MI Travel Counts III

Household Travel Survey

Final Methodology Report

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1 Project Summary and Background

The Michigan Department of Transportation (MDOT) is responsible for the development, maintenance, and application of the statewide passenger travel model and eight Small Urban Model Area (SUMA) travel demand models as well as coordinating six Transportation Management Areas (TMA) in their model developments.

The purpose of the MI Travel Counts III (MTC III) household travel survey, conducted between April and December of 2015, was to provide much-needed travel behavior data for use in the statewide and regional transportation models. MTC III serves to update the MI Travel Counts (MTC I) survey conducted in 2004–2005 and the MTC II follow-up survey conducted in 2009. In MTC III, 16,276 households across the state provided household demographic information and reported their travel for one day. In addition, 1,325 of the households carried a GPS (global positioning system) unit for a three-day period. The Southeast Michigan Council of Governments (SEMCOG), the Metropolitan Planning Organization (MPO) for Detroit, joined forces with MDOT to collect data from an additional 12,394 households in their region.

This report documents the methodology used to carry out the MTC III survey. A separate report, the Travel Characteristics Report, provides information about the travel characteristics of Michigan residents.

Consultant Team 2

Westat served as the prime data collection contractor for MTC III. Westat is an employee-owned research firm known for the quality of its professional staff in a broad range of research areas, including statistical design, survey research, and program evaluation. The Westat team was led by Susan Swain through the survey design phase of the project. Jesse Casas took over as Project Director through the data collection and data analysis. Martha Wilaby served as the Associate Project Director. Jeremy Wilhelm and Shawn McCloskey were Project Managers. They were assisted by Westat sampling and weighting statisticians, systems design and development experts, and data collection and quality control specialists.

The Westat team included support from Parsons Brinckerhoff (PB) modelers Rick Donnelly, Christi Willison, Peter Vovsha, and Sarah Binkowski, and public awareness specialist Darrel Cole. Parsons Brinckerhoff's Systems Analysis Group is a national leader in advanced four-step and activity-based travel demand models and travel forecasting research, development, application, and interpretation. The group is highly accomplished and world-renowned in the development of regional and statewide travel demand forecasting models, truck models, and land-use models for MPOs, transit agencies, and state departments of transportation.

Also part of the team was Nancy McGuckin of Travel Behavior Associates. Ms. McGuckin has extensive experience analyzing and reporting on travel behavior data for federal, state, and local public agencies. As the sole proprietor of the firm, she specializes in creating information out of complex data sources to help clients understand trends and forecast travel behavior, and she is well-known for her data briefs, presentations, and visualizations.

3 Survey Design

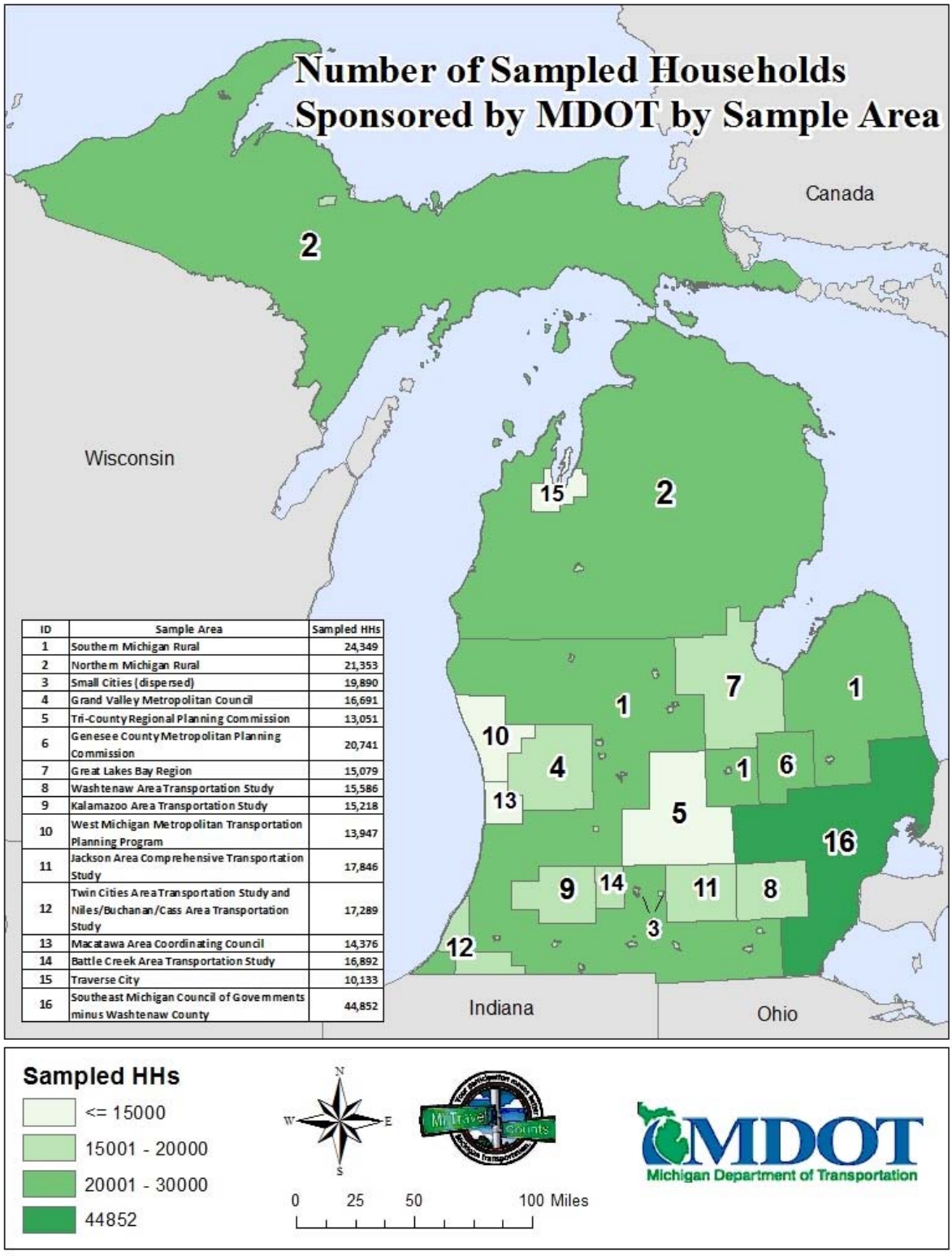
Michigan residents were invited to participate in MTC III based on a random sample of households from all residential addresses in 16 sample areas statewide. Households were stratified by size and income because income can be used as an indicator for vehicle ownership and households with higher incomes may make more discretionary trips than less-wealthy households with the same number of vehicles. A map with the number of the sampled households by area can be seen in Figure 3-1.

Participants completed a web- or phone-based recruitment survey, were assigned a travel date, and were then asked to report the details of their travel in the web-based retrieval survey or report their travel by phone. Some households were offered the opportunity to participate in a global positioning system (GPS) technology component of the study. In the GPS subsample, all household members aged 16–75 were asked to carry a wearable GPS device for 3 days.

It was important that all prospective participants be provided the ability to participate in the survey and to note that not all Michigan residents are proficient in the English language. The three most commonly spoken languages in Michigan are English, Spanish, and Arabic. The website text and survey materials were translated into Spanish and Arabic by a professional translation firm. A tagline was added to the bottom of the English recruitment letter in Spanish and Arabic, referring respondents to the webpages where the translated materials could be downloaded. The firm was also available to translate if a respondent called or emailed needing assistance in completing either the recruitment or retrieval survey.

A pilot study was conducted from January to March of 2015. The main data collection was conducted in two phases. There was a spring data collection beginning in April 2015, followed after a break in the summer by a fall data collection beginning in September 2015. The Project Work Plan containing the project schedule can be found in Appendix A.

Figure 3-1. State map with number of sampled households by sample area



ID	Sample Area	Sampled HHs
1	Southern Michigan Rural	24,349
2	Northern Michigan Rural	21,353
3	Small Cities (dispersed)	19,890
4	Grand Valley Metropolitan Council	16,691
5	Tri-County Regional Planning Commission	13,051
6	Genesee County Metropolitan Planning Commission	20,741
7	Great Lakes Bay Region	15,079
8	Washtenaw Area Transportation Study	15,586
9	Kalamazoo Area Transportation Study	15,218
10	West Michigan Metropolitan Transportation Planning Program	13,947
11	Jackson Area Comprehensive Transportation Study	17,846
12	Twin Cities Area Transportation Study and Niles/Buchanan/Cass Area Transportation Study	17,289
13	Macatawa Area Coordinating Council	14,376
14	Battle Creek Area Transportation Study	16,892
15	Traverse City	10,133
16	Southeast Michigan Council of Governments minus Washtenaw County	44,852

3.1 Sampling

Westat used address-based sampling (ABS) to obtain a representative sample of households for each of the 16 MDOT sample areas. The sampling frame was a database of addresses created by Marketing Systems Group (MSG) from the U.S. Postal Service's (USPS's) Computerized Delivery Sequence (CDS) file. Westat used MSG's geocoding for the initial frame selection, but re-geocoded all addresses in the frame to confirm location before final sample selection. In addition to containing non-vacant addresses, the sampling frame included vacant residential addresses in each region except in areas where the vacancy rate was found to be higher than generally found in other areas across the state. P.O. Box addresses were excluded from the sampling frame, except in the Northern Michigan Rural Area, where P.O. Boxes are often the only way for households to receive mail. The sampling frame also included throwback addresses (i.e., street addresses for which mail is redirected by USPS to a specified P.O. Box).

The MTC III target population excluded individuals living in group quarters, which is defined as a place where people live or stay in a group living arrangement that is owned or managed by an entity or organization providing housing and/or services for the residents. These services may include custodial or medical care and other types of assistance, and residence is commonly restricted to those receiving these services. Group quarters include places such as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, and worker dormitories. The MTC III target population also excluded individuals staying in transient housing such as camp grounds, marinas, nonprofit lodgings (e.g., YMCAs, youth hostels), and commercial hotels and motels.

After defining the target population, the second step in developing a sample design was to consider the analysis goals of the survey and how these determine the desired number of completed cases. The MTC III survey data will be used to develop transportation planning models for 16 sub-state areas. If a single statewide sample were to have been selected for MTC III by using simple random sampling, the sample sizes in the less populous planning areas might have been too small to estimate the area's model parameters with the desired degree of precision. However, the use of stratified sampling, where the first level of stratification corresponds to the 16 areas for which transportation models were developed, permitted the size of the sample to be specified for each transportation model area. Thus, the sample sizes for less populous areas could be increased by sampling them at a higher rate relative to the sampling rates for more populous areas.

Within each transportation model area, some types of households have lower response rates than other types of households. For example, households with four or more persons have a higher response burden than do smaller households, and it is Westat's experience that they have lower response rates. By creating secondary strata based on the prevalence of demographic characteristics associated with low response rates, Westat directed additional data collection efforts to sub-strata where it was needed to compensate for low response rates and away from sub-strata where it was not needed. Westat refers to secondary strata that have either a high or a low prevalence of characteristics correlated with low response rates as high-density strata and low-density strata, respectively.

In each sample area, Westat selected a stratified sample of addresses consisting of a high-density stratum and a low-density stratum. The high-density stratum contained a higher concentration of hard-to-reach households than the low-density stratum. Oversampling the high-density stratum helped in achieving specified sample size targets for post-stratification cells defined by respondent characteristics, such as household size and income.

During the sampling process, addresses were randomly assigned a day of week and a release group for the initial mail-out. Assigning addresses with a day of week helped balance travel across the travel week, Monday through Thursday. Release groups were used to manage the release of the sample and subsequently the flow of completed households throughout the field period. Westat released addresses on an arranged schedule based on expected response rates. A reserve sample was drawn at the same time the main sample was drawn as insurance in case response rates were lower than anticipated. Samples for the pilot and spring data collection were drawn at the same time. Westat used the results of the spring data collection to inform the amount of sample and frequency of release groups required for the fall data collection. Table 3-1 displays the primary sampling strata for MTC III.

Table 3-1. Primary sampling strata

Sample area	Housing units (occupied)[2]	Sample size[3]	% Total housing units (occupied)
Statewide model			
Southeast Michigan Council of Governments (SEMCOG) minus Washtenaw County (WATS)	1,707,565	1,650	0.10%
Southern Michigan Rural	386,208	1,200	0.31%
Northern Michigan Rural	306,995	1,200	0.39%
Small Cities	130,357	1,000	0.77%
Urban model areas			
Grand Valley Metropolitan Council (GVMC)	263,361	1,000	0.38%
Tri-County Regional Planning Commission (TCRPC)	183,589	800	0.44%
Genesee County Metropolitan Planning Commission (GCMPC)	169,202	800	0.47%
Great Lakes Bay Region (GLBR)	157,051	800	0.51%
Washtenaw Area Transportation Study (WATS)	137,193	800	0.58%
Kalamazoo Area Transportation Study (KATS)	110,760	800	0.72%
West Michigan Metropolitan Transportation Planning Program (WestPlan)	86,600	650	0.75%
Jackson Area Comprehensive Transportation Study (JACTS)	60,771	650	1.07%
Twin Cities Area Transportation Study (TwinCATS) and Niles/Buchanan/Cass Area Transportation Study (NATS)[1]	57,322	800	1.40%
Macatawa Area Coordinating Council (MACC)	43,752	650	1.49%
Battle Creek Area Transportation Study (BCATS)	37,849	650	1.72%
Traverse City (TVC)	33,933	650	1.92%
TOTAL	**3,872,508**	**14,100**	0.36%

[1] Combined: a minimum number of samples will be taken in each model area to ensure that specific trip length parameters can be calculated for each of the model areas.

[2] Source: 2010 Decennial Census.

[3] Source: MDOT Sample Size Determination Analysis.

3.2 Public Awareness

The public awareness campaign for MTC III was an effective tool to reach and engage audiences that may not otherwise have been involved in the survey data collection effort, and to bring awareness to the overall project. People who were asked to participate may have been more likely to do so because they had been exposed to the survey through various public awareness tools and strategies. Branding helped with recognition in that the same logo was used for all three MTC data collections.

Social media sites were leveraged to raise exposure of the survey, including the creation of accounts on Facebook and Twitter. These sites provided links to the public project website (and vice versa). In comparing the Facebook and Twitter accounts, the Facebook page seemed less effective. It had a total of only 72 "likes" by the end of data collection. PB staff made an average of one post a day to the Facebook page, which included a mix of original posts and posts from other partners. PB noted that the Facebook page was necessary for the survey to have a presence online but it is increasingly hard to get grassroots engagement through Facebook because the algorithms favor those who pay for Facebook advertising.

The Twitter account, with 454 followers, seemed more successful. PB staff made over 1,484 tweets during the project, an average of three tweets per day since the first tweet on January 23, 2015. Influential followers included: multiple MDOT accounts, SEMCOG, Arab American News, Oakland County Road Commission, Detroit People Mover, Michigan Municipal League (MML), County Road Association, ZipCar Detroit, Michigan VanPool, COMTO Michigan, Engineering Society of Detroit, MSU Black Alumni, local governments (Port Huron, Mount Clemens, Lathrup Village, Harrison Township), Washtenaw Area Transportation Study, Transportation 4 Michigan, Ann Arbor Transit Authority, Michigan Public Transit Association, Safe Roads Yes, Dan Gilmartin (CEO of MML), Michigan Trails and Greenways Alliance, Michigan Fitness Foundation, and the Ann Arbor Get Downtown Program.

The public awareness campaign also included press releases by MDOT and SEMCOG to coincide with the mailing of invitation letters. MDOT also mailed letters to local governments so that public officials would be knowledgeable about the survey, and officials were asked to encourage their invited constituents to take part in the survey. MDOT also coordinated with key local government groups, the County Road Association, and the Michigan Municipal League/Michigan Townships

Association (MTA). Each of these groups shared MTC III information via their expansive contact list and networks and through online and social media.

The "News about the Survey" section of the public site provided links to any media coverage. The goal of these efforts was to provide a sense of legitimacy for prospective participants. The public site also provided a means for participants or prospective participants to send questions or feedback to the survey team. A member of the team responded to each comment, and in cases where the message included a complaint or observation about the transportation system in Michigan, these were forwarded to MDOT staff for review and response as appropriate.

The website also hosted two MDOT-created videos about the study. One video explained the importance of participating in the survey and how the results fit into the transportation planning process, while the other video explained step-by-step how the survey worked. These videos were also available on YouTube. Based on the large number of households that were invited to participate in the survey and visited the website, the videos had relatively few views, with less than 1,500 each. The public awareness plan can be found in Appendix B.

3.3 Recruitment

Each sampled address was sent up to three pieces of mail requesting its participation in the study. The first contact was a letter on letterhead using the logos for MI Travel Counts and MDOT. The letter provided a brief description of the study, an overview of the requirements for participation, information about the incentive, the URL for the public website, the toll-free study phone number, and a personal identification number (PIN) providing access to the survey. If needed, the second and third contacts were reminder postcards. These contained a bit less information but still provided the URL and PIN that allowed access to the survey website. The first reminder postcard was sent 7 days after the initial invitation letter and was mailed to all sampled addresses. The second reminder postcard was sent 7 days after the first and was sent only to non-responding addresses.

Sampled households were directed to the secure project website, where they completed the recruitment survey. This component of the survey process was where respondents indicated their willingness to participate and provided key demographic and contact data for the household. Although the primary mode of participation at this stage was via web, a telephone recruitment option was provided for those participants who requested to complete their enrollment by phone.

As part of the sample selection, Westat attempted to match each sampled address to a telephone number. This process typically resulted in approximately 40 to 50 percent of the sampled addresses having an associated telephone number. These telephone numbers were used to augment the contact information collected from each household in the recruitment survey (telephone number and email address), and to attempt to recruit households by telephone.

Each responding household was assigned a travel date at the end of the recruitment survey. Before the assignment of the travel date, survey participants were offered a choice of whether they wanted to have personalized travel logs (diaries) mailed to them or to print the logs themselves from the website. Households that chose to have the travel logs mailed were assigned a travel date at least 10 days in the future so the logs could be prepared and mailed to arrive a few days before the travel date. Those who opted to print their own materials were assigned the next available travel date.

The travel log packets for the log-only households were sent using first class postage in 6 x 9 envelopes and included a cover letter, individualized travel logs for all household members, and a $1 bill (as a "primer" incentive to further encourage completion of the travel day survey). The letter also reminded participants about the final $20 household incentive.

Appendix C contains recruitment survey instrument for the web, and Appendix D contains the recruitment survey instrument for CATI. The Data Memo (which includes Westat's recommendations for data elements to be included in the MTC III) is located in Appendix E. The respondent materials include the advance letter, 7-day postcard, 14-day postcard, travel log, travel log letter, example travel log, and long distance travel log. Recruitment respondent materials are in English, Spanish, and Arabic. These materials can be found in Appendices F through Z.

3.4 Interviewer Staff and Training

Westat used two types of interviewing staff to conduct the MTC III household travel survey. Westat's Rockville, Maryland-based Telephone Research Center (TRC) was responsible for retrieval contacts only. Another set of interviewers were located at an inbound call center operation. Inbound call staff received additional training targeted at assisting respondents with miscellaneous issues (e.g., troubleshooting internet browser problems, tracking GPS shipping) and were responsible for responding to calls to the toll-free number and emails received through the public website. All call staff were trained to conduct the surveys, including contact procedures and refusal avoidance. The

interviewer training manual is located in Appendix AA and a template of email responses to frequently asked questions can be found in Appendix BB.

3.5 Project Website and Software

Westat created a project-specific, public-facing website that was used for promoting the survey and communicating with the general population, and that served as an access point to the survey instruments. This website included highlights of the project, frequently asked questions, PDF versions of survey materials (e.g., travel logs and GPS instructions), links to "in the news" items and to the MDOT home page, and the toll-free project phone number and an email link to contact the study team. Westat coordinated with the MDOT Office of Communications to ensure that the public awareness campaign and the project website were linked and in sync with each other.

The website was the access point for the self-administered web-based data collection instrument. The recruitment and retrieval surveys were supported through an integrated WebGeoSurvey (WGS)/TripBuilder Web™ (TBW) software system, a web-based survey system designed by Westat specifically for household travel surveys. TBW is a Web 2.0 application with an integrated online map (provided via the Google Maps API) that enables real-time geocoding and point-of-interest lookups to collect accurate travel details via a web browser.

TBW was used for computer-assisted self-interviews (CASI) and computer-assisted telephone interviews (CATI). Using this one system for the collection of all travel survey data ensured that all collected data went through the same underlying questions and corresponding response options, the same branching, and the same logic checks. The data were all stored in one database, with the reporting mode—web or telephone—captured as an additional data element.

Screenshots of the project website can be found in Appendix CC. The participant tutorials for the diary retrieval and GPS retrieval can also be found in Appendixes DD and EE, respectively.

3.6 Pre- and Post-travel Day Follow-up and Retrieval

Westat developed a sophisticated reminder protocol that was implemented in the MTC III household travel survey. In the recruitment survey, each participating household was informed that they would be provided with reminders and asked how they would prefer to receive those

reminders. The reminder options were telephone, text, and email. If by telephone, the first reminder occurred the day before the travel date. If by email or text, the reminder was sent two days before the travel day. If an electronic reminder failed for any reason, this approach provided time for the participating household to be contacted by other means (if they were available). Post-travel day email and text reminders were programmed to be delivered at one, five, and ten days after the travel day.

In the recruitment survey, respondents were asked to indicate how they would prefer to complete the retrieval survey. Those preferring telephone participation were contacted by an interviewer the first day following the assigned travel date. Those choosing to respond online were given two days to do so before being contacted by telephone. Westat asked all respondents to provide a telephone number in the recruitment survey, even if a telephone match was obtained at the time the address was sampled. Westat made at least five retrieval calls per each household that had yet to complete their retrieval survey.

A completed household was defined as one in which a household-level recruitment survey was completed and a retrieval survey was completed that included the trip data for each household member. In households with more than four total household members, the household was considered complete if no more than one household member failed to complete the retrieval survey.[1] In the specific case of the GPS sub-sample, a completed household was one in which all household members who had been equipped with a GPS device used it at least on the assigned travel date. In larger households (those with more than four total household members), the household was considered complete if no more than one household member failed to comply with all of the completion requirements

The script for the retrieval instrument (both Web and CATI) can be found in Appendix FF and GG respectively. The data elements can be located in Appendix HH and the codebook can also be found in Appendix II while the text and email reminder scripts are located in Appendix JJ.

3.7 Log-only Household Incentives

Incentives have become an essential component of survey research, and determining a responsible level of incentive was vital to the success of the project. Based on Westat's experiences conducting

[1] For example, the survey is considered as complete if four people in a five-person household provide the trip data.

these surveys and observations from other types of survey experiments, a two-stage incentive approach was used for the travel log component of MTC III.

The invitation letter described the survey process and the incentive offer of a $20 check per household upon completion of the retrieval interview. This incentive was consistent with rates used successfully in the past. To further facilitate a higher retrieval response rate, a $1 bill was included in the travel log package. This "primer" incentive was used to encourage households to keep track of and report their travel. More information on the log-only methodology can be found in the Diary Survey Methodology Memo in Appendix KK.

3.8 GPS-based Prompted Recall and Incentives

During the recruitment survey, 40 percent of the entire sample was flagged as GPS eligible, and those respondents were asked if they would be willing to participate in a GPS technology component of the study. Depending on the assigned travel day, the number of GPS households was capped to achieve an overall 10 percent GPS subsample.

For selected households that agreed to participate in this component of the study, GPS devices were sent to all household members between the ages of 16 and 75. The GPS participants were asked to carry these wearable devices for three consecutive days and then to report their travel details for the first of the three days in a GPS-based Prompted Recall (GPS+PR) survey. The travel date assignment was consistent with the non-GPS households, with the first of the three GPS travel days starting Monday through Thursday, and continuing for two additional consecutive days.

GPS households were offered an incentive check for $25 per GPS-instrumented person upon completion of the GPS+PR interview and travel reporting for non-GPS eligible household members. This amount was consistent with amounts offered in Westat's other wearable GPS studies. This approach provided an incentive that was commensurate with the level of burden required to participate in the study, and that was enough to motivate households to return the GPS devices. GPS households received only the GPS person-based incentive and not the household-level completion incentive offered to non-GPS households. More information on the GPS methodology can be found in the GPS Survey Methodology Memo in Appendix LL.

3.9 The Retrieval Survey Process for GPS Households

Once participants returned the GPS devices to Westat, the GPS data were downloaded from the devices, and the data files were uploaded to a secure project website and processed into place sequences, the chronologically enumerated list of destinations identified from the GPS logger data on the travel date. After the data had been processed, the household was notified by text, email, and/or phone that their retrieval survey was ready to be completed. Respondents were encouraged to complete the survey online, but they could also complete the survey by speaking with an interviewer.

Instead of reporting all the places visited on the travel day, as was done by non-GPS households, GPS-eligible respondents were presented with a survey interface that showed the travel traces from their GPS device and were asked to confirm the list of places visited and to provide details about each place. They were also asked to use their completed travel log as a reference. Travel details for non-GPS-eligible household members were entered based on their travel log information.

Westat processed the GPS data for days two and three, identifying trip ends and trip attributes, and imputing travel modes and trip purposes. Westat used discrete choice modeling techniques for identifying trip purpose on days two and three. This method included developing and estimating a multinomial logit (MNL) model for selecting trip purposes using the day one data and then applying it to the other two days. Because this model was estimated using day one data (which is a weekday), trip purpose was imputed only for GPS-based travel occurring on Tuesday through Thursday.

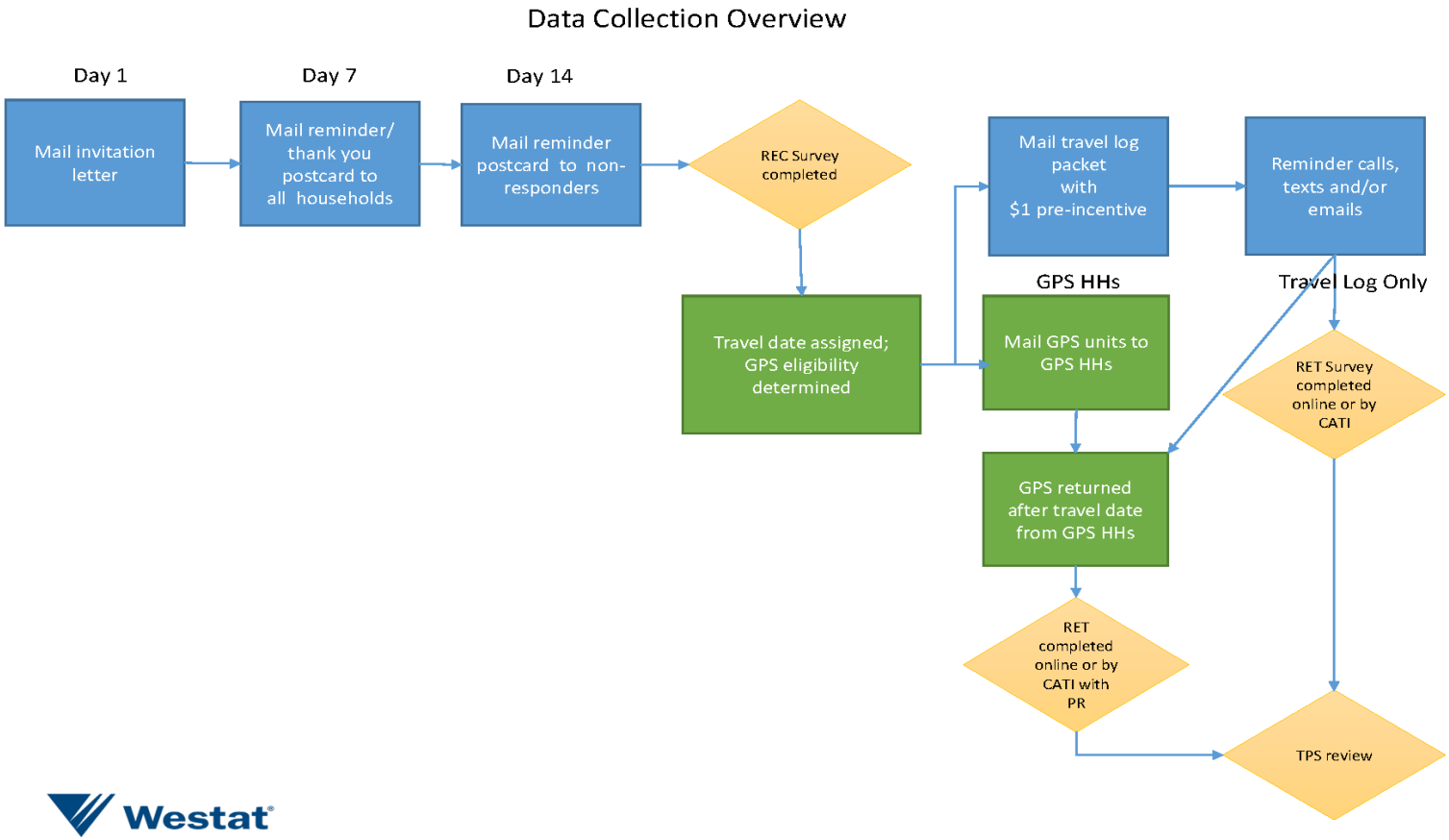
The purpose of the GPS+PR sample was two-fold: (1) to calculate GPS correction factors for use with the data from the non-GPS sample, and (2) to generate calibration and validation datasets to improve the accuracy of the imputation algorithms and models used in generating trip details (such as trip purpose and travel mode) for the additional GPS days collected by the GPS+PR households. The GPS+PR design had the advantage of combining increased report accuracy and lower respondent burden compared to log-based self-report data collection methods, and it provided the ability to capture travel activities across multiple days. GPS respondent materials included GPS household letter, equipment usage log, device usage and return instructions, and the equipment retrieval letter. These materials were available in English, Spanish, and Arabic. These materials can be found in Appendices MM through VV.

The Trip Mode and Purpose Imputation Procedure Memo can be found in Appendix WW.

3.10 Survey Flow Chart

The data collection overview can be found in Figure 3-2. The blue squares represent communication from Westat. The diamonds represent survey data. The green boxes are GPS related.

Figure 3-2. Survey flow chart



4 Data Collection

4.1 Schedule

The study was conducted in two phases. After a short pilot, there was a spring data collection, followed after a break in the summer by a fall data collection. The exact dates can be found below in Table 4-1.

Table 4-1. Data collection schedule

Pilot	
First invitation letter	01/26/2015
First travel date	02/09/2015
Last travel date	03/04/2015
Retrieval closed	03/15/2015
Spring 2015	
First invitation letter	04/06/2015
First travel date	04/20/2015
Last travel date	06/04/2015
Retrieval closed	06/18/2015
Fall 2015	
First invitation letter	08/29/2015
First travel date	09/08/2015
Last travel date	11/24/2015
Retrieval closed	12/08/2015

4.2 Pilot Study

Work began on the design and development of the materials, instruments, software, websites, and public outreach efforts in October 2014, with the goal of delivering a simulation of the survey experience for a staff pretest in January 2015. Feedback from the staff pretest was then incorporated before a pilot survey was conducted in February 2015, in which 11,290 households were randomly selected from the general public and invited to participate. The focus of the pilot survey was to test the methods and systems developed in collaboration among staff from Westat, MDOT, and SEMCOG.

Specifically, these exercises were intended to identify weaknesses or shortcomings of the data collection tools, to seek out opportunities for enhancement of all processes, and to reveal any unanticipated procedural or data quality shortcomings. Therefore, the sample selection process did not use a proportionally representative approach but rather an even allocation of sampled households throughout the state. Households with targeted sociodemographic characteristics were also not included in the sampling for the pilot. Participation rates for the pilot were useful for assessing assumptions about recruitment and retrieval rates, and for adjusting the number of invited households for the spring data collection phase, but were not intended to evaluate the performance of the sample in specific two-way aggregate cells (e.g., household size by income), or for comparison against American Community Survey (ACS) benchmarks.

Target and actual response rates of the overall pilot are summarized in Table 4-2, which shows that the actual rates for each category were better than anticipated. This resulted in a higher than expected number of completed pilot surveys, which in turn led to changes in the mailing strategy for the first phase of the main survey data collection.

Table 4-2. Sample performance rates for pilot; targeted versus actual

Rates	Targeted	Actual
Recruitment rate[1]	5.0%	7.5%
Participation rate[2]	62.0%	66.4%
Completion rate[3]	3.1%	5.0%
Completed surveys	350	560

[1] The percentage of households that joined the survey (based on the number of invitations mailed).

[2] The percentage of recruited households that reported travel.

[3] The product of the recruitment rate and the completion rate.

Improvements identified for the main data collection and survey processes such as re-wording questions, re-ordering the sequence for the long distance questions, and making changes to question skip logic within the instruments are detailed in the Pilot Report, which can be found in Appendix XX. The report contains a description of the changes, the survey element that was changed, and a note of explanation of each change.

4.3 Spring Data Collection

Following a successful pilot test, Westat fielded the MTC III spring data collection. The first travel date of the spring data collection was April 20, 2015. The invitation letters were mailed by U.S. mail

in four batches. The first letters were mailed on April 6, 2015, followed seven days later by a reminder/thank you postcard to all addresses. A second reminder postcard was sent 14 days after the initial invitation letter and seven days after the first reminder postcard. This second postcard was sent to only those addresses that had not yet responded to the survey. The second batch of letters was sent on April 14, 2015. The third batch of letters was sent on April 21, 2015. The fourth batch of letters was sent on April 28, 2015, for a total of 127,660. Of those invited, 12,407 households completed the recruitment survey and were assigned a travel day, and 7,856 of the 12,407 recruited households completed the retrieval survey.

The overall goal for the survey was to obtain a 10 percent subsample of complete GPS+PR households. There were no set targets at the sampling area level. A total of 1,091 households were recruited for the GPS sample. Although the actual total recruit volume of non-GPS households exceeded the target for the spring, the GPS recruitment remained consistent throughout the data collection by setting the GPS household daily limit at 46.

During the data quality control process, the 953 GPS households that completed retrieval were reviewed. Of these, 20 percent were disqualified from delivery for various reasons, including cases where a participant changed the data in a fashion that violated basic speed checks by moving a GPS-based location away from the GPS-derived geocode, or cases where a participant ignored the times associated with a GPS-derived location and entered new arrival or departure times that violated basic speed checks. This resulted in a delivered rate of 58 percent, which is 2 percentage points lower than the anticipated rate of 60 percent. The shortfall from the spring was recovered in the fall. The Spring Data Collection Memo describes the results of the spring survey and the changes made for the fall based on these results. This memo can be found in Appendix YY.

4.4 Fall Data Collection

Westat used the spring response rates to predict the number of retrieval completes for the fall data collection. Westat increased the number of mailed letters in selected model areas and increased the oversampling of the high-density stratum in selected areas where it appeared to further decrease shortfalls. The size of the fall invitation letter mailing was 116,601 letters. This was implemented to reduce shortfalls for low-income households, three-person households, and households with four or more persons. Of those invited, 11,931 households completed the recruitment survey and were assigned a travel day, and 8,420 of the 11,931 recruited households completed the retrieval survey.

Strategies for improving GPS data quality from participants were added for the fall data collection. These included prompts that warned participants when they were about to change the GPS data in a way that rendered the results illogical and unusable.

Data Quality 5

5.1 Quality Control Plan

Westat utilized the data coding and quality control manuals from the previous MI Travel Counts surveys and updated them to reflect changes in household travel survey methods and technologies that have occurred in recent years.

Quality control, by definition, includes a well-designed sampling plan, survey instruments, respondent materials, and a carefully executed data collection operation. The designs for the MTC III sampling plan, survey instruments, and respondent materials were addressed in earlier chapters. The elements of the project management plan that were considered critical to quality assurance included the following:

- Effective involvement of MDOT staff to ensure survey outcomes meet the agency needs
- Monitoring the areas of design where biases and errors can occur
- A dedicated team of supervisors, trainers, and interviewers
- Establishing and maintaining a detailed project work schedule
- Developing and maintaining detailed data collection protocols
- Effective selection, training, and debriefing of interviewers, explaining the effort and their responsibilities
- Periodic monitoring of interviews and calls in the helpdesk accompanied by continuous supervisor monitoring and feedback in the form of supplemental training
- Electronic tracking and monitoring of interviewers' performance – dialing statistics, completed interviews, refusals, non-contacts, and average interviewer lengths
- Implementing an appropriate public information effort
- Establishing measures to protect respondents' data privacy and to ensure confidentiality of survey data

- Secure processing, storage, and eventual disposal of survey data, equipment, and materials

Quality control requires that each household sample element be individually tracked through its lifecycle in the survey from sample release to completion or to final disposition. For this purpose, Westat applied its Survey Management System (SMS), which is specifically developed to handle multi-mode household travel surveys. This web-based sample management system provided the up-to-date status of each household sample element through all steps of the survey. The system's built-in call scheduler and disposition monitoring generated continuous information to ensure that each household received appropriate attention so that quick remedial action could be taken as needed. Furthermore, the SMS system was tightly integrated with the survey's secure public website, its online and CATI instruments, the automated reminder program that sent emails and text messages to households to help them along the data collection process, and the continuous automated checking system. This integration made it possible for Westat to develop reports that were continuously updated and always reflected the current state of the survey as a whole.

Westat's household travel survey data collection process included several layers of automated data checks. The first set of checks was included in the online instruments and was followed by automated checks performed nightly on all households that completed the retrieval interview. The final round of checks happened once data delivery files were extracted from the project's database.

5.2 Data Checks

Data processing and data cleaning were conducted on an ongoing basis throughout the study. Updates were made to variables that affected data collection during the administration of survey (e.g., the removal of a household member that was originally reported in the recruit interview, but no longer lives at the household location) and at the conclusion of data collection for data that did not affect the flow of the survey (e.g., recoding trip purposes 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 and online programs as needed. Automated checks were run to evaluate the validity of reported trip data and household location data.

Frequency reviews were conducted for each data delivery throughout the study to ensure that all data were being properly captured in the survey database. Additional reviews were performed following any changes to the survey instrument after the start of the survey.

5.2.1 Logic Checks Built into Online Instruments

Logic checks were programmed into the recruit and retrieval instruments to ensure that questions were answered as accurately as possible. These included requiring that key questions be answered, even if the answer is "don't know" or "prefer not to answer," and forcing the data type (e.g., requiring a number for numeric questions, U.S.-formatted telephone numbers for phone questions, etc.).

Data range checks were conducted to guarantee that the data fell within the expected range for a given question (e.g., 0–110 for AGE). Skip logic was programmed into the instruments such that questions that did not apply were not asked (e.g., participants were asked if they have a driver's license only if they were at least 16 years old). Specific information on these built-in checks and skip logic features can be found in the instrument design documents. In addition, the following checks were built into the online instruments:

- If a household member reports being employed, the number of jobs reported must be at least one
- The household respondent (person 1) cannot report that they are under 18 years of age and complete recruitment
  - Must confirm they are at least 18 years of age at the beginning of recruitment
  - Cannot enter an age or age category under 18 years of age
- If an age is reported as zero, a follow-up question confirms that the person is an infant
- Households are required to provide details on as many members as they report in their household size; after they are done rostering the household, they are asked if there are any other household members that they need to report
- The household must confirm their home address (or P.O. Box) matches the sampled address
- Number of household members on a trip is not asked of one-person households

- Households that report zero vehicles are not asked if a household vehicle was used on a trip

Westat's online travel data retrieval tool, TBW, integrated several data consistency checks within its user interface (UI). This ensured that collected places passed basic data completeness and consistency requirements. One of these checks included the requirement that all visited places be associated with a geocoded location. That way, all records deemed complete at the end of the retrieval instrument would have all destinations geocoded. Other checks built into the TBW UI include:

- All places must have valid arrival and departure times (i.e., times must increment)
- All places after the first one must have a travel mode associated with them
- First place of the day must have an arrival time equal to 3:00 am
- Last place of the day must have a departure time equal to 2:59 am
- If the trip to a place took longer than expected (based on captured distance and minimum mode speed), a follow-up question asked for a reason
- If a participant reported a single place on their travel date, a follow-up question asked for the reason why no travel was reported

In addition, the following checks were performed on the captured long distance trips:

- The start date must be before and within three months of the current date (i.e., when the survey is collected)
- Must have an end date that is the same or is after its start date
- A geocode for the destination is captured
- The three-month and twelve-month frequency questions trigger confirmation questions if reported at values higher than 30 and 100, respectively

5.2.2 Automated Edit Checks

Travel data were processed through Westat's trip processing system (TPS). TPS included a series of consistency checks on reported travel data. When a TPS edit check 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 were 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 that successfully passed these edits were considered as complete in the final dataset.

5.2.3 Upcoding and Cleaning

At the conclusion of the data collection period, open-ended and "other, specify" responses were reviewed and upcoded or collapsed as appropriate. The upcoding of responses was the activity of recoding an open-ended response into a categorical response option (e.g., recoding "slept" to "typical home activities"). The process included removing the "other, specify" (open-ended) text response.

Westat also combined or collapsed other responses that were similar to each other. These responses appeared in the original dataset as independent responses ("one-offs") due to a misspelling or different letter spacing in the response or capitalization issues. Combining these text responses allowed for more efficient analysis.

5.3 Item Non-response

The Westat data quality team evaluated the levels of item non-response for key variables (e.g., age, income, employment status, trip purpose, etc.) at the household and person level to ensure data completeness. Relevant variables were compiled and calculated for review by the project management team. These variables included the total number of items asked, the number of items answered and refused, the resultant item non-response rate, and an enumerated list of refused items by household and household member. Using these data, the project management team defined thresholds to be applied to the dataset that were used to disqualify households from delivery as complete households.

5.4 Geocoding Methods and Quality Checks

Home locations were initially geocoded as part of the address-based sample and were updated during the online interview, with the exception of P.O. Box sample addresses.[2] These locations, along with their geocoded coordinates, were then transferred to the retrieval instrument once the household completed the recruit interview.

The online instruments collected place data for frequently visited locations, referred to as habitual locations, in the recruitment survey, and there were integrated advanced online ("on-the-fly") geocoding and points of interest (POI) resources in the WGS platform and the TBW travel data retrieval tool. These resources made it possible to geocode person-level habitual locations (e.g., work and school) as part of the recruit interview. The recruit instrument required that a geocode was collected for all habitual locations. The long-distance component of the retrieval instrument also required that a geocode of the destination be provided; wording on the question indicated to participants that only a city-level location was expected to be provided.

The web-based UI used in TBW to retrieve travel data allowed participants to select a habitual location from a list or to enter address information using free-form text. The input fields were capable of processing place name (e.g., Starbucks), street address, or intersection information to assist the respondent in providing the address of the trip destination.

Only after an initial search was done were the inputs sent to the Google Maps geocoding and Google Places Search application-programming interfaces (APIs). The address data were used to search for geocode matches, while the place name was used to search for POI locations around the provided address or map center if no address is provided. A list of potential matches was then displayed to the participant in a list box and added to the electronic map using "pushpins."

Once a result was selected, the geocoded coordinates were saved using longitude and latitude values in decimal degrees (WGS84 datum) along with the address components, the place name (in the case of POI results, the place name returned by the search was saved), and a geocode type. In addition to these search capabilities, the geocoding UI allowed participants to click on the map to set the geocode coordinates, or to drag and drop a previously geocoded result; in these cases a reverse-

[2] If a P.O. Box was sampled, the physical home address was captured in the recruitment survey.

geocode lookup using the updated coordinates was performed using the Google Maps API. This ensured that address information was derived for the manually adjusted coordinates.

When returning coordinates for address information, Google APIs automatically offset coordinates from the street centerline; in regions where Google had access to parcel data, it geocoded coordinates placed on the center of the parcel. Westat automated a process that flagged geocodes that fell closer than 25 feet from the MI Geographic Framework road network for adjustment. Westat consulted with MDOT to ensure that the latest version of the road network was incorporated into this process.

Westat performed speed checks on the collected geocodes and travel data as part of the automated review process completed through TPS. These checks detected geocoded locations that were not consistent with the reported times and travel modes. The distance used to perform these checks was derived from shortest path routes that were computed by Google Maps and integrated into the TBW UI, and the selected travel mode was used to tell Google Maps whether to compute an auto, bike, or walk route (transit modes were treated as auto for the purpose of route generation). This capability removed the need to conduct further processing on a GIS tool such as TransCAD to derive network distances.

Within TPS, each travel mode had a maximum speed that was compared against the average trip to place speed, computed using the shortest network path distance and the travel time derived from the provided arrival and departure times (Table 5-1). Places that had computed average speeds above the maximum travel mode value, or below 5 mph for motorized modes or 1 mph for non-motorized modes, were flagged for analyst review.

When a check failed, analysts reviewed the geocoded results and place name and address information and used it to identify a possible alternate match using Internet search resources such as Google, Bing, and Yahoo! In cases where additional information was needed to address a data inconsistency, the household record was sent to "research." In the research status, cases were re-contacted by a specially trained member of the interviewing team to address the inconsistencies and seek a resolution from the household member. During the research call, interviewers had the ability to perform those same speed checks to verify the quality of the recollected geocode or adjusted time and travel mode information.

Table 5-1. Travel modes and maximum speed values

Mode ID	Name	Max Speed (mph)
1	Walk	13
2	Bicycle	20
3	Motorcycle/moped	95
4	Auto/ van/truck (as the driver)	95
5	Auto/van/truck (as the passenger)	95
6	Carpool/vanpool	95
7	School bus	50
8	Public transit/local bus	50
9	Dial-a-ride/paratransit	50
10	Private bus or shuttle	50
11	Taxi/limo	95
12	Train/Amtrak	95
13	Detroit People Mover	50
14	Airplane	600
15	Boat/ferry	50

Finally, all collected geocodes were checked for completeness of address attributes (i.e., address or intersection, city, state, and zip code). Whenever necessary, reverse geocoding using Google Maps and Bing was used to fill in missing address components.

5.5 GPS Processing and Checks

The GPS data collected by the participants were imported into TBW, and the UTC (Universal Time Coordinate) date and time stamps in the GPS point data were translated to local date and time. The wearable GPS data loggers were programmed with speed filter settings that screened out all points with zero values for speed, and points with speeds greater than zero were recorded using a three-second interval. The initial process of creating a sequence of places based on the input stream of GPS points is summarized in the following steps:

- Filter out GPS data based on the assigned travel date range.
- Create first place of the day so that the display can be place-based; the arrival time of this place is pre-set to 3:00 am and its departure time is set to the start time of the first identified GPS trip; the coordinates for this place are also set based on the first identified trip's origin.
- Split GPS points into trips leading to places using a 120-second dwell time criteria.
- Look for mode transitions within each detected trip (non-motorized to motorized and vice-versa) and further split trips based on these detected mode transitions.

- Determine if each identified trip can be attributed to real movement or GPS noise using heuristics-based criteria.
- Check resulting trips to places against minimum travel time and distance constraints (distance covered ≥ 100 meters and travel time ≥ 1 minute); if a trip fails to meet these constraints, its points are aggregated onto the next place.
- Compare each place's destination point against the household's geocoded habitual locations and associate trip ends with location if the distance between them is less than 75 meters.

Once initial GPS processing in TBW was completed, the resulting place sequences were visually reviewed by analysts to screen out traffic delays and other falsely identified stops with dwell times of 120 seconds or more, and to add stops with short dwell times not identified in the initial processing but clear stop characteristics—for example, a brief stop (under 120 seconds) at a post office/mailbox or a fast food drive-thru. These data were pushed to the TBW and the participating household was contacted to complete the prompted recall survey online (or by telephone).

Following the prompted recall survey completion, the GPS-derived places for all other days were processed and reviewed according to the following criteria:

- Review places with durations greater than 60 minutes or shorter than 2 minutes.
- Review places with distances greater than 60 miles or shorter than 0.25 miles.
- Ensure that travel mode is present for each place greater than place 1.
- Trip passes all speed checks.
- Maximum point speed is not greater than 85 mph.
- Average speed is not greater than maximum point speed.
- Review places with a gap distance greater than 0.5 miles (gap distance is the distance between the previous destination and the first GPS point on the trip to the current destination).
- Review GPS places that are outside the travel date range.
- Review last GPS place of each day if it does not end at participant's home.

More information can be found in the Data Quality Control and Geocoding Procedures Memo in Appendix ZZ.

5.6 Weekly Reports

During the two data collection periods, Westat produced weekly reports used in managing the ongoing survey operations. See Appendix AAA for the final weekly report. The final weekly report shows the actual and target number of completed households by sample area and household size and income. The weekly reports indicated adherence to, or departures from, the sampling plan in the areas of: number of completed cases by sample area, substrata, and post-strata (subpopulations to which completed cases are assigned following data collection); recruitment rates by sample area and substrata; retrieval rates by sample area, substrata, and post-strata; and achievement rates for the sample areas and post-strata, where an achievement rate is the ratio of the number of completed cases in a cell to the associated data-collection goal for the cell.

5.7 Data Deliveries

Westat delivered a series of unweighted interim datasets after the pilot, spring, and fall data collections and a final weighted dataset after the fall data collection ended. The delivered files included household-level, person-level, location, place, and long-distance files and updated codebooks, data elements spreadsheet, and GPS data. The interim deliveries were reviewed by MDOT to identify any problems. Problems identified during reviews were addressed in subsequent deliveries. Each delivery included the cumulative data retrieved and checked to that point. Data delivery observations in a table of changes can be found in Appendix BBB. A schedule of the data deliveries is listed in Table 5-2.

Table 5-2. Data deliveries

Data deliveries	
Spring Interim (unweighted)	07/24/2015
Spring Final (unweighted)	09/18/2015
Fall Interim (unweighted)	11/20/2015
Fall Draft Final (unweighted)	01/25/2016
Final Data (unweighted)	03/04/2016
Final Data (weighted)	03/22/2016

Results 6

6.1 Sampling

The sample design for MTC III assumed a recruitment rate of 6 percent and a retrieval rate of 65 percent for an overall participation rate of 3.9 percent. These rates would require 361,539 invitations to recruit 21,692 households and retrieve 14,100 households. This section provides details of the actual response rates achieved in the data collection for each model area and for the sample overall. Westat's final sampling plan can be found in Appendix CCC.

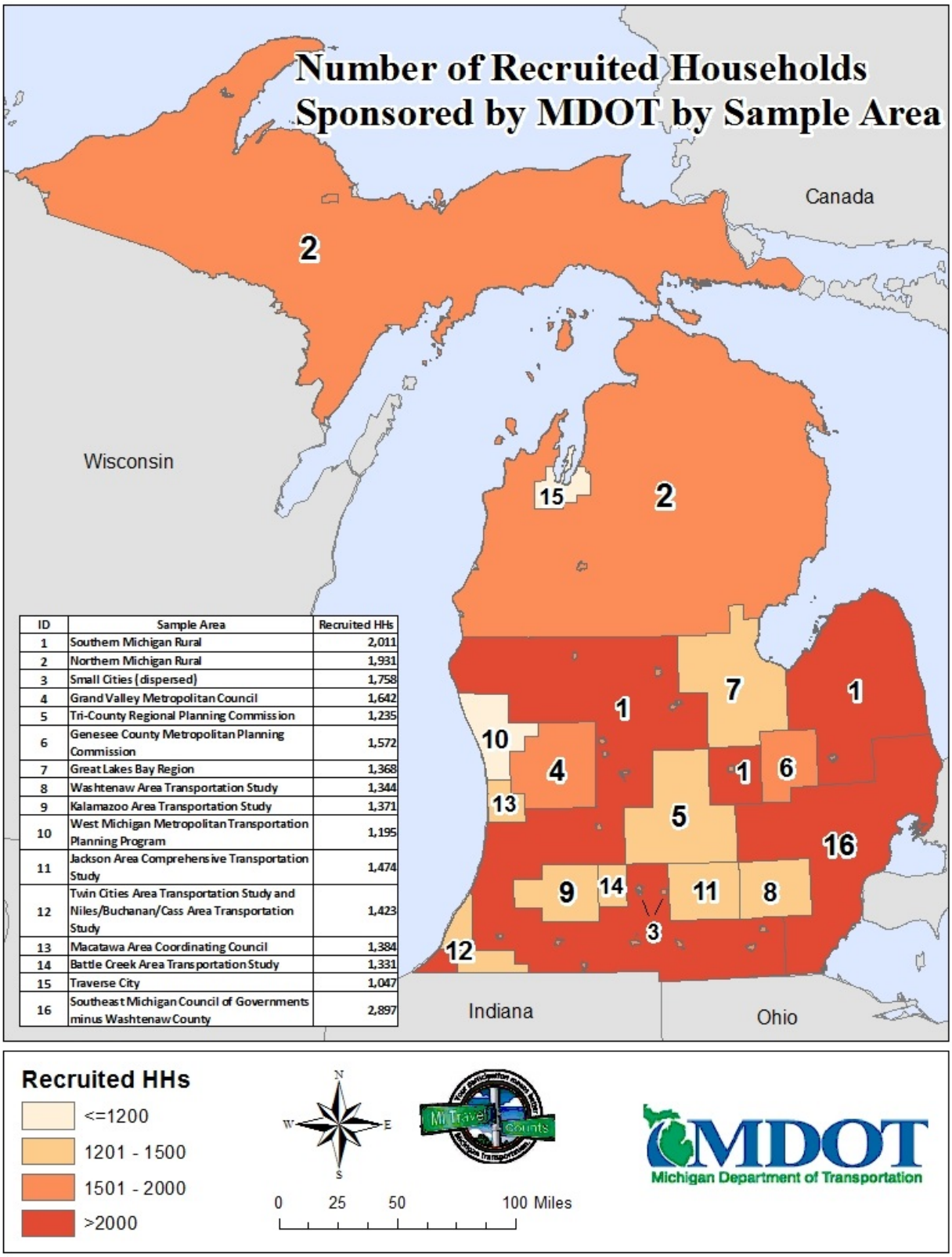
6.2 Recruit Goals Versus Actual by Sample Area

Table 6-1 shows the samples invited, actual recruits, and targets alongside the recruitment rates that were observed in data collection for each model area and for the overall sample. The recruitment rate ranges from 7.5 percent in the SEMCOG minus WATS model area to 12.8 percent in Traverse City. On average, during the spring and fall survey periods, the sample areas achieved a 10 percent recruitment rate. As a result, fewer invitations were mailed for the fall phase of data collection. In many of the sample areas, the percentage of actual to target numbers is lower than 100 percent because the retrieval rate in those areas for the spring data collection phase exceeded the expected rate of 65 percent, resulting in fewer required recruited households. Areas where the percentage of actual to target exceeds 100 percent were generally found to be underperforming in the spring collection within certain hard-to-reach cells, which led to an increase in oversampling for fall and an increase in the overall share of invited sample. Figure 6-1 is a map of the number of recruited households by sample area. Participants could respond to the recruitment survey either by calling the toll free survey line or going online. Eight point six percent of the participants called and completed the recruitment instrument by phone while 92.4 percent completed online.

Table 6-1. Recruitment rates by sample area

	Sample areas	Invitations mailed	Postal non-deliverable (PND)	Recruited households	Target	Recruit to target percent	Recruitment rate
Statewide	Southeast Michigan Council of Governments (SEMCOG) minus Washtenaw County (WATS)	38,125	860	2,876	2,750	105%	7.5%
Statewide	Southern Michigan Rural	20,284	598	1,984	2,000	99%	9.8%
Statewide	Northern Michigan Rural	17,133	962	1,882	2,000	94%	11.0%
Statewide	Small cities	16,221	647	1,705	1,667	102%	10.5%
Statewide model areas total		**91,763**	**2,847**	**8,447**	**8,417**	**100%**	**9.2%**
Urban model areas	Grand Valley Metropolitan Council (GVMC)	12,981	345	1,592	1,667	96%	12.3%
Urban model areas	Tri-County Regional Planning Commission (TCRPC)	10,251	443	1,172	1,333	88%	11.4%
Urban model areas	Genesee County Metropolitan Planning Commission (GCMPC)	17,561	406	1,535	1,333	115%	8.7%
Urban model areas	Great Lakes Bay Region (GLBR)	12,045	395	1,321	1,333	99%	11.0%
Urban model areas	Washtenaw Area Transportation Study (WATS)	12,590	334	1,310	1,333	98%	10.4%
Urban model areas	Kalamazoo Area Transportation Study (KATS)	12,139	465	1,337	1,333	100%	11.0%
Urban model areas	West Michigan Metropolitan Transportation Planning Program (WestPlan)	11,365	415	1,159	1,083	107%	10.2%
Urban model areas	Jackson Area Comprehensive Transportation Study (JACTS)	15,279	486	1,442	1,083	133%	9.4%
Urban model areas	Twin Cities Area Transportation Study (TwinCATS) and Niles/Buchanan/Cass Area Transportation Study (NATS)	14,188	439	1,396	1,333	105%	9.8%
Urban model areas	Macatawa Area Coordinating Council (MACC)	11,803	258	1,339	1,083	124%	11.3%
Urban model areas	Battle Creek Area Transportation Study (BCATS)	14,519	360	1,290	1,083	119%	8.9%
Urban model areas	Traverse City (TVC)	7,777	281	998	1,083	92%	12.8%
Urban model areas total		**152,498**	**4,627**	**15,891**	**15,083**	**105%**	**10.4%**
Grand total		**244,261**	**7,474**	**24,338**	**23,500**	**104%**	**10.0%**

Figure 6-1. Map of number of recruited households by sample area



ID	Sample Area	Recruited HHs
1	Southern Michigan Rural	2,011
2	Northern Michigan Rural	1,931
3	Small Cities (dispersed)	1,758
4	Grand Valley Metropolitan Council	1,642
5	Tri-County Regional Planning Commission	1,235
6	Genesee County Metropolitan Planning Commission	1,572
7	Great Lakes Bay Region	1,368
8	Washtenaw Area Transportation Study	1,344
9	Kalamazoo Area Transportation Study	1,371
10	West Michigan Metropolitan Transportation Planning Program	1,195
11	Jackson Area Comprehensive Transportation Study	1,474
12	Twin Cities Area Transportation Study and Niles/Buchanan/Cass Area Transportation Study	1,423
13	Macatawa Area Coordinating Council	1,384
14	Battle Creek Area Transportation Study	1,331
15	Traverse City	1,047
16	Southeast Michigan Council of Governments minus Washtenaw County	2,897

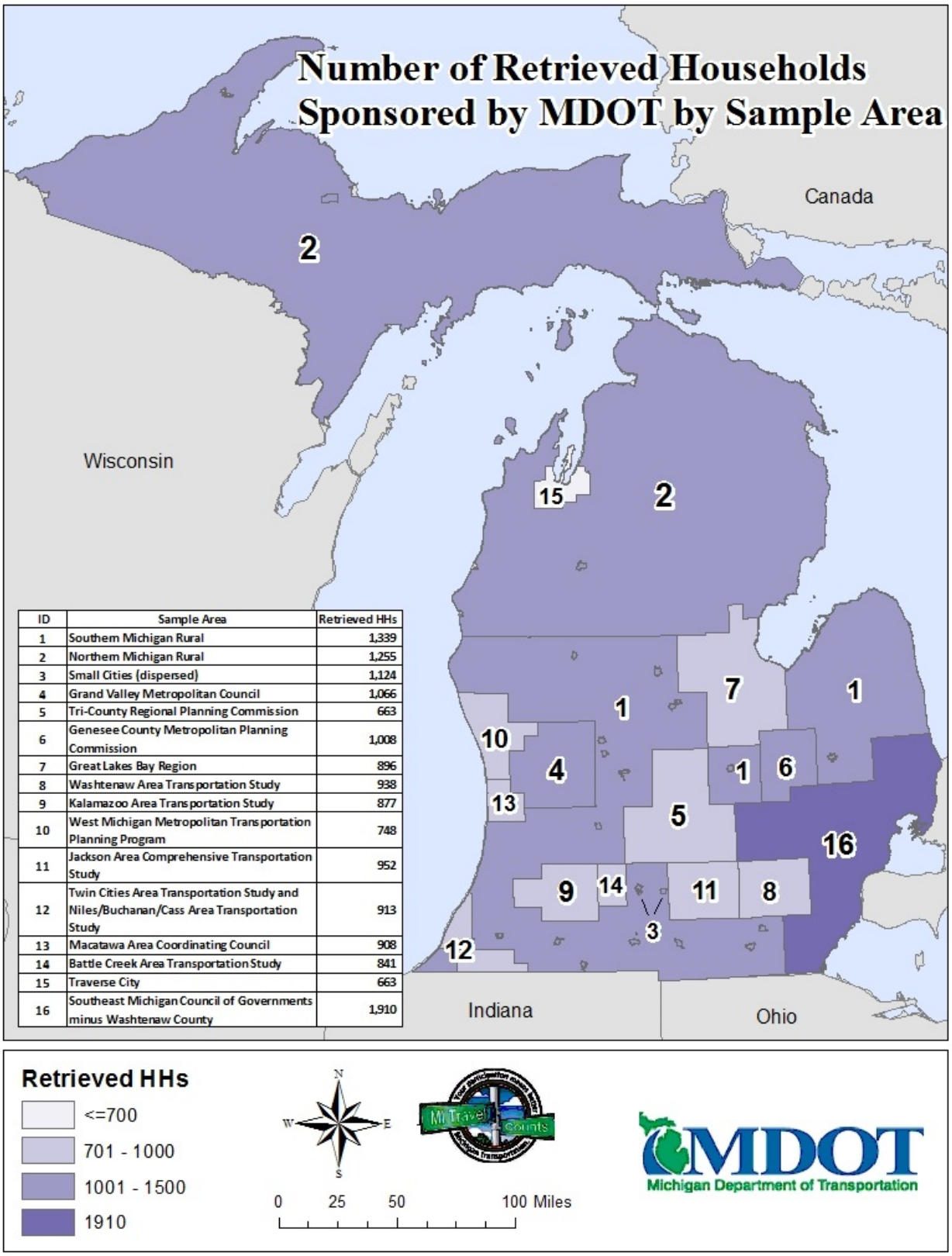
6.3 Retrieval Goals Versus Actual by Sample Area

Table 6-2 shows the retrieval results for the MDOT sample areas. The average retrieval rate of 67 percent was slightly better than the anticipated rate of 65 percent for every model area with the exception of the West Michigan Metropolitan Transportation Planning Program (WestPlan) area rate of 64.5 percent. The participation rate in the table below is the recruitment rate from table 6-1 multiplied by the retrieval rate. The average participation rate was slightly higher than the assumed 6 percent. Figure 6-2 is a map of the number of retrieved households by sample area. Respondents could also respond to the retrieval survey either by calling the toll free survey line or going online. Twenty nine point three percent of the respondents called and completed the retrieval instrument by phone while 70.7 percent completed it online. The 16,276 completed log and GPS households were paid incentives totaling $415,680.

Table 6-2. Retrieval and participation rates by sample area

	Sample Areas	Delivered retrievals	Target	Percent of target met	Retrieval rate	Participation rate
Statewide	Southeast Michigan Council of Governments (SEMCOG) minus Washtenaw County (WATS)	1,910	1,650	116%	66.4%	5.0%
Statewide	Southern Michigan Rural	1,339	1,200	112%	67.5%	6.6%
Statewide	Northern Michigan Rural	1,255	1,200	105%	66.7%	7.3%
Statewide	Small cities	1,124	1,000	112%	65.9%	6.9%
Statewide model areas total		**5,628**	**5,050**	**111%**	**66.6%**	**6.1%**
Urban model areas	Grand Valley Metropolitan Council (GVMC)	1,066	1,000	107%	67.0%	8.2%
Urban model areas	Tri-County Regional Planning Commission (TCRPC)	838	800	105%	71.5%	8.2%
Urban model areas	Genesee County Metropolitan Planning Commission (GCMPC)	1,008	800	126%	65.7%	5.7%
Urban model areas	Great Lakes Bay Region (GLBR)	896	800	112%	67.8%	7.4%
Urban model areas	Washtenaw Area Transportation Study (WATS)	938	800	117%	71.6%	7.5%
Urban model areas	Kalamazoo Area Transportation Study (KATS)	877	800	110%	65.6%	7.2%
Urban model areas	West Michigan Metropolitan Transportation Planning Program (WestPlan)	748	650	115%	64.5%	6.6%
Urban model areas	Jackson Area Comprehensive Transportation Study (JACTS)	952	650	146%	66.0%	6.2%
Urban model areas	Twin Cities Area Transportation Study (TwinCATS) and Niles/Buchanan/Cass Area Transportation Study (NATS)	913	800	114%	65.4%	6.4%
Urban model areas	Macatawa Area Coordinating Council (MACC)	908	650	140%	67.8%	7.7%
Urban model areas	Battle Creek Area Transportation Study (BCATS)	841	650	129%	65.2%	5.8%
Urban model areas	Traverse City (TVC)	663	650	102%	66.4%	8.5%
Urban model areas total		**10,648**	**9,050**	**118%**	**67.0%**	**7.0%**
Grand total		**16,276**	**14,100**	**115%**	**66.9%**	**6.7%**

Figure 6-2. Map of number of retrieved households by sample area



ID	Sample Area	Retrieved HHs
1	Southern Michigan Rural	1,339
2	Northern Michigan Rural	1,255
3	Small Cities (dispersed)	1,124
4	Grand Valley Metropolitan Council	1,066
5	Tri-County Regional Planning Commission	663
6	Genesee County Metropolitan Planning Commission	1,008
7	Great Lakes Bay Region	896
8	Washtenaw Area Transportation Study	938
9	Kalamazoo Area Transportation Study	877
10	West Michigan Metropolitan Transportation Planning Program	748
11	Jackson Area Comprehensive Transportation Study	952
12	Twin Cities Area Transportation Study and Niles/Buchanan/Cass Area Transportation Study	913
13	Macatawa Area Coordinating Council	908
14	Battle Creek Area Transportation Study	841
15	Traverse City	663
16	Southeast Michigan Council of Governments minus Washtenaw County	1,910

6.4 Overall Response Rate

The combined increase in the recruitment and retrieval rates led to a final delivery of 16,276 households or 115 percent of the goal for the project. This translated into an overall participation rate of 6.663 percent. Independently, the 2016 American Association for Public Opinion Research (AAPOR) standards for calculating the minimum response rates were used. In particular, Response Rate 3 (RR3) was selected as it "estimates what proportion of cases of unknown eligibility is actually eligible." Given the frame of the sample is the USPS distribution file, which is updated monthly, the assumption is that PND addresses are not considered to be known ineligible. Therefore, only a small fraction of cases with known ineligibility can be used to calculate the proportion of eligible households for e in the equation below:

$$RR3 = \frac{I}{(I+P)+(R+NC+O)+e(UH+UO)}$$

Where:

Variable	Description	Count
RR3	Response rate	–
I	Complete interview	16,276
P	Partial interview	10,875
R	Refusal and break-off	208
NC	Non-contact	0[1]
O	Other	2,067
UH	Unknown if household/occupied HU	7,599
UO	Unknown, other	207,219
–	Known ineligible	16
e	Proportion of known eligibility	99.946%

[1] It is presumed that all households sampled and released in the survey received a mailing unless the materials were returned as Postal Non-deliverable (PND).

Using these parameters, the MDOT survey final response rate is 6.667 percent. Note again that this is nearly the same as the calculated participation rate, due to the fact that the known ineligible share of contacted households is only .054 percent, meaning e is effectively 1.

The overall goal for the GPS portion of the survey was to obtain a 10 percent subsample of complete households. There were no set targets at the sampling area level. The number of recruited GPS+PR households was 2,130. Of those recruited, 1,368 completed the retrieval phase and after the data cleaning process, 1,325 households were delivered.

6.5 Data

This section presents a few key highlights from the MTC III data. More details can be found in the MTC III Travel Characteristics report.

Table 6-3 shows the summary of the number of households, number of people, and weekday trips by region from the MTC III survey. A trip is movement from one location to another, a person trip is when a person travels, and a vehicle trip is when a vehicle travels. For example, if someone walked to the store and then back home, that would be two person trips: one from home to the store and one from the store back home. Vehicle trips count the number of times a vehicle makes a movement from one location to another regardless of how many people are in the car: two people sharing a ride to work is counted as one vehicle trip. A vehicle trip is also sometimes called a vehicle-driver trip because the driver characteristics are used to describe it—a vehicle trip would only count as a commute trip if the driver was going to work.

The data show that, overall, residents of the state averaged about 4 trips per person on weekdays, and together people in households generated about 10 trips by all means of travel and for all purposes. About 60 percent of these weekday trips were vehicle trips, while the rest were people riding as passengers in vehicles or people traveling by transit, walking, or other means of travel.

Table 6-3 shows another important aspect of travel in the state: on average, household and person trip rates vary across geographic areas. For example, the Holland area has the highest trip rate per household (10.8), which is 20 percent higher than the Northern Michigan Rural area, with the lowest rate of 8.8 trips per household.

Table 6-4 shows the relationship between household size and number of trips. Households with more people—and especially more workers or households with children—generate more travel than smaller households. This table shows the data statewide.

Table 6-3. Number of households, people, and weekday trips by region (weighted)

Region	Households	Person counts	Trips per person (Wtd)	Vehicle Trips per person (Wtd)	Person trips per household (Wtd)	Vehicle trips per household (Wtd)
Metro Detroit Area	1,707,565	4,359,950	3.8	2.4	9.6	6.1
Southern Michigan Rural	386,208	1,018,702	3.6	2.4	9.4	6.2
Northern Michigan Rural	306,995	735,146	3.7	2.4	8.8	5.9
Small Cities	130,357	329,776	4.0	2.5	10.2	6.4
Grand Rapids Area	263,361	708,941	3.8	2.5	10.1	6.6
Greater Lansing Area	183,589	464,037	3.8	2.4	9.6	6.1
Flint Area	169,202	425,793	3.7	2.4	9.4	6.0
Midland–Bay City–Saginaw	157,051	391,570	3.9	2.6	9.7	6.6
Ann Arbor Area	137,193	344,793	4.0	2.3	10.0	5.9
Kalamazoo Area	110,760	277,101	3.7	2.5	9.4	6.3
Muskegon Area	86,600	225,015	3.7	2.5	9.6	6.4
Jackson Area	60,771	160,249	3.7	2.5	9.7	6.5
Benton Harbor–St. Joseph–Niles	57,322	144,073	3.9	2.5	9.9	6.4
Holland Area	43,752	122,842	3.9	2.6	10.8	7.2
Battle Creek Area	37,849	93,998	3.8	2.4	9.4	6.0
Traverse City Area	33,933	81,664	3.8	2.5	9.2	6.1
Total	3,872,508	9,883,650	3.8	2.4	9.6	6.2

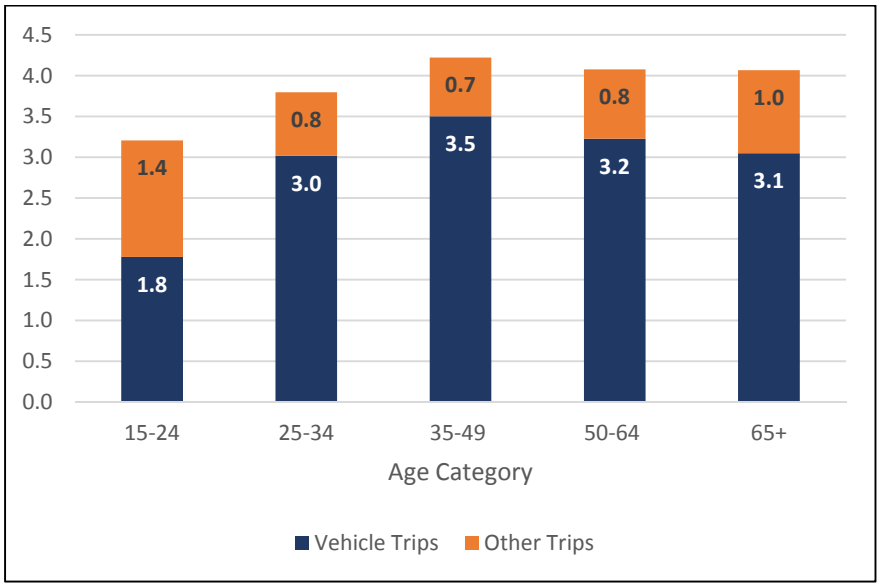
Table 6-4. Estimate of weekday person and vehicle trips per household by number of people

Household size	Person trips	Vehicle trips
One person	4.7	3.7
Two people	8.0	5.9
Three people	11.6	7.7
Four or more people	18.1	9.6
All	9.6	6.2

Figure 6-3 shows the average weekday trip rates by age category. Not surprisingly, people with the highest vehicle and person trip rates are aged 35-49 years old, which coincides with peak workforce participation, and with home-building and child-rearing for many. Remember, vehicle trips are coded to the driver, so "other" trips include trips made as a passenger in the vehicle and trips by walking, transit, and other means. When combined, these are the estimates of weekday person trips.

Younger people have the lowest overall trip rates and the lowest vehicle-driver trip rates of all—significantly different compared to people aged 35-49, and nominally different than the other groups. In addition to delayed licensing, a smaller portion of young people are in the workforce—less than half of residents aged 16-24 are employed, compared to almost 75 percent of those aged 35-49. Interestingly, 15 percent of people 65 and older are still working.

Figure 6-3. Weekday trip rates by age



People in Michigan travel on weekdays for a wide range of purposes—work, dropping off children at school, shopping, going out to eat. Figure 6-4 shows the distribution of weekday travel by purpose for three groups: all people, people aged 15 and older, and workers. For workers, travel to and from work is about one-quarter of their daily trips, a higher proportion than any other single purpose, whereas for all people, including children and retired, errands and shopping are the most common weekday purposes of travel.

Figure 6-4. Distribution of weekday trip by purpose for three groups

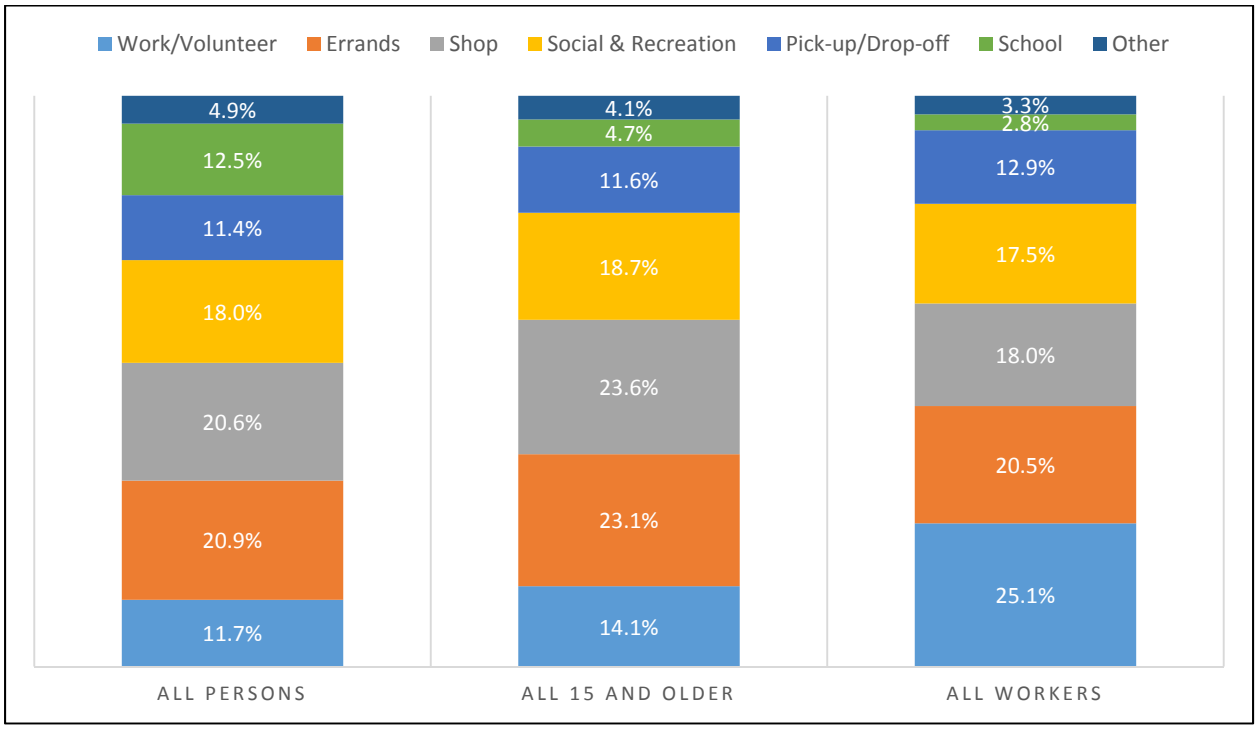
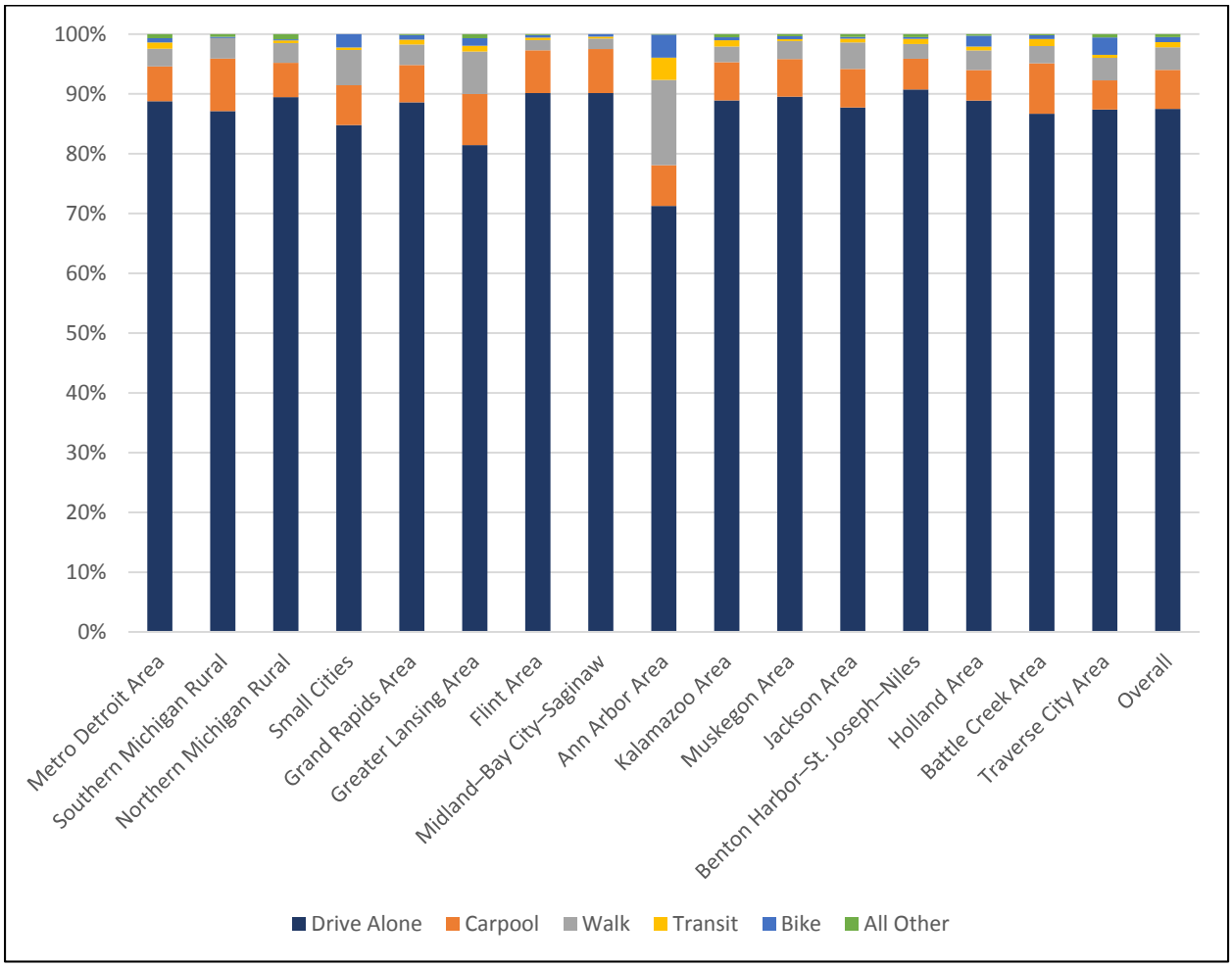


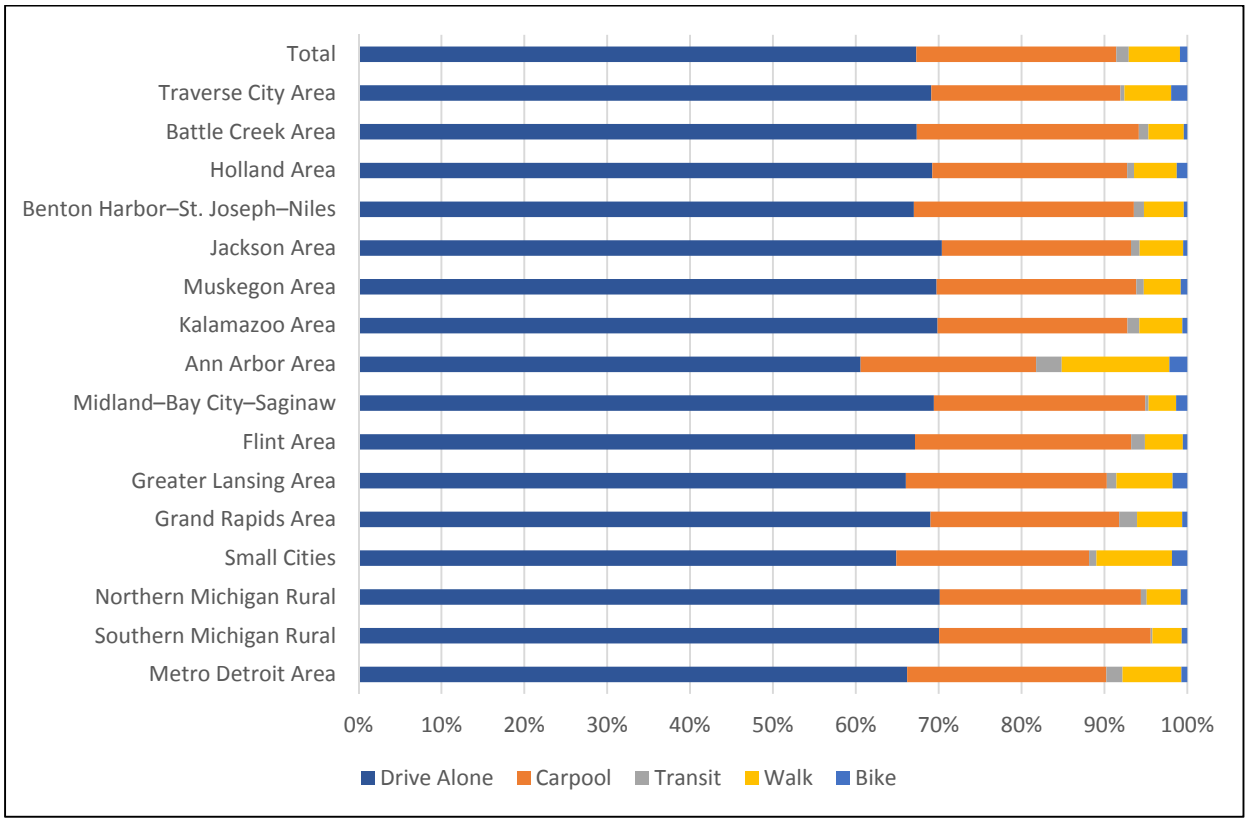
Figure 6-5 shows the mode share for commuting for each of the regions. Notable differences in the means of travel to work are apparent for Ann Arbor, with larger shares of walk and transit compared to other areas.

Figure 6-5. Means of travel to work by region



Location is important for understanding differences in how people travel across the region: in areas where densities and infrastructure support other means of travel—places with sidewalks and crosswalks, bike paths, and good local transit—the amount of walking, biking, and transit is higher compared to other areas. The proportion of weekday trips by different means of travel for each region is shown in Figure 6-6. Similar to the means of travel to work, notable differences are shown between Ann Arbor and other areas in the proportion of walk, bike, and transit trips for daily travel.

Figure 6-6. Proportion of weekday trips by means of travel by region



The percent of person trips by start time is shown in Figure 6-7. The trips to and from work (Home-Based Work and Non-Home-Based Work trips), shown in the bottom two categories of the bars in the chart, show the typical peak period distribution. On the other hand, shopping, social, and non-home-based "other" trips build throughout the day and evening periods. The largest proportion of trips start around noon, and overall trip-making is highest between 11 am and 3 pm. This could be a result of people going out—or home—for lunch, running errands at lunchtime, or shiftwork.

Figure 6-7. Person trips by start time (hour) and general purpose[3]

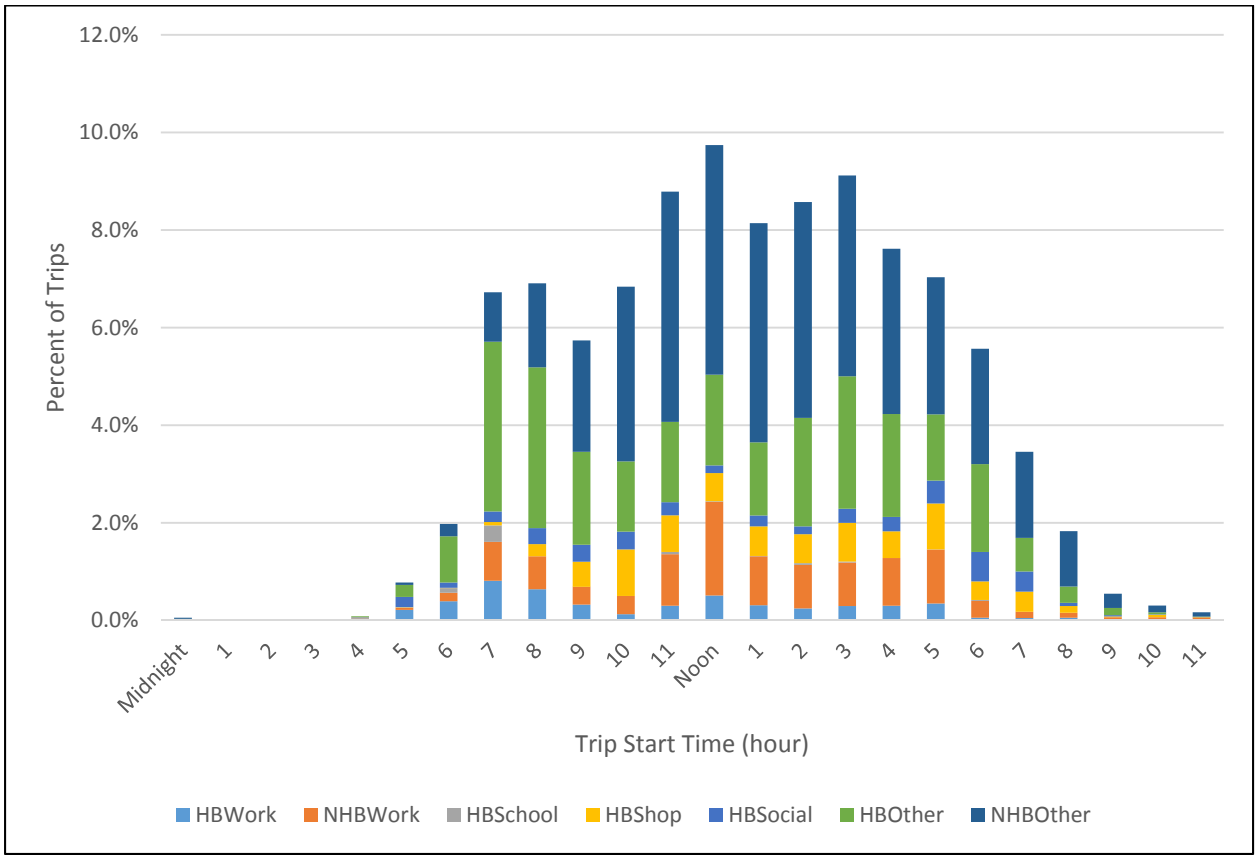
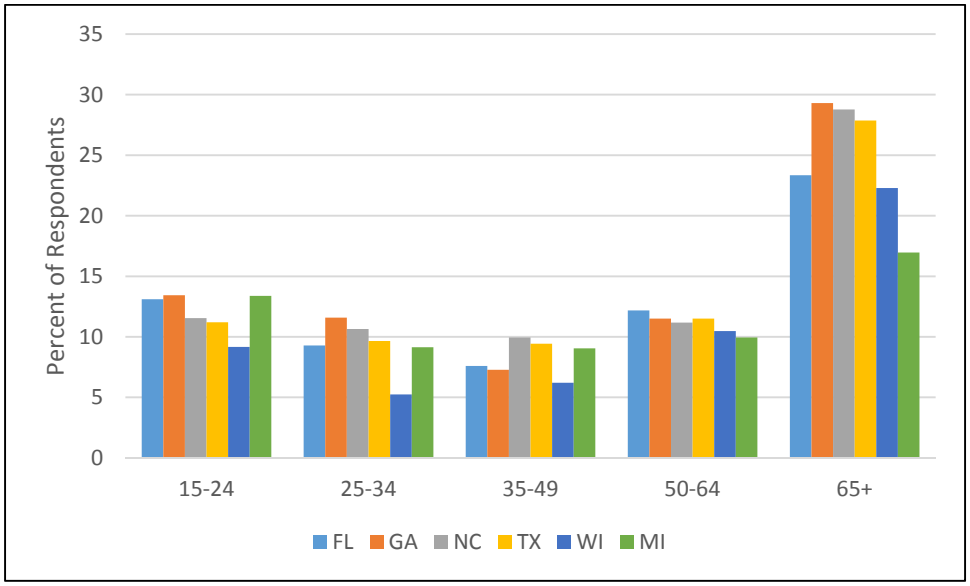


Figure 6-8 shows the percentage of people by age groups who reported no travel on the assigned travel day in Michigan compared to selected states in the 2009 National Household Travel Survey (NHTS). As shown, the percentage of people aged 65 and older who report no travel in Michigan is much lower than NHTS.

[3] General Purpose assigns the trips by purpose for both the origin and destination. "HBWork" indicates a trip directly from home to work or work to home, "HBShop" is a trip directly from home to shop and shop to home, etc. "NHBWork" is a trip with one end at work but the other not at home, for instance a trip from "drop-passenger" to work or from work to lunch. "NHBOther" is the largest share, and indicates trips in chains, such as a trip from one shop to another.

Figure 6-8. Percentage of people reporting no travel, Monday-Thursday, 2009 NHTS selected states and 2015 MDOT



Data Weighting 7

7.1 Types of Weights

When different strata have different sampling rates or different response rates, it is necessary to use weights when analyzing the collected data. If weighting is not conducted, then areas and sub-areas with higher sampling rates or higher response rates will be over-represented relative to areas and sub-areas with lower response rates. Because survey data can be reported at different levels—for example, household level or person level—weights are often labeled with their associated reporting unit. For example, *household weights* are used to compute estimates from data reported at the household level, whereas *person weights* are used to compute estimates from data reported at the person level.

For the MTC III samples, Westat delivered separate files of household weights and person weights for the retrieval completes. The file of household weights contained a full-sample household weight and an associated set of replicate household weights for each household in the sample that completed a retrieval interview. The file of person weights contained a full-sample person weight and an associated set of replicate person weights for each eligible person in a household in the sample that completed a retrieval interview. The final weighting plan can be found in Appendix DDD.

Weights were developed in a series of steps to compensate for unequal selection probabilities, non-response, non-coverage, and sampling fluctuations from known population totals. The steps in the weighting process were as follows:

1. Construction of household base weights (the reciprocal of the probability of selection of each sampled address);

2. Adjustment for non-response at the household level, yielding non-response-adjusted weights;

3. Further adjustment of the household weights to achieve consistency with characteristics for the full population of households (achieved by *poststratifying* or *raking* the non-response adjusted weights to independent household level totals, referred to as *control totals*);

4. Calculation of initial person weights, which will be the non-response-adjusted household weight applied to each eligible person in a responding household; and

5. Further adjustment of the initial person weights to achieve consistency with characteristics for the universe of eligible persons (achieved by *poststratifying* or *raking* the initial person-level weights to independent person-level control totals).

7.2 Calculation of Base Weights

The household base weight reflects the probability of selection for a sampled household and was calculated simply as the reciprocal of its probability of selection. The fact that two samples were selected—a spring sample and a fall sample—complicates the calculation of the base weights because MSG updated its address frame several times between the selection of the spring and fall samples. If only one sample had been selected, the formula for the base weight would be the following:

$$Base\ weight = N_h / n_h ,$$

where N_h is the number of addresses in MSG's sampling frame for stratum h, and n_h is the number of addresses sampled from stratum h. However, because two samples were selected, the denominator of the base weight becomes the sum of the unduplicated number of addresses selected in either the spring or fall. For the numerator, some analysts would use the stratum's average of the spring and fall frame sizes. Westat used the fall sample's frame size for the numerator of the base weight because the date of the address frame used to select the fall sample is closer to the middle of 2015 than that of the address frame used to select the spring sample and would thus better represent the universe of addresses in 2015. Base weights were calculated for all sampled addresses, not just for respondents. Table 7-1 contains the calculated base weights for each sample area and sub-stratum.

Table 7-1. Base weights for MDOT samples

Sample area	Base weight by sub-stratum	
	Low density	High density
Statewide models		
SEMCOG minus WATS	50.416	42.803
Southern Michigan Rural	23.556	16.439
Northern Michigan Rural	21.663	15.137
Small cities	9.993	7.485
Urban model areas		
GVMC	22.861	20.818
TCRPC	22.436	15.569
GCMPC	12.685	6.798
GLBR	14.379	12.362
WATS	16.583	7.893
KATS	11.238	8.507
WestPlan	10.009	6.860
JACTS	5.173	3.511
TwinCATS + NATS	4.941	3.695
MACC	4.210	3.977
BCATS	3.107	2.366
TVC	6.601	3.568

7.3 Adjustments for Household-level Non-response

At the end of data collection, each sampled address was assigned a disposition code, which for weighting purposes was assigned to one of the following four categories:

- *Undeliverable address*;
- *Eligible respondent*, i.e., a retrieval complete;
- *Other-ineligible case* (i.e., other than being an undeliverable address), e.g., a business address instead of a residential address; and
- *Non-respondent*, e.g., (1) a recruitment refusal, (2) a recruitment complete that fails to complete a retrieval interview, or (3) a non-respondent to the recruitment interview, with no evidence that the address was undeliverable.

The base weights of the *eligible respondents* were multiplied by a non-response adjustment factor to compensate for the non-completion of recruitment interviews by the *non-respondents*. The base weights for the *other-ineligible cases* were adjusted to reflect that some *non-respondents* may be ineligible. The base weights for the *undeliverable addresses* were not adjusted, and the adjusted base weights for the *non-respondents* were set to zero.

The calculation of the non-response adjustment factors required that each sampled address that was not an undeliverable address be assigned to a set of sampled addresses, called a *non-response adjustment cell*. Sampled addresses assigned to the same non-response adjustment cell should have similar response rates. Respondents and non-respondents were assigned to non-response adjustment cells, so the assignment process was based on information available for respondents and non-respondents. The 32 sampling substrata were used to define the non-response adjustment cells and investigated also using wave (i.e., spring or fall), match status (i.e., whether or not an address was matched to a landline telephone) and, as suggested by Norman and Sigman,[4] the type-of delivery point (i.e., city delivery, rural delivery, P.O. boxes, and highway contact) to define non-response adjustment cells. So that the adjusted base weights for MDOT-funded retrieval completes in the SEMCOG Minus WATS area could be used to calculate composite weights for MDOT-plus-SEMCOG-funded retrieval completes, the county containing the sampled address was also used to define non-response adjustment cells for the MDOT-funded retrieval completes in the SEMCOG Minus WATS area.

After the non-response adjustment cells were created, the following formula was used to compute non-response adjustment factors for each cell:

$$f_c^{(1)} = \frac{\sum_{i \in ER_c} w_i + \sum_{i \in OI_c} w_i + \sum_{i \in NR_c} w_i}{\sum_{i \in ER_c} w_i + \sum_{i \in NR_c} w_i},$$

where $\sum_{i \in ER_c} w_i$ was the sum of base weights for *eligible respondents* in weighting cell *c,* $\sum_{i \in OI_c} w_i$ was the sum of base weights for *other-ineligible cases* in weighting cell *c,* and $\sum_{i \in NR_c} w_i$ was the sum of base weights for *non-respondents* in weighting class *c*.

[4] Norman, G. and Sigman, R. (2007). Using addresses as sampling units in the 2007 Health Information National Trends Survey, Proceedings of the Survey Research Section, American Statistical Association, Alexandria, VA.

7.4 Benchmarking

The MTC III household weights were benchmarked to the 2010 Census within three-dimensional cells defined by the 16 model areas, four levels of household income (less than $25,000, $25,000 to $49,999, $50,000 to $74,999, and $75,000 or more), and four levels of the number of persons in the household (1, 2, 3, and 4 or more).

In each model area, poststratification was used to benchmark the person weights. The poststratified weights for all the respondents in a model area summed to the number of persons in the area according to the 2010 Census. Similarly, the poststratified weights for all respondents age 15 or younger in each model area summed to the number of persons age 15 or younger in the area according to the 2010 Census. The person weights for respondents age 16 or older were poststratified to counts of persons from the 2010 Census that have been redistributed to poststratification cells defined by sex (male or female), age (16–19, 20–54, 55–64, or 65+), and employment status (civilian employed, civilian unemployed or not in the labor force, or in the armed forces).

8 GPS Correction Factors

8.1 Correction Factor Plan

To account for possible under-reporting of travel in MTC III, 10 percent of the recruited households were instrumented with person-based GPS data loggers. This captured all of the actual travel movements of respondents on a given travel day. Consequently, these data were used to assess the magnitude and pattern of under-reporting of travel in the larger, non-GPS main survey sample. They were also used to estimate correction factors that can be applied to more fully account for full sample travel. In other words, the GPS correction factor analysis attempted to identify the factors that significantly affect trip under-reporting so that the resulting information can be used to derive a set of weights (i.e., correction factors) for more accurate estimation of household trip rates.

It is widely acknowledged that respondents, when self-reporting or reporting for others in their household, typically under-report trips in household travel surveys. One common method to measure and correct for trip under-reporting is to deploy GPS data loggers to a sample of households and compare the self-reported trips to those collected passively by the GPS loggers. Analysis is conducted to identify circumstances that lead to under-reporting, and correction factors are calculated. Because there is substantial variation that occurs in under-reporting, some households may not require a correction factor whereas others will require a fairly large weight (see Zmud & Wolf, 2003); applying a single correction factor to all log-reported travel is not appropriate. There are several factors or conditions that can contribute to trip under-reporting. For example, trip length has been shown to be correlated with trip under-reporting. Trips of short duration are often missing from respondent logs more frequently than trips of long durations (Zmud & Wolf, 2003). Variables examined in the past have included trip duration, household size, reported vehicle ownership, household income, respondent age, employment status, student status, and presence of children under 18 in the household.

As noted above, the traditional travel correction factor generation process applies to study designs where GPS and survey data are collected concurrently and independently in what is often referred to as the dual-method design. This approach does not apply to the MTC III prompted recall design, in which the GPS data serve as a basis for travel reporting and confirmation, but we believe it is helpful

to explain the traditional approach Westat used in previous studies so that differences in the two approaches are known and understood.

Under the dual-method design, the process for developing travel correction factors begins with a database of GPS trip records used to test a model of trip misreporting. A dummy variable is used to indicate if a trip record was "missing" when compared to the GPS data. A logistic regression model is then used to determine which of the variables associated with the trip record (e.g., household size, household income, employment status, age, etc.) has a statistically significant effect on travel under-reporting. Based on the logistic regression analysis, adjustment factors are developed for specific combinations of household, person, and trip types. These factors are then applied to all households, allowing for more accurate estimation of household trip rates for a wider population.

The process for developing correction factors for MTC III was notably different from the traditional trip correction process because of the project's use of the GPS prompted recall (GPS-PR) design. Instead of comparing two 'streams' of data from the same sub-sample of households to identify underreported travel, this process involved a comparison of GPS-captured travel made and confirmed by GPS households with the reported travel behavior equivalents from non-GPS households. The thought is that the participants using the GPS-PR retrieval method are more likely to capture all travel movements on the travel day. Under this assumption, data from the GPS households were used to identify and quantify travel under-reporting in non-GPS households, and estimate correction factors that could be applied to more fully account for the travel of the full sample.

8.2 Development Process

Westat structured the GPS correction derivation process around tour and stop frequencies. However, Westat did not use tour generation models to determine statistical significance of travel under-reporting in the non-GPS portion of the sample. Instead of following this approach, a process tailored to the MTC III and STC15 was developed to compute travel correction factors (TCFs). It included the following general steps:

1. Prepare tour data files that translate place-based survey database to tours, as well as linked trip files; these allow the estimation of tour and tour stop frequencies.

2. Identify tour segmentations (e.g., tour type, person type, and tour mode combinations) for which statistically significant tour frequency distribution differences exist between GPS and non-GPS groups.
3. Use a similar exploratory approach to identify tour stop frequency segmentations (e.g., by tour mode and stop counts) that show under-reporting in the non-GPS group.
4. Utilize person-level weights to expand the GPS and non-GPS tour frequencies for the segmentations found to have significant under-reporting and compute tour frequency TCFs (i.e. compute weighted tour frequencies using the person level weights for GPS and non-GPS and use them to calculate a ratio).
5. Compute tour stop frequency TCFs by tabulating tours using person weights multiplied by the tour frequency travel correction factors derived in step 4 (i.e., compute weighted tour frequencies classified by number of stops using the product of person level weights and tour frequency TCFs for GPS and non-GPS groups and use them to calculate a ratio).

8.3 Applying Corrections

The computed TCFs should be used whenever summarizing travel attributes, such as traveled distance in conjunction with existing household or person weights. For example, to compute average trip distance by person, one should multiply individual place distances by the product of the person weights and the place TCFs, sum the resulting values and then divide by the sum of the product of the person weights and TCFs as noted in the following equation:

$$\bar{d} = \frac{\sum d \cdot w_p \cdot TCF_{freq} \cdot TCF_{stop}}{\sum w_p \cdot TCF_{freq} \cdot TCF_{stop}}$$

where:

d : trip distance,

w_p : person level weight,

TCF_{freq} : tour frequency travel correction factor, and

TCF_{stop} : stop frequency travel correction factor.

More details can be found in the Data Integration and GPS correction Factors Plan located in Appendix EEE as well as the final trip correction factors.

Lessons Learned and Future Recommendations 9

The data collected in 2015 during MTC III constitutes a rich resource for examining travel behavior across all of Michigan. The dataset gives insight about the travel and activities for 16,276 households while providing proportional coverage of this geographically and demographically diverse state. The experience of the sample design, data collection, and analysis of the resulting data revealed some lessons that can be applied to future survey projects.

The survey included a comprehensive effort to engage the public with press releases, informational videos, social media coverage, and a clean, modern survey website. The two sponsoring agencies were featured prominently in the materials and all communications, lending credibility to invitation mailings and other forms of contact made on behalf of the survey. The project logo was the same logo used in the last two surveys. All of these factors combined led to a higher than anticipated response rate across every sample area in the study. Maintaining and building upon this approach to public outreach in future surveys will be critical to their success. It is foreseeable that an even greater role for social media may exist in future surveys as the market penetration of the use of these services approaches 100 percent.

The two MDOT-created videos available on both the public website and YouTube received relatively few views considering the number of people invited to participate in the study. The cost of creating the videos versus the benefit of the limited number of views should be considered for future studies. The number of videos could be reduced or potentially eliminated for future studies, dependent on recent experience from other surveys.

MTC III translated materials from English to Spanish and Arabic to make it accessible to citizens who speak the three most common languages in Michigan. Although we have no quantitative evidence that this affected the response rate in any particular language, anecdotally, negative feedback was received from approximately a dozen English speakers, particularly regarding using funds to translate materials to Arabic. The translation service received only two calls from Arabic speakers and around six calls from Spanish speakers. While it is important to be inclusive, there is a cost associated with the translation off all of the materials. The lack of response from Spanish and Arabic speakers was disappointing. In the future, it may be more cost effective to translate only a few key materials, such as the recruitment letter and travel log while including a tagline on all other

materials in Spanish and Arabic with the phone number to the interpreter service for additional assistance.

As a part of the dataset validation, PB typically aggregates trips by person type. This requires data on worker status (full- or part-time) and student, retiree, and other statuses that are taken from various person-level questions in the survey. For MTC III, the question of hours worked was not asked, and therefore, the full- or part-time status of workers could not be validated against surveys from other sample areas that had a means for separating the two types of people. PB recommends including this variable in future surveys. Other variables to consider (especially if there is any interest in migrating to an activity-based model) would include the collection of a household vehicle list and the collection of the drivers of the vehicle for each trip made.

Appendices 10