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Greater Fairbanks Transportation Survey

Final Report

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Executive Summary

The Alaska Department of Transportation and Public Facilities (ADOT&PF) conducted the Greater Fairbanks Transportation Survey (GFTS), a regional household travel survey, to obtain travel behavior data needed to support the regional travel demand model. The planning region is comprised of the North Star Borough known as the PM2.5 nonattainment region that includes the City of Fairbanks and the City of North Pole.

The study was conducted in two phases. The first phase of the study was fielded in the fall of 2013. The second phase was fielded in the winter of 2014. In Phase I of this household transportation survey effort, an address based sampling (ABS) frame was used to recruit households to participate in a one-day personal travel survey data collection. A subsample of participating households was asked to take part in a special technology component in which up to three vehicles would be equipped with a Global Positioning Satellite (GPS) and On-Board Diagnostic (OBD) device for one week. Those participating in the GPS/OBD study were asked to report their travel and use the devices. The travel survey collected details about the places visited on an assigned travel day for all household members, while the technology devices collected data points electronically.

A total of 1,782 households from the Greater Fairbanks region were recruited to participate in the study. Recruitment efforts exceeded expectations. The study goal was to complete interviews with 1,000 households. In total, 1,250 households across the region completed the survey by reporting travel details for their assigned travel day. Data from the technology portion of the study was used in a vehicle-based Missed Trip Analysis and in the development of a better understanding of the impact of vehicle emissions on air quality in the PM2.5 nonattainment region.

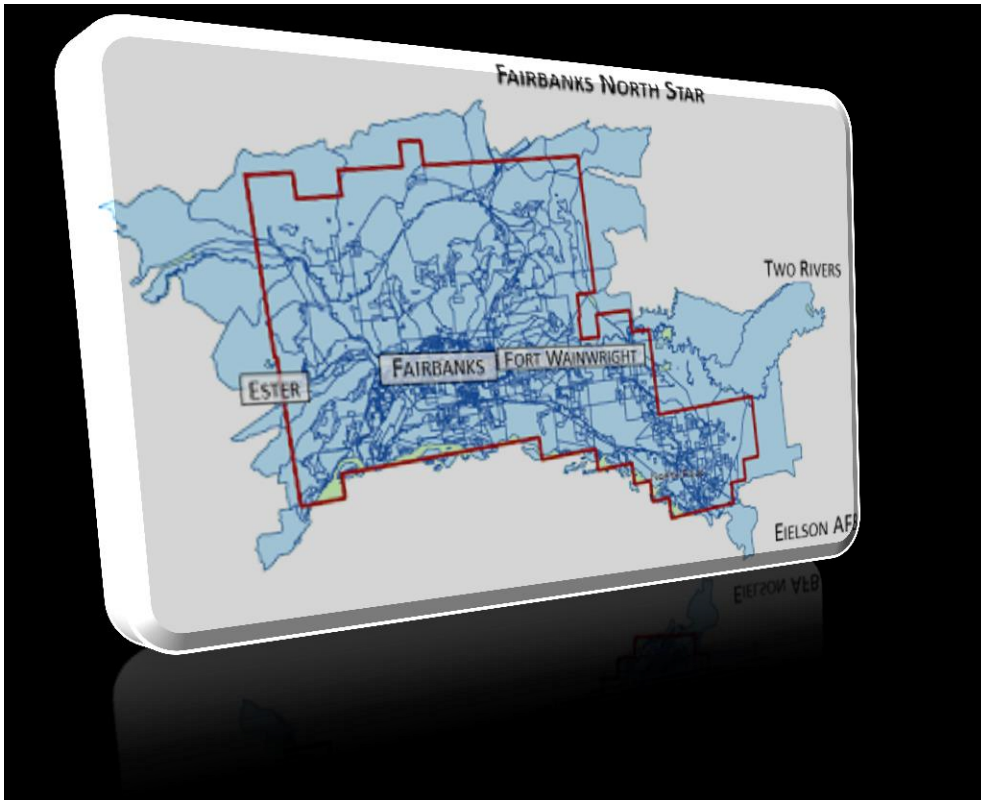
The GPS/OBD component of the study included recruitment of 220 households in Phase I of the effort. Of those, 135 completed all requirements (GPS, OBD and travel day reporting) for survey participation. In Phase II, 115 households were re-contacted and agreed to continue their participation in the study. Of those, 97 met the all requirements for study participation.

Incentives were provide to participating households and varied depending on whether the household was a travel day only or technology-based household. In addition, all participating households were entered in a sweepstakes to win one of ten Alaska Airlines miles packages.

1 Introduction

The Alaska Department of Transportation and Public Facilities (ADOT&PF) contracted with Westat to conduct the 2013 Greater Fairbanks Transportation Survey (GFTS). This household travel survey (HTS) included the collection of assigned one-day household travel behavior from a selected sample population, and was designed to meet regional transportation modeling data needs. The planning region is comprised of the North Star Borough known as the PM2.5 nonattainment region that includes the City of Fairbanks and the City of North Pole (Figure 1).

Figure 1. Survey Study Area



The survey included interviews with 1,250 households during September and October of 2013. The sample included residents of the PM2.5 non-attainment area (main sample), Fort Wainwright Army Base, Eielson Air Force Base (AFB) and the University of Alaska at Fairbanks. In addition to inclusion in the travel behavior survey, a randomly selected subsample of households participating in the GFTS was offered the opportunity to take part in a two-phase technology based study. Each household participating in this subsample agreed to use a Global Positioning System (GPS) unit and an On-Board Diagnostic device (OBD) in up to three household vehicles during two separate time

frames. The first time period was during the GFTS and the second was in January and February, 2014. Details about the GPS and OBD subsample are provided in Section 4.6.

2 Project Overview

The research methodology included the conduct of focus groups to help determine the effectiveness of various presentations of materials (such as envelopes and letterhead), and the appeal of different types of incentives as inducements to participate in the survey. These focus group results were used to help design the public outreach campaign, and the materials and incentives used in the project.

Because survey response rates were expected to be low across the survey population, all households in the geographically specified region were selected for inclusion in the study. The sample was divided into three mail-out release groups in order to recruit households and retrieve data across the study period in an orderly fashion. Data collection instruments were developed that allowed for web-based or telephone interview responses. A final dataset was derived and provided to the client.

At the initiation of data collection, specially designed letters and envelopes were mailed in waves to the sampled respondent households inviting them to participate in the study. Households were encouraged to register for the HTS (self-recruit) by logging onto the project website, using their unique personal identification number (PIN). Reminder postcards were scheduled to be sent within seven days to those households who did not self-recruit via the website. All participants were able to select their preferred mode (either web or telephone) of communication and the reporting of travel data.

At the conclusion of the recruitment survey, all household were assigned a specific date upon which to track their travel, provided a travel log package, and were guided through the data collection and retrieval processes. A portion of the households were also invited to participate in the GPS/OBD study that was conducted in the fall and again in the winter as is described below. Reminders were sent periodically to encourage household members to report their travel information. Respondents received a cash incentive and a chance to win airline miles for future travel.

Further details on the recruitment and data collection tasks are included in Section 4.3.

3 Branding and Public Outreach

Declining survey response rates, and related data quality issues are among the factors behind recent efforts to expand public outreach for travel behavior survey research. Beyond the general concerns about response rates, there was specific concern that response rates would be particularly low for residents in the Greater Fairbanks region. In order to help determine the most appropriate branding and public outreach efforts, two focus groups were conducted in Fairbanks with diverse residents of the region during the survey design phase. The focus group participants were recruited to provide feedback about proposed project specific materials such as the survey branding (name and logo), contact materials (envelope, letter, and reminder post card), postage options, and types and levels of incentives for participation. Information gained from the focus groups was used in the development of recruitment materials. Details about the focus group results are available in the Focus Groups Final Report, under separate cover.

One of the first steps taken with respect to public outreach was to create a brand that would be used on all participant materials and the public website. It was important that the brand reflect the region and specifically transportation in the region. Branding incorporates both the image and the study name. Based on the feedback during the focus groups, the survey was branded as the Greater Fairbanks Transportation Survey. Figure 2 shows the final artwork for the GFTS logo. Because the ADOT&PF is well known and popular in the region, all participant materials also included the ADOT&PF seal.

Figure 2. Study Logo

The typical regional HTS is conducted during an abbreviated period in the spring or the fall. The limited data collection window provides a number of challenges; among them is effective sample management. While sample performance estimates are made in the proposal stage, they are estimates based on previous experiences with similar surveys. Each region responds differently and short field periods combined with the multi-stage approach of HTSs leaves little time to adjust if observed

response rates deviate from the assumptions used in the design phase of the study. Thus, it is critical that the survey sponsors embark on a public outreach campaign that makes the general public aware of the survey efforts. The campaign was conducted prior to recruitment of study participants through various press releases and social media postings. In the GFTS, response rates were much higher than expected, with the study likely benefitting from effective branding and public outreach efforts of the ADOT&PF. Because the survey response rates observed were higher than anticipated, less sample recruitment was required and data were collected from 250 more households than targeted at the start of the survey.

4 Survey Methodology

The GFTS design included a multi-mode survey approach to collect basic demographic and household level data as well as individual travel behavior over an assigned one-day (24-hour) period for a sample of 1,000 households across the PM2.5 non-attainment region served by the ADOT&PF travel demand model. This goal included the participation of 100 of these households in the GPS/OBD data collection activities. This section of the report describes the survey methodology used in the completion of the GFTS.

4.1 Sample Design

4.1.1 Sample Frame and Selection

An address-based sample (ABS) frame was used to identify all residential addresses in the study region. The ABS was selected from the United States Postal Service (USPS) Computerized Delivery Sequence File and included street addresses and Post Office boxes (POBs). Attempts were made to match each sampled address with a published telephone number. The phone numbers returned in the matching process were used to contact non-responding sampled addresses during the data collection process.

The study design included four independent sample groups, the main sample, and three subsamples from the community. Two local military installations (Fort Wainwright Army Base and Eielson Air Force Base) and the University of Alaska at Fairbanks were included in the sample because of the contribution each makes to transportation in the region.

In anticipation of low response rates, every address in the Census tracts within the PM2.5 non-attainment region was sampled, including all POBs. This frame was subset to only those addresses located inside the PM2.5 non-attainment area, with the exception of those in ZIP Code 99703 (Fort Wainwright). Westat was unable to obtain a sampling frame from the Eielson AFB garrison and therefore, residents of the Eielson AFB were ultimately not included in the study. For analysis purposes, the sample was grouped into three population groups, the main sample, Fort Wainwright, and the University of Alaska Fairbanks.

Once data collection began, Westat concluded that the number of addresses sampled was significantly higher than the number of addresses that would be required to achieve the targeted 1,000 completed household surveys. The estimated number of addresses to be fielded was approximately 42,000, in essence a census of the region. However, because recruitment rates exceeded all expectations, less than half of the sampled addresses (18,927) were contacted and invited to participate in the survey. The smaller sample release (45 percent of the sample) resulted in the completion of 1,250 household surveys (25 percent more responses than were planned). Because assignment to each of the sample release groups was random, using fewer samples than originally planned did not introduce any additional sample bias.

4.1.2 Sample Preparation

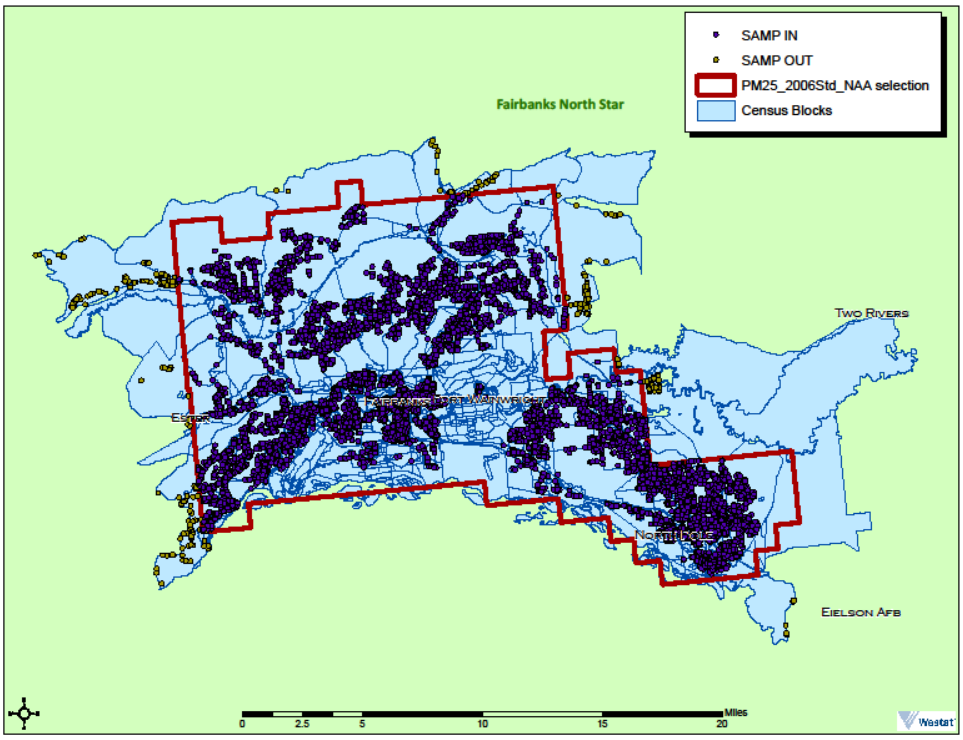
Prior to the beginning of data collection, the sampled addresses were randomly assigned to mail-out release groups. Release groups are used to control the timing and amount of sample released. In this study design, release groups were the equivalent of mailing groups. Each release group in the GFTS contained roughly 9,500 addresses.

To achieve a balanced travel day distribution, the sampled addresses were randomly assigned a specified weekday (Monday to Friday) travel day. This was done prior to the initiation of data collection and only assigns the day of week. The actual travel date was assigned at the end of the recruitment survey.

After the assignment of the travel day, 40 percent of all sampled addresses were flagged to be invited to participate in the technical component of the study (GPS/OBD). Prior to the completion of the recruitment survey, flagged addresses were evaluated to ensure they were eligible to participate in the technology survey before being invited to do so. Details about eligibility for the technology subsample are discussed in Section 4.6.

The ABS sampling strategy was designed to provide the best opportunity to effectively and efficiently achieve the sample objectives. Figure 3 shows the location of all sampled addresses, including those outside the PM2.5 non-attainment area.

Figure 3. Sampled Household Locations



4.2 Survey Design

The GFTS was designed to collect travel behavior data from 1,000 households in the North Star Borough PM2.5 non-attainment region in the fall of 2013. The survey was designed as a mixed mode study making use of web, telephone, and mail contacts and response options. In addition to the traditional self-report daily travel survey, a two-stage GPS/OBD subsample was included in the HTS.

4.2.1 Survey Recruitment and Retrieval Instruments

The GFTS instrument was designed to collect key analytic data required to support the ADOT&PF transportation models in both the short- and long-term. The extensive survey instrument collected data for each person of age 5 and older in the household, including the travel behavior data for one assigned day (24-hour period).

While these data are important, it is critical that they be collected in a way that minimizes respondent burden. The recruitment and retrieval surveys were administered using an integrated web survey software system that was used for both computer-assisted self-interviews (CASI) and computer-assisted telephone interviews (CATI). The surveys completed by web or telephone used the same underlying questions, branching, format, and logic checks. The web-based recruitment and retrieval instruments were accessible to participants via the project specific public website. Each household was assigned a unique personal identification number (PIN) allowing secure access to both questionnaires. Survey staff entered data supplied on travel logs received by mail into this same database, using the same web system.

The recruitment questionnaire collected general demographic information about each household including income, household size, type of housing, and information about vehicle ownership. This questionnaire also asked for demographic characteristics about each member of the household. At the conclusion of the recruitment survey, households were assigned a travel date. Households were also asked to indicate their preferred mode of contact for future reminders; options included telephone calls, text messages, and emails. This information allowed Westat to tailor reminder and subsequent re-contact attempts to the participants' preferences.

Travel day details were collected through the TripBuilder™ component of the web survey software system, with an integrated online map that enables real-time geocoding to collect accurate travel details. Travel details were collected in two steps. The first step was the creation of a sequential list of places visited and basic attributes, including arrival and departure times, mode of travel, vehicle used, place type, location information, and travel companions. The second step collected additional place details, such as activities engaged in at the place.

The following sections list the key information that was verified, collected or derived about each completed household.

4.2.1.1 Household Data

Household level details were collected for each household in the final dataset. Among the variables reported are:

- Home address
- Residence type
- Owner/Renter status
- Household size
- Household income
- Number of vehicles
- Number of bicycles in working condition
- Typical winter temperature for plugging in vehicles

4.2.1.2 Vehicle Data

For each household vehicles owned, leased, or available for regular use by the current household members we asked for the:

- Make
- Model
- Year
- Body type (e.g., SUV)
- Fuel type

For vehicles with model years of 1996 and newer, we also asked if they had a working cigarette lighter or electrical outlet in the vehicle. This equipment was a prerequisite for inclusion in the GPS/OBD subsample.

4.2.1.3 Person Data

Specific questions were asked about each household member living in the home on the date the recruitment survey was completed. Key person-level variables collected about household members include:

- Age
- Gender
- Relationship of all household members to the recruited survey respondent
- Disability status and type (if applicable)
- Licensed driver status (age eligible)
- Employment status (age eligible)
  - If employed, additional data items related to work
- Student status
  - If a student, additional data items related to school
- Highest level of education earned
- Race

4.2.1.4 Travel Day Trip Data

The travel day began at 3 a.m. on the assigned date. Data were collected for each trip made by each household member (age five and older) throughout the day until 2:59 a.m. the following day. Key trip related details that were collected include:

- Trip start and end locations
- Trip start and end times

- Mode of travel
  - If household vehicle was used, additional data items related to the vehicle and passengers
- Primary and secondary activity at each location (trip purpose)

4.3 Data Collection

The data collection phase began with letters of invitation being mailed in August and ended with final assigned travel dates in late October, 2013. The official study travel dates were September 3, 2013 through October 17, 2013. To accommodate participant requested changes in the randomly assigned travel dates, five households were assigned a travel date beyond October 17, 2013.

The survey data collection process included the recruitment of participants, various reminder contacts distributed across the field period, and the retrieval of the travel day data. The following sections describe this process in more detail.

4.3.1 Recruitment Process

Recruitment began by mailing a letter of invitation to participate in the survey to sampled addresses. The letter explained the purpose of the study and requested that the recipient visit the project website to register (self-recruit) for and to complete the survey. A unique PIN was supplied to each sampled address.

As previously noted, recruitment response rates far exceeded the initial projections. Invitation letters were mailed to 18,927 addresses in the region. This represents about two-thirds of the original sample of addresses selected for the study. All mailed materials included a toll-free number to reach the study team if respondents had questions or preferred to participate by phone.

Attempts to recruit sampled addresses into the study also included telephone contacts. Recipients of the mailed materials were given the option to self-recruit via the website, or to speak with one of Westat's survey team over the phone. Most households completed the recruitment process online. If a household had not self-recruited, and a telephone number was available, telephone interviewers

attempted to recruit households until the targeted recruitment goals had been met. Table 1 show the target and actual number of recruitment responses for each of the three sample populations.

Table 1. Target and Actual Recruited Households by Population Group

Population Group	Recruitment		
	Target	Actual	Percentage
Main	1,667	1,740	104%
Fort Wainwright	40	18	45%
University of Alaska	40	24	60%

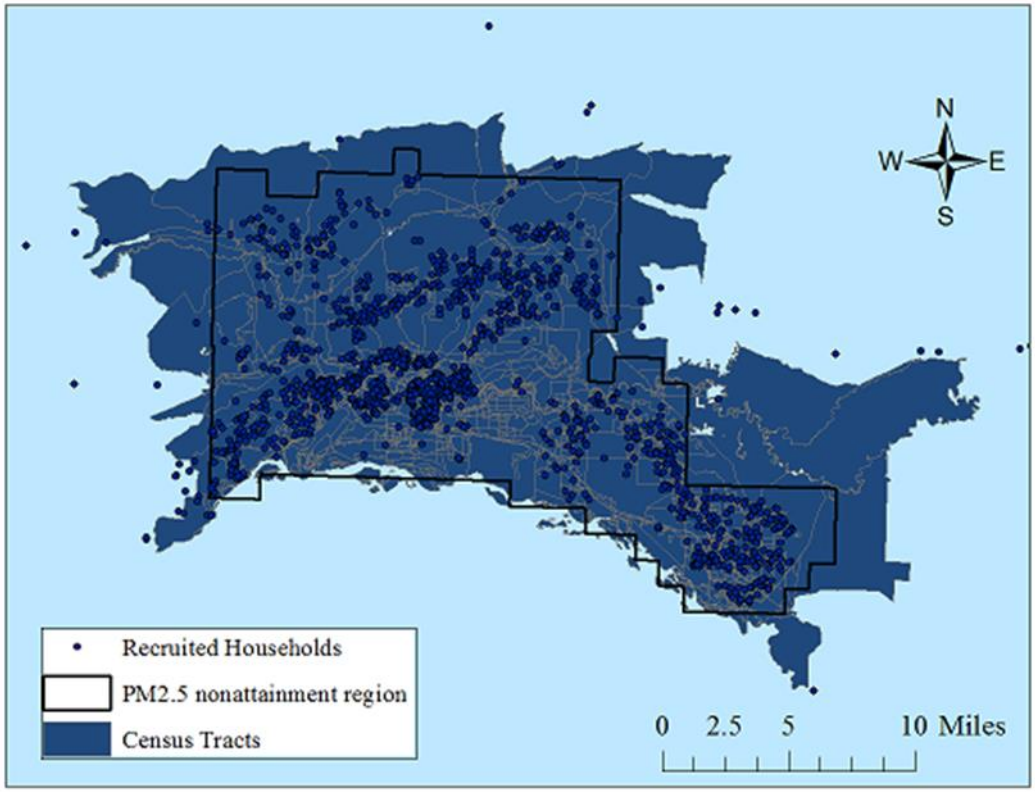
Regardless of whether or not a sampled address had a phone match, a letter of invitation to participate in the survey was sent. The letter was addressed to "city" resident (e.g., Fairbanks Resident), printed on project branded letterhead and signed by Steve Titus, Regional Director of the ADOT&PF.

The letter informed the recipient about the purpose of the study and encouraged them to login to the project website using their PIN, or to call the survey team to complete a brief survey. The letter also informed the recipient that each participating household would be eligible for various incentives. (See Appendix 7.1.1 for the advance letter.)

Because of the unique nature of the population of the GFTS as compared to other HTS samples, several additional steps were taken in the advance mailing in hopes to boost recruitment rates. To help legitimize the study and enhance recognition, the GFTS project logo was paired with the ADOT&PF logo on the envelope and letterhead (Figure 2). Additionally, the envelope was mailed from Fairbanks, with a live stamp (as opposed to metered mail) and displayed the local ADOT&PF return address. Using local and recognizable mail was part of the effort to reach and recruit more households.

The locations of all recruited households are shown in Figure 4.

Figure 4. Participant Household Locations – Recruited Households



4.3.1.1 Recruitment Reminder Contacts (Postcards)

The study protocol included sending each address in the sample a reminder postcard seven days after the advance letter was sent. However, due to the higher than anticipated response rates, only households in the first mail group were sent the reminder postcard. In total, reminder postcards were sent to 9,451 addresses. (See Appendix 6.1.2 for reminder postcard.)

4.3.1.2 Travel Date Assignment

When the sample was initially selected, each address was randomly assigned to a day of the week (Monday through Friday). Specific travel dates were assigned at the time the household was recruited into the study based on the day they were assigned when sampled. During the recruitment survey, households agreeing to participate were assigned the next available date that fell on the pre-assigned day of the week, beginning seven days after the recruitment date. Travel days were scheduled seven

days after the recruitment interview to allow sufficient time for individualized travel logs to be prepared and mailed to each household. Households were also given the option to print the travel logs themselves. There was no delay in the assignment of the travel date when this option was selected.

Table 2 shows the distribution of recruited households by day of week. Typically, travel day distribution is fairly balanced. In this study, the distribution of travel days varied by just one percent from the norm.

Table 2. Distribution of Recruited Households by Day of Week

Day of Week	Unweighted	
	Frequency	Percentage
Monday	371	21%
Tuesday	360	20%
Wednesday	360	20%
Thursday	354	20%
Friday	337	19%

4.3.1.3 Recruitment Confirmation

When a recruited household provided an email address or text message contact number, they received an automated recruitment confirmation message via their preferred contact mode. This message confirmed that their recruitment survey data were successfully received and provided a phone number to reach a study team member if they had questions.

4.3.2 Travel Log and Pre-Travel Date Contacts

Between recruitment into the study and the actual travel behavior data collection, other steps were taken to enhance household participation and provide materials to assist in the process. These efforts are presented next.

4.3.2.1 Travel Log Mailing

Once recruited, each household was mailed a travel log packet. The mailing included a letter thanking the household for agreeing to participate, instructions regarding how to participate, individualized travel logs for each household member (age 5 and older) and an exemplar log that showed how to complete the log. These materials were available online for those who chose to download the materials, rather than receive them through the mail.

The instructions asked household members to use the travel log (on the assigned travel day) as a tool to help them record all trips made beginning at 3 a.m. on that date through 2:59 a.m. the following day. Instructions were provided regarding how to report travel online or over the phone. The letter indicated that all completed households would receive a $20 incentive and be entered into a drawing to win one of ten Alaska Airlines miles packages worth 25,000 miles. (See Appendices 7.1.1 and 7.1.4.1 for the letter and travel log)

4.3.2.2 Pre-Travel Day Reminder Contacts

The day before the assigned travel day, each household was contacted by their preferred method to be reminded of their travel day (phone, email or text message). If contacted by phone, Westat verified that all travel day materials had been received and ensured any questions were answered. Email reminders allowed participants to respond to the email with questions. Study team members responded to each participant email in a timely manner.

4.3.3 Retrieval Process

In total, there were 1,250 households who completed the survey from the sampled North Star Borough PM2.5 non-attainment region. This total includes special population subsamples for both Fort Wainwright and the University of Alaska Fairbanks (UAF). Households were encouraged to self-report their travel data online. Interviewer-assisted telephone support was used to supplement the data retrieval effort for those who preferred to complete their travel reporting by phone or did not complete online in a timely manner. In addition to web or telephone response, some participants mailed back completed travel logs. While this was not a prescribed mode of participation, data from these travel logs were entered into the survey web tool by Westat staff. Participants were

subsequently contacted by Westat to collect any missing data elements. Twenty of the completed surveyed households used the mail option.

4.3.3.1 Post-Travel Day Reminder Contacts

A series of electronic reminders were delivered to recruited households in an attempt to improve survey response. Beginning the day after the travel day, up to five reminder prompts were sent as text messages or emails depending on the contact preference requested by the household. These reminders included the households' PIN and links to the public website.

4.3.3.2 Retrieval Details

Households were able to begin reporting their travel day trip and activity details by web or computer-assisted telephone interview (CATI) beginning the day after the travel day. Households preferring to complete by telephone with an interviewer were called the first day after their assigned travel day. Those preferring to complete by web were called if the household had not reported their travel by the third day after the travel day.

The retrieval questionnaire data was collected using Westat's TripBuilder™ (TBW) web-based software that enabled all participants regardless of response mode to provide travel and activity details while geocoding each reported location in real-time. TBW uses a built-in Google Maps interface.

4.3.4 Sample Monitoring

Recruitment and retrieval results were monitored daily. Each sample release (also referred to as a mail group) was monitored to assess sample yields. Sample releases were adjusted as discussed previously to meet the overall study targets.

Figure 5 shows the percentage of recruited households by recruitment mode. Although participants were encouraged to self-recruit online, providing response choices allowed participants the option to

select the mode of participation that best suited them. Overall, 89 percent of all recruited households took advantage of the self-recruiting option.

Figure 5. Recruitment Response Mode (CATI & Web)

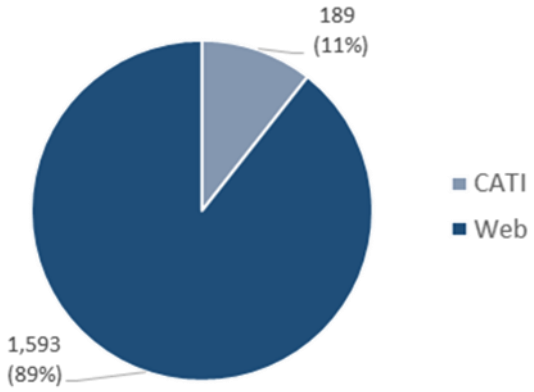


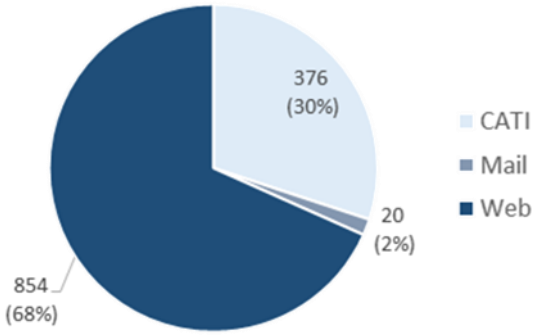
Table 2 presented the distribution of recruited households across day of week and Table 3 presents the completed or retrieved households by day of week. The percentages are similar with Monday, Wednesday and Thursday percentages being the same in both tables and slightly higher percentages for Tuesdays and a lower percentage for Fridays represented in the final dataset.

Table 3. Distribution of Retrieved Households by Day of Week

	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Monday	253	20%	6,598	21%
Tuesday	265	21%	6,937	22%
Wednesday	260	21%	6,412	20%
Thursday	252	20%	6,479	20%
Friday	220	18%	5,750	18%

Retrieval percentages by response mode are presented in Figure 6 and show that 68 percent of all completed households completed the travel survey online with most other households reporting by telephone.

Figure 6. Retrieval Response Mode (CATI, Mail & Web)



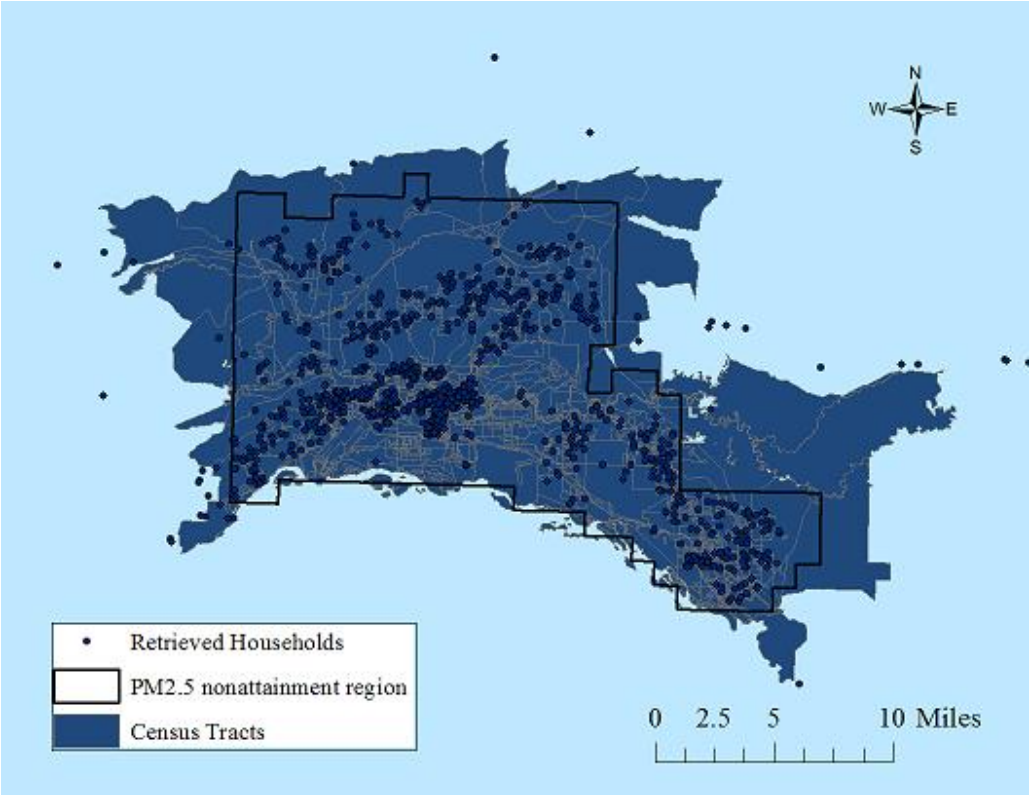
The overall retrieval goal was 1,000 households with 30 each coming from the three special populations groups. As noted above, only two of the three groups were ultimately included in the study. Because response rates for the two special populations were not as high as those observed in the main sample, these targets were not achieved. Table 4 shows the completed households by population group. Section 4.5 provides details about response rates.

Table 4. Overall Retrieved Households Summary

Population Group	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample	1,230	98%	31,602	98%
Fort Wainwright	10	1%	546	2%
University of Alaska	10	1%	28	0%

Figure 7 shows how the participating households were distributed across the region.

Figure 7. Participant Household Locations – Retrieved Households



4.3.5 Demographic Characteristics of Survey Participants

In Table 5, several unweighted demographic variables captured in the survey are compared to those same variables as reported in the 2010 Census for the Greater Fairbanks region. Consistent with most survey samples, many of the hard-to-survey populations were underrepresented in the GFTS (e.g., larger households, non-whites, and young adults).

Table 5. Demographic Results Compared to 2010 Census Data

Demographic		Retrieved Households	General Population Data
Total Households		1,250	36,441
Household Size	1	26.5%	26.7%
	2	39.4%	32.5%
	3	15.1%	16.6%
	4+	19.0%	24.2%
Household Vehicles	0	4.2%	5.1%
	1	26.0%	32.0%
	2	36.2%	39.6%
	3+	33.7%	23.3%
Residence Tenure	Own	73.8%	58.8%
	Rent	25.0%	41.2%
	Other	1.2%	-
Race	White	87.5%	77.0%
	Alaska Native or Native American	5.4%	4.5%
	African American	1.6%	7.0%
	Other	5.5%	11.5%
Participant Gender	Male	49.5%	52.8%
	Female	50.5%	47.2%
Participant Age	<18 years old	22.6%	25.2%
	18 - 24	7.1%	14.8%
	25 - 54	42.5%	42.9%
	55 - 64	15.5%	11.2%
	65+	12.3%	5.90%

4.4 Survey Processing and Data Cleaning

4.4.1 Overview

Data processing and data cleaning were conducted on an on-going basis throughout the study. Updates were made to variables that impacted data collection during the administration of the survey (e.g., the addition of a car that was not originally reported) and at the conclusion of data collection for data that did not impact the flow of the survey (e.g., recoding race based on 'other specify' responses).

A series of automated edits, range checks, and consistency checks were performed within the survey instrument, and data preparation staff performed frequency reviews and problem resolution to monitor, correct, and update the data. Automated checks were conducted to evaluate the validity of reported trip data.

The following sections provide more details for each of the data quality checks used.

4.4.2 Logic Checks

Logic checks were programmed into the recruit and retrieval instruments to ensure that questions were answered as accurately as possible. These included requiring that certain questions be answered, even if the answer was 'don't know' or 'prefer not to answer' and forcing the data type (e.g., requiring a number for AGE). Data range checks were also employed to ensure that the data fell within the expected range for a given question (e.g., 0-112 for AGE). Consistency checks were conducted to ensure that when a variable is present in more than one data file, each data file contained the same value for the variable (e.g., household size or participant age).

4.4.3 Real-Time Geocoding

Westat's TBW survey software was used to conduct the retrieval portion of the GFTS. All trip ends were geocoded during the completion of the trip reporting, in real-time, using a Google interface. Respondents could enter the address of the trip location or were able to use the Google search engine to locate a specific place (e.g., the CVS drugstore at a specific intersection) when they did not know the address of the location. TBW captured full address information and the matching X/Y coordinates of the location.

4.4.4 Frequency Reviews

Frequency reviews were conducted at the beginning, in the middle and at the end of data collection to ensure that all data were being properly captured in the survey database. A report displaying a frequency table for each survey variable was generated and included branching logic, question text and responses. Through the review of these frequency reports, analysts would identify and correct issues with the data as appropriate.

4.4.5 Edit checks

A series of edit check queries were conducted on the data to identify potential reporting inconsistencies. If an edit check failed, the data from the household was manually reviewed by an analyst. Edit checks were completed on trip and non-trip data; each are discussed below.

4.4.5.1 Trip Data Checks

Trip data was processed through Westat's trip processing system (TPS). TPS includes a series of consistency checks on reported trip data.

Table 6 provides a list of the TPS checks performed on these data. When a TPS edit failed, an analyst reviewed the data to determine whether adjustments to the data could be made based on information provided by another household member or if the household needed to be re-contacted to resolve the inconsistency in the data. Whether the data was updated by an analyst or an interviewer as a result of a re-contact with the household, the entire household record was reprocessed through the TPS checks. Each case was subjected to this process until it cleared TPS without any failures. Only households successfully passing these edits were included in the final dataset.

4.4.5.2 Non-Trip Data Checks

Non-trip edit checks were executed as part of the frequency reviews described in Section 4.4.4 and included checks of each survey variable.

Table 6. Trip Data Checks

Location is missing X,Y coordinates
Location is missing full address
Location name text contains "Home" but is not location type 1 (Home location).
Location type 1 (Home location) text is not "HOME"
Location name text contains "Work" but is not location type 2 (Work location).
Location name text contains "School" but is not location type 3 (School location).
Consecutive locations have identical X,Y coordinates
Consecutive locations have identical location name
Household locations with same coordinate do not have matching addresses
At least one place is present for every retrieved person
Travel does not begin at home or does not end at home on assigned travel day
Travel does not begin and end at same location on assigned travel day
Trip companion(s) expected but missing
Place's arrival time is earlier than previous place's departure time
Place's departure time is earlier than its arrival time
Person did not leave vehicle at place where activity duration greater than 30 minutes
Place travel speed too fast for travel mode
Place travel speed too slow for travel mode
Place has a person number that does not exist
Place where household members disagree on number of companions
Persons report travelling together but companion count does not match
Persons report travelling together but more than one driver reported
Persons report travelling together but times do not match
Persons report travelling together but mode does not match
Persons report travelling together but locations do not match
Travel mode of "passenger" but members on trip < 2
Trip has no "driver" travel mode assigned to any member on trip

4.4.6 Upcoding and Cleaning

At the conclusion of data collection period open-ended and 'other specify' responses were reviewed and upcoded or collapsed as appropriate. Upcoding responses is the activity of recoding an open-ended response into a categorical response option (e.g., recoding Caucasian to white). The process includes removing the 'other specify' (open-ended) text response..

In addition to upcoding open-end text into categorical responses, Westat also combined or collapsed other responses that were similar to each other. These responses appear in the original dataset as independent responses (one offs) because of things like, misspelling of the response, different letter

spacing in the response or capitalization issues (e.g., MEXICAN and Mexican be unique responses). Combining these text responses makes analysis more efficient.

4.4.7 Derived Variables

Several of the variables in the final dataset were derived using counts from participant responses. In survey research, some data elements are captured in more than one question or format causing discrepancies in the data. For example, asking how many people live in a household, followed by a roster of household members. Limiting the number of people that may be rostered based on the response to another question may affect the accuracy of the reported data in the more specific roster format.

Derived variables also provide the sum of an attribute across a household. For example, HHSTUD is the count of all household members that answered the STUDE question with a 1 or 2 (full-time or part-time student). The result is an actual count of the number of students in a household. STUDE is also available in the delivered dataset, so analyses can be conducted at the person level using the reported, rather than the derived household level data.

Another type of derived variable provided in this dataset converts the data collected in multiple units (e.g., hours and minutes) into a single unit of measurement (e.g., minutes). Calculations can also be used to determine quantitative values such as number of non-household members on a trip. This number is derived by subtracting the number of household members (HHPARTY) reported on a trip from the total number reported (PARTY) being reported on the trip. A list of all of the derived variables included in the data deliverable can be found in Appendix 7.1.5.

4.5 Survey Response Rates

Response rates were calculated for both the recruitment and retrieval stages of the survey. The recent decline in HTS and other survey response rates has been well documented. The shift from random-digit-dial (RDD) to ABS frames provides many benefits to targeted sampling and coverage bias, but only adds to the diminishing response rate issue. In general, approximately 40 to 50 percent of all sampled addresses are matched to a telephone number, and about 15 percent of those matches generally prove to be improper matches (e.g., not associated with the sampled address). Because

more than half of the sampled households are only reachable by mail in the ABS sample design, passive refusals happen at a high rate. Response rates achieved from ABS frames are largely dependent on the salience of the study, the presentation of the recruitment materials, and public outreach campaigns.

The recruitment rate ($R_{Recruit}$) in survey's using an ABS is calculated by dividing the number of responding households by the number of eligible addresses.

$$R_{Recruit} = \frac{Recruited\ Households}{Sampled\ Addresses\ -\ Postal\ Returns}$$

The retrieval rate ($R_{Retrieve}$) is the percentage of household that completed the study after agreeing to participate.

$$R_{Retrieve} = \frac{Retrieved\ Households}{Recruited\ Households}$$

The final response rate (R_{Final}) is the product of the recruitment and retrieval rates.

$$R_{Final} = R_{Recruit} \times R_{Retrieve} = \frac{Retrieved\ Households}{Sampled\ Addresses - Postal\ Returns}$$

Table 7 shows the recruitment, retrieval and overall response rates for the GFTS. Observed recruitment rates were higher than expected for the region in the main sample, and lower in the two special population groups. The observed retrieval rates for the main sample were also higher than anticipated at nearly 75 percent, but lower in the special population groups.

Table 7. Response Rates

Population Group	Recruitment	Retrieval	Overall
Main	9.2%	74.9%	6.9%
Fort Wainwright	2.9%	56.3%	1.7%
University of Alaska	3.3%	55.6%	1.8%
Total	8.9%	74.6%	6.6%

Standard in all voluntary survey data is some level of item non-response. The programming for the GFTS did not allow participants to skip questions; however, participants could provide a "don't know" or "prefer not to answer" response to most survey questions. Table 8 presents the non-response percentages for home ownership, household income and disability. The observed non-response rates for these variables were consistent with other HTSs recently conducted by Westat.

Table 8. Household Variables – Item Non-Response

Non-response Items	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Home Ownership	6	0.5%	226	0.7%
Household Income	172	13.8%	4,215	13.1%
Household Disability	3	0.2%	97	0.3%

Table 9 presents several person-level non-response items. The non-response for age is off-set by a follow-up age range classification question asked when age was not initially reported. Of the 103 refusals to provide age, an age range was collected for all but seven. The item non-response for public transit access is higher than is typically found in most studies. Of the 147 non-respondents, 97 percent reported that they didn't know if they had access to public transit.

Table 9. Person Variables – Item Non-Response

Non-Response Items	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Age	103	3.4%	3,187	3.6%
Age Range	7	0.2%	194	0.2%
Race	121	4.0%	4,277	4.9%
Employment	6	0.3%	314	0.5%
Volunteer	47	2.0%	1,750	2.6%
Days traveled to work per week	35	2.3%	987	2.4%
Public transit access	147	6.2%	4,280	6.3%
Level of Education	43	1.6%	1,610	2.0%
Student Status	36	1.2%	1,309	1.5%

4.6 Global Position Satellite (GPS) and On-Board Diagnostic (OBD) Subsample

4.6.1 GPS and OBD Subsample Design

The GFTS design included a 10 percent GPS subsample, with a two-stage data collection period. Recruited households would receive in-vehicle GPS data loggers and OBD devices to be used in up to three household vehicles over a seven-day period in the fall of 2013 and the winter of 2014. In the fall, the devices were installed in each sampled vehicle beginning with the travel day assigned to the household. A $50 incentive per instrumented vehicle was offered to each household recruited into the GPS/OBD subsample. To be considered complete and qualify for the fall incentive all

household members were required to report their travel data, use all GPS and OBD devices provided, and return all the devices.

Data from this technology based subsample was to provide ADOT&PF with a general assessment of household vehicle trip underreporting and to assist in evaluating vehicle emissions' potential role in PM 2.5 non-attainment of air quality standards.

When the GPS/OBD households were recruited, the following screening criteria were employed:

- The household must have at least one household vehicle of model year 1996 or newer (required for OBD data collection);
- The household could not be physically located on a military base (due to privacy concerns associated with GPS trace data collection); and,
- The household must be willing to participate in the fall HTS data collection and the winter GPS/OBD data collection field periods.

The second phase of the GPS/OBD study was conducted in January and February of 2014. Participants in the fall data collection were re-contacted over the winter and asked to participate in another one-week collection. The goal was to obtain data from 100 households across both rounds of data collection.

4.6.2 GPS Equipment and On-Board Diagnostic Sensor

The QStarz BT-Q1000x Travel Recorder (see Figure 8) was used for the vehicle GPS component of this study. This device captures date, time, latitude, longitude, speed, and other standard GPS variables in one-second intervals, and can be configured to collect additional variables including heading, horizontal dilution of precision (HDOP), and number of satellites. The speed filter settings were set to screen out all zero point speeds, with non-zero speed points recorded at a one-second frequency. The GPS data logger requires external power from the vehicle in order to collect data over a one-week period.

Figure 8. QStarz BT1000xt GPS Data Logger and CarChip Pro OBD Data Logger

		
QStarz BT 1000xt	CarChip Pro (top)	CarChip Pro (bottom)

The CarChip Fleet Pro OBD Sensor, also seen in Figure 8, was used for the vehicle GPS/OBD component of this study. The device firmware was customized to capture speed at a one second interval as well as intake air temperature, engine load, engine speed, and coolant temperature in 5-second intervals. Participants were asked to insert this device into the diagnostic port in their vehicle on their assigned travel day. Once installed, the device recorded data whenever the vehicle was powered on. The OBD device does not require external charging.

4.6.3 GPS / OBD Subsample Data Collection

4.6.3.1 Deployment: Materials and Procedures,

Households were recruited into the study at least 10 days prior to their assigned travel date during the fall data collection to allow sufficient time to prepare the personalized GPS instructions, travel logs, equipment, and to schedule the arrival of the package prior to the assigned travel date.

Clear instructions were shipped with the devices and included an assignment sheet with each household vehicle assigned a specific GPS and OBD. To further assist in the data collection effort, a sticker with the vehicle year and model was affixed to each GPS device. Small colored dot stickers were placed on each device and on the device assignment sheet to further help participants match the devices to the correct vehicle. A toll-free phone number was also provided in the instructions in case further assistance with installation and use of the devices was required. The instructions for the fall survey emphasized that even though the household was included in the technology component of the study, they also needed to use the travel logs to record all the places they went on the assigned travel date.

An equipment usage sheet was also provided in the GPS/OBD package. The participants were asked to complete and return this form with the devices. The form asked household members to record if they used the data loggers, and if not, to list the reason(s) why. GPS/OBD packages were shipped via FedEx and included the following materials:

- A letter for the household introducing the GPS/OBD materials and devices;
- Personalized travel logs for each person of age 5 and older (fall study period only):
- Instructions for installing the GPS and OBD devices;
- An equipment assignment sheet showing the assignment of each GPS and OBD device (by device ID) to a specific vehicle, fields to the record the device installation and removal dates, and odometer readings for each vehicle at the start of the study;
- GPS and OBD devices, a power source for each GPS device, and a splitter for the cigarette lighter; and
- FedEx return packaging, including a prepaid label and instructions for returning the devices, the power cables, and the equipment usage sheet.

The equipment was shipped to arrive two business days prior to the assigned travel day (fall) or the first day of the one-week equipment deployment period (winter). Participants were asked to return all of the equipment and the completed equipment assignment sheet immediately after the assigned GPS data collection period, but asked to hold onto their logs to use when reporting their travel online or over the phone (for the fall data collection).

4.6.3.2 Device Processing

After receiving the returned equipment, the deployment staff downloaded the GPS and OBD data from each data logger and cleared the device memory for redeployment. The downloaded GPS and OBD files were then imported into the project database where the data processing was conducted.

The deployment team tracked the household deployment status for each household using an internal database. The default deployment status was "Recruited." The status of each household in the system was updated daily to reflect the households' current state in the deployment process. Below is a list of all household deployment status codes: the first four statuses reflect the ideal progression of a successful deployment from recruited to equipment used and returned (i.e., GPS/OBD

complete). The final four statuses were assigned to GPS/OBD-recruited households that did not result in the collection of any, or any useful, GPS/OBD data

- Recruited
- Shipped
- Deployed
- Returned Deployed (used and returned equipment)
- Invalid Address
- Returned Refused (elected not to participate)
- Return-Delivery Exception (package unable to be delivered by FedEx)
- Not Returned / Lost

4.6.3.3 Winter GPS/OBD Study: Recruitment, Materials and Procedures

When the households completing the fall phase of the study received the participation incentive, they were reminded that they would be contacted again sometime between December and February for the second one-week GPS and OBD deployment period. The travel dates for the winter data collection period included fifteen possible starting travel dates from January 27, 2014 through February 14, 2014 with the last day of data collection on February 20, 2014 (based on a seven-day deployment window).

Westat contacted each eligible household several weeks before the winter data collection date to confirm their participation and the composition of household vehicles. Westat used mail, email, text and telephone calls to re-connect with households who participated in the fall GPS/OBD subsample. Of the 135 households who took part in the fall data collection, 115 households were successfully recruited to participate in the winter data collection effort. The 20 non-participating households either refused to participate or we were unable to re-contact them to confirm their willingness to continue in the study.

When a household reported changes to the composition of household vehicles between the fall and winter field periods, the household vehicle roster was modified to match the new household vehicle composition. A record for each newly sampled vehicle was added to the vehicle table in the

database. An additional field was included that identified data collection phase in which each vehicle was sampled and deployed.

Each household in the winter data collection was offered $50 per instrumented vehicle. Due to extreme temperatures in Fairbanks during January and February, the winter data collection protocols included a requirement that GPS devices be taken inside whenever the car was not in use.

The winter data collection package included the same materials described in Section 4.6.3.1 above.

A series of electronic reminders was sent to each household throughout the winter data collection period. These messages included reminders to:

- Install the devices in the assigned vehicles on the first data collection date;
- Continue to use the devices until the last data collection day;
- Remove and return the equipment after the last data collection day; and
- Return equipment (sent as needed for households that had not returned equipment).

Once the devices were returned to Westat, they were processed as described above in Section 4.6.3.2.

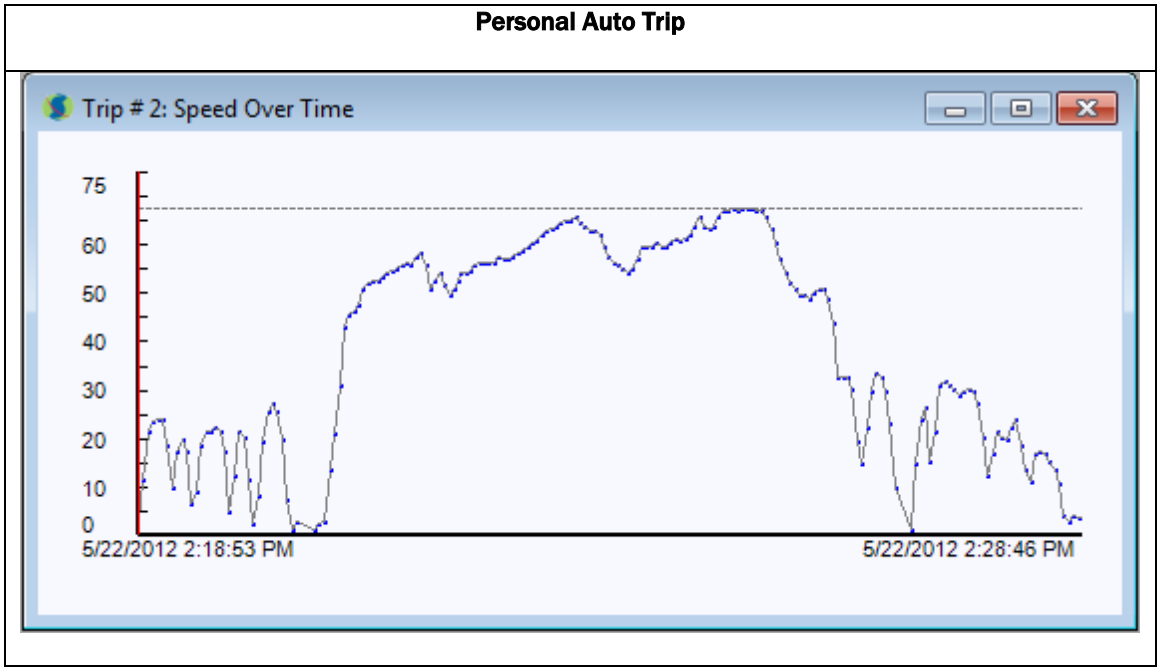
4.6.4 GPS / OBD Data Processing

4.6.4.1 GPS and Log Processing Methods: Fall Data

As the GPS data were imported into the project database, the Universal Time Coordinate (UTC) date and time stamps in the GPS point data were translated to local (Fairbanks) date and time. The GPS trace data for each participant were processed using Westat's Trip Identification and Analysis System (TIAS) software to identify potential trip ends based on time intervals between consecutively logged points. For this study, all initial dwell times of 120 seconds or more were flagged as potential trip stops. The GPS trip data were then visually reviewed by analysts to screen out traffic delays and other falsely identified potential trips with dwell times of 120 seconds or more, as well as to add stops that had dwell times of less than 120 seconds but had clear "stop" characteristics. Examples of typical stops that would not be automatically detected by the 120 second dwell time are short drop-off/pick-ups (e.g., school or work).

When geocoded addresses were available from the survey data, the analyst used these locations to assist in the trip end identification and/or confirmation process. Once this step was completed, the updated GPS-based trips collected were compared and matched with the trips reported for each person's assigned travel day. Figure 9 shows an example[1] of a personal auto trip as viewed in TIAS.

Figure 9. Speed Profiles –Personal Auto Trip



Once all GPS trip ends were identified the next step was to import the unique vehicle trips reported in the survey (log) by GPS households into TIAS for the trip comparison process. Westat's' GPS/log trip matching interface was designed to compare GPS trips with survey reported trips using time and location as the significant variables for automated matching. Trips were considered matched if the trip end times fell within 12.5 minutes of each other or trip end locations were within 100 meters of each other.

Data quality control guidelines were established that allowed the TIAS analysts to make adjustments to the automated matches as appropriate. These exceptions included matching beyond the programmed thresholds if information in the data supported an adjustment.

[1] This example is not from the GFTS dataset.

4.6.4.2 GPS and Log Comparison Results: Missed Trip Analysis

This GPS data deliverable included data collected from 220 households deployed with GPS devices in the fall, and 115 households deployed in the winter survey period. Westat delivered GPS data from full and partially completed households. However, only the completed households from the fall data collection are included in GPS to travel log trip comparisons (147 households).

In the missed trip analysis process the GPS captured and survey (log) reported trips are compared. Of the 147 GPS/Log complete households, 10 were dropped from the missed trip analysis process because they did not meet the requirements for inclusion in the analysis. These requirements were:

1. The household must meet the previously stated completion rules (see Section 4.6.1).
2. The household must conform to one of three possible scenarios regarding trips recorded by GPS and log:
    a. Both records must have contained only a single trip,
    b. Both records must have contained more than one trip, or
    c. Both records must have contained zero trips.
3. The household data had to be flagged as "Matched." Rules used to determine "Matched" status were:
    a. When GPS and survey reported log vehicle trips matched perfectly, the file was coded as "Matched."
    b. When GPS and survey reported log vehicle trips had at least one matched trip, the file was coded as "Matched."
    c. When GPS and survey reported log vehicle trips contained no matched trips, the file was coded as "Not a match." and the file was excluded from the Missed Trip Analysis.

There were a total of 230 GPS-equipped vehicles in the 137 households included in the Missed Trip Analysis. The GPS devices used in these vehicles captured 1,209 vehicle trips on the assigned travel day, while self-report data resulted in 1,044 trips from the same vehicles.

4.6.4.2.1 Reporting Exceptions

In some household travel surveys, work-related trips (e.g., commercial use of personal auto) and external to external trips - those that have origins and destinations outside of the planning regions, are not reported in the travel log and not collected during the retrieval survey. In this study, all trips, including those where activity took place outside of the study area were to be reported, resulting in zero cases of unmatched trips outside of the study area. Other typically unreported trip types include loop trips (i.e., those that start and end at the same location) and on-site travel (e.g., trips that are conducted on the premises of one property, like a hospital or apartment complex). These types of trips are less common in vehicle GPS studies. In GFTS, only one loop trip and 35 on-site trips were detected in the GPS data and not reported on the travel logs. The following discussion will present results that include both raw and adjusted frequencies. The GPS-detected loop and on-site trips were removed from the adjusted frequencies for those cases that did not have matching log-reported trips.

4.6.4.2.2 Matching Results

The following sections describe the three different types of matches observed in the GFTS data; 100 percent matched trips, trips that were reported in the survey, but not observed in the GPS data and trips observed in the GPS data, but not reported in the survey.

100 Percent Matched Trips. A perfect match was when all vehicle trips reported by the participant in the survey (using an instrumented vehicle) matched the trips captured by the GPS device in that vehicle[2]. This includes vehicles that had no GPS data collected on the travel date and no trips reported for that vehicle on the assigned travel date. Of the 230 vehicles instrumented with GPS devices, 39 were confirmed as "no travel vehicles." This represents 16.9 percent of all instrumented GPS vehicles. In total, 142, or 61.7 percent, of the 230 vehicles in the GPS subsample were 100 percent matched, including the 39 vehicles not used on the travel day. In terms of trips, this dataset resulted in a 100 percent match rate for 509 (48.7 percent) reported and collected trips in the GPS subsample.

Table 10 contains the trip frequency statistics for the vehicles included in this category.

[2] The presence or absence of OBD data was not used in the GPS Missed Trip Analysis.

Table 10. Trip Frequencies for Perfect Matches

Trips (#)	Frequency	Frequency (%)	Cumulative (%)
0	39	27.5%	27.4%
1	0	0.0%	27.4%
2	27	19.0%	46.5%
3	14	9.9%	56.3%
4	12	8.5%	64.8%
5	10	7.0%	71.8%
6	11	7.7%	79.6%
7	13	9.2%	88.7%
8	6	4.2%	93.0%
9	3	2.1%	95.1%
10	2	1.4%	96.5%
11	2	1.4%	97.9%
12	1	0.7%	98.6%
13	1	0.7%	99.3%
14	0	0.0%	99.3%
15	0	0.0%	99.3%
16	1	0.7%	100.0%
Totals	142	100.0%	100.00%

Trips reported in survey data but not captured by GPS. The second comparison identified trips reported by participants in the survey for which there was no corresponding GPS trip captured. During the matching process, 31 survey reported trips made by 18 vehicles had no corresponding GPS trip identified (2.6 percent of all GPS trips). In our experience, this is rare and typically happens when the GPS device is not adequately powered.

Trips captured by GPS but not reported in survey data. The last category in the matching process examined those cases where trips were identified in the GPS data, but not reported in the survey data. Of the 230 vehicles and 1,044 GPS captured trips, a total of 196 trips were not reported by the participant in the survey data (196/(1,044+196)=15.8 percent).

Table 11 shows the frequency of missing GPS and survey report trip counts detected for the 88 GPS-equipped vehicles that were not perfect matches. Five vehicles in the sample had some combination of missing GPS trips and missing survey reported trips.

Table 11. Trip Frequencies for Missing Trips

Number of Missing Trips	Missing GPS Capture Frequency	Missing Survey Report Frequency Trips	Adjusted Frequency of Missing Survey Reported Trips
1	11	37	41
2	3	17	13
3	3	7	5
4	0	3	1
5	1	3	3
6	0	1	1
7	0	2	2
8	0	1	0
9	0	0	0
10	0	1	2
11	0	0	1
12	0	1	0
13	0	1	0
14	0	1	1
15	0	0	0
16	0	0	0
Totals	18	75	70

4.6.4.3 OBD Data Collection and Processing

The OBD device settings were customized to collect the data requested by the ADOT&PF. The parameters included vehicle speed, intake air temperature, engine load, engine speed and coolant temperature. The device logging interval may vary depending on the vehicle response, and values for some specified variables can be absent from some or all trip records on any given vehicle. Table 12 presents the OBD device configuration settings for the study.

Table 12. OBD Device Configuration Parameters

Parameter	Recording Interval	Unit System	Units	Decimals	Range
Vehicle Speed	1 sec	Metric	km/h	0	0-255
Intake Air Temperature	5 sec	Celsius	Degrees	0	-40 to +215
Engine Load	5 sec	N/A	%	1	0-100
Engine Speed	5 sec	U. S.	RPM	0	0-16,384
Coolant Temperature	5 sec	Celsius	Degrees	0	-40 to +215

Additional data elements were queried at lower frequencies and reported as available by vehicle. The full list of other recorded variables types (which vary by vehicle) for the custom OBD configurations

is shown below. These variable follow and additional information about them can be found in the OBD data dictionaries.

- Activity records:
  - Device plugged into vehicle
  - Device unplugged from vehicle,
  - Emissions censors checked
  - Readiness codes (recorded when activity record event type is 8 – list of codes provided in the data dictionary)
- Diagnostics Trouble Codes (DTC) records
- Trip start and trip end
- Trip duration
- Vehicle Identification Number (VIN)
- Vehicle Protocol
- Max speed
- Average speed
- Trip distance
- Hard brake, hard acceleration, extreme brake, extreme acceleration counts
- Speed records—speed record for each of the hard and extreme brake and acceleration events
- Malfunction Indicator Light (MAL)—distance with MAL on, distance since Diagnostic Trouble Codes cleared
- Fuel Type—Type of fuel, percentage of ethanol in fuel

4.6.5 Participation Results

To achieve the goal of obtaining 100 GPS/OBD completed households at the end of the winter deployment period Westat estimated the recruitment goal to be 200 households in the fall GFTS.

A total of 220 households were recruited into the GPS/OBD component of the study and at the end of the fall data collection a total of 135 households were eligible to participate in the winter deployment.

Of the 135 households participating in the fall deployment period, 115 were successfully contacted and willing to participate in the winter data collection. Eighteen of the 115 households that were recruited into the winter data collection did not qualify as completed households for various reasons. Three of the 18 returned the equipment unused and noted that they were unable to participate. The remaining 15 households did not have complete GPS and OBD data and were determined to be partial complete households. All GPS and OBD data collected from the partial households is included in the GPS and OBD data tables. Table 13 summarizes the recruitment and completion results of both GPS/OBD deployment efforts.

Table 13. GPS/OBD Recruitment and Completion Results

	Recruit Goal	Recruit Total	Recruit Percentage Complete	GPS/OBD/ Log Complete Goal	GPS/OBD/Log Complete Actual	Percentage Complete Goal
Fall	200	220	110%	130	135	104%
Winter	135	115	85%	100	97	97%

4.6.5.1.1 Survey Data Comparison Summary

Overall, the missed trip analysis revealed that 15.8 percent of vehicle trips made by the GPS-instrumented vehicles were not reported in the survey data (196/(1,044+196)=15.8 percent)[3]. This percentage decreases to 13.7 percent when the 166 "on-site trips" identified in the GPS data were removed from the analysis (166/(1,044+166)=13.7 percent). This is consistent with findings from previous GPS-enhanced travel surveys. As explained during the survey design phase, the GPS sample size is too small to perform trip rate adjustments for the larger 90 percent log-only sample.

4.6.6 GPS and OBD Datasets

Table 14 highlights key summary statistics from the GPS dataset and includes data from all returned GPS devices and the devices in the completed household sample. Participating households

[3] Remember only data from completed household was used in this analysis.

(completes) averaged 0.7 more trips per day in the fall than in the winter. The GPS data in all completed households represents 50,355 miles traveled over 1,762 hours.

Table 14. Summary of GPS Trip Characteristics

	Fall Deployment		Winter Deployment	
	Returned Households	Completed Households	Returned Households	Completed Households
Number of Trips	9,573	7,310	4,940	4,752
Miles Traveled	40,730	30,106	21,196	20,249
Time (Hours)	1,343	1,014	780	748
Number of Households	194	135	112	97
Average Number of Trips/Household	49.3	54.1	44.1	49.0
Average Number of Trips/Day per Household	7.0	7.7	6.3	7.0

Table 15 presents an overview of the GPS/OBD deployment effort for both the fall and winter data collection periods.

Table 15. GPS/OBD Processing Summary

	Households	Vehicle	GPS Trips	OBD Trips
Fall Deployment				
Deployed Households	220	370	-	-
Returned Households	194	330	9,573	9,261
Completed Households	135	225	7,310	6,634
Missed Trip Analysis Households	137	230	1,209	-
Winter Deployment				
Deployed Households	115	185	-	-
Returned Households	112	178	4,940	4,805
Completed Households	97	151	4,752	4,316

All GPS and OBD data are linked to a specific household vehicle using the household and vehicle IDs. As part of the final data deliverable, Westat provided an Access database with the following tables:

- GPS households
- GPS vehicles
- GPS trips
- GPS points
- GPS and reported trip matches and misses
- GPS and reported missed trip analysis

- OBD points
- OBD trips

In addition to the processed data tables for the GPS/OBD data representing completed households, a separate Access database that contains the OBD data as it came directly from the downloaded device files was provided to ADOT&PF. This database includes the following tables:

- obd_activityrecords
- obd_activityrecordreadinesscodes
- obd_diagnosticcodes
- obd_trips
- obd_fuelsampledata
- obd_extdistancesampledata
- obd_tripsampledata

4.7 OBD Time Offset Estimates

In the preparation of the winter GPS and OBD datasets, Westat discovered that the internal clocks in the OBD devices had not been updated prior to being deployed for the GFTS. The clocks in the OBD units experience a slight time drift that increases daily. Because of this drift, the time stamp on the OBD data did not correspond closely with the GPS data. This was true in both the fall and winter field periods. The variance in the fall data was small and not initially noticeable. To address this issue, Westat developed a process to identify the time offset that resulted in the best match between GPS point speeds and OBD point speeds for each device. This offset was then used to update the times in each OBD data table in both the fall and the winter datasets and revised datasets provided to ADOT&PF.

For the vehicles that did not have a matching GPS file, the offset applied was calculated by comparing the current time on the OBD device clocks to a computer clock which was synchronized to an Internet Time Service (ITS) server from the National Institutes of Standards and Technology (NIST). Although the offset values estimated using this process are less desirable than the ones developed by matching the speed values to GPS data, they are the best estimates of the clock drift that can be achieved for these devices.

To validate these procedures, Westat re-estimated the clock drifts from several OBD devices for whom drift estimates were generated and found the difference in drift in all cases was less than five minutes. Based on this analysis, we are confident that the adjusted times are likely to be within five minutes of the actual time during their data collection periods, assuring that time of day analysis can be performed using these data if desired.

Three vehicles from the fall data collection that did not have GPS data, and for which the OBD clock was unable to validate the current offset are included in the dataset. The OBD data for those vehicles should not be used for analysis. Those vehicles are associated with vehicle number two in SAMPNO 5017536, 5008798, and 5010903.

5 Weighting

Survey samples are designed to elicit response from a representative sample of the population of interest. However, survey data collection rarely yields a totally representative sample due to differential response rates by various population subgroups, item non-response, and other factors. To mitigate the difference in the results between survey respondents and the population, weights are constructed and assigned to records in a survey data set so the data can be expanded to represent the population of inference as closely as possible. The weights are usually developed in a series of stages to compensate for unequal selection probabilities, nonresponse, non-coverage, and sampling fluctuations from known population values.[4] The use of raw or unweighted survey data will result in biased analyses, especially if the sample was selected with unequal probabilities which is often the case when targeting hard-to-reach populations or when the responding sample is very different from the survey population.

Survey weights were developed for four types of analytic units associated with all households in the GFTS dataset – household weights, vehicle weights, person weights, and trip weights – to permit inference to the corresponding target populations. Household weights were assigned to responding households. Vehicle weights were assigned to each reported vehicle in a household and are the same as the household level weight. Person and trip weights were assigned to responding persons within responding households.

In addition to the survey weights, replicate weights were developed for each type of analytic unit associated with the travel study. The replicate weights are used to calculate the variances of survey estimates using the paired jackknife replication method. The methods used to derive these weights were aimed at reflecting the features of the sample design, so that when the jackknife variance estimation procedure is implemented, approximately unbiased estimates of sampling variance are obtained. In addition, the various weighting procedures were repeated on each set of replicate weights to appropriately reflect the impact of the weighting adjustments on the sampling variance of a survey estimate.

[4] Brick, J.M. and Kalton, G. (1996). Handling Missing Data in Survey Research. Statistical Methods in Medical Research, 5, 215-238.

The steps in the weighting process for the travel study component were as follows.

- Construction of base weights (the reciprocal of the probability of selection of each sampled address);
- Adjustment for non-response at the household level;
- Adjustment of the household weights to achieve consistency with characteristics for the full population of households in the study area (achieved by raking the non-response adjusted weights to independent household level figures for the study area—raking can be thought of as multivariate post-stratification). This is the final household weight;
- Construction of the vehicle weights
- Assignment of the final household weights to all responding persons within completed households;
- Person-level raking. This is the final person weight; and,
- Construction of the trip weights.

In this section of the report, tables are displayed by key survey variables summarized for the GFTS region. Appendices 7.3 and 7.4, Additional Recruitment Frequency Tables, contain an additional series of tables with variables not discussed in this section, but captured during the survey effort.

5.1 Household Base Weights

The household base weight reflects the probability of selection for a sampled household and is calculated simply as the reciprocal of its probability of selection.

5.1.1 Adjustment for Non-Response at the Household-Level

After the assignment of the household level base weight, an adjustment for non-response was made to reflect those for which a retrieval interview was not obtained.. The adjustments for household nonresponse were made within adjustment cells defined by population group and by sampling stratum (high density of key sample characteristics[5]/remaining households). A nonresponse adjustment factor was calculated for each cell as the ratio of the sum of household weights for all

[5] Within each county, the first stratum consisted of addresses in Census tracts with a high percentage of households in which the number of workers is greater than the number of vehicles, and Census tracts with high percentages of 0-vehicle or 0-to-1-vehicle households.

eligible households to the sum of the household weights for all recruited households. The nonresponse adjustment factor was applied to the household weight of each responding household. In this way, the weights of the responding households are "weighted up" to represent the full set of responding and nonresponding households in the adjustment cell.

5.1.2 Raking at the Household-Level

Raking adjustment procedures are used to improve the reliability of survey estimates and, to some extent, correct for the bias due to undercoverage and/or non-response. Raking is a post-stratification adjustment procedure where survey weights are iteratively adjusted to independent control totals for various demographic categories. The process has the effect of differentially adjusting the weights of the sampled households within groups of demographically similar households, so that the total sum of weights for the sampled households equals the corresponding independent control totals for all households.

The raking process used with the GFTS data had four "dimensions." The weights were adjusted to equal the totals within the cells for each dimension in an iterative process, until the process converges, and every dimension's cell totals equal the independent control totals. The dimensions at the household weighting level included the following:

- Household Size
- Vehicles per Household
- Workers per Household
- Household Income

The independent control total for Household Size came from 2010 Decennial Census. Control totals for Vehicles per Household and Workers per Household came from the 2007-2011 5-year American Community Survey (ACS). The ACS control totals were adjusted to reflect 2010 Decennial Census distribution. In Table 16 through Table 24 the weighted and unweighted frequencies for several key household-level demographic variables (e.g., household size, number of workers, etc.) are presented. Of these key demographic variables, only household income (Table 20) was impacted by item non-response. A total of 172 households in the study did not provide a valid income range.

Table 16. Household Size (Unweighted and Weighted)

Household Size	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
1	331	26%	7,929	25%
2	492	39%	11,294	35%
3	189	15%	4,947	15%
4+	238	19%	8,006	25%
Total	1,250	100%	32,176	100%

Table 17. Household Number of Vehicles (Unweighted and Weighted)

Household Vehicles	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0	52	4%	1,807	6%
1	325	26%	10,438	32%
2	452	36%	12,484	39%
3	251	20%	4,794	15%
4+	170	14%	2,654	8%
Total	1,250	100%	32,176	100%

Table 18. Number of Household Workers (Unweighted and Weighted)

Household Workers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0	247	20%	5,676	18%
1	465	37%	13,921	43%
2	467	37%	10,261	32%
3+	71	6%	2,318	7%
Total	1,250	100%	32,176	100%

Table 19. Household Number of Students (Unweighted and Weighted)

Household Students	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0	793	63%	18,958	59%
1	255	20%	6,907	21%
2	121	10%	3,699	11%
3+	81	6%	2,612	8%
Total	1,250	100%	32,176	100%

Table 20. Household Income (Unweighted and Weighted)

Household Income	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Less than $10,000	31	2%	947	3%
$10,000 – $19,999	65	5%	1,867	6%
$20,000 – $29,999	71	6%	2,146	7%
$30,000 – $49,999	150	12%	4,141	13%
$50,000 – $59,999	88	7%	2,382	7%
$60,000 – $74,999	164	13%	4,361	14%
$75,000 – $99,999	194	16%	5,065	16%
$100,000 – $149,999	216	17%	4,860	15%
$150,000 or More	99	8%	2,193	7%
Don't Know	22	2%	644	2%
Refused	150	12%	3,571	11%
Total	1,250	100%	32,176	100%

Table 21. Household Residence Type (Unweighted and Weighted)

Household Residence Type	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Single-family attached house	111	9%	3,231	10%
Single-family detached house	886	71%	21,495	67%
An apartment or condo	201	16%	5,966	19%
Manufactured Home or Trailer	25	2%	699	2%
Dorm Room, Fraternity or Sorority House, Barracks	4	0%	81	0%
Some other type of housing	16	1%	492	2%
Refused	7	1%	213	1%
Total	1,250	100%	32,176	100%

Table 22. Ownership of Household Residence (Unweighted and Weighted)

Household Residence Ownership	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Own/Buying	922	74%	22,325	69%
Rent	313	25%	9,389	29%
Occupied w/o payment of rent	9	1%	236	1%
Don't know	1	0%	36	0%
Refused	5	0%	190	1%
Total	1,250	100%	32,176	100%

Table 23. Number of Licensed Drivers in Household (Unweighted and Weighted)

Household Drivers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0	29	2%	1,019	3%
1	365	29%	9,430	29%
2	733	59%	18,217	57%
3	93	7%	2,360	7%
4+	30	2%	1,151	4%
Total	1,250	100%	32,176	100%

Table 24. Residency Status

Residency Status	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Less than 1 month	3	0%	98	0%
1-6 months	15	1%	424	1%
6 or more months	1,224	98%	31,433	98%
DON'T KNOW	2	0%	60	0%
PREFER NOT TO ANSWER	6	0%	161	1%
Total	1,250	100%	32,176	100%

5.2 Vehicle Level Weights

The vehicle weight is equivalent to the household weight. Table 25 and Table 26 provide weighted and unweighted frequencies for vehicle age and fuel type. Forty-eight percent of the vehicles in surveyed households were less than 10 years old and 93 percent were reported as fueled by gasoline.

Table 25. Vehicle Age (Unweighted and Weighted)

Vehicle Age	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0 – 4	570	21%	13,430	22%
5 – 9	744	27%	18,190	29%
10 – 14	624	23%	13,953	22%
15 – 19	345	12%	7,609	12%
20 +	407	15%	7,426	12%
Don't know	67	2%	1,455	2%
Refused to answer	11	0%	258	0%
Total	2,768	100%	62,322	100%

Table 26. Vehicle Fuel Type (Unweighted and Weighted)

Vehicle Fuel Type	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Diesel	163	6%	3,396	5%
Flex Fuel	14	1%	368	1%
Gas	2,562	93%	57,979	93%
Hybrid	27	1%	538	1%
Some other fuel	1	0%	13	0%
Refused	1	0%	29	0%
Total	2,768	100%	62,322	100%

5.3 Person Level Weights

5.3.1 Adjustment of Initial Person Level Weights

The final household weight was assigned to each person in responding households in the sample. This weight represents the initial person level weight.

5.3.2 Raking at the Person-Level

For the same reasons raking was used at the household-level (improved reliability, reduction of potential bias, and to achieve consistency with known population counts), a simple raking/post-stratification procedure was used at the person-level as well. Survey weights of responding persons were adjusted so that the sum of the weights of the responding persons equaled the corresponding independent control total for the study area population. The dimensions at the person-level weighting included the following:

- Sex
- Age
- Race

The independent control totals came from 2007 – 2011 ACS data. Table 27 though Table 33 present the weighted and unweighted frequencies for a number of person level variables (e.g., gender, race, etc.). Three percent of respondents (n=103) refused to provide their ages, but 97 ultimately provided an age range. A small item non-response rate was found in other person-level demographic variables like race, education and number of jobs. The majority of the sample identified as white (84 percent)

and 5 percent reported race as Alaska Native. Most participants (38 percent) had a bachelor's degree or higher, 28 percent had at least some college, and 87 percent reported having one job.

Table 27. Participant Gender (Unweighted and Weighted)

Person Gender	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Male	1,470	49%	46,022	52%
Female	1,497	50%	41,303	47%
Refused	30	1%	857	1%
Don't know	1	0%	10	0%
Total	2,998	100%	88,191	100%

Table 28. Participant Age Distribution (Unweighted and Weighted)

Person Age	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0 – 4	229	8%	7,007	8%
5 – 17	425	14%	15,456	18%
18 – 24	205	7%	11,771	13%
25 – 29	190	6%	5,957	7%
30 – 34	249	8%	7,795	9%
35 – 39	202	7%	5,663	6%
40 – 44	169	6%	4,801	5%
45 – 49	175	6%	4,863	6%
50 – 54	245	8%	5,440	6%
55 – 59	241	8%	5,941	7%
60 – 64	209	7%	4,724	5%
65 – 69	165	6%	2,260	3%
70 – 74	104	3%	1,325	2%
75+	87	3%	1,999	2%
Don't know	6	0%	281	0%
Refused	97	3%	2,907	3%
Total	2,998	100%	88,191	100%

Table 29. Participant Age Range (Unweighted and Weighted)

Person Age	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0 – 4	237	8%	7,315	8%
5 – 15	381	13%	13,414	15%
16 – 17	56	2%	2,416	3%
18 – 64	1,949	65%	59,007	67%
65 -74	281	9%	3,846	4%
75 +	87	3%	1,999	2%
Refused	7	0%	194	0%
Total	2,998	100%	88,191	100%

Table 30. Participant Race (Unweighted and Weighted)

Person Race	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
White	2,522	84%	62,386	71%
Alaska Native	137	5%	5,254	6%
Asian	65	2%	2,085	2%
Black	46	2%	5,615	6%
Hispanic	53	2%	5,149	6%
Native American	18	1%	424	0%
Pacific Islander	15	1%	500	1%
Some other race	21	1%	2,501	3%
Don't Know	5	0%	323	0%
Refused	116	4%	3,955	4%
Total	2,998	100%	88,191	100%

Table 31. Participant Number of Jobs (Unweighted and Weighted)

Person Jobs	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
0	9	1%	539	1%
1	1,420	87%	39,305	85%
2	156	10%	4,241	9%
3	4	0%	307	1%
4+	5	0%	97	0%
Don't Know	7	0%	193	0%
Refused	33	2%	1,497	3%
Not Ascertained	4	0%	109	0%
Total	1,638	100%	46,288	100%

Table 32. Participant Work Locations (Unweighted and Weighted)

Person Work Place	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Fixed	1,283	81%	35,227	80%
Home	85	5%	2,567	6%
Varies	199	13%	5,514	13%
Don't know	11	1%	419	1%
Refused	9	1%	298	1%
Total	1,587	100%	44,025	100%

Table 33. Educational Attainment (Unweighted and Weighted)

Person Educational Attainment	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Not a high school graduate	476	17%	17,456	22%
High School Graduate	413	15%	12,804	16%
Some College Credit but no Degree	507	18%	15,324	19%
Associate or Technical School Degree	266	10%	7,935	10%
Bachelor's or Undergraduate Degree	612	22%	15,208	19%
Graduate Degree	437	16%	10,342	13%
Some other degree	2	0%	59	0%
Don't know	11	0%	479	1%
Refused	32	1%	1,132	1%
Total	2,756	100%	80,737	100%

5.3.3 Trip Weights and Rates

Trip weights were generated by multiplying the final person weight by 260 to represent the number of trips on any given weekday within a year. These weights should be used to expand the data to the survey population.

Trip rates in Table 34 though Table 38 were calculated by dividing the sum of trips by the sum of households or persons in the survey. Consistent with findings from other household travel surveys, the GFTS data show that larger households make more trips per household than do smaller households (Table 36). Households with more workers also made more trips than those with fewer workers (Table 37). Trip rates in the region also seem to be correlated to household income as well (40).

Table 34. Household Trip Rates (Unweighted and Weighted)

Household Trip Rate	
Unweighted	Weighted
7.43	7.88

Table 35. Person Trip Rates (Unweighted and Weighted)

Person Trip Rate	
Unweighted	Weighted
3.95	3.89

Table 36. Trip Rates by Household Size (Unweighted and Weighted)

Household Size	Trip Rate	
	Unweighted	Weighted
1	4.45	4.23
2	7.79	7.90
3	10.14	9.40
4+	13.74	13.37

Table 37. Trip Rates by Number of Household Workers (Unweighted and Weighted)

Household Workers	Trip Rate	
	Unweighted	Weighted
0	6.05	5.90
1	6.67	7.25
2	9.55	10.4
3	14.11	16.65
4+	17.50	13.70

Table 38. Trip Rates by Household Income (Unweighted and Weighted)

Household Income	Trip Rate	
	Unweighted	Weighted
Less than $10,000	4.52	4.62
$10,000 – $19,999	5.10	5.19
$20,000 – $29,999	6.28	6.63
$30,000 – $49,999	7.10	7.52
$50,000 – $59,999	7.79	8.14
$60,000 – $74,999	8.68	9.14
$75,000 – $99,999	8.01	9.68
$100,000 – $149,999	9.00	9.68
$150,000 or More	8.63	12.16
Don't Know	4.65	3.78
Refused	8.36	8.95

In Table 39 through Table 43 unweighted and weighted frequencies for trip purpose and mode are shown. The most prevalent trip purposes were associated with home and work, illustrated in Table 39. It is important to recognize that the travel day for most participants in the study began at home. This contributed to the high percentage of home-based trip purposes reported.

Table 39. Primary Trip Purpose (Unweighted and Weighted)

Trip Purpose (Primary)	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Attend major special event	27	0%	721	0%
Change / Transfer trip mode	208	2%	7,617	3%
Drive-thru errands	168	2%	3,960	1%
Drop off / Pick up passenger	885	8%	24,636	8%
Eat out	384	4%	10,514	4%
Grocery Shopping	574	5%	14,765	5%
Health care visit	195	2%	5,134	2%
Household & personal errands	734	7%	17,924	6%
Indoor exercise or recreation	219	2%	6,284	2%
Major purchase shopping	45	0%	920	0%
Other Shopping	558	5%	13,645	5%
Outdoor exercise or recreation	217	2%	5,039	2%
Religious or community event	94	1%	2,612	1%
School / Studying	595	6%	23,901	8%
Socialize with friends / relatives	316	3%	7,824	3%
Typical home activities	3,296	31%	95,612	32%
Vehicle service	130	1%	2,778	1%
Volunteering	139	1%	2,952	1%
Work at fixed work location	1,551	14%	41,691	14%
Work at non-fixed work location	303	3%	7,350	2%
Working at home (paid)	40	0%	758	0%
OTHER, SPECIFY	5	0%	103	0%
DON'T KNOW	13	0%	339	0%
REFUSED	30	0%	680	0%
Total	10,726	100%	297,757	100%

Auto travel is the largest mode choice for all trips (89 percent) and work related trips (92 percent). Auto travel decreases for school related trips with 24 percent of these trips made by school bus. Table 43 presents the frequency of trips by day of week. The results show travel across the region was well balanced by day of week.

Table 40. All Trip Modes (Unweighted and Weighted)

Trip Travel Mode	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Walk	540	5%	24,084	8%
Bike	170	2%	5,383	2%
Auto/Van/Truck (as the driver)	7,830	73%	194,926	65%
Auto/Van/Truck (as a passenger)	1,713	16%	54,266	18%
Public Transit – Local Bus	90	1%	4,553	2%
Dial-a-ride/Paratransit	8	0%	213	0%
Taxi/Limo	25	0%	1,250	0%
School bus	268	2%	10,259	3%
Motorcycle/Moped	21	0%	352	0%
Private Shuttle/Bus	13	0%	406	0%
Carpool	27	0%	1,207	0%
Vanpool	4	0%	242	0%
Something else	17	0%	615	0%
Total	10,726	100%	297,757	100%

Table 41. Mode to Work (Unweighted and Weighted)

Trip Travel Mode to Work	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Walk	42	3%	1,234	4%
Bike	32	3%	1,001	3%
Auto/Van/Truck (as the driver)	1,050	86%	26,962	84%
Auto/Van/Truck (as a passenger)	74	6%	2,460	8%
Public Transit – Local Bus	10	1%	328	1%
Motorcycle/Moped	3	0%	63	0%
Carpool	2	0%	41	0%
Dial-a-ride/Paratransit	1	0%	24	0%
Taxi/Limo	3	0%	74	0%
Private Shuttle/Bus	3	0%	49	0%
Something else	1	0%	24	0%
Total	1,221	100%	32,260	100%

Table 42. Mode to School (Unweighted and Weighted)

Trip Travel Mode to School	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Walk	50	10%	3,395	17%
Auto/Van/Truck (as a passenger)	195	38%	6,877	34%
Auto/Van/Truck (as the driver)	124	24%	4,202	21%
Bike	9	2%	393	2%
Carpool	5	1%	232	1%
Public Transit – Local Bus	9	2%	342	2%
School bus	122	24%	4,387	22%
Private Shuttle/Bus	1	0%	27	0%
Taxi/Limo	1	0%	116	1%
Total	516	100%	19,971	100%

Table 43. Number of Trips by Day of Week (Unweighted and Weighted)

Trips on Travel Day	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Monday	2,156	20%	62,480	21%
Tuesday	2,161	20%	64,145	22%
Wednesday	2,175	20%	54,545	18%
Thursday	2,225	21%	58,474	20%
Friday	2,009	19%	58,113	20%
Total	10,726	100%	297,757	100%

5.4 Replicate Weights

In addition to the survey weight, a set of 100 replicate weights was calculated for each analytic sample unit (household, vehicle, person, and trip). These replicate weights are used in calculating the sampling variance of estimates obtained from the data, using the paired jackknife repeated replication method. The method of deriving these weights was aimed at reflecting the features of the sample design appropriately for each sample, so that when the jackknife variance estimation procedure is implemented, approximately unbiased estimates of sampling variance are obtained. In addition, the various weighting procedures were repeated on each set of replicate weights to appropriately reflect the impact of the weighting adjustments on the sampling variance of a survey estimate.

Many software packages for personal computers exist for replication variance estimation methods. For example, WesVar, later versions of SAS, and STATA all have the capability of producing replication estimates. These software packages produce both the appropriate estimates and corresponding variance estimates for the estimates. WesVar, developed and distributed by Westat, is available without charge.

6 Summary

The GFTS successfully collected travel behavior data from 1,250 households across the North Star Borough PM2.5 non-attainment region including the cities of Fairbanks and North Pole, University of Alaska at Fairbanks, and Fort Wainwright Army Base. Response rates far exceeded expectations and resulted in a more robust dataset than originally projected with an additional 25 percent of households in the final sample.

The survey methodology provided sampled households two options for recruitment (web and phone) and three for participation at the retrieval stage (web, phone, and mail back). The invitation letter sent to sampled households encouraged self-report on the project's secure website. Eighty-nine percent of all recruited households took advantage of the opportunity to respond online. The majority of participants also took advantage of reporting their travel day data online (68 percent), 30 percent reported their travel data by phone and the remaining 2 percent responded by mail.

A total of 10,726 trips were reported by respondents of the GFTS. An examination of primary trip purpose shows that the majority of trips were work related, accounting for 14 percent of all trips. Running household related errands and dropping off or picking up passengers accounted for 15 percent of all trips. Social activities, such as visiting with friends or relatives, and participating in recreational activities accounted for 5 percent of all reported trips. Eating a meal out was reported as the trip purpose for another 4 percent of all trips. The trip purpose of "any other activities at home" was reported 31 percent of the time; however, when reporting this statistic it is important to remember that most travel days start at home and respondents typically report this purpose when place one is home. When analyzing trip purpose for the home location it is advisable to consider the location for place one.

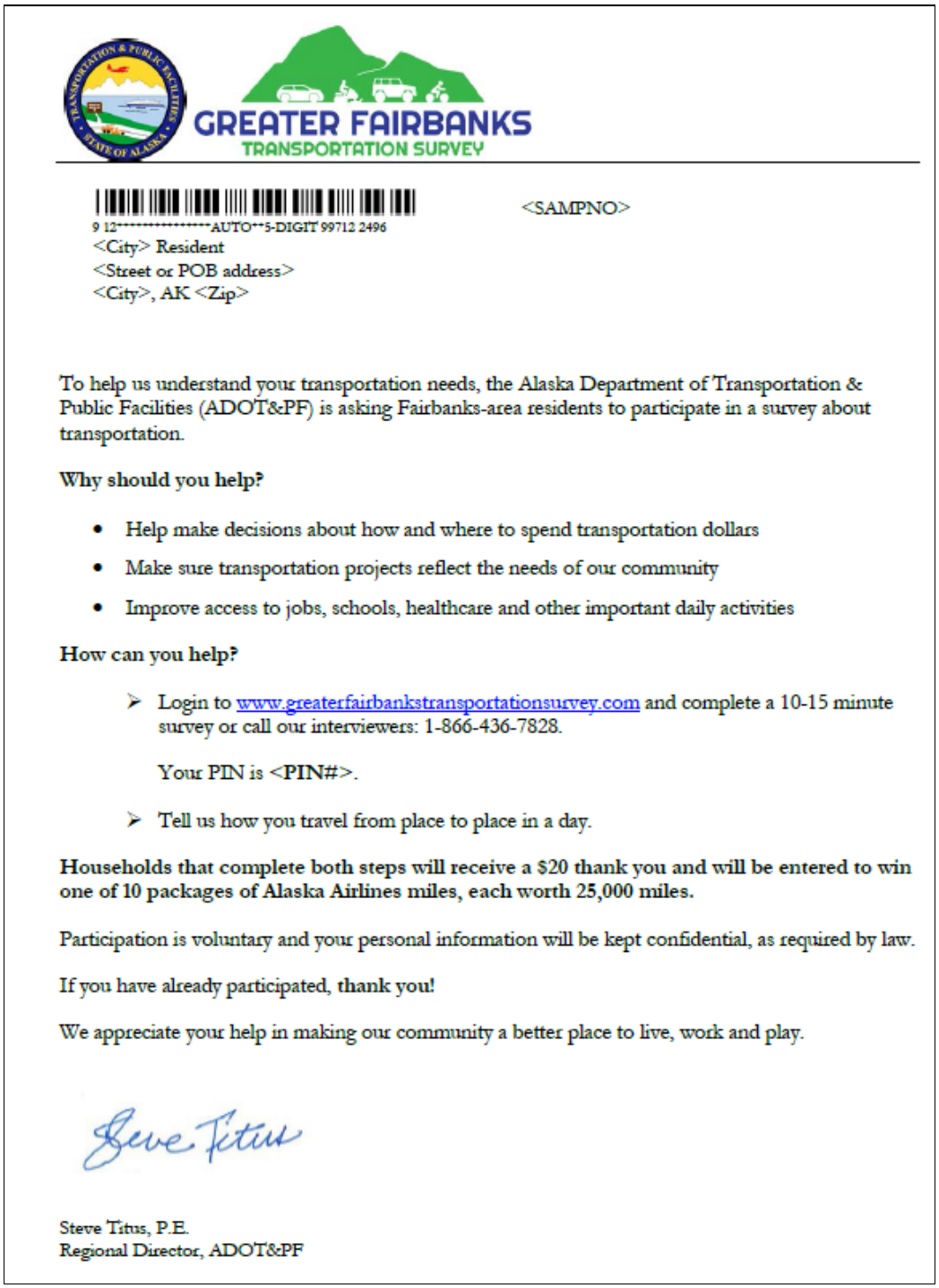
The most popular trip mode in the survey across all trips was personal vehicle with 73 percent using an auto/van/truck as the driver and another 16 percent as the passenger. Reported mode to work was 92 percent personal vehicle. Walk and bicycle were reported as trip mode for 7 percent of all trips and 6 percent of all work trips.

The data collected through this survey effort provides transportation modelers with a rich source of data that can be used to update the regional travel model for the Greater Fairbanks region.

7 Appendices

7.1 Participation Documents

7.1.1 Invitation Letter



GREATER FAIRBANKS
TRANSPORTATION SURVEY

9 12**********AUTO**5-DIGIT 99712 2496
<City> Resident
<Street or POB address>
<City>, AK <Zip>

<SAMPNO>

To help us understand your transportation needs, the Alaska Department of Transportation & Public Facilities (ADOT&PF) is asking Fairbanks-area residents to participate in a survey about transportation.

Why should you help?

- Help make decisions about how and where to spend transportation dollars
- Make sure transportation projects reflect the needs of our community
- Improve access to jobs, schools, healthcare and other important daily activities

How can you help?

- Login to www.greaterfairbankstransportationsurvey.com and complete a 10-15 minute survey or call our interviewers: 1-866-436-7828.

  Your PIN is <PIN#>.

- Tell us how you travel from place to place in a day.

Households that complete both steps will receive a $20 thank you and will be entered to win one of 10 packages of Alaska Airlines miles, each worth 25,000 miles.

Participation is voluntary and your personal information will be kept confidential, as required by law.

If you have already participated, thank you!

We appreciate your help in making our community a better place to live, work and play.

Steve Titus

Steve Titus, P.E.
Regional Director, ADOT&PF

7.1.2 Reminder Postcard

7.1.2.1 Postcard (Front)

7.1.2.2 Postcard (Back)

7.1.3 Travel Log Letter

«Firstname» «Lastname» <<DateNow>>
«HOUSENUMBER» «STREETNAME» «STREETSUFFIX»
«APARTMENTNUMBER»
«CITY», «STATE» «ZIP»-«ZIP4»

Dear «Firstname»,

Thank you for participating in the Greater Fairbanks Transportation Survey! The information you provide will help Alaska Department of Transportation and Public Facilities (ADOT&PF) ensure that future transportation projects reflect what your community needs and that transportation funds are spent wisely.

Households that complete both steps of the survey will be entered to win 1 of 10 Alaska Airlines Super Saver Award Tickets worth 25,000 miles.

NEXT STEPS ☞

- Keep track of all the places you visit on «DOW», «FIRSTTRAVELDAY».
- Tell us about the places you went on **«FIRSTTRAVELDAY»**
  - Online: Go to **www.GreaterFairbanksTransportationSurvey.com** and enter PIN#: **«PINNO».**
  - By Phone: Call toll-free 1-888-648-1756 to talk with an interviewer.

Once you report your travel information for all household we will send your **$20** thank you award for participating in the survey **AND** enter you into the sweepstakes for the Alaska Airlines miles.

Participation is voluntary and your personal information will be kept confidential, as required by law.

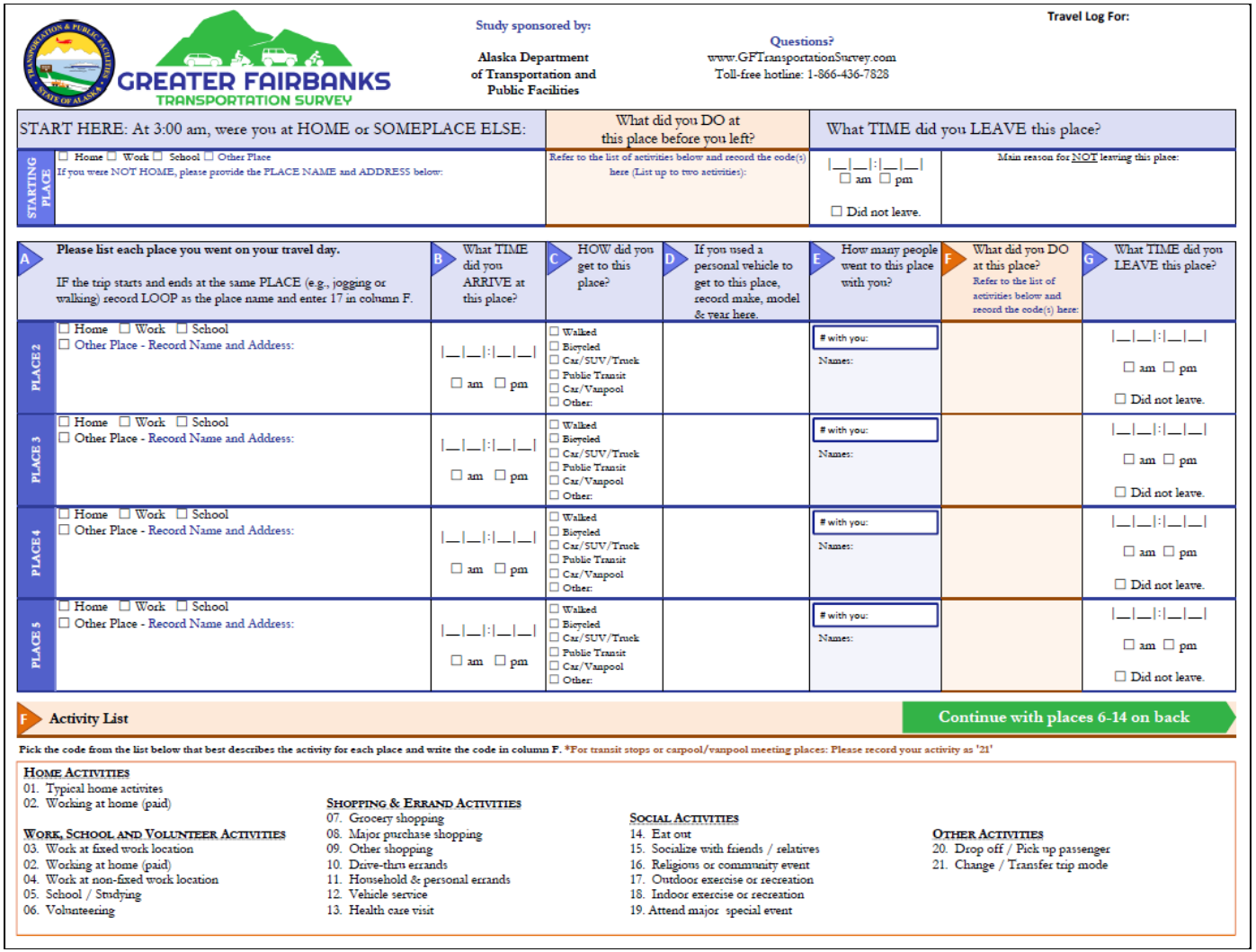
Thank you for helping make our region a better place to live, work and play.

Steve Titus

Steve Titus, P.E.
Regional Director, ADOT&PF

7.1.4 Travel Logs

7.1.4.1 Participant Log



GREATER FAIRBANKS TRANSPORTATION SURVEY

Study sponsored by:

Alaska Department of Transportation and Public Facilities

Questions?
www.GFTransportationSurvey.com
Toll-free hotline: 1-866-436-7828

Travel Log For:

START HERE: At 3:00 am, were you at HOME or SOMEPLACE ELSE:	What did you DO at this place before you left?	What TIME did you LEAVE this place?	
STARTING PLACE ☐ Home ☐ Work ☐ School ☐ Other Place If you were NOT HOME, please provide the PLACE NAME and ADDRESS below:	Refer to the list of activities below and record the code(s) here (List up to two activities):	____:____ ☐ am ☐ pm ☐ Did not leave.	Main reason for NOT leaving this place:

	A Please list each place you went on your travel day. IF the trip starts and ends at the same PLACE (e.g., jogging or walking) record LOOP as the place name and enter 17 in column F.	B What TIME did you ARRIVE at this place?	C HOW did you get to this place?	D If you used a personal vehicle to get to this place, record make, model & year here.	E How many people went to this place with you?	F What did you DO at this place? Refer to the list of activities below and record the code(s) here:	G What TIME did you LEAVE this place?
PLACE 2	☐ Home ☐ Work ☐ School ☐ Other Place - Record Name and Address:	____:____ ☐ am ☐ pm	☐ Walked ☐ Bicycled ☐ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:		# with you: Names:		____:____ ☐ am ☐ pm ☐ Did not leave.
PLACE 3	☐ Home ☐ Work ☐ School ☐ Other Place - Record Name and Address:	____:____ ☐ am ☐ pm	☐ Walked ☐ Bicycled ☐ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:		# with you: Names:		____:____ ☐ am ☐ pm ☐ Did not leave.
PLACE 4	☐ Home ☐ Work ☐ School ☐ Other Place - Record Name and Address:	____:____ ☐ am ☐ pm	☐ Walked ☐ Bicycled ☐ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:		# with you: Names:		____:____ ☐ am ☐ pm ☐ Did not leave.
PLACE 5	☐ Home ☐ Work ☐ School ☐ Other Place - Record Name and Address:	____:____ ☐ am ☐ pm	☐ Walked ☐ Bicycled ☐ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:		# with you: Names:		____:____ ☐ am ☐ pm ☐ Did not leave.

F Activity List — Continue with places 6-14 on back

Pick the code from the list below that best describes the activity for each place and write the code in column F. *For transit stops or carpool/vanpool meeting places: Please record your activity as '21'

HOME ACTIVITIES
01. Typical home activites
02. Working at home (paid)

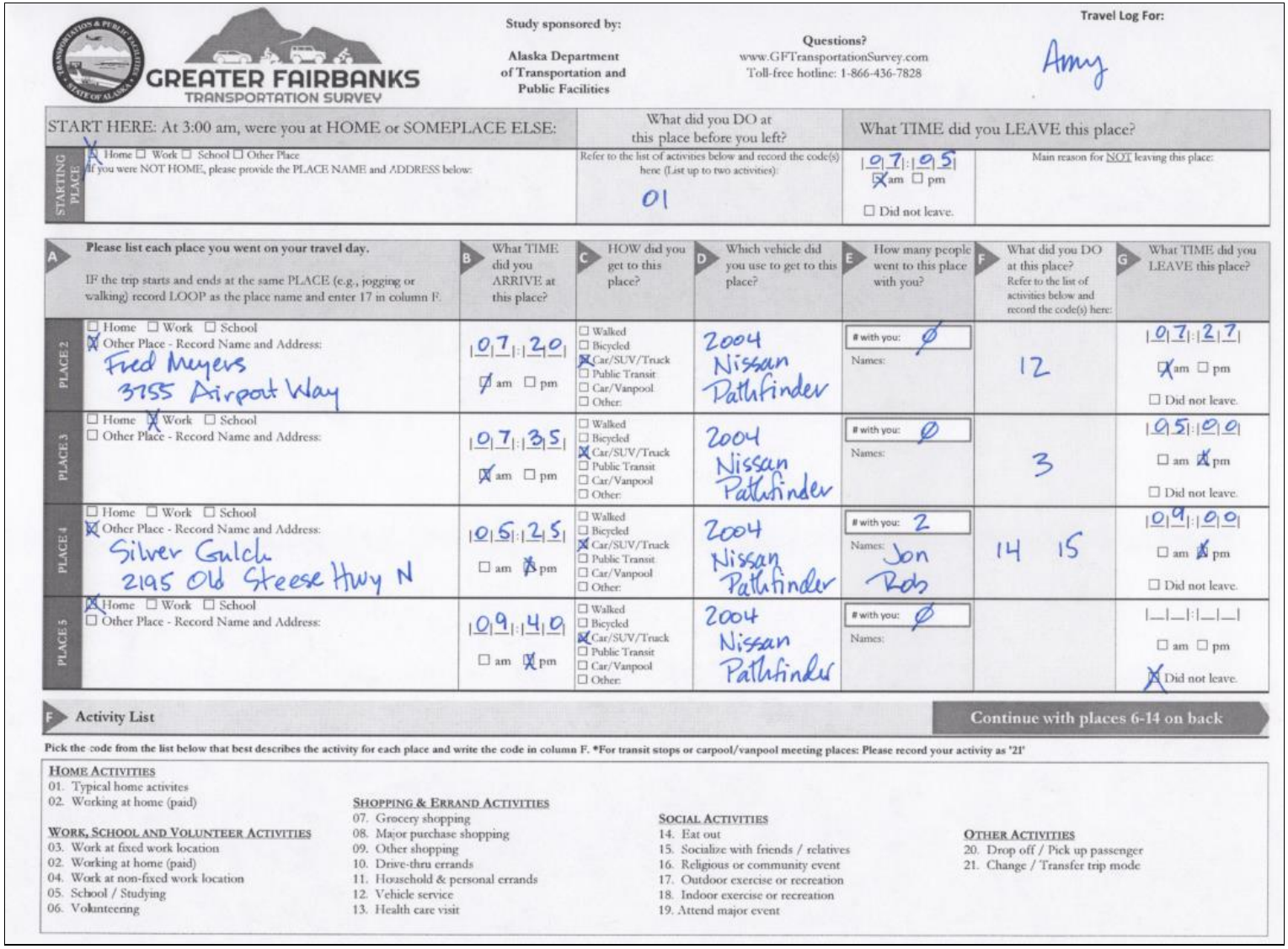
WORK, SCHOOL AND VOLUNTEER ACTIVITIES
03. Work at fixed work location
02. Working at home (paid)
04. Work at non-fixed work location
05. School / Studying
06. Volunteering

SHOPPING & ERRAND ACTIVITIES
07. Grocery shopping
08. Major purchase shopping
09. Other shopping
10. Drive-thru errands
11. Household & personal errands
12. Vehicle service
13. Health care visit

SOCIAL ACTIVITIES
14. Eat out
15. Socialize with friends / relatives
16. Religious or community event
17. Outdoor exercise or recreation
18. Indoor exercise or recreation
19. Attend major special event

OTHER ACTIVITIES
20. Drop off / Pick up passenger
21. Change / Transfer trip mode

7.1.4.2 Example Log



GREATER FAIRBANKS TRANSPORTATION SURVEY

Study sponsored by:
Alaska Department of Transportation and Public Facilities

Questions?
www.GFTransportationSurvey.com
Toll-free hotline: 1-866-436-7828

Travel Log For: Amy

START HERE: At 3:00 am, were you at HOME or SOMEPLACE ELSE:	What did you DO at this place before you left?	What TIME did you LEAVE this place?	
STARTING PLACE: ☒ Home ☐ Work ☐ School ☐ Other Place. If you were NOT HOME, please provide the PLACE NAME and ADDRESS below:	Refer to the list of activities below and record the code(s) here (List up to two activities): 01	07:05 ☒ am ☐ pm ☐ Did not leave.	Main reason for NOT leaving this place:

A: Please list each place you went on your travel day. IF the trip starts and ends at the same PLACE (e.g., jogging or walking) record LOOP as the place name and enter 17 in column F.	B: What TIME did you ARRIVE at this place?	C: HOW did you get to this place?	D: Which vehicle did you use to get to this place?	E: How many people went to this place with you?	F: What did you DO at this place? Refer to the list of activities below and record the code(s) here:	G: What TIME did you LEAVE this place?
PLACE 2: ☐ Home ☐ Work ☐ School ☒ Other Place - Record Name and Address: Fred Meyers 3755 Airport Way	07:20 ☒ am ☐ pm	☐ Walked ☐ Bicycled ☒ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:	2004 Nissan Pathfinder	# with you: 0 Names:	12	07:27 ☒ am ☐ pm ☐ Did not leave.
PLACE 3: ☐ Home ☒ Work ☐ School ☐ Other Place - Record Name and Address:	07:35 ☒ am ☐ pm	☐ Walked ☐ Bicycled ☒ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:	2004 Nissan Pathfinder	# with you: 0 Names:	3	05:00 ☐ am ☒ pm ☐ Did not leave.
PLACE 4: ☐ Home ☐ Work ☐ School ☒ Other Place - Record Name and Address: Silver Gulch 2195 Old Steese Hwy N	05:25 ☐ am ☒ pm	☐ Walked ☐ Bicycled ☒ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:	2004 Nissan Pathfinder	# with you: 2 Names: Jon Rob	14 15	09:00 ☐ am ☒ pm ☐ Did not leave.
PLACE 5: ☒ Home ☐ Work ☐ School ☐ Other Place - Record Name and Address:	09:40 ☐ am ☒ pm	☐ Walked ☐ Bicycled ☒ Car/SUV/Truck ☐ Public Transit ☐ Car/Vanpool ☐ Other:	2004 Nissan Pathfinder	# with you: 0 Names:		☐ am ☐ pm ☒ Did not leave.

F: Activity List — Continue with places 6-14 on back

Pick the code from the list below that best describes the activity for each place and write the code in column F. *For transit stops or carpool/vanpool meeting places: Please record your activity as '21'

HOME ACTIVITIES
01. Typical home activites
02. Working at home (paid)

WORK, SCHOOL AND VOLUNTEER ACTIVITIES
03. Work at fixed work location
02. Working at home (paid)
04. Work at non-fixed work location
05. School / Studying
06. Volunteering

SHOPPING & ERRAND ACTIVITIES
07. Grocery shopping
08. Major purchase shopping
09. Other shopping
10. Drive-thru errands
11. Household & personal errands
12. Vehicle service
13. Health care visit

SOCIAL ACTIVITIES
14. Eat out
15. Socialize with friends / relatives
16. Religious or community event
17. Outdoor exercise or recreation
18. Indoor exercise or recreation
19. Attend major event

OTHER ACTIVITIES
20. Drop off / Pick up passenger
21. Change / Transfer trip mode

7.1.5 GBS/OBD Fall Deployment Letter

«FIRSTNAME» «LASTNAME» «DATENOW»
«ADDRESS»
«CITY», «STATE» «ZIP»

Dear «FIRSTNAME»,

Thank you for participating in the Greater Fairbanks Transportation Survey! The information you provide will help Alaska Department of Transportation and Public Facilities (ADOT&PF) ensure that future transportation projects reflect what your community needs and that transportation funds are spent wisely.

Households that complete both steps of the survey will be entered to win 1 of 10 Alaska Airlines Super Saver Award Tickets worth 25,000 miles.

NEXT STEPS ☞

- Keep track of all the places you visit on «DOW», «FIRSTTRAVELDAY».
- Use the GPS / OBD devices from **«FIRSTTRAVELDAY»** to **«LASTTRAVELDAY»** as assigned in the table below. Instructions are provided in the package.

Vehicle	Year	Make	Model	GPS Unit ID	OBD Unit ID
«VEHICLE1»	«YEAR1»	«MAKE1»	«MODEL1»	«GPSUNITID1»	«OBDUNITID1»
«VEHICLE2»	«YEAR2»	«MAKE2»	«MODEL2»	«GPSUNITID2»	«OBDUNITID2»
«VEHICLE3»	«YEAR3»	«MAKE3»	«MODEL3»	«GPSUNITID3»	«OBDUNITID3»

- Tell us about the places you went on **«FIRSTTRAVELDAY»**
  - Online: Go to **www.GreaterFairbanksTransportationSurvey.com** and enter PIN#: **«PINNO».**
  - By Phone: Call toll-free 1-888-648-1756 to talk with an interviewer.
- Return the equipment (in the pre-paid FedEx package) immediately after your seven-day GPS / OBD travel period.

Once you report your travel information for all household members and you return the equipment, we will send your $**«INAMT»** thank you award for participating in the survey **AND** enter you into the sweepstakes for the Alaska Airlines miles.

Participation is voluntary and your personal information will be kept confidential, as required by law.

Thank you for helping make our region a better place to live, work and play.

Steve Titus

Steve Titus, P.E.
Regional Director, ADOT&PF

7.1.6 GPS/OBD Winter Deployment Letter

[DATENOW]

[FirstName] [LastName]
[Street] [Unit]
[City], AK [Zipcode]

Dear [FirstName] [LastName],

Thank you for completing Phase 1 of the GPS and engine sensor portion of the Greater Fairbanks Transportation Survey conducted on behalf of the Alaska Department of Transportation and Public Facilities (ADOT&PF). Please accept the enclosed $[INAMT] check as a token of our appreciation for your participation in this study.

We will contact your household again for Phase 2 between December 2013 and February 2014 for another one-week GPS and engine sensor data collection period.

What happens in Phase 2?

- We contact you to schedule a time for you to accept the GPS and engine sensor devices
- You provide basic information about changes in your household that may occur between now and then
- You use and return the GPS and engine sensor devices again
- We send you another check for $50 per vehicle

Your participation will help ADOT&PF build a more accurate picture of transportation needs in your region and achieve their mission of keeping Alaska moving through service and infrastructure. If you have any questions you may reach our survey team at 1-866-436-7828 or by email at GreaterFairbanksTransportationSurvey@Westat.com.

Sincerely,

Jeremy Wilhelm
Westat Project Manager

7.2 List of Derived Variables

HOUSEHOLD TABLE

- HHSIZX: Actual count of number of household members.
- HHSTUD: Count of the number of students in each household (STUDE = 1 or 2).
- HHWORKER: Count of the number of workers in each household (EMPLY = 1).
- HHLICDRV: Count of the license holders in each household (LIC = 1).
- HHCHILD: Count of the number of children in each household (AGE = 1 or AAGE = 2).
- HHTRIPS: Count of total number of trips taken by household on travel day
- LIFCYCLE: Classification of each household using the number of children, adults and retired members. Each household is classified into one of the 10 categories below.
  - 01 = Household has one adult, no children and no retired persons.
  - 02 = Household has 2 or more adults, no children and no retired persons.
  - 03 = Household has one adult and the youngest child is 0 to 5 years old.
  - 04 = Household has 2 or more adults and the youngest child is 0 to 5 years old.
  - 05 = Household has one adult and the youngest child is 6 to 15 years old.
  - 06 = Household has 2 or more adults and the youngest child is 6 to 15 years old.
  - 07 = Household has one adult and the youngest child is 16 to 21 years old.
  - 08 = Household has 2 or more adults and the youngest child is 16 to 21 years old.
  - 09 = Household has one retired adult and no children.
  - 10 = Household has 2 or more adults; at least one is retired and no children.

PERSON TABLE

- WSTRT: Conversion of the participant's work start time to military time
- WEND: Conversion of the participant's work end time to military time

VEHICLE TABLE

- HHVEHX: Count of the number of vehicles rostered in each household.

TRIP TABLE

- NONHHMTP: Count of non-household members on trip.

7.3 Additional Recruitment Frequency Tables

Table 44. Number of Children in Household by Population Group

Household Children	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
0	888	72%	20,927	66%
1	148	12%	4,227	13%
2	116	9%	3,839	12%
3	51	4%	1,674	5%
4+	27	2%	935	3%
	1,230	98%	31,602	98%
Fort Wainwright				
0	4	40%	135	25%
1	5	50%	311	57%
2	1	10%	100	18%
	10	1%	546	2%
University of Alaska				
0	8	80%	23	80%
1	2	20%	6	20%
	10	1%	28	0%
Total	1,250	100%	32,176	100%

Table 45. Participant Employment Status by Population Group

Person Employment Status	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
Worker	3	0%	89	0%
Retired	388	52%	7,134	36%
Homemaker	131	18%	4,144	21%
Unemployed, but looking for work	50	7%	2,165	11%
Unemployed, not seeking employment	12	2%	431	2%
Student	106	14%	4,297	21%
Something else	38	5%	1,487	7%
Don't Know	2	0%	32	0%
Refused	6	1%	176	1%
NOT ASCERTAINED	4	1%	105	1%
	740	98%	20,060	92%
Fort Wainwright				
Homemaker	2	50%	142	54%
Unemployed, but looking for work	1	25%	31	12%
Student	1	25%	89	34%
	4	1%	262	1%
University of Alaska				
Homemaker	1	11%	119	8%
Unemployed, not seeking employment	1	11%	119	8%
Student	6	67%	1,024	72%
Something else	1	11%	163	11%
	9	1%	1,425	7%
Total	753	100%	21,747	100%

Table 46. Participant Volunteer Status by Population Group

Person Volunteer Status	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
Yes	639	27%	15,980	25%
No	1,654	71%	45,086	72%
Don't know	20	1%	997	2%
Refused	27	1%	753	1%
	2,340	98%	62,817	93%
Fort Wainwright				
Yes	3	16%	207	19%
No	16	84%	882	81%
	19	1%	1,090	2%
University of Alaska				
Yes	7	33%	1,209	34%
No	14	67%	2,346	66%
	21	1%	3,555	5%
Total	2,380	100%	67,461	100%

7.4 Additional Retrieval Frequency Tables

Table 47. Total Persons Traveling on Trip by Population Group

Trip Party Size	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
1	6,395	61%	154,450	56%
2	2,622	25%	72,490	26%
3	780	7%	25,641	9%
4	339	3%	9,814	4%
5+	414	4%	13,135	5%
	10,550	98%	275,531	93%
Fort Wainwright				
1	32	44%	1,124	25%
2	30	41%	2,841	63%
3	11	15%	542	12%
	73	1%	4,507	2%
University of Alaska				
1	62	60%	9,939	56%
2	26	25%	5,189	29%
3	9	9%	1,473	8%
4	5	5%	955	5%
5+	1	1%	163	1%
	103	1%	17,719	6%
Total	10,726	100%	297,757	100%

Table 48. Household Members Traveling on Trip by Population Group

Trip Household Members	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
1	7,381	70%	180,256	65%
2	2,063	20%	60,650	22%
3	607	6%	19,819	7%
4	253	2%	7,765	3%
5+	246	2%	7,040	3%
	10,550	98%	275,531	93%
Fort Wainwright				
1	48	66%	2,957	66%
2	19	26%	1,126	25%
3	6	8%	425	9%
	73	1%	4,507	2%
University of Alaska				
1	83	81%	14,402	81%
2	12	12%	2,006	11%
3	8	8%	1,310	7%
	103	1%	17,719	6%
Total	10,726	100%	297,757	100%

Table 49. Non- Household Members Traveling on Trip by Population Group

Trip Non-household Members	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
0	9,195	87%	237,517	86%
1	1,051	10%	28,575	10%
2	132	1%	3,700	1%
3	46	0%	1,182	0%
4	15	0%	533	0%
5+	111	1%	4,023	1%
	10,550	98%	275,531	93%
Fort Wainwright				
0	57	78%	2,674	59%
1	11	15%	1,716	38%
2	5	7%	117	3%
	73	1%	4,507	2%
University of Alaska				
0	76	74%	12,139	69%
1	22	21%	4,626	26%
2	3	3%	630	4%
3	1	1%	163	1%
4	1	1%	163	1%
	103	1%	17,719	6%
Total	10,726	100%	297,757	100%

Table 50. Reason for No Trips on Travel Day by Population Group

Person No Travel Reason	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
Personally Sick	31	9%	1,271	11%
Vacation or Personal Day	66	18%	2,006	18%
Caretaking Sick Kids	4	1%	190	2%
Caretaking Sick Other	1	0%	61	1%
Home-bound Elderly or Disabled	13	4%	349	3%
Worked at home for pay	15	4%	651	6%
Not Schedule to Work	32	9%	855	7%
Worked Around Home (Not For Pay)	78	21%	2,081	18%
Out of Area	68	19%	1,877	16%
No Transportation Available	5	1%	152	1%
Other	26	7%	1,051	9%
Don't know	9	2%	420	4%
Refused	15	4%	439	4%
	363	99%	11,401	98%
Fort Wainwright				
Vacation or Personal Day	2	100%	121	100%
	2	1%	121	1%
University of Alaska				
Vacation or Personal Day	1	100%	119	100%
	1	0%	119	1%
Total	366	100%	11,642	100%

7.5 Crosstabs for Key Sample Management Variables

Table 51. Workers by Household Size by Population Group

Household Size/Workers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
1				
0	126	39%	3,171	40%
1	200	61%	4,689	60%
	326	27%	7,860	25%
2				
0	110	23%	2,035	18%
1	138	28%	3,934	35%
2	240	49%	5,264	47%
	488	40%	11,233	36%
3				
0	8	4%	384	8%
1	38	21%	1,834	40%
2	102	56%	1,742	38%
3	33	18%	648	14%
	181	15%	4,609	15%
4+				
0	2	1%	82	1%
1	78	33%	3,116	39%
2	118	50%	3,034	38%
3	23	10%	1,034	13%
4+	14	6%	633	8%
	235	19%	7,900	25%
	1,230	98%	31,602	98%
Fort Wainwright				
1				
1	2	100%	61	100%
	2	20%	61	11%
2				
2	1	100%	53	100%
	1	10%	53	10%
3				
1	2	33%	170	51%
2	4	67%	163	49%
	6	60%	332	61%
4+				
1	1	100%	100	100%
	1	10%	100	18%
	10	1%	546	2%

Table 52. Workers by Household Size by Population Group (continued)

Household Size/Workers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
University of Alaska				
1				
0	1	33%	3	33%
1	2	67%	6	67%
	3	30%	8	30%
2				
1	2	67%	6	67%
2	1	33%	3	33%
	3	30%	8	30%
3				
1	1	50%	3	50%
2	1	50%	3	50%
	2	20%	6	20%
4+				
1	1	50%	3	50%
3	1	50%	3	50%
	2	20%	6	20%
	10	1%	28	0%
Total	1,250	100%	32,176	100%

Table 52. Vehicles by Household Size by Population Group

Household Size/Vehicles	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
1				
0	35	11%	1,240	16%
1	206	63%	5,317	68%
2	59	18%	931	12%
3	13	4%	185	2%
4	12	4%	173	2%
5+	1	0%	14	0%
	326	27%	7,860	25%
2				
0	10	2%	393	4%
1	63	13%	2,680	24%
2	210	43%	5,673	51%
3	127	26%	1,698	15%
4	48	10%	489	4%
5+	30	6%	300	3%
	488	40%	11,233	36%
3				
0	4	2%	117	3%
1	24	13%	1,121	24%
2	72	40%	1,831	40%
3	41	23%	1,011	22%
4	24	13%	319	7%
5+	16	9%	210	5%
	181	15%	4,609	15%
Main Sample				
4+				
0	1	0%	51	1%
1	23	10%	1,098	14%
2	105	45%	3,762	48%
3	68	29%	1,861	24%
4	21	9%	619	8%
5+	17	7%	509	6%
	235	19%	7,900	25%
	1,230	98%	31,602	98%

Table 53. Vehicles by Household Size by Population Group (continued)

Household Size/Vehicles	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Fort Wainwright				
1				
2	2	100%	61	100%
	2	20%	61	11%
2				
2	1	100%	53	100%
	1	10%	53	10%
3				
1	2	33%	106	32%
2	2	33%	170	51%
3	1	17%	36	11%
5+	1	17%	21	6%
	6	60%	332	61%
4+				
1	1	100%	100	100%
	1	10%	100	18%
	10	1%	546	2%
University of Alaska				
1				
0	1	33%	3	33%
1	2	67%	6	67%
	3	30%	8	30%
2				
0	1	33%	3	33%
1	2	67%	6	67%
	3	30%	8	30%
3				
1	2	100%	6	100%
	2	20%	6	20%
4+				
2	1	50%	3	50%
3	1	50%	3	50%
	2	20%	6	20%
	10	1%	28	0%
Total	1,250	100%	32,176	100%

Table 53. Vehicles by Workers by Population Group

Household Vehicles/Workers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Main Sample				
0				
0	31	62%	1,091	61%
1	13	26%	511	28%
2	4	8%	136	8%
3	2	4%	63	3%
	50	4%	1,801	6%
1				
0	79	25%	2,266	22%
1	184	58%	5,892	58%
2	45	14%	1,667	16%
3	5	2%	191	2%
4+	3	1%	198	2%
	316	26%	10,215	32%
2				
0	77	17%	1,621	13%
1	151	34%	4,876	40%
2	205	46%	5,223	43%
3	13	3%	478	4%
	446	36%	12,198	39%
3				
0	25	10%	339	7%
1	74	30%	1,638	34%
2	129	52%	2,083	44%
3	15	6%	454	10%
4+	6	2%	242	5%
	249	20%	4,755	15%
4+				
0	34	20%	356	14%
1	32	19%	656	25%
2	77	46%	931	35%
3	21	12%	496	19%
4+	5	3%	193	7%
	169	14%	2,633	8%
	1,230	98%	31,602	98%

Table 54. Vehicles by Workers by Population Group (continued)

Household Vehicles/Workers	Unweighted		Weighted	
	Frequency	Percentage	Frequency	Percentage
Fort Wainwright				
1				
1	1	33%	100	49%
2	2	67%	106	51%
	3	30%	206	38%
2				
1	4	80%	231	81%
2	1	20%	53	19%
	5	50%	283	52%
3				
2	1	100%	36	100%
	1	10%	36	7%
4+				
2	1	100%	21	100%
	1	10%	21	4%
	10	1%	546	2%
University of Alaska				
0				
0	1	50%	3	50%
1	1	50%	3	50%
	2	20%	6	20%
1				
1	4	67%	11	67%
2	2	33%	6	33%
	6	60%	17	60%
2				
3	1	100%	3	100%
	1	10%	3	10%
3				
1	1	100%	3	100%
	1	10%	3	10%
	10	1%	28	0%
Total	1,250	100%	32,176	100%