. The RTC Onboard Survey project Website served as a central location for all assignment information. Reports were generated by the Website and disseminated by the NuStats Project Manager for monitoring and for identifying surveying deficiencies for correction.

The surveyor manager prepared status reports from the Web-based field management system. This automated application conducted consistency checks, flagged problem records, and cleaned and purged flagged records. The field coordinator reviewed this information for accuracy in the status, response, and performance reports to the Web-based field management system.

4.4.5 In-Field Scanning

Following the team check-in, all returned BA cards were presented to the field coordinator for alighting location entry. Each stack of cards returned by the surveyors represents all of the cards returned by riders at one alighting location. One card in each stack was scanned and associated with the alighting location during surveying, so any additional cards in each stack must be entered and matched to that location.

4.4.6 Geocoding Tool

NuStats utilized TransiTap, a proprietary application loaded onto our tablet technology, to collect spatial data. This program improves the efficiency and quality of collecting activity data based on that they are reviewed in real-time with the respondent to validate their one-way trip. TransiTap also collects waypoints for transit users who make transfers to complete their trip. Obtaining valid waypoints is essential if transit providers are to understand their market and the symbiotic relationship with other routes and transit services. Throughout the interview process, 100 percent of the spatial data was reviewed by a highly trained TransiTap interviewer to detect issues with the data, such as unreasonable walking distances or illogical rider alightment locations based on rider final destination. This real-time quality control allowed the interviewer to document atypical travel behavior, and ensures RTC has been provided with accurate and model-ready data.

4.4.7 Research Edit Check

Data was required to pass both automated and manual checks for data integrity before being delivered. Cases that did not meet the appropriate criteria were resolved prior to being delivered. The quality assurance (QA) department implemented these checks as an additional tool to ensure continued data quality.

- Interviewers are individually updated regarding each of their completed records that fail the edit check process, and receive additional QA support.
- Cumulative Edit Check results are used to determine problematic trends and initialize shift-based QA strategies to resolve them.
- Edit check statistics are used to provide the interviewer team with group-based feedback.

4.4.8 Survey Process Flow Chart

Since the survey is web based (both on-line and off-line), the information collected from transit users is housed in a web dataset that could be accessed at any time by NuStats data processing staff. NuStats conducted ongoing verification of the aggregate, cumulative data files utilizing a specialized program to perform routine and customized quality checks on the data to meet agreed-upon quality requirements. The flow of the collected survey data is presented in Figure 2. With each data collection shift, NuStats' field management team provides feedback to the teams.

Figure 2: Survey Process Flow Chart

KEY
Blue – Field Work
Purple – NuStats (Austin)
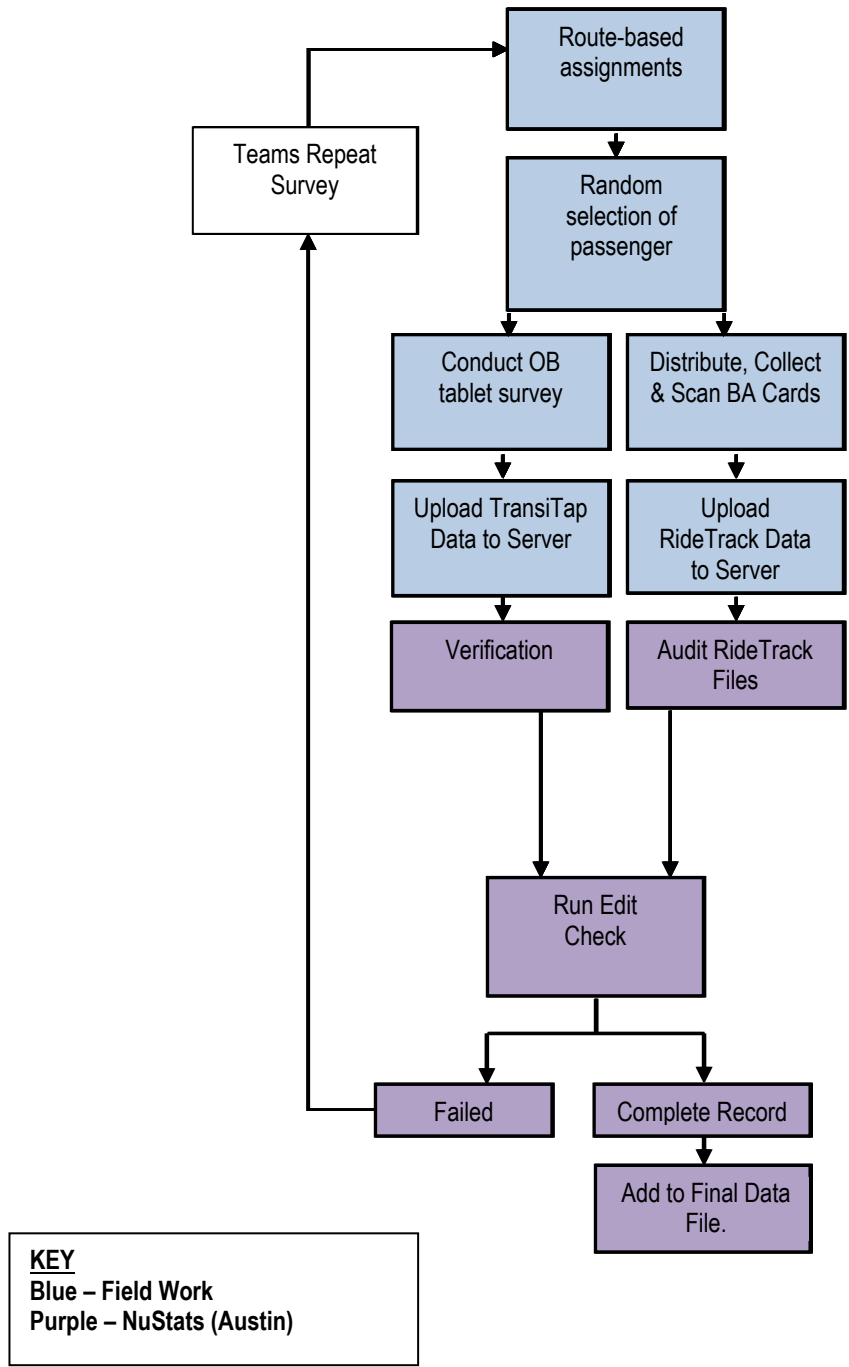
5 Analysis

From a finite population sampling theory perspective, analytic weights are needed to develop estimates of population parameters and, more generally, to draw inferences about the population that was sampled. Without the use of analytic weights, population estimates are subject to biases of unknown (possibly large) magnitude.

In onboard surveys, the universe of trips operated by transit routes cannot be sampled. At the same time, all the riders who board the sampled routes cannot be surveyed due to non-response. All these factors lead to biases in the survey data. Consequently, sample weighting and expansion is critical to account and correct for these biases. In particular, sample weighting adjusts for non-response at the bus stop level and accounts for trip sampling rates at the route, time of day, and direction level (RTD). Sample expansion on the other hand, expands the weighted sample to reflect the population ridership at the system-wide level.

5.1 Sample Weighting

Sample weighting is a critical consideration to account and correct for biases in the survey data. As a simple example, one route may have 1,000 passengers per day and another, 100 passengers. If 50 surveys were collected on each route, the percentage collected would be 5 and 50%, respectively. Without weighting, the data collected on the route with 100 passengers would be over-represented in the results. Thus, weighting balances these differences and aligns the weighted sample to the known distribution of population ridership.

The sample weighting process includes calculation of: (1) Response factor that corrects for non-response at the bus stop level for both boardings and alightings, (2) Adjustment factors that correct for trip sampling rates at the direction and time of day level. Each of these factors is discussed below in detail.

5.1.1 Response Factor

In order to capture all the non-responding passengers, a response factor was computed and applied to all the respondents in the survey. The response factor was computed at boarding-alighting stop (group) pair level for each bus trip as follows,

$$RF_{ij} = \frac{P_{ij}}{R_{ij}} \qquad\qquad \text{(i)}$$

Where RF_{ij} = Response factor for respondents boarding at stop (group) i and alighting at stop (group) j

P_{ij} = number of passengers boarding at stop (group) i and alighting at stop group j

R_{ij} = number of respondents (who completed the survey) boarding at stop (group) i and alighting at stop (group) j

i = ID of the boarding stop (group) along the specific bus trip

j = ID of the alighting stop (group) along the specific bus trip

Ideally, the response factor would expand the respondents who had completed the survey to the total number of passengers who ever rode the bus trips, while, at the same time, maintain the proportion of passengers who boarded and alighted at each specific stop (group) pair. However, the boarding or alighting counts only recorded the marginal distribution of bus ridership, i.e. the total number of passengers who boarded (=$\sum_j P_{ij}$)or alighted (=$\sum_i P_{ij}$) at each stop, but not the information of the corresponding alighting or boarding stops of the counted passengers. In other words, the Pij is not available directly from the survey results for computation of response factor in the equation (i). Therefore, an iterative proportional fitting (IPF) procedure was employed to estimate Pij based on the marginal distribution of boardings and alightings along bus stops and the distribution of the sample respondents among bus stop OD pairs (Rij).

The IPF procedure would not converge or produce stable results if there are zero-value cells in the marginal distribution or in the sample respondent distribution. The zero-value cells in the sample respondent distribution are unavoidable. This is because the number of passengers boarding at stop A and alighting at stop B must be zero if B locates ahead of A in the bus stop sequence along the bus trip. In order to achieve a converged result, a relatively very small number was assigned to these cells as initial values during IPF. In addition, a pair of boarding stop and alighting stop was grouped to resolve a few issues that prevent IPF from conversing. These issues include (1) no completed surveys at bus stops where at least one adult boarded the bus (response issue), and (2) fewer adult boardings than the number of completed surveys collected at the bus stop (counter error). The following gives the essential of the algorithm for grouping stops of case (1) and (2) above,

1. All the stops are scanned according to the sequence of stops along the bus trip;

2. A bus stop of case (1) or (2) above would be grouped with either the subsequent or the previous stop according to the distance them to the current stop, i.e. the closest stop would be grouped with the current stop; This step should be repeated until a balanced group is formed, i.e. both cases (1) and (2) are eliminated

3. If the previous stop has been assigned to a group during the previous steps, the current would be grouped with the subsequent stop or stops until a balanced group is formed;

4. If the destination stop has been reached before a balanced group is formed, merge the current stop with the previous stop group. If the balance in the previous group is broken after merging the current stop, consider the unbalanced group as the current stop and go back to step 2.

5. All the stops would form a single-stop group by themselves or be assigned to a balanced group; the largest balanced group would be the group including all the bus stops along the trip.

The IPF procedure would produce a new P_{ij} distribution matrix based on the new stop grouping, where i and j are the new stop group ID instead of individual stop ID. Thereafter, the response factor can be computed using equation (i).

In the new P_{ij} distribution matrix, the sum of values in each column or each row will be equal or very close to the marginal distribution of boardings and alightings. Therefore, the total of cell values would be equal or very close to the total of boardings or alightings. However, the IPF procedure also assigns non-zero values to the cells where, theoretically, P_{ij} should be equal to zero, i.e. where stop j locates in front of stop i along the bus trip since we have assigned them a very small initial value. For those cells, response factors cannot be computed using equation (i) due to zero denominators, and a default weight of 1.0 was assigned. So the total number of respondents will not be expanded to the total boardings or alighting by the response factors

due to loss of counts in such cells. In order to minimize such impact, another weighting factor was computed at bus trip level as,

$$W_k = \frac{\sum B_i}{\sum RF_{ij} * R_{ij}} \qquad \text{(ii)}$$

Where W_k = Trip weight of trip k

RF_{ij} = Response factor for respondents boarding at stop (group) *i* and alighting at stop (group) *j* through

R_{ij} = The number of respondents (who completed the survey) boarding at stop (group) *i* and alighting at stop (group) *j*

B_i = The number of respondents who boarded at stop (group) *i*

The final weight applied to respondents should be,

$$W_k * RF_{ij} \qquad \text{(iii)}$$

In (iii), the k, i, j are the trip id, boarding stop group id, and alighting stop group id of the trip that the respondent rode.

Following the calculation of the final weights, any small and large weights were trimmed to have a minimum and maximum value equivalent to the first and third quartile, respectively. This is done to avoid the side effect of very small and large weights, a by-product of the IPF procedure. The total amount trimmed is distributed among the records that were not trimmed to retain the total weight.

5.1.2 Adjustment Factors

Not every trip in the survey universe was sampled, so adjustment factors are needed to allow representation of riders who did not have a chance to be sampled. These factors are described below:

The Headway factor is calculated as the number of trip direction for a route per time period of day divided by the number of sampled trip direction.

> **Headway Factor = Total number of trip direction / Sampled trip direction**

The time of day factor is calculated as the number of time periods in a day for a route divided by the number of sampled time periods.

> **Time of Day Factor = Total number of time periods / Sampled time periods**

5.1.3 Sample Expansion

Sample expansion factors adjust the weighted sample to the total trips at the system-wide level. The calculation of the Expansion factor is described in the following sections.

5.1.3.1 Expansion Factor

The Expansion factor is calculated by comparing the expected ridership given the observations and the average weekday daily ridership at a route level using the formula below. As an example, assume that the weighted sample ridership for Route 1 is 7,270 and the population average daily weekday ridership for this route is 7,742. This produces an expansion factor of 1.06 (7,742 divided by 7,270).

Expansion Factor = Population Average Daily Ridership / Weighted Ridership

5.1.3.2 Expansion Weight

The final sample 'weighting and expansion' weight is referred to as the Expansion weight. In particular, the Expansion weight is calculated by multiplying the weight by the Expansion factor. Following the application of the Expansion weight, the weighted data represents the population boarding to alighting trips.

Expansion Weight = Weight Factor * Expansion Factor

6 Summary of Survey Results - Onboard

The survey analysis includes a complete summary of survey results, including a breakdown of riders by frequency of use, demographic characteristics, trip purpose, and reasons for using RTC. The survey results identify key trends and/or areas of concern. Additionally, rider behavior and preferences among different user groups and rider characteristics, such as how frequently a rider uses transit or whether a rider has access to a car, has been evaluated.

Table 3 documents the sample goals and the number of completed surveys for the individual bus routes that serve the RTC. Throughout the entirety of the bus system, 1,209 surveys were collected and processed.

Table 3: Bus Goals

Route	Route Name	Goals	Completes	Completion Rate
RAPD	S Virginia St	193	139	72%
1	Ninth / Silverada / RTC CENT PLAZA	91	128	141%
2	Ninth / Silverada	94	86	91%
2S	West Seventh	19	23	121%
3CC	Sutro / Sun Valley	8	20	250%
3CL	Arlington / Moana	33	26	79%
4	Stead	31	33	106%
5	Kietzke	71	45	63%
6	Fourth / Prater	30	47	157%
7	Terminal / Neil	72	36	50%
9	VA Hospital / Grove	53	48	91%
11	East Mill	98	60	61%
12	Sutro / Wedekind / TMCC	64	49	77%
13	Idlewild	28	52	186%
14	Lemmon Valley	38	71	187%
15	Glendale / Greg	56	42	75%
16	Glendale / Greg Express	18	25	139%
17	Wells / Airport	22	29	132%
18	Sparks Marina	43	56	130%
18X	East Prater / Baring	3	4	133%
19	East Prater	13	30	231%
21	Kings Row / Sky Mtn (counterclockwise)	19	10	53%
25	Sky Mtn / Kings Row (clockwise)	12	27	225%
26	Mira Loma	13	14	108%
54	South Meadows / Damonte Ranch	22	38	173%
56	RTC INTERCITY Reno/Carson City	28	42	150%
INT C	RTC RAPID	6	14	233%
SS	SIERRA SPIRIT	22	15	68%
Total		1,200	1,209	101%

A cross-tabulation of line by time of day demonstrates the number of observations collected for the RTC bus routes. Thirty-six percent of all samples originated from the PM Peak period while only three percent of the sample was representative of the Evening/Early AM period.

Table 4: Cross-Tabulation of Line by Time of Day

| Route | Time of Day | | | | | | | | Total |
| | AM Peak | | Eve/Early AM | | Mid-day | | PM Peak | | |
	N	%	N	%	N	%	N	%	
RAPD	648	8.4%	83	11.4%	1,377	14.5%	1,684	16.3%	3,792
1	329	4.3%	136	18.7%	914	9.6%	617	6.0%	1,997
2	278	3.6%	221	30.3%	1,013	10.6%	456	4.4%	1,968
2S	143	1.8%	0	0.0%	0	0.0%	287	2.8%	430
3CC	81	1.1%	0	0.0%	47	.5%	54	.5%	183
3CL	172	2.2%	82	11.2%	0	0.0%	612	5.9%	866
4	0	0.0%	0	0.0%	0	0.0%	726	7.0%	726
5	729	9.4%	0	0.0%	297	3.1%	673	6.5%	1,699
6	0	0.0%	0	0.0%	523	5.5%	173	1.7%	697
7	972	12.6%	0	0.0%	741	7.8%	111	1.1%	1,824
9	251	3.3%	0	0.0%	838	8.8%	157	1.5%	1,246
11	707	9.1%	75	10.2%	635	6.7%	949	9.2%	2,366
12	1,309	16.9%	0	0.0%	508	5.3%	380	3.7%	2,198
13	157	2.0%	68	9.3%	165	1.7%	237	2.3%	626
14	267	3.5%	0	0.0%	358	3.8%	374	3.6%	1,000
15	484	6.3%	0	0.0%	368	3.9%	348	3.4%	1,200
16	0	0.0%	39	5.4%	207	2.2%	194	1.9%	440
17	130	1.7%	0	0.0%	164	1.7%	194	1.9%	488
18	397	5.1%	0	0.0%	303	3.2%	495	4.8%	1,195
18X	0	0.0%	0	0.0%	35	.4%	40	.4%	75
19	58	.7%	0	0.0%	136	1.4%	121	1.2%	315
21	0	0.0%	0	0.0%	235	2.5%	235	2.3%	470
25	82	1.1%	0	0.0%	144	1.5%	78	.8%	304
26	0	0.0%	0	0.0%	252	2.7%	59	.6%	311
54	117	1.5%	26	3.5%	163	1.7%	129	1.2%	435
56	210	2.7%	0	0.0%	88	.9%	444	4.3%	742
INTC	0	0.0%	0	0.0%	0	0.0%	149	1.4%	149
SS	210	2.7%	0	0.0%	0	0.0%	379	3.7%	589
Total	7,732	100.0%	729	100.0%	9,513	100.0%	10,355	100.0%	28,330

Table 5 documents the usable route observations and the bus population; it was expanded based on ridership figures from fiscal year 2014. Bus data were weighted and expanded to a total population of 28,330 from the 1,209 pieces of sample collected.

Table 5: Expansion of Bus Route Data

Route	Route Name	Total Usable Records	Total Expanded Data
RAPD	S Virginia St	139	3,792
1	Ninth / Silverada / RTC CENT PLAZA	128	1,997
2	Ninth / Silverada	86	1,968
2S	West Seventh	23	430
3CC	Sutro / Sun Valley	20	183
3CL	Arlington / Moana	26	866
4	Stead	33	726
5	Kietzke	45	1,699
6	Fourth / Prater	47	697
7	Terminal / Neil	36	1,824
9	VA Hospital / Grove	48	1,246
11	East Mill	60	2,366
12	Sutro / Wedekind / TMCC	49	2,198
13	Idlewild	52	626
14	Lemmon Valley	71	1,000
15	Glendale / Greg	42	1,200
16	Glendale / Greg Express	25	440
17	Wells / Airport	29	488
18	Sparks Marina	56	1,195
18X	East Prater / Baring	4	75
19	East Prater	30	315
21	Kings Row / Sky Mtn (counterclockwise)	10	470
25	Sky Mtn / Kings Row (clockwise)	27	304
26	Mira Loma	14	311
54	South Meadows / Damonte Ranch	38	435
56	RTC INTERCITY Reno/Carson City	42	742
INT C	RTC RAPID	14	149
SS	SIERRA SPIRIT	15	589
Total		1,209	28,330

Table 6 shows the relationship between vehicle ownership and household income. Overall, the vast majority (55 percent) of bus respondents reported not owning any vehicles. Bus respondents with an average annual income of between $10,000 and $24,999 were the most likely to own one vehicle. Bus respondents reporting an annual income of between $10,000 and $24,999 were also the group most likely to not own any vehicles.

Table 6: Cross-Tabulation of Vehicle Ownership and Household Income

Vehicle Owner-ship	Household Income												Total
	$0-$9,999	$10k-$24,999	$25k-$34,999	$35k-$49,999	$50k-$74,999	$75k-$99,999	$100k-$149,999	$150k-$199,999	$200k-$249,999	$250k +	DK	RF	
None	3,167	5,691	3,867	1,400	237	94	70	0	0	0	540	183	15,248
1	1,918	2,079	1,569	887	381	60	3	25	29	39	354	120	7,463
2	776	546	588	366	257	50	43	14	0	0	391	92	3,122
3	103	213	184	85	135	100	27	4	0	0	154	84	1,088
>=4	224	160	189	104	30	19	16	12	0	0	34	0	790
Total	6,188	8,689	6,397	2,842	1,039	323	159	55	29	39	1,471	479	27,711

Figure 3 shows the distribution of origin trip purposes for bus passengers. Nearly half (49 percent) of bus passengers' origin location was home. Respondents who were coming from work or work related activities comprised the next largest percentage with 22 percent of the bus population.

Figure 3: Distribution of Origin Trip Purpose
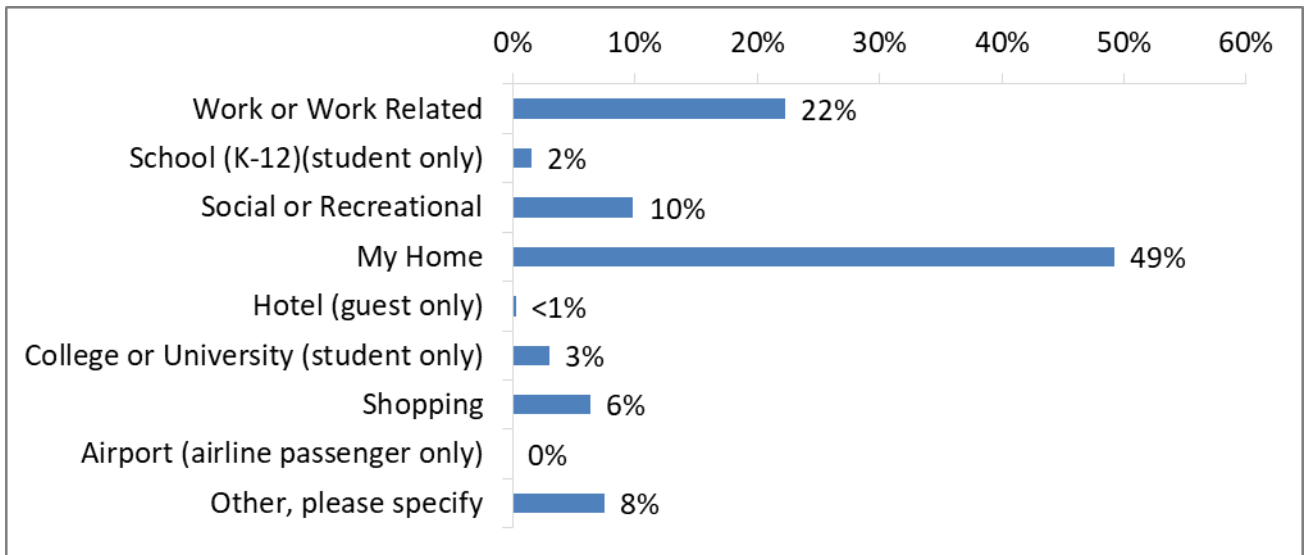
Slightly more than one-third (34 percent) of bus passengers' destination location was home, as illustrated in Figure 4. Work or work related made up 22 percent of passengers' destination purposes.

Figure 4: Distribution of Destination Trip Purpose
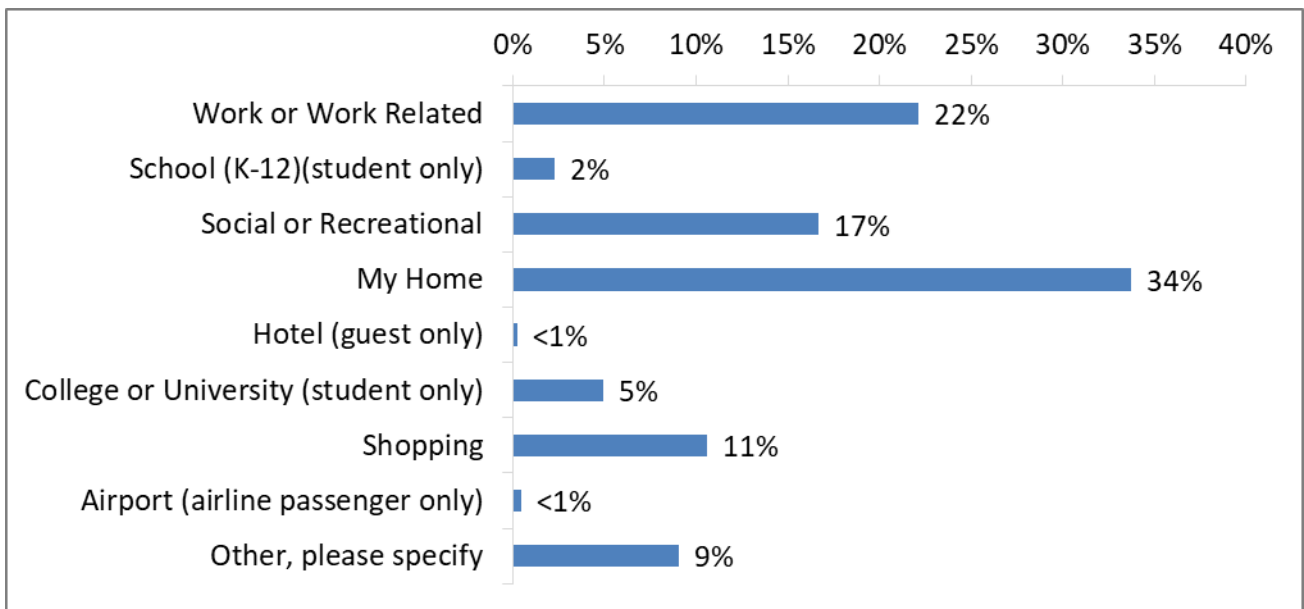
More than 90 percent of bus passengers walked from their origin location to their first stop and walked after their final stop to their destination location, as described in Table 7.

Table 7: Cross-Tabulation of Egress Mode by Access Mode

Egress Mode	Access Mode						Total
	Walked	Wheelchair	Bicycle	Dropped off	Drove	Other, please Specify	
Walked	25,057	82	17	704	210	468	26,539
Wheelchair	0	111	0	0	0	0	111
Bicycle	36	0	462	55	0	16	570
Picked up	342	0	0	79	0	0	421
Drove	52	0	0	14	0	0	66
Other, please specify	552	0	42	30	0	0	624
Total	26,039	193	521	883	210	485	28,330

Figure 5 presents how bus passengers access transit. An overwhelming majority of passengers (92 percent) walked from their origin location to their first bus or train.

Figure 5: Distribution of Access Mode
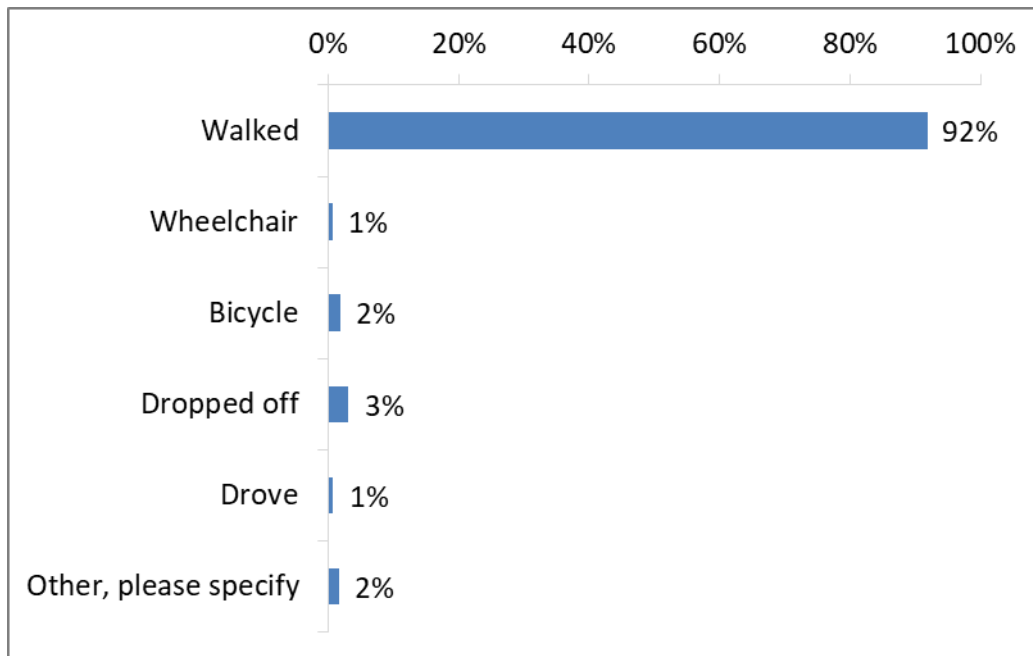
Figure 6 presents how RTC bus passengers egress transit. The egress mode results closely mirror those for the access mode. The vast majority of passengers (94 percent) walked to their final destination after their last bus or train.

Figure 6: Distribution of Egress Mode
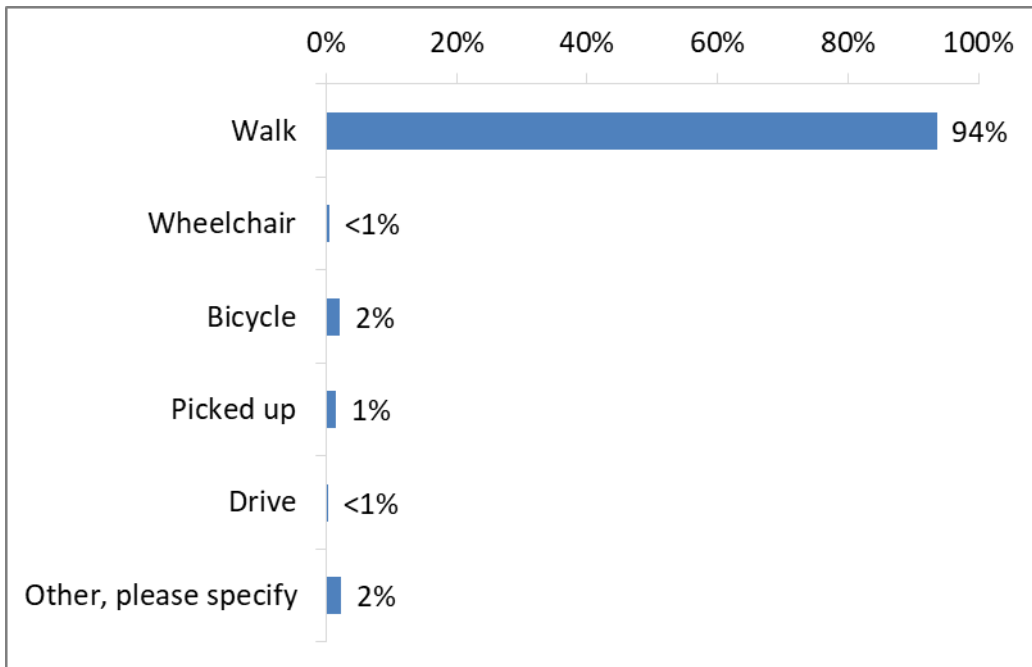
Table 8 illustrates the relationship between the bus route surveyed, and the total number of bus vehicles needed to complete respondents' one-way trips. Forty-nine percent of all bus passengers used one bus vehicle to complete their one-way-trip. Forty-four percent of passengers used two bus vehicles to complete their one-way trip. No passengers reported needing greater than four bus vehicles to complete a one-way trip.

Table 8: Cross-Tabulation of Line by Total Bus Vehicles Used

| Route | Total Vehicles | | | | Total |
	1	2	3	4	
RAPD	2,215	1,458	119	0	3,792
1	1,318	679	0	0	1,997
2	693	1,039	236	0	1,968
2S	251	179	0	0	430
3CC	133	50	0	0	183
3CL	506	360	0	0	866
4	274	416	36	0	726
5	736	802	161	0	1699
6	420	251	26	0	697
7	1,111	658	55	0	1,824
9	651	549	19	27	1,246
11	1,037	1,142	187	0	2,366

Route	Total Vehicles				Total
	1	2	3	4	
12	975	1,223	0	0	2,198
13	360	231	35	0	626
14	414	554	31	0	1,000
15	465	734	0	0	1,200
16	55	385	0	0	440
17	80	391	17	0	488
18	881	284	30	0	1,195
18X	39	36	0	0	75
19	198	116	0	0	315
21	94	188	188	0	470
25	109	80	116	0	304
26	147	7	132	25	311
54	90	272	72	0	435
56	153	270	319	0	742
INT C	97	30	22	0	149
SS	406	145	39	0	589
Total	13,907	12,531	1,841	52	28,330

Figure 7 details the number of working vehicles available to RTC Transit users. Fifty-five percent of users stated they did not have a vehicle available to make their one-way trip.

Figure 7: Vehicle Availability
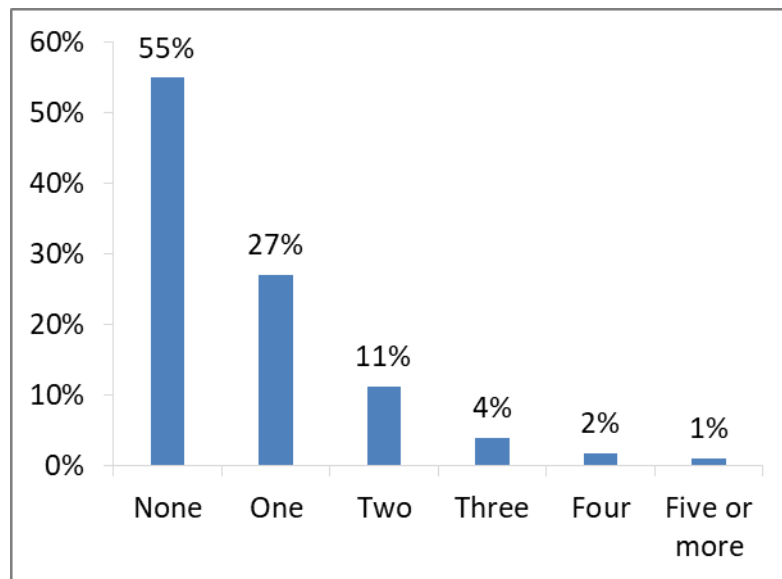
Figure 8 documents how bus passengers paid their fare. Thirty-seven percent of bus passengers used cash to pay for their trip, while 26 percent of bus passengers paid their fare using a PrePurchase – 31 day pass.

Figure 8: Distribution of Fare

Fare Type	Percentage
Cash - Single Ride	37%
Cash - 24 hour	8%
PrePurchase Pass - 24 hour	8%
PrePurchase Pass- 10 ride	6%
PrePurchase Pass- 7 day	4%
PrePurchase Pass- 31 day	26%
PrePurchase Pass- 31 day disabled	5%
Other	6%
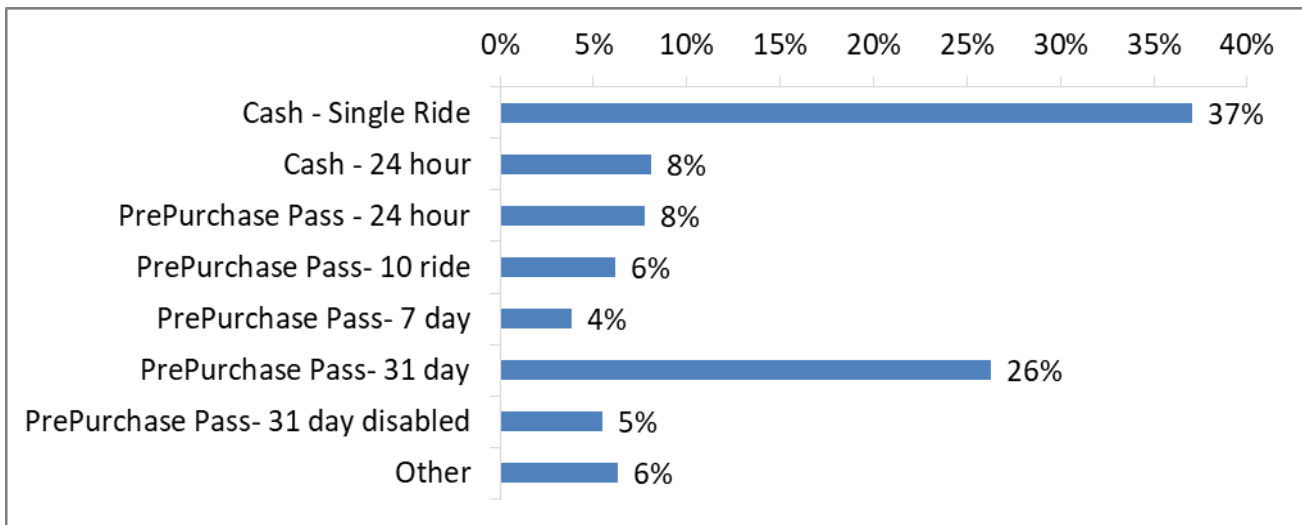
Figure 9 summarizes the number of full-time or part-time workers in a surveyed household. Sixty-one percent of bus passengers have one or fewer employed household members. Bus passengers living in households with two or more employed members account for 39 percent the ridership.

Figure 9: Distribution of Household Workers

Workers	Percentage
0	23%
1	38%
2	25%
3	8%
4+	6%
DF/RF	1%
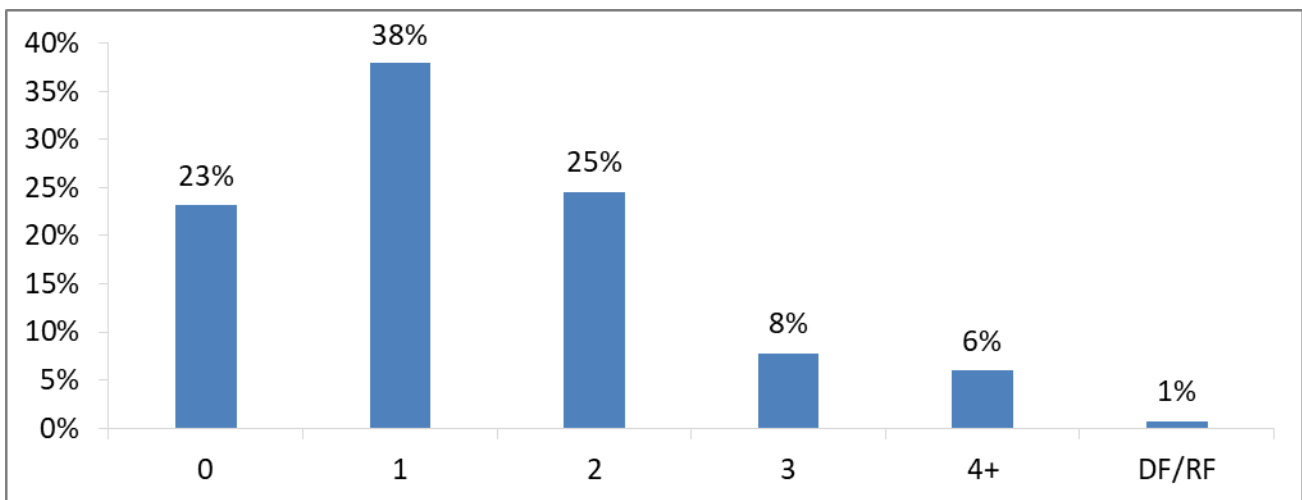
Figure 10 characterizes bus passengers' driver's license status. Nearly two-thirds of bus passengers do not possess a valid driver's license.

Figure 10: Distribution of Valid Driver's License
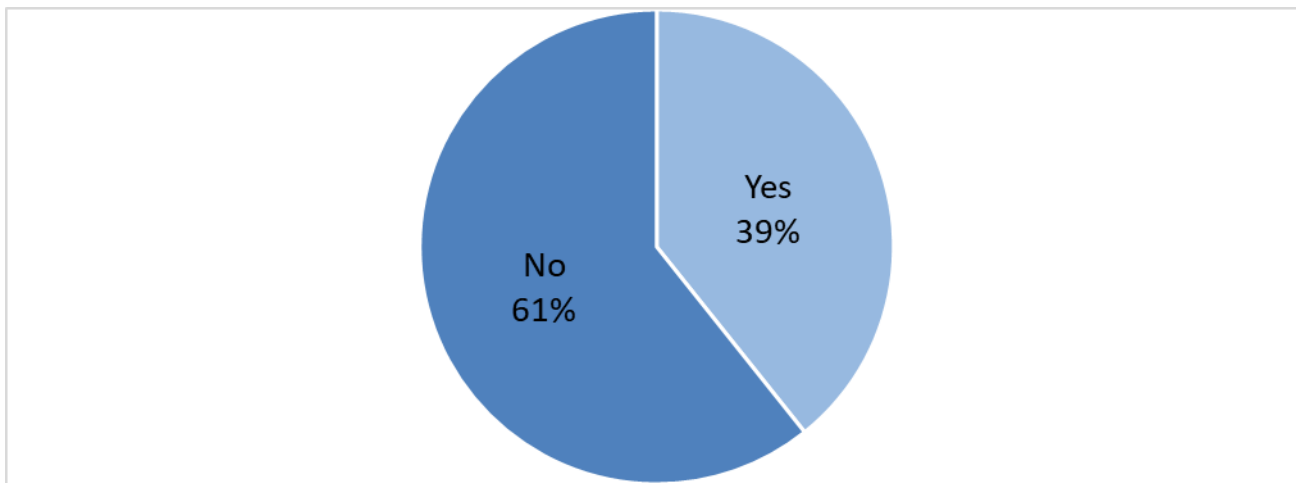
Bus passengers who participated in the survey specified their employment status as reported in Figure 11. Fifty-eight percent of bus passengers are employed either full- or part-time. Twelve percent of bus passengers are students, while 29 percent of bus passengers are not employed, either unemployed, retired, or a homemaker.

Figure 11: Distribution of Employment Status
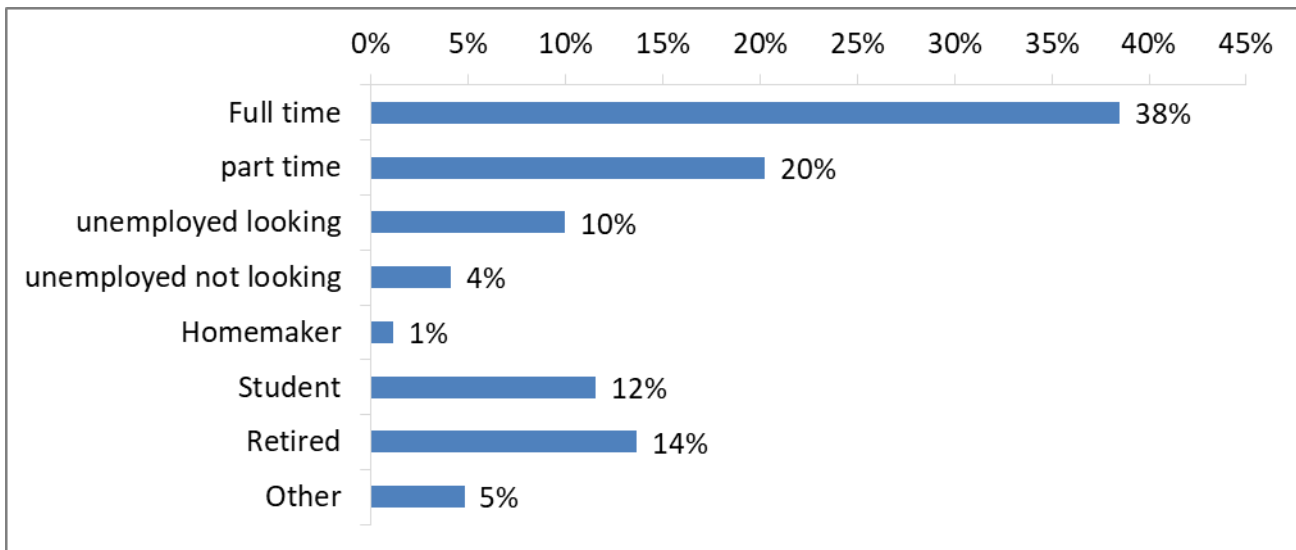
Figure 12 shows the age distribution of bus passengers. One fifth of bus passengers are between the ages of 25 and 34 years old. Forty-two percent of bus passengers are younger than 35, and 24 percent of passengers are 55 years of age or older.

Figure 12: Distribution of Age
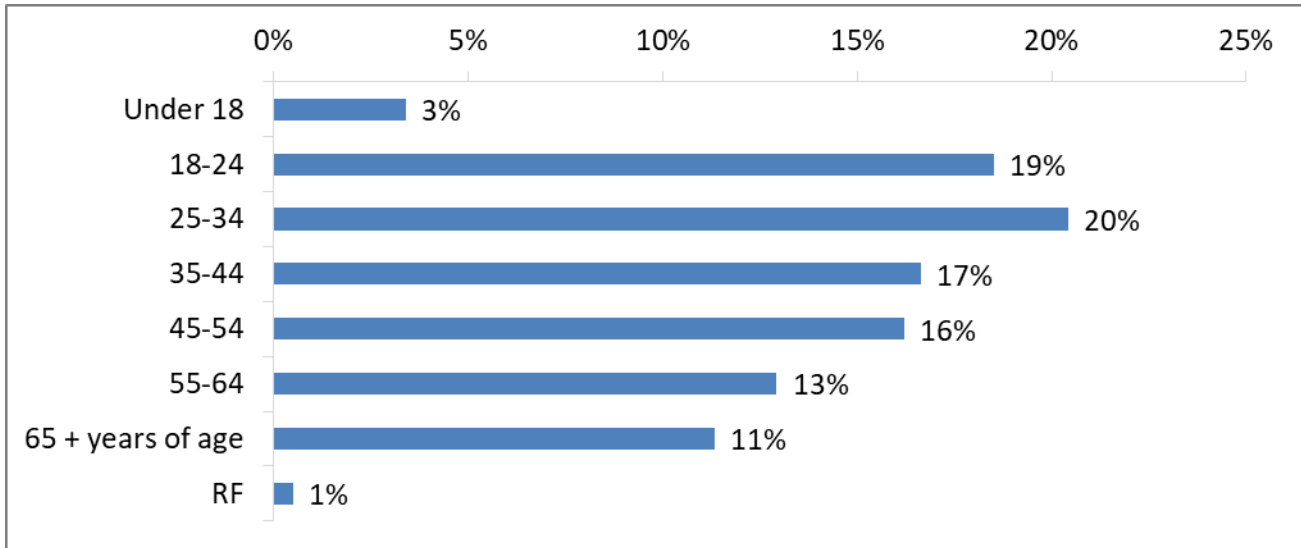
Figure 13 shows the distribution of ethnicity of bus passengers. White/Caucasian, at 61 percent of the ridership, makes up the majority of bus passengers; Hispanic passengers make up the second largest group, at 20 percent of the ridership.

Figure 13: Distribution of Ethnicity
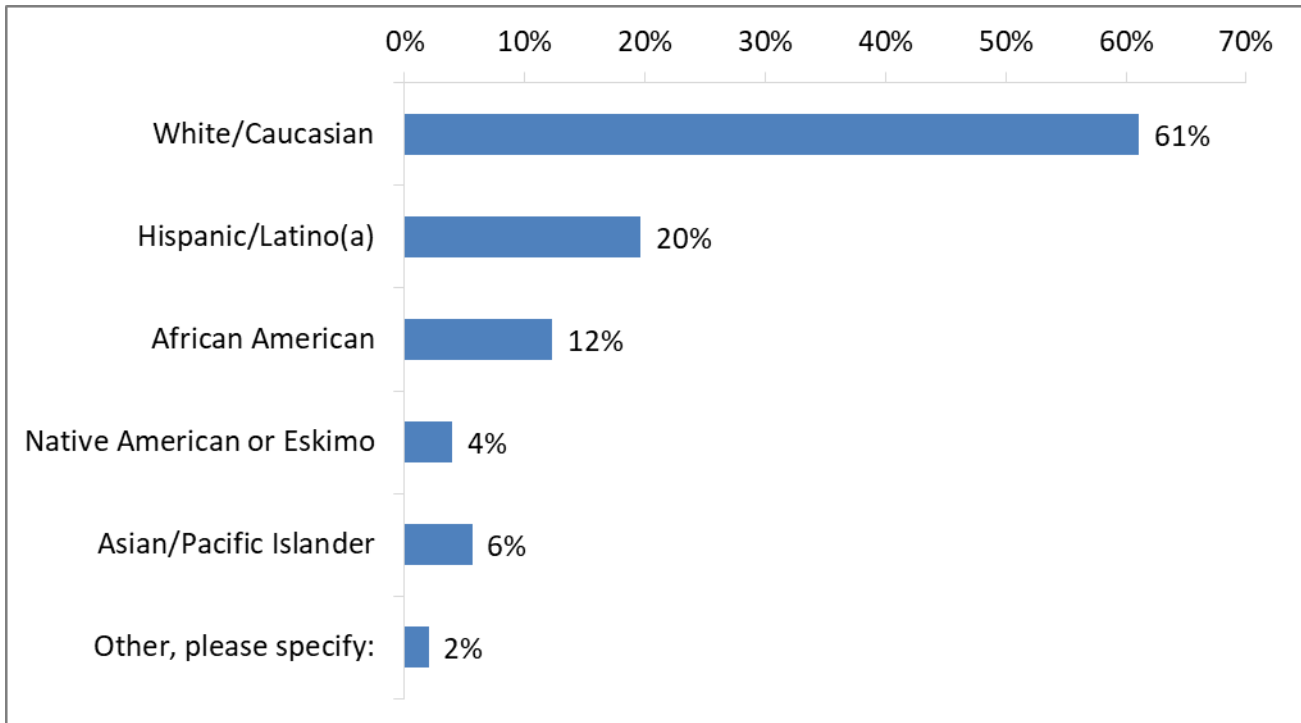
As seen in Figure 14, more than one-half (53 percent) of bus passengers' household income is less than $25,000 annually, while between six and seven percent of passengers make an annual income of $50,000 or more.

Figure 14: Distribution of Household Annual Income
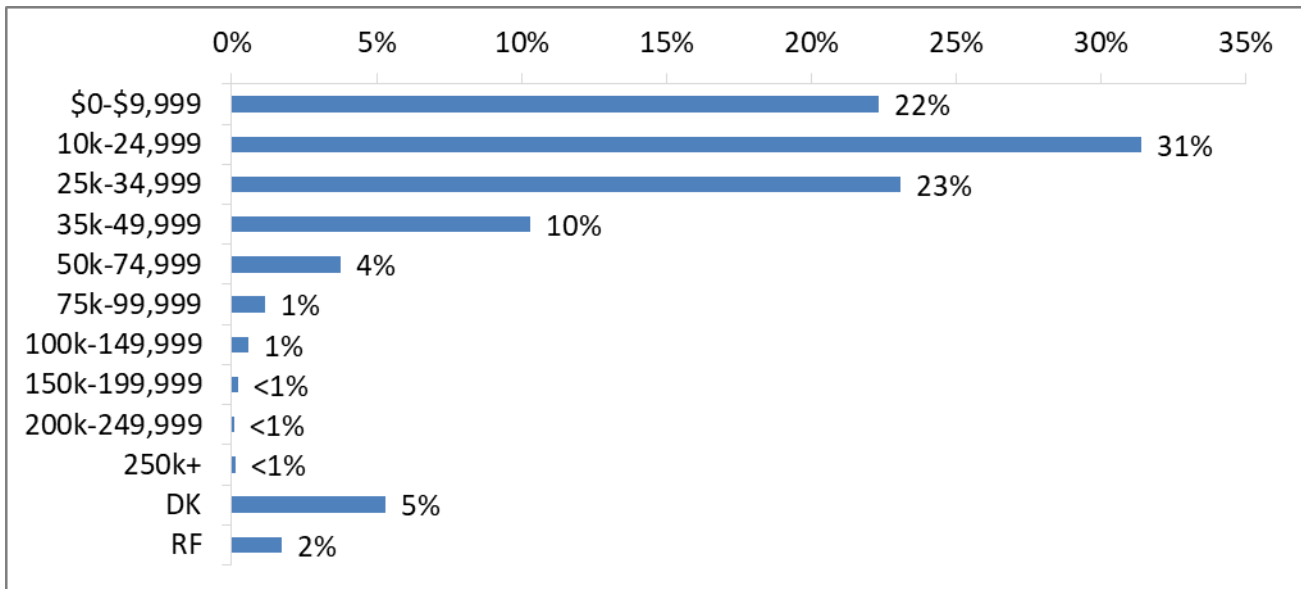
Overwhelmingly 99.7 percent of bus surveys were completed in English, while less than one-half percent of bus passengers took the survey in Spanish.

Figure 15: Distribution of Language
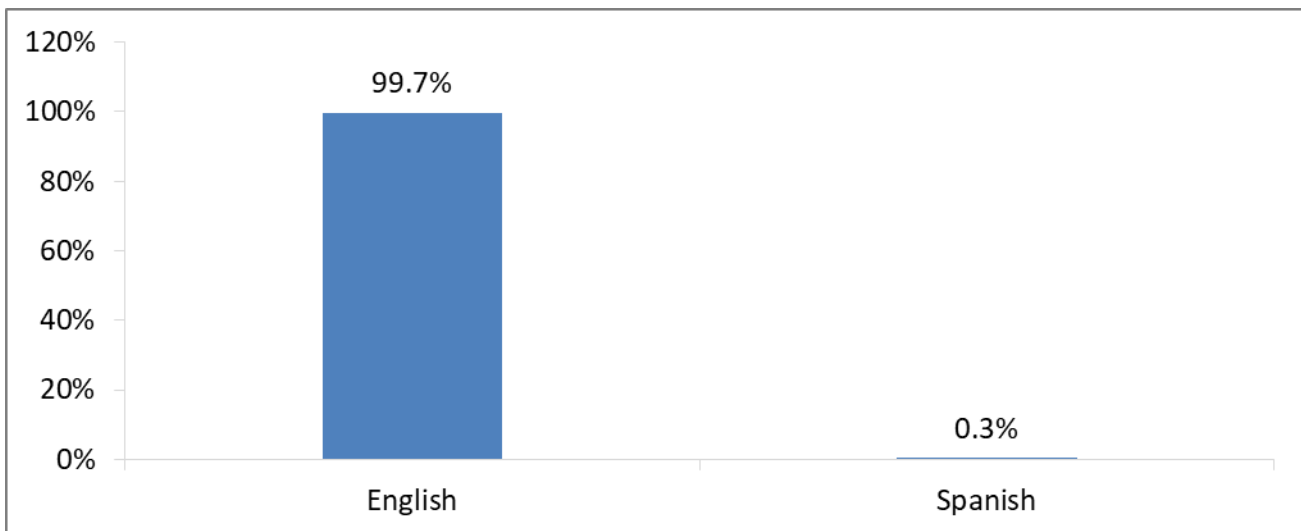
7 Summary of Results – On-to-Off Board

This section discusses the results of the on-to-Off Board survey.

Table 9 illustrates the comparison between the average daily boardings and alightings, observed boardings and alightings. No surveyable boardings and alightings were observed for Routes 2S, 3CC, 13, 14, 16, 17, and 21. Route RAPD, with the largest volume of daily average boardings and alightings, showed the highest volume of responses, however when looking at the percentage of observed surveys, the largest percentage of surveys was observed for Route 19.

Table 9: Observed Boardings and Alightings by Route

Route	Route Name	Daily Average		Observed		% of Daily Average Observed	
		Boardings	Alightings	Boardings	Alightings	Boardings	Alightings
RAPD	S Virginia St	3,639	3,638	599	619	16%	17%
1	Ninth / Silverada / RTC CENT PLAZA	1,840	1,846	15	15	1%	1%
2	Ninth / Silverada	1,774	1,718	229	229	13%	13%
2S	West Seventh	390	392			0%	0%
3CC	Sutro / Sun Valley	156	163			0%	0%
3CL	Arlington / Moana	812	825	364	364	45%	44%
4	Stead	711	714	381	382	54%	53%
5	Kietzke	1,498	1,497	448	457	30%	31%
6	Fourth / Prater	629	633	49	49	8%	8%
7	Terminal / Neil	1,707	1,482	51	92	3%	6%
9	VA Hospital / Grove	1,167	1,173	39	39	3%	3%
11	East Mill	2,438	2,261	76	76	3%	3%
12	Sutro / Wedekind / TMCC	1,599	1,604	43	43	3%	3%
13	Idlewild	603	601			0%	0%
14	Lemmon Valley	941	940			0%	0%
15	Glendale / Greg	1,201	1,203	159	187	13%	16%
16	Glendale / Greg Express	410	410			0%	0%
17	Wells / Airport	465	465			0%	0%
18	Sparks Marina	1,041	1,040	277	288	27%	28%
18X	East Prater / Baring	59	58	17	17	29%	29%
19	East Prater	262	273	140	151	53%	55%
21	Kings Row / Sky Mtn (counterclockwise)	489	490			0%	0%
25	Sky Mtn / Kings Row (clockwise)	144	204	37	37	26%	18%
26	Mira Loma	303	301	24	24	8%	8%
54	South Meadows / Damonte Ranch	431	432	186	186	43%	43%
56	RTC INTERCITY Reno/Carson City	731	728	336	336	46%	46%
INT C	RTC RAPID	171	177	70	70	41%	39%
SS	SIERRA SPIRIT	179	177	91	91	51%	51%
TOTAL		25,789	25,446	3,631	3,752	14%	15%

8 Maps

Figure 16: RTC Transit Work Origin
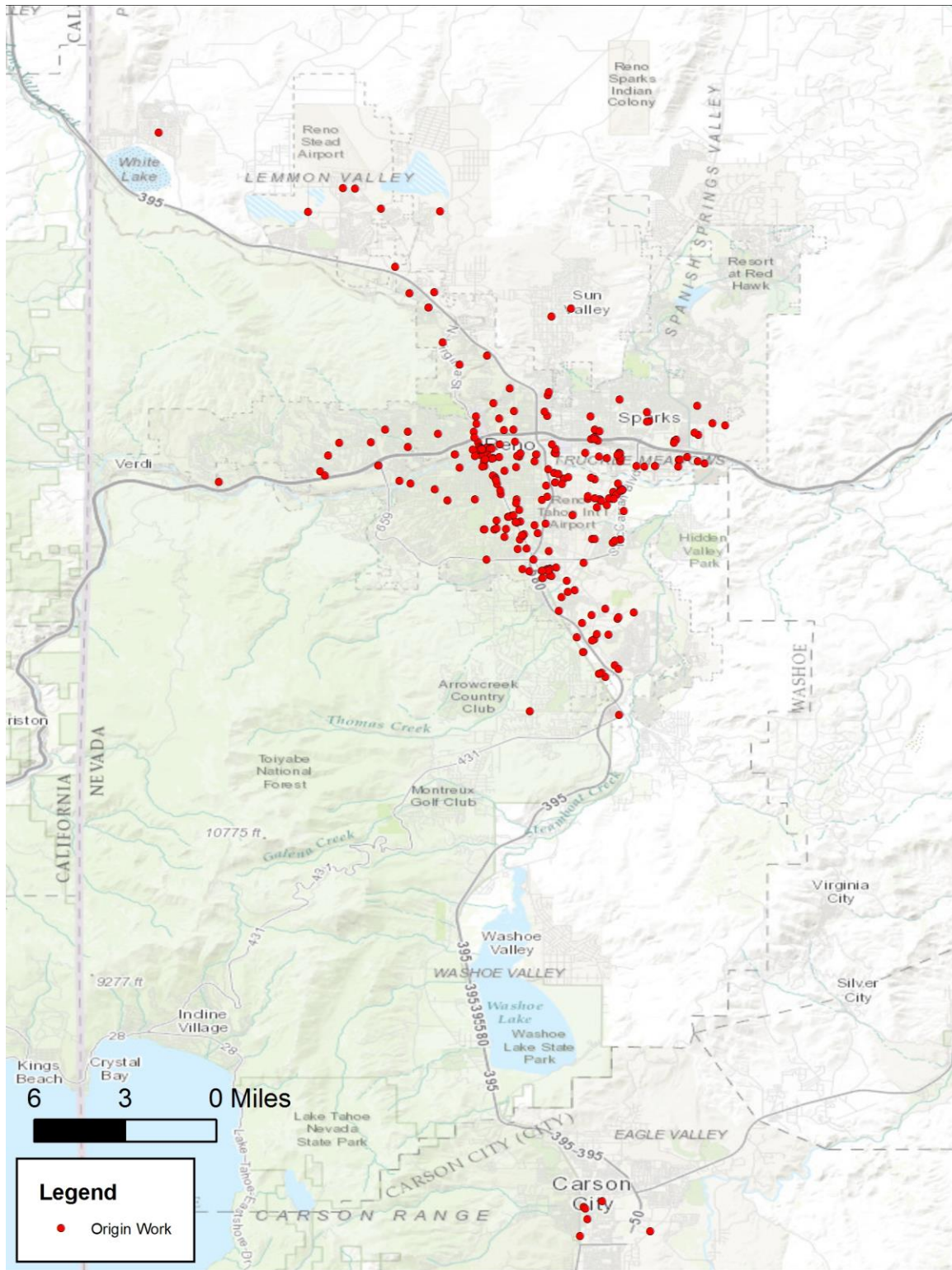
Figure 17: RTC Transit Work Destination
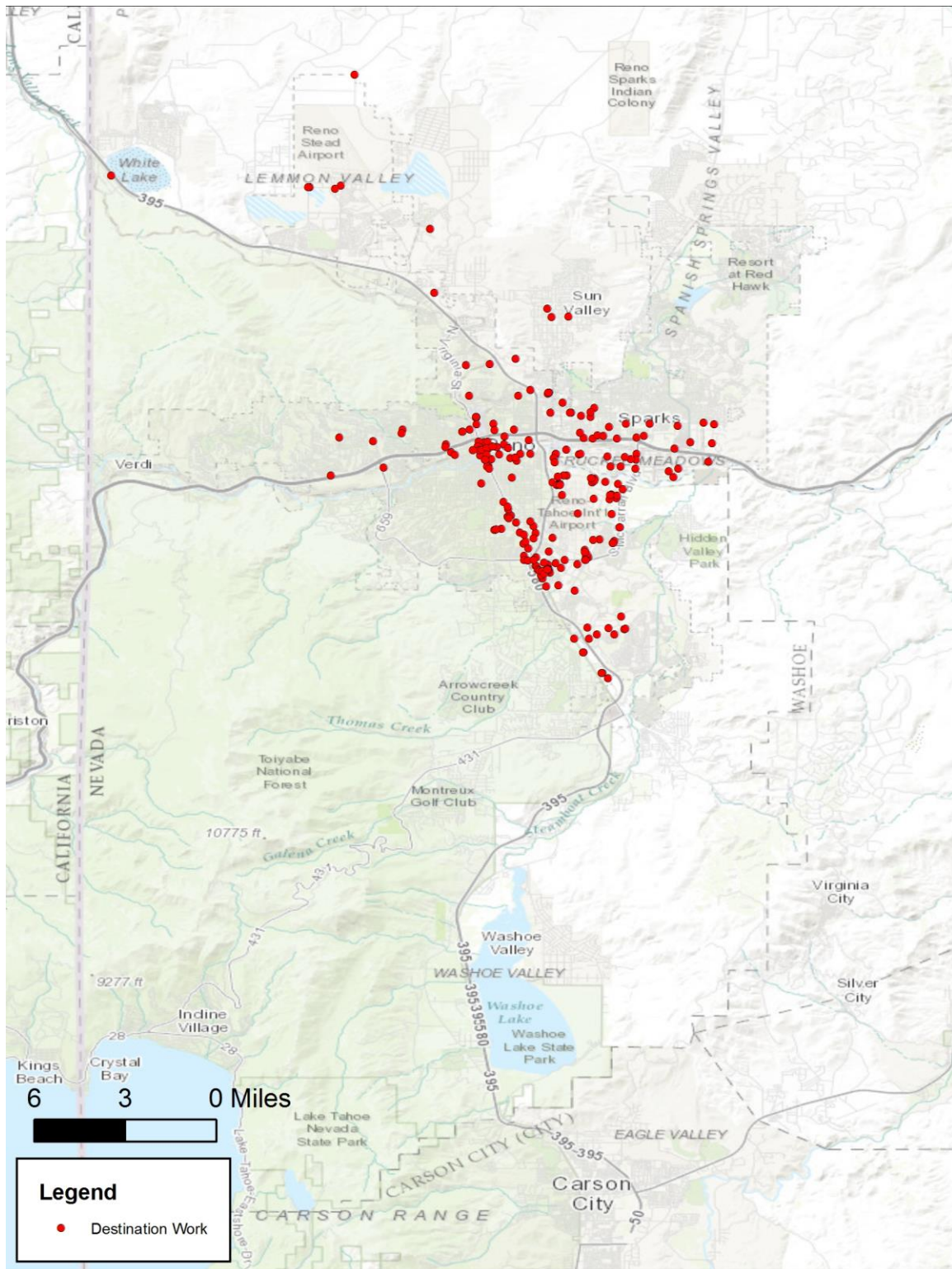
Figure 18: RTC Transit Home Origin
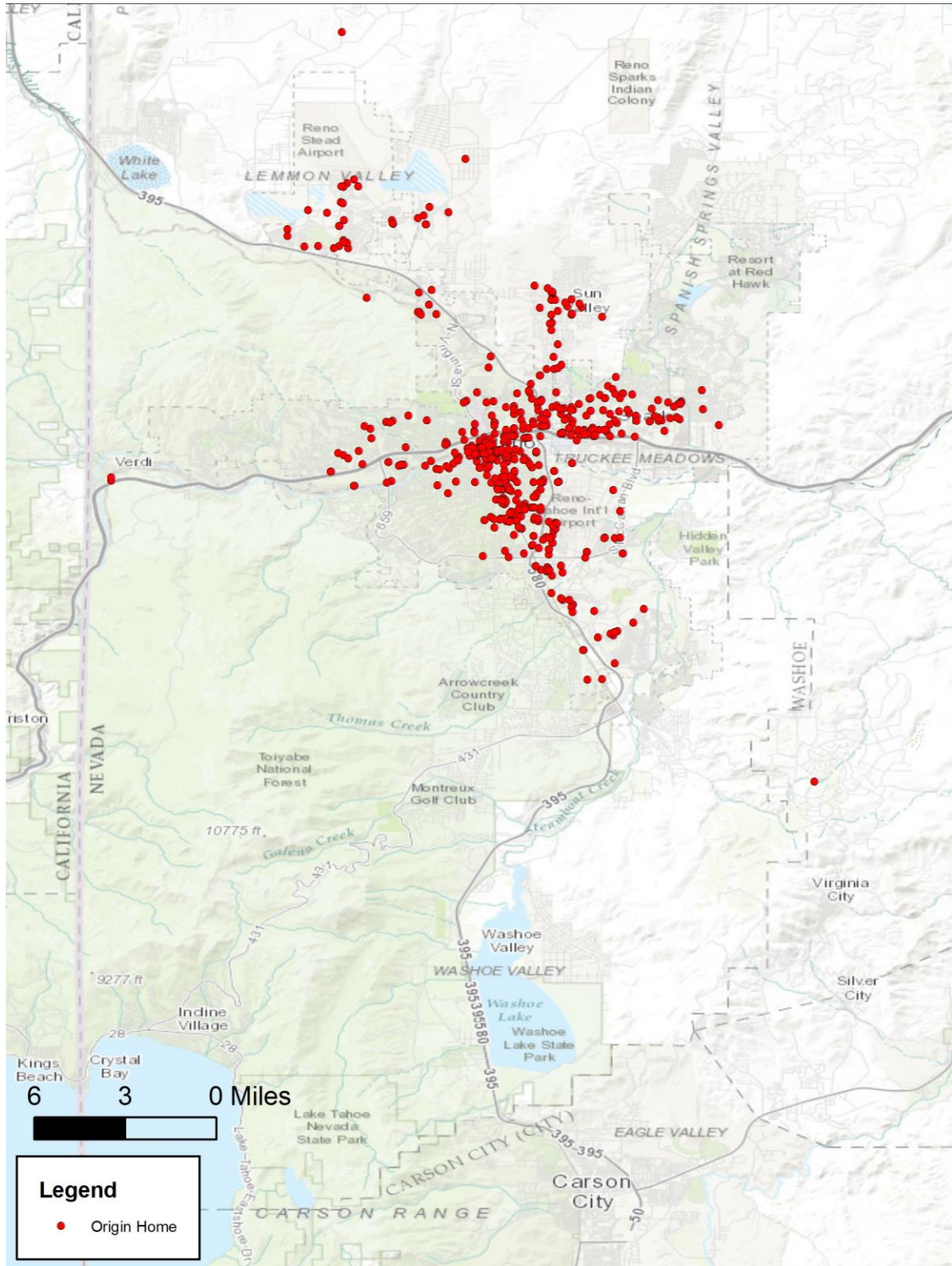
Figure 19: RTC Transit Home Destination
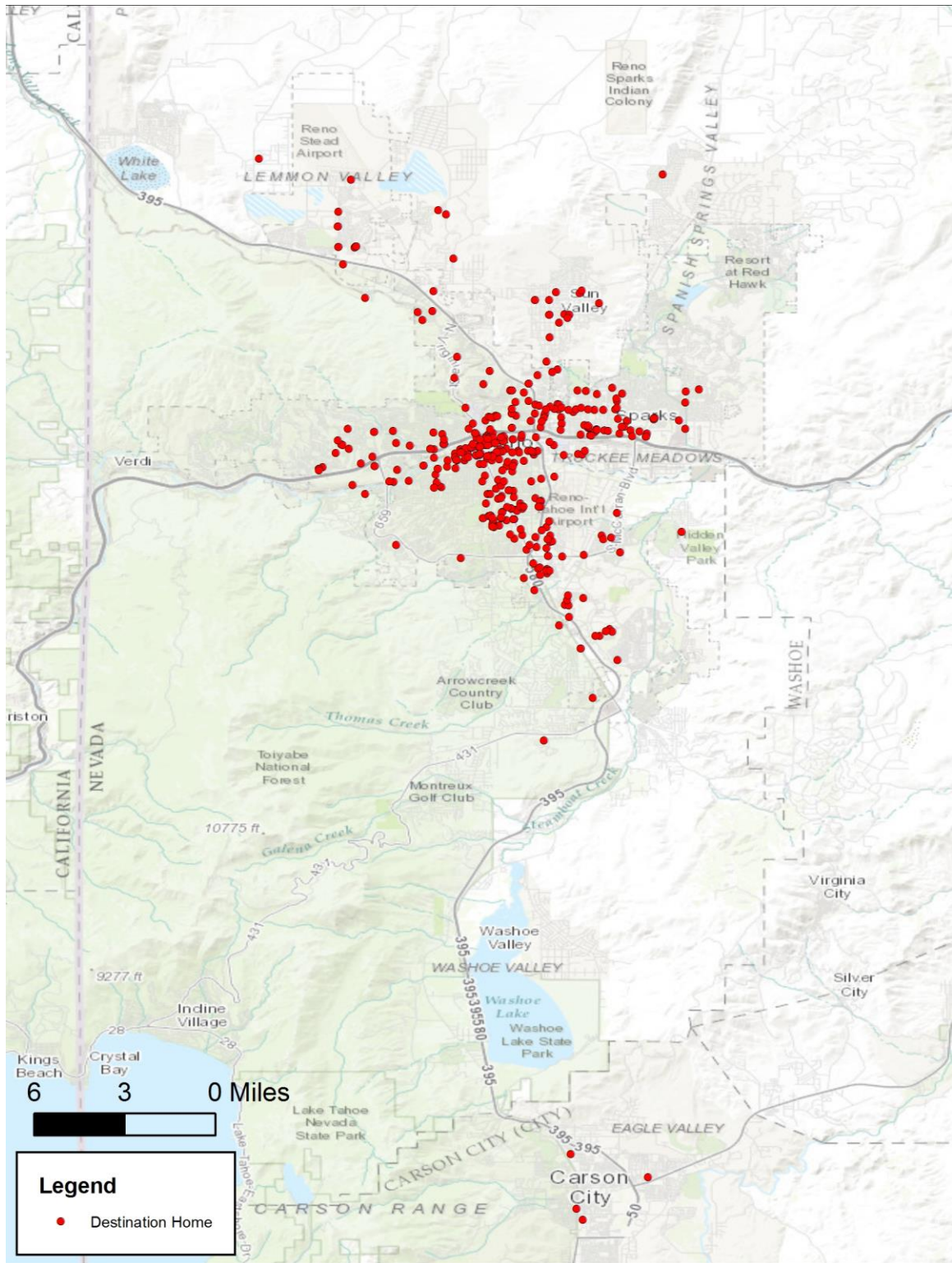
Figure 20: RTC Transit Origin Mode Walk
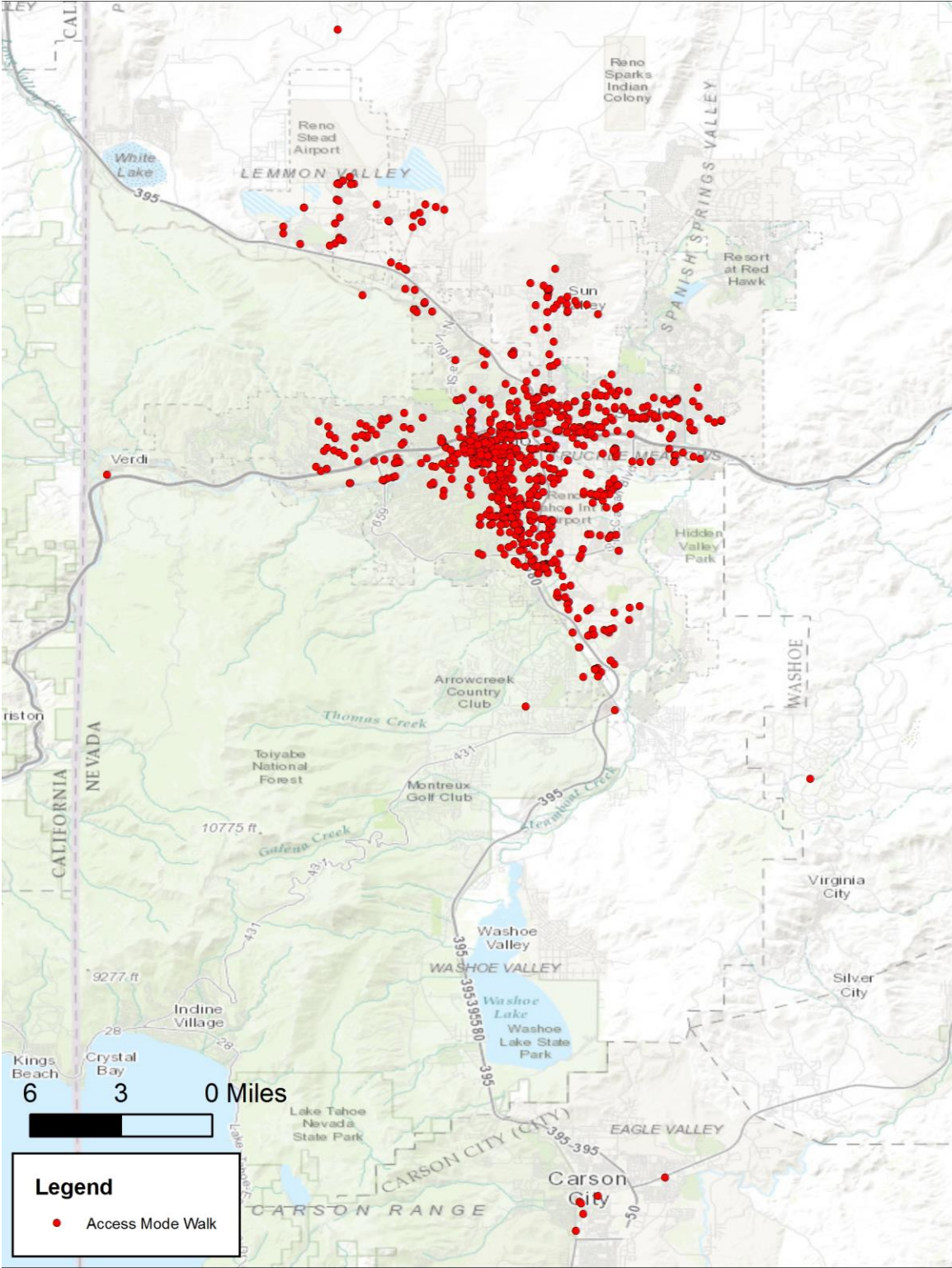
Figure 21: Origin Mode Other
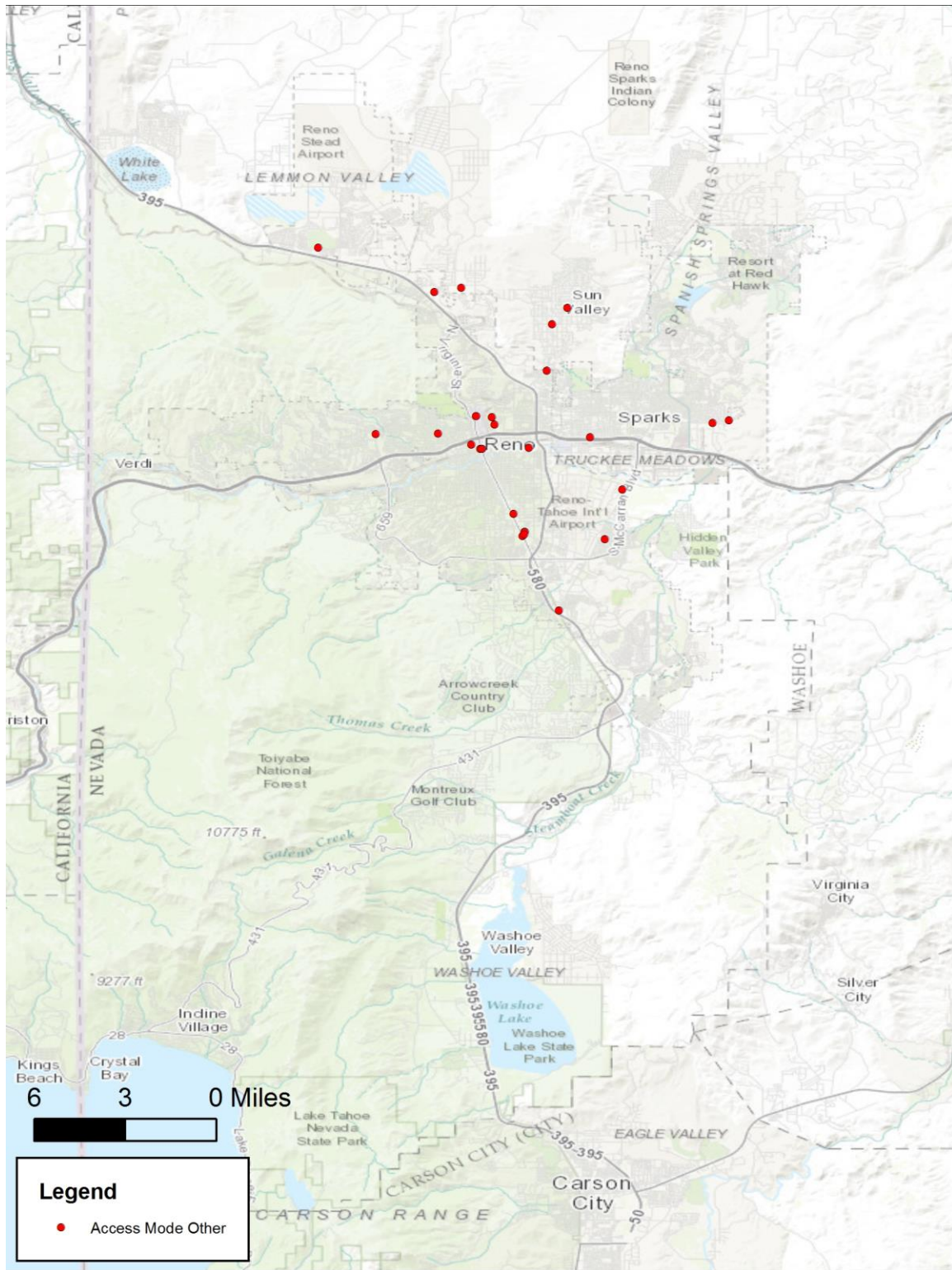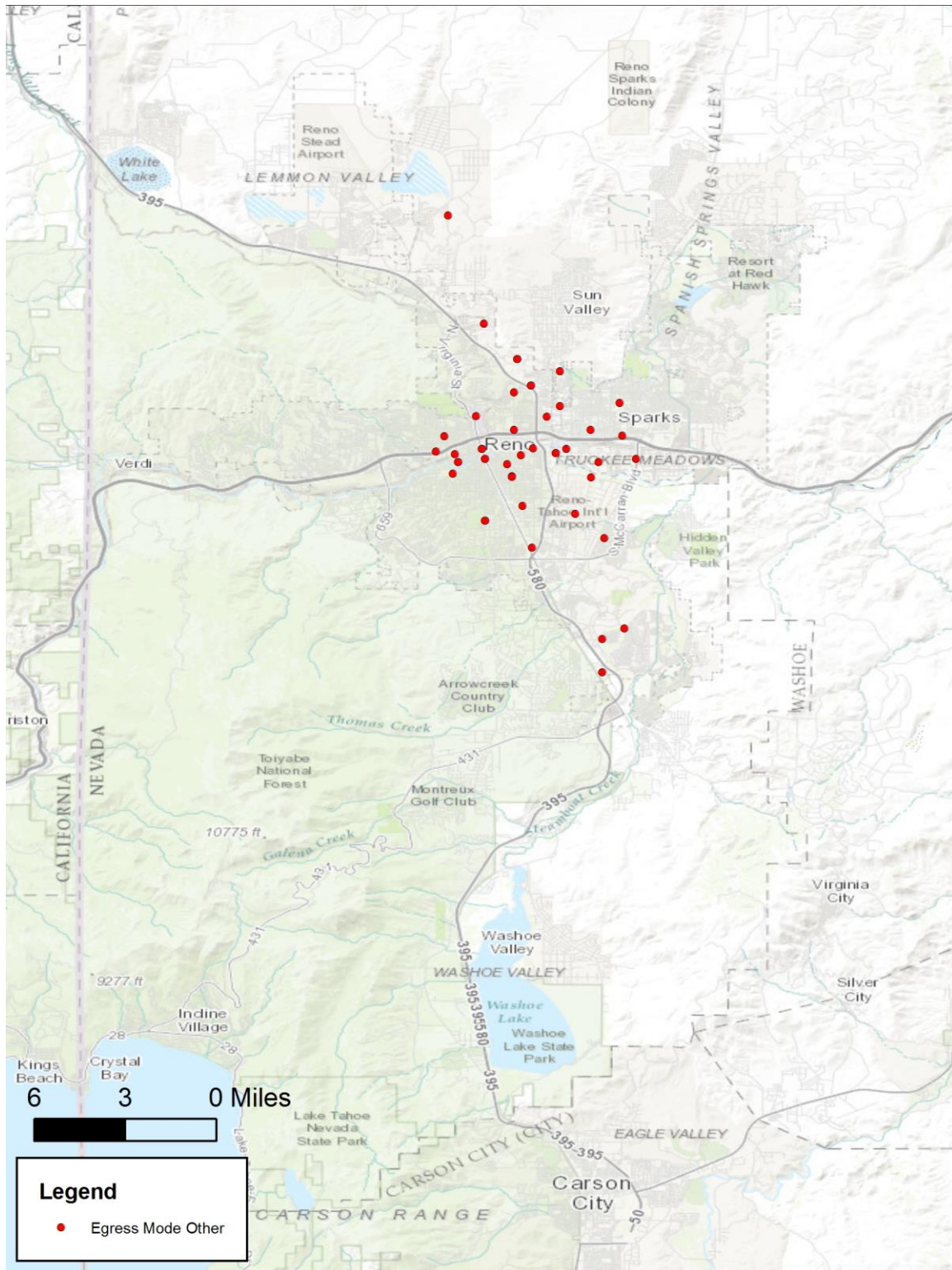
Figure 22: RTC Transit Destination Mode Walk

Figure 23: RTC Destination Mode Other

Legend
● Egress Mode Other

Appendix A: Survey Card

Figure 24: English Onboard Survey Instrument

Figure 25: Spanish Onboard Survey Instrument

Appendix B: RideTrack Application

➤By using the client provided data to download into the unit itself, each assignment is matched up by route, block, trip, direction, and pattern.

➤When the counter enters this information from their assignment sheet, they are able to access a list of all stops belonging to the route, block, trip direction, and pattern.

➤These assignments are created by field staff using the run-cut files and uploaded to the website to be placed in the devices.

➤The assignments are uploaded into the unit by the field coordinator while in field.

➤The field coordinator links the device to their laptop with Microsoft active sync. The field coordinator has the project website open, goes into the device, and selects the upload assignments form web.

➤This allows counters to simply select their assignment on the device and not enter the entire run and block information every time they start a trip.

➤The assignments link to the run-cuts with the stop files by route, block, trip, direction, and pattern.

➤The ability to upload assignments into the devices minimizes user error such as entering the wrong assignment info resulting in faulty data.

Appendix C: TransiTap Application – Onboard Questionnaire

The first five items in the onboard questionnaire were not actual questions. The TransiTap application had preloaded items that the surveyor would complete for each variable, as listed in the VARIABLE column, and complete each value as listed in the VALUES column.

QUESTION	VARIABLE	VALUES
AUTO	RECORD	unique ID for this record
	route	Current route being surveyed (from GTFS)
	service_id	Service Id being surveyed (from GTFS)
	TOD_trip	Time of Day
	direction	trip headsign from GTFS
	TRIPID	Current trip_id being surveyed (from GTFS)
	SCREEN	Only filled in if on bus less than 5 minutes, so we can call them.
	SCREENNUMBER	Only filled in if on bus less than 5 minutes, so we can call them.
	SCREENDATE	Only filled in if on bus less than 5 minutes, so we can call them.
	BRDDAT	Boarding time formatted (MM/DD/YYYY)
	BRDTIM	Boarding time formatted (HH:MM:SS)
	BRDDATTIM	Boarding date and time
	BRDTIM_UNIX	Boarding time in UNIX timestamp format
AUTO	BRD_COORDS	Boarding stop x/y coordinates
AUTO	BRD_LAT	Boarding latitude (decimal degrees)
AUTO	BRD_LONG	Boarding longitude (decimal degrees)
AUTO	BRD_STOPID	Boarding stop stop_id from GTFS
	BRD_STOP_NAME	Boarding stop name from GTFS
	ORIG_NAME	Origin name
Search for Origin Address or Long Press Map for Cross Streets	ORIG_COORDS	Origin stop x/y coordinates
AUTO	ORIG_LAT	Origin latitude (decimal degrees)
AUTO	ORIG_LONG	Origin longitude (decimal degrees)
	ORIG_ADDR	Origin location address
	ALTDATTIM	Alighting time formatted (pilot only)
	ALTTIM_UNIX	Alighting time in UNIX timestamp format
	ALT_STOPID	Alighting stop stop_id from GTFS
	ALT_COORDS	Alighting stop x/y coordinates
	ALT_LAT	Alighting latitude (decimal degrees)
	ALT_LONG	Alighting longitude (decimal degrees)
	ALT_STOP_NAME	Alighting stop name
	DEST_NAME	Destination name
Search for Destination Address or Long Press Map to Set Location	DEST_COORDS	Destination location x/y coordinates
AUTO	DEST_LAT	Destination latitude (decimal degrees)
AUTO	DEST_LONG	Destination longitude (decimal degrees)
	DEST_ADDR	Destination location address

Questions asked of the respondent follow.

1. How many transfers did you make?

1. 0   GO TO Q2
2. 1   GO TO Q1.a.
3. 2   GO TO Q1.d.
4. 3   GO TO Q1.g.
5. 4   GO TO Q1.j.
6. 5   GO TO Q1.m.

1.a. Select 1st transfer from drop down menu.
1.b. Select boarding transfer stop from drop down menu.
1.c. Select alighting transfer stop from drop down menu. IF Q1 = 2. GO TO Q2; IF Q1 = 3. GO TO Q1.d.
1.d. Select 2nd transfer from drop down menu.
1.e. Select 2nd boarding transfer stop from drop down menu.
1.f. Select 2nd alighting transfer stop from drop down menu. IF Q1 = 3. GO TO Q2; IF Q1 = 4. GO TO Q1.g.
1.g. Select 3rd transfer from drop down menu.
1.h. Select 3rd boarding transfer stop from drop down menu.
1.i. Select 3rd alighting transfer stop from drop down menu. IF Q1 = 4. GO TO Q2; IF Q1 = 5. GO TO Q1.j.
1.j. Select 4th transfer from drop down menu.
1.k. Select 4th boarding transfer stop from drop down menu.
1.l. Select 4th alighting transfer stop from drop down menu. IF Q1 = 5. GO TO Q2; IF Q1 = 6. GO TO 1.m.
1.m. Select 5th transfer from drop down menu.
1.n. Select 5th boarding transfer stop from drop down menu.
1.o. Select 5th alighting transfer stop from drop down menu. GO TO Q2

2. How did you access the first (your origin) vehicle?

    1   Walked
    2   Wheelchair
    3   Bicycle
    4   Dropped off
    5   Drove
  97   Other, please specify

3. How did you get to your final destination?

    1   Walked
    2   Wheelchair
    3   Bicycle
    4   Dropped off
    5   Drove
  97   Other, please specify

4. Where are you coming FROM now?

    1   Work or Work Related
    2   School (K-12)(student only)
    3   Social or Recreational
    4   My Home
    5   Hotel (guest only)
    6   College or University (student only)
    7   Shopping
    8   Airport (airline passenger only)
  97   Other, please specify

5. Where are you going TO now?

 1 Work or Work Related
 2 School (K-12)(student only)
 3 Social or Recreational
 4 My Home
 5 Hotel (guest only)
 6 College or University (student only)
 7 Shopping
 8 Airport (airline passenger only)
 97 Other, please specify

6. What is your age?

 1 Under 18
 2 18-24
 3 25-34
 4 35-44
 5 45-54
 6 55-64
 7 65+
 8 RF

7. What is your employment status?

 1 Full time
 2 part time
 3 unemployed looking
 4 unemployed not looking
 5 Homemaker
 6 Student GO TO Q7.a.
 7 Retired
 97 Other

 7.a. IF Q7 = 6 What is your student status?

 1 Yes - Full time
 2 Yes - Part time
 3 No
 97 Other
 99 RF

8. How many people live in your household?

 1 1
 2 2
 3 3
 4 4
 5 5
 999 not asked

9. What is your occupation?

 1 Management Occupations, such as President, CEO, Manager, Director

2   Business and Financial Operations Occupants, such as Management Analyst, Research Analyst, Agent, Accountant

3   Computer and Mathematical Occupations, such as Computer Programmer, Web Developer, Statistician

4   Architecture and Engineering Occupations, such as Architect, Engineer, Drafter, Surveyor

5   Life, Physical, and Social Science Occupations, such as Scientist, Survey Research, Psychologist, Science Technician

6   Community and Social Service Occupations, such as Counselor, Clergy, Social Worker, Probation Officer

7   Legal Occupations, such as Lawyer, Law Clerk, Paralegal

8   Education, Training and Library Occupations, such as Teacher, College Professor, Librarian, Teacher Assistant

9   Arts, Design, Entertainment, Sports and Media Occupations, such as Professional Athlete, Writer, Camera Operator

10 Healthcare Practitioners and Technical Occupations, including MD, RN, LVN, Dentist, Veterinarian, Licensed Technician, Therapist

11 Healthcare Support Occupations, such as Health Aide, Nursing Assistant, Massage Therapist

12 Protective Service Occupations, such as Correctional Officer, Police Officer, Firefighter, Security Guard, Crossing Guard, Security Screener, Lifeguard

13 Food Preparation and Serving Related Occupations, such as Cook, Waiter/Waitress, Bartender, Food Server, Dishwasher

14 Building and Grounds Cleaning and Maintenance Operations, such as Janitor, Maid, Housekeeper, Gardener

15 Personal Care and Service Occupations, such as Hairdresser, Tour Guide, Childcare Worker, Card Dealer

16 Sales and Related Occupations, such as Cashier, Sales Clerk, Sales Agent, Real Estate Broker

17 Office and Administrative Support Occupations, such as Bank Teller, Office Clerk, Account Clerk, Postal Service Clerk, Data Entry Clerk, Secretary, Administrative Assistant

18 Farming, Fishing, and Forestry Occupations, including Farmer, Field Worker, Animal Trainer/Breeder

19 Construction and Extraction Occupations, including Electrician, Carpenter, Painter, Construction Equipment Operator, Miner, Driller, Explosive Worker, Etc.

20 Installation, Maintenance, and Repair Occupations, such as Repairer, Mechanic, Equipment Installer

21 Production Occupations, such as Assembler, Baker, Machinist, Lab Technician (Medical, Dental, and Ophthalmic), Jeweler

22 Transportation and Material Moving Occupations, such as Bus or Taxi Driver, Truck Driver, Crane Operator, Ship Loader

23 Military Specific Occupations

97 Other, Please Specify

98 DK

99 RF

10. How did you pay for your fare?

1   Cash - Single Ride
2   Cash - 24 hour
3   PrePurchase Pass - 24 hour
4   PrePurchase Pass - 10 ride
5   PrePurchase Pass - 7 day
6   PrePurchase Pass - 31 day
7   PrePurchase Pass - 31 day disabled
97 Other, please specify

11. What type of fare did you pay?

      1   Adult

      2   Reduced

12. What is your gender?

      1   Female

      2   Male

13. How many working vehicles are in your household?

      0   0

      1   1

      2   2

      3   3

      4   4

      5   5+

   999   not asked

14. How many people in your household are currently employed?

      0   0

      1   1

      2   2

      3   3

      4   4

      5   5+

    97   DF/RF

   999   not asked

15. Do you have a temporary or permanent condition that makes it difficult to travel outside the home?

      1   Yes

      2   No

16. LANGUAGE – QUESTION NOT ASKED; INTERVIEWER SELECTS

      1   English

      2   Spanish

17. Do you have a current driver's license?

      1   Yes

      2   No

18. In what range does your household income fall?

      1   $0-$9,999

      2   10k-24,999

      3   25k-34,999

      4   35k-49,999

      5   50k-74,999

      6   75k-99,999

      7   100k-149,999

      8   150k-199,999

9   200k-249,999
10   250k+
10   DK
12   RF
999   not asked

Thank you for participating in the RTC Onboard survey!