

2015 Southeast Florida Household Travel Survey

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Modeling Subcommittee

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Southeast Florida Transportation Council

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Executive Summary

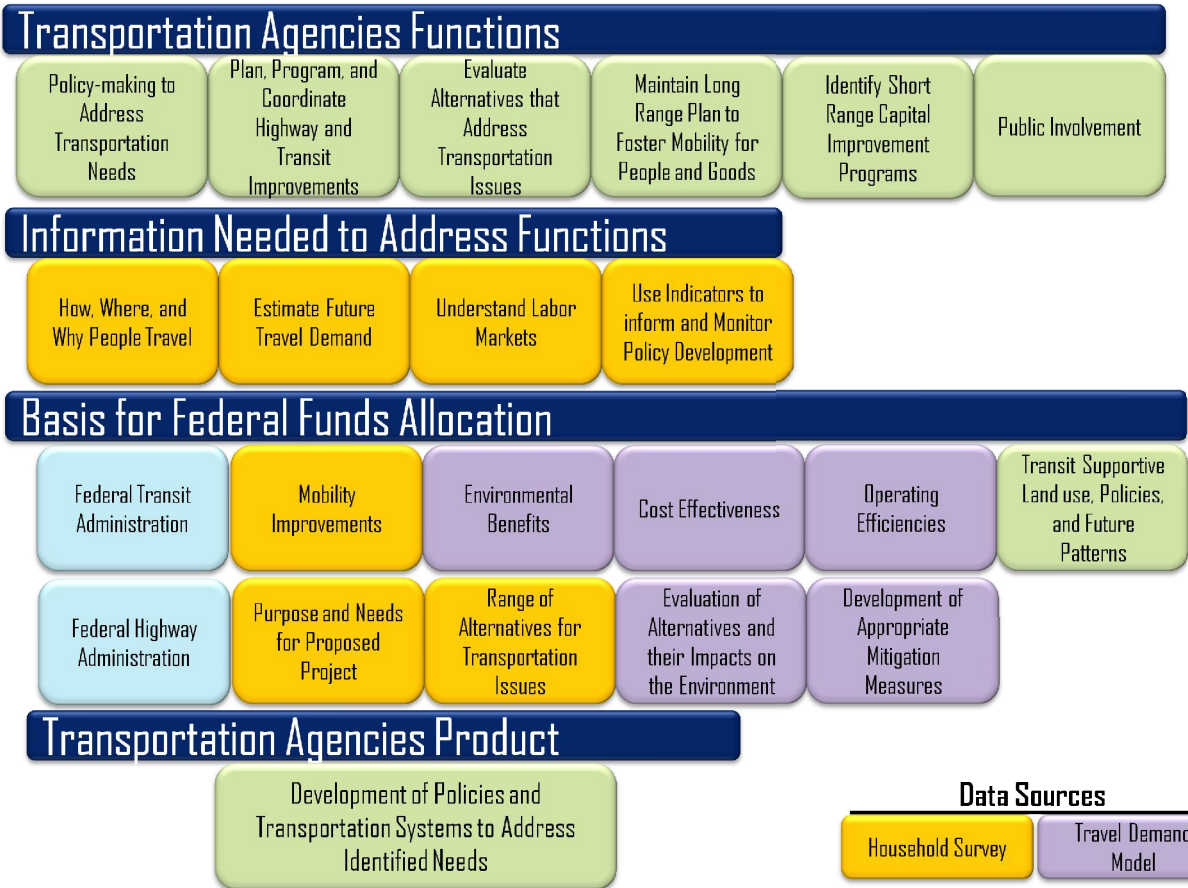
The Southeast Florida region has been changing rapidly and is expected to continue growing and evolving over the next decades. The universe of travel choices is expanding, partly in response to technological change and preferences for alternative transportation options, but also in response to fiscal constraints.

Why is a household survey needed?

Household surveys provide transportation agencies with the necessary information to address their functions and seek funding for the projects identified through the planning process. Travel data are needed to inform and provide guidance to decision-makers in a variety of areas including:

- transportation policy-making,
- short and long range planning, and
- management of current and future transportation assets.

The needed information is obtained directly from the household survey or through a travel demand model which is built upon the data collected from the household surveys.

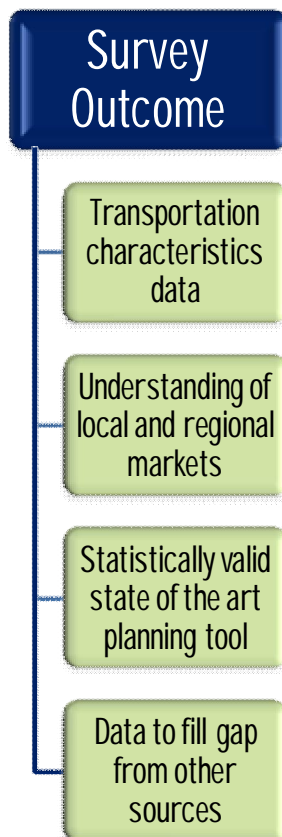


Household travel surveys provide essential information for transportation planning by helping to quantify the travel behaviors of the region's residents, and helping to quantify how such behaviors relate to population characteristics, travel options and travel costs, changing work and living arrangements, and a myriad of other factors that affect regional travel patterns.

Can we do without a survey?

Without the 2015 Southeast Florida Household Survey, transportation agencies and policy-makers will lack the information needed to address their functions as planners of a transportation system that meets the needs of the region.

- Essential and current transportation characteristics data will not be available to understand and address transportation issues throughout the region and for all modes of transportation, as well as develop relevant data to meet the new performance measures required under MAP-21.



- Significant changes in technology, mobility options, and demographics have occurred in the region (and the nation) since the last survey was conducted. Local information is important to understand the unique combination of characteristics that relate to Southeast Florida, including changing importance of teleworking, usage of transit and managed lanes options, effects of attitudes and preferences of Millennials, and interest in and usage of non-motorized transportation.

- Decision-makers would lack the necessary information to understand local and regional travel markets to plan crucial elements of the region's transportation system including connectivity of passenger facilities, accessibility to public transportation, financial implication of tolled/managed lanes facilities, and impacts of proposed developments or revitalization of targeted economic nodes such as central business districts.

- State (FDOT) and local (MPO) planning agencies would not have the ability to build state of the art tools to identify, implement, and prioritize congestion mitigation measures to address transportation issues since they would not be reflecting current travel characteristics in the region.

- Crucial data will not be available to fill the gap from other data sources such as National Household Travel Survey (NHTS) and Census Data. The small sample size prevents the development of detailed observed travel patterns at county or sub-county levels. Other limitations include under-representation of certain populations, such as non-retiree households, children, and even large subareas of the region.

Are there other means to obtain the data?

Various limited data collection methods are available to gather information on travel selected characteristics. These methods include:

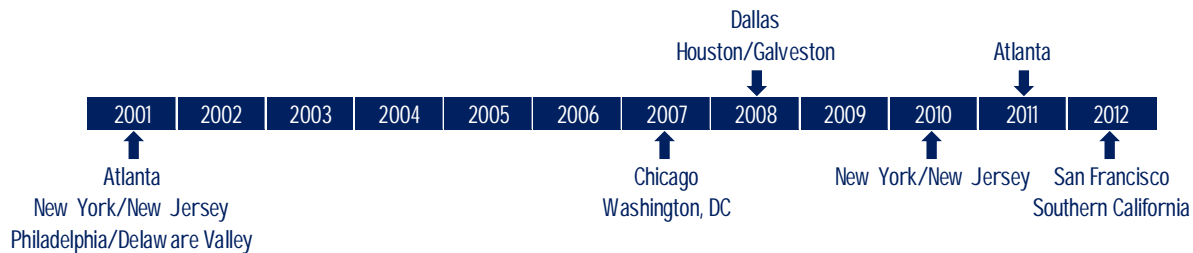
- Census Transportation Planning Package (CTPP)
- Longitudinal Employer – Household Dynamics (LEHD)

- Cellular Device Data (BlueTOAD)
- Transit On-Board Surveys

Extensive research on the data available from these methods reveals their limitations and shortcomings that can only be addressed through a comprehensive household survey. These methods do not address the elements needed to adequately identify, evaluate, and develop transportation systems that address the needs of all sectors of the population, all trip purposes and work tours, and all modes of transportation. The household survey can pinpoint overall regional travel patterns and then be refined by these other methods to maximize the understanding of the Southeast Florida travel markets.

What is being done in other major metropolitan areas?

The need-for-travel survey has been the cornerstone of development of transportation systems in the United States since they started being conducted in the 1960s. They are now being conducted in practically all medium and large size metropolitan regions of the United States at approximately 10 to 15 year intervals. Ten of the largest metropolitan areas in the country have conducted comprehensive household surveys in the past five years, including New York, Atlanta, San Francisco and Washington, DC. New travel surveys are particularly important in the development of more advanced planning and forecasting tools, such as Activity Based Models (ABM). These sophisticated models require information about the use of the transportation system that was not collected in earlier surveys. Increasingly these tools are being used to plan for our transportation systems. Other regions in Florida (Jacksonville and Tampa) and the Southeast (Atlanta) are actively developing Activity Based Models.



Recommendation for Southeast Florida

In Southeast Florida, the last large sample comprehensive household travel survey was conducted in 2000, as part of the Southeast Florida Regional Travel Characteristics Study (SEFRTCS). Data from this survey have been used to develop and refine the regional travel demand model, which in turn has been used in multiple highway and transit corridor studies, in addition to the Long Range Transportation Plan. The past 14 years have brought substantial changes to Southeast Florida and the way we use our transportation system such as the I-95 and the Florida East Coast Corridors through all three counties in the region. A Regional Household Travel Survey will allow these changes to be captured in a comprehensive and statistically valid way to support needs for funding to improve mobility for the users.

The 2015 Southeast Florida Household Travel Survey (HTS) will gather travel behavior data from a statistically valid sample of households stratified by location, income, household characteristics and other factors that will permit the data to be expanded to the universe of households. Data on personal travel trends are needed to examine whether the transportation system is meeting current demands and is capable of accommodating future demands, to assess the feasibility of proposed highway and transit projects, to assess the effectiveness of travel demand management strategies, and to measure and mitigate, as needed, adverse effects on the environment and impacted populations. The changing

nature of travel patterns, and of the factors that affect and influence travel behavior, can only be observed, measured and understood by periodically surveying the system's users.

As the region moves forward developing transportation plans to improve mobility and foster economic growth, comprehensive and timely information about regional travel behaviors, and the factors that influence these behaviors, is essential to develop tools to first identify unmet needs and under-served populations, and then formulate strategies to provide effective and sustainable transportation options. The 2015 Southeast Florida Household Travel Survey is the crucial element to develop these tools.

1 Introduction

Household travel surveys have been conducted in the United States since the 1960s, and are now conducted in practically all medium and large size metropolitan regions of the United States at approximately 10 to 15 year intervals. In Southeast Florida, the last large sample comprehensive household travel survey was conducted in 2000, as part of the Southeast Florida Regional Travel Characteristics Study (SEFRTCS). Data from this survey have been used to develop and refine the regional travel demand model, which in turn has been used in multiple highway and transit corridor studies, in addition to the Long Range Transportation Plan.

In 2008 approximately 2,700 Southeast Florida households were surveyed as part of the National Household Travel Survey (NHTS). The Southeast Florida 2008 NHTS Add-On suffered from various methodological problems that limited, though not precluded, its usefulness for transportation planning. Chief among these limitations was the small sample size, which precluded the development of detailed observed travel patterns at county or sub-county levels. Other limitations include under-representation of certain populations, such as non-retiree households, children, and even large subareas of the region. Largely due to its national scope, a number of issues important in Southeast Florida were left unexplored, including the travel patterns of seasonal populations, self-employed workers, workers with multiple jobs and multiple work locations, and college-age students; the travel behavior of transit choice riders and transit-dependent populations; the impact of parking cost, parking availability, alternative work arrangements, and communications technologies on transportation choices; and willingness to pay for toll or managed lane facilities.

This white paper documents the purpose and needs for the survey, summarizes the results of the latest trends at the national level, information available and limitations of other data collection methods, and recommendation for Southeast Florida.

2 Purpose and Needs

A Household Travel Survey (HTS) gathers travel behavior data from all persons in a sample of households throughout the SE Florida region. It provides a comprehensive “snapshot” of household travel behavior for a wide range of planning and research activities, and it is the foundational source for understanding travel markets and trip-making in the region. Data on personal travel trends are needed to examine whether the transportation system is meeting current demands and is capable of accommodating future demands, to assess the feasibility of proposed highway and transit projects, to assess the effectiveness of travel demand management strategies, and to measure and mitigate, as needed, adverse effects on the environment and impacted populations. The changing nature of travel patterns, and of the factors that affect and influence travel behavior, can only be observed, measured and understood by periodically surveying the population.

One of the longest continuous surveys in the United States is the National Household Transportation Survey (NHTS), which has been conducted seven times since its inception, in 1969, 1977, 1983, 1990, 1995, 2001 and 2008 (Hu and Reuscher, 2004). The NHTS data have been used nationwide to support a wide variety of transportation planning studies, across multiple disciplines.

Just in a four-year period (2006 to 2011), more than 100 publications, presentations and monographs cited the use of NHTS data for the following types of studies (NHTS, 2011):

- Bike and Pedestrian Studies
- Demographic Trends
- Energy Consumption
- Environment
- Policy and Mobility
- Special Population Groups
- Survey, Data Synthesis, and Other Applications
- Traffic Safety
- Transit Planning
- Travel Behavior
- Trend Analysis and Market Segmentation

NHTS data have also been used to develop travel demand forecasting models, specifically in regions that subscribe to the Add-On program. While many of the studies cited above are national in scope, at the metropolitan region level a household travel survey also plays an essential role supporting the following transportation planning activities:

1. Conform to Federal, state and local mandates. Titles 23 and 40 of the Code of Federal Regulations (CFR) require that Metropolitan Planning Organizations (MPOs) “identify the projected transportation demand of persons and goods in the metropolitan planning area over the period of the [regional transportation] plan” (23 CFR 450.322.b.1), and require the use of network-based travel models to “estimate the regional transportation emissions used to support conformity determinations” (40 CFR 93.122.b.1). Moreover, MPOs and the State DOT must certify that the regional transportation plan is consistent with current and forecasted transportation and land use conditions and trends (23 CFR 450.322.a). In order to meet these regulations, MPOs develop and maintain regional travel demand models, which are used in the development of the Long Range Transportation Plan, Transportation Improvement Plans, and corridor studies, among other uses. The adequacy of the regional travel demand model must be certified by the MPO and DOT, and approved by FHWA as part of the air quality conformity determination. As described below, current information about regional travel patterns, as obtained from a household travel survey, is absolutely essential to maintain a regional travel demand model for a region such as Southeast Florida.
2. Understanding the travel patterns and travel needs of important regional populations. In a broader sense, the mission of the MPO is to “... encourage and promote the safe and efficient development, management, and operation of surface transportation systems to serve the mobility needs of people and freight (including accessible pedestrian walkways and bicycle transportation facilities) and foster economic growth and development, while minimizing transportation-related fuel consumption and air pollution” (23 CFR 450.300). A household travel survey directly supports the MPO mission by providing information that allows examining the extent to which the mobility needs of the people sampled (as representative of the entire population) are being met and to identify adversely impacted populations. The MPO is charged with “seeking out and considering the needs of those traditionally underserved by existing transportation systems, including but not limited to low-income and minority households” (23 CFR 450.316.b.1.vi).

3. Maintaining the regional travel demand model up to date. As indicated above, MPOs are required by federal law to develop a process that allows forecasting travel demand in a manner consistent with current and future land use plans, that accurately reflects the characteristics of the transportation system, and that is consistent with demographic and employment projections. The most accepted method for meeting this requirement in a region as large and populous as Southeast Florida is to maintain a regional travel demand model. The household travel survey is critical for maintaining the Southeast Florida Regional Travel Model (SERPM) up-to-date in two related by fundamentally different ways. First, the survey is the most complete and comprehensive data source for depicting current travel patterns, and is therefore used to verify and ensure that SERPM is able to reproduce current conditions across numerous spatial, demographic and link/route segmentations. Second, the household travel survey provides the data required for updating the mathematical specification of the model components, which is required periodically to ensure that the model reflects current conditions, responds to changes in the system appropriately, and reflects appropriate sensitivities to policies and projects that may not have been envisioned at the time the model was created. The maxim that the model “is only as good as the data used to develop it” encapsulates the importance of accurate, up-to-date information.
4. Research activities. Research conducted at the region’s universities using household travel survey data directly contributes to our understanding of travel behaviors and of how different populations use and are impacted by the transportation system. Research works specifically conducted with Southeast Florida data range from the development of tools to support traffic impact studies (Steiner et al, 2010), investigation of car-ownership behavior (Nowrouzian and Srinivasan, 2013), and research on the travel behavior of the elderly, to on-going studies of the land-use/transport interaction (Srinivasan et al, 2103). Some of the research needs that the current data have been unable to meet include the use and impact of real-time information on transportation choices, with a particular focus on cellular devices.

3 Background

3.1 Previous Household Travel Surveys in the Region

In the past 20 years two region-wide household travel surveys have been conducted in the three-county Southeast Florida region – the Southeast Florida Regional Travel Characteristics Study, conducted in 2000, and the National Household Travel Survey Florida Add-On, conducted in 2008. These two efforts differed substantially in their comprehensiveness, with the earlier survey providing a more complete assessment of travel behavior in the region. Each effort is described next, followed by a discussion of the need to start planning for the next region-wide household travel survey.

3.1.1 Southeast Florida Regional Travel Characteristics Study (SEFRTCS)

SEFRTCS was a joint effort of Florida DOT Districts 4 and 6, and the MPOs of Miami-Dade, Broward and Palm Beach counties. The entire data collection effort comprised five different surveys, listed below (Carr Smith Corradino, 2000):

- Household travel survey (5,100 complete households)
- On-board transit survey (11,173 complete surveys)
- Visitor travel survey (1,063 complete visitor parties)

- Truck movement survey (848 firms completed the survey)
- Workplace survey (1,163 completed employee surveys)

For the household travel survey, households were randomly assigned to a non-holiday weekday travel day between February 23, 1999 and July 1, 1999; that is, excluding summer days. Full-time and part-time Florida residents were included in the sample, though the sample was not stratified by residency status. Instead, the sample was stratified by geographic subareas to ensure coverage from all subareas of the model region. Approximately one-third of the sample was drawn from each county.

The SEFRTCS used multiple techniques known to improve the quality and usefulness of the reported data. Households were recruited using computer-aided telephone interviews (CATI), and the trip diary data was also retrieved via CATI. When CATI is used, respondents are walked through the data retrieval by an experienced interviewer and the software branches appropriately, thus greatly reducing inconsistencies and misses in the reported data. Trip locations were geocoded during the data retrieval step, which provides an opportunity to verify trip addresses in the event that trips are not successfully geocoded or that the reported address is inconsistent with the reported travel time.

Complete one-day travel diaries were required from all persons in a household, including infants. This is an essential requirement to understand, and eventually model, how households as a unit plan their travel.

3.1.2 National Household Travel Survey

In 2008 Florida participated in the National Household Travel Survey (NHTS) Add-On program, which collected travel data from approximately 15,900 households throughout the state. In Southeast Florida, the NHTS sampled 4,524 households, of which 2,662 were usable for understanding and modeling typical weekday travel. The unusable households reported weekend travel, were poorly geo-coded, or were missing adult travel diaries. The Southeast Florida 2008 NHTS Add-On suffered from various methodological problems that limited, though not precluded, its usefulness for activity-based travel demand modeling purposes. The most critical limitations include the following:

- *Small sample size.* Given a sampling rate of approximately 1 observation for every 1,000 households in the region, on average, the survey was not large enough to support detailed analyses of travel behavior in the region, particularly for subareas and/or subpopulations within the region. Because certain infrequent populations were under-sampled, some households in the Southeast Florida NHTS exhibit expansion factors substantially higher than 1,000, and as high as 17,000. The wide spread exhibited by the expansion factors can cause biases when the data are tabulated across multiple dimensions, since certain households have very influential weights.
- *Captured weekend only travel for some households.* More than one-quarter of all the households recruited for the Southeast Florida NHTS Add-On were assigned to report travel on a weekend day. Since SERPM7 forecasts typical weekday travel only, the entire weekend subsample was not usable for modeling purposes.
- *Over-sampled households that include retired persons.* Approximately 37% of all the persons that returned complete travel diaries are non-working adults age 65 or older. In reality, this subgroup represents only approximately 20% of the total population. It is possible to weight the observations so that estimates of total trip making are not biased by the over-representation of the retired population. There is however a substantial loss of information because other types of households, such as households with working adults, households with workers that commute long distances, transit-using households and households with children represent, overall, a small sample in absolute terms.

- *Incomplete household diaries.* To reduce respondent burden, NHTS by design omitted collecting the trip diaries of children younger than 5 years old, and accepted a household as a complete observation if at least half of the adult household members returned a diary. The SERPM7 modeling framework is designed to forecast travel accounting for the interactions among household members, and in doing so more closely approximates real, observed travel behavior. For this reason the estimation and calibration of the model requires travel data from all members of a household. Approximately one-tenth of the NHTS Add-on sample was not usable for certain models due to missing adult trip diaries.
- *Failed to capture seasonal residents* in large enough numbers. Although Florida added a question to the NHTS to identify seasonal residents, the sample was not designed to specifically target this subpopulation. As a result, very few of the surveyed households are in fact seasonal residents. The subsample of seasonal resident households is too small to support any type of comparative travel behavior analysis.
- *Sample design failed to capture key behaviors in sufficiently large numbers.* Due to the national nature of NHTS, the sample design was not adjusted to local conditions, and as a result infrequent but important behaviors were not captured in sufficiently large samples to provide confidence in the observed patterns. Among the more important behaviors that were missed one can cite current transit users and people making long commutes.
- NHTS did not ask for information that is critical to understand certain travel choices in Southeast Florida, such as the availability of free/subsidized parking at work, whether workers hold more than one job, whether the usual workplace is a fixed or variable location, work schedule flexibility, regular use of a transit pass or other discounted fare, and use/ownership of a SUNPASS transponder to pay tolls, among others.

In spite of these limitations, the 2008 NHTS data were used intensively in the development of the recently completed Southeast Florida Regional Planning Model (SERPM7). While the sample is insufficiently large to support the original estimation of most of the submodels that comprise SERPM7, it provided sufficient information to develop region-wide calibration targets for most submodels. In developing these calibration targets, the NHTS data were supplemented with a wide variety of other data sources, including Census and American Community Survey data, Longitudinal Employment – Household Dynamics data, data from the Florida Department of Motor Vehicles, SUNPASS account sales data, transit on-board survey data, transit ridership data, and school attendance data, among others. The SERPM7 calibration targets were compared to similar targets developed for other regions, to verify that the aggregate tabulations of travel behavior across various person types and types of travel exhibited similar relationships.

Because the SERPM7 models could not be estimated with local data, a complete model specification was adopted, patterned after the San Diego Association of Governments (SANDAG) activity-based model. The adequacy of the model transfer was evaluated by examining how well the transferred model, without updates, matched the calibration targets developed from NHTS data. The transferred model was in fact able to reproduce fairly well the Southeast Florida travel behavior at an aggregate level (Picado, 2012). The submodels that performed least well are, not surprisingly, the trip location models. This can be explained partly by differences in model region size between San Diego County and Southeast Florida, and partly also due to differences in multi-modal accessibilities and the composition and location of employment. The development of the tour-level mode choice models also relied on various relationships of transit tours to transit trips obtained from a recent Atlanta on-board survey, given the near lack of transit tour observations in the NHTS Southeast Florida sample.

While a substantial effort was made to develop SERPM7 with all available data, it cannot be denied that the model would have benefited from a larger sample size, particularly in the estimation and validation of the tour location models and calibration of the mode choice models. Estimation of models using local data remains the most accepted method for specifying travel demand models. Confidence in the forecasts produced by SERPM7 will increase by demonstrating its ability to reproduce observed travel behaviors at a fairly disaggregate level. At the same time, our understanding of travel patterns in the region and specific travel behavior drivers of the Southeast Florida population is constrained by the limited availability of real, observed travel data. As discussed next, this is a substantial limitation given the changing nature of the travel options and population demographics, the impact of the widespread adoption of internet-based communication technologies, and the growing focus on travel demand management and congestion pricing.

3.2 Changing Travel Patterns and Travel Choices

In a region as large and dynamic as Southeast Florida, travel patterns change over time even though the region as a whole is already nearly completely urbanized. Travel patterns are essentially a response to two related yet fundamentally different forces: changes in work customs and population demographics, and changes in the travel choices available in the region. Together with the surveys conducted in 2000 and 2008, the next household travel survey will provide the opportunity to perform a detailed comparative analysis of changes in travel behavior in the region. Some of the trends and behaviors important to understand to assess future demand and how to meet it include the following:

- Changing nature of work schedules, including work scheduling flexibility, alternative work schedules and telecommuting, and their impact on travel choices. Work travel remains one of the largest shares of total travel during peak periods. Flexible work schedule policies have been promoted as a way to provide an option to travel outside of peak periods (or at least peak hours), and also to avoid traveling for work five days a week. The 2000 and 2008 household travel surveys did not ask for information on schedule flexibility, so the effectiveness of these policies region-wide remains unknown. One important aspect that is not well-understood is the extent to which peak travel is constrained not so much by work schedules, but by non-work activities such as escorting children to/from school. Similarly, it is unclear the extent to which workers that rely on transit are able to take advantage of flexible work schedules, given that transit service during off-peak periods is much reduced compared to peak service.
- Changing demographics. Like many of the metropolitan areas in the Sunbelt, the Southeast Florida region has been changing rapidly and is expected to continue growing and evolving over the next decades. Household surveys help to track this evolution and to understand how changing demographics affect travel patterns, providing insights towards understanding how best to serve the regions' travel needs. The following examples can be cited:
 - The fast growth of the Hispanic population in Southeast Florida is well known; between 2000 and 2010 the share of Hispanics relative to the total Southeast Florida population grew from 34% to 41% (BEHR, 2013). Most of this growth reflects an influx of foreign immigrants, typically used to lower rates of auto ownership and higher transit use. There is great diversity within the immigrant population, and they tend to congregate in particular areas of the region. It is unknown, however, whether their travel patterns remain different from the rest of the population as they get assimilated into U.S. living conditions.

- The Southeast Florida region is expected to age over the next 30 years. Travel demand models assume that a 65 year old person 30 years from now behaves in the same way as a 65 year old person today, on average. This assumption needs to be re-examined, given expectations about average retiring age, advances in life expectancy, and simply changes in the composition of the elderly population. One option is to compare the travel behavior of population cohorts between 2000 and 2015, for example, as a basis to project behavior into the future.
- Similarly, there is anecdotal evidence that the millennial cohort (young adults) behaves differently from today's middle-aged population when it comes to travel choices; they tend to exhibit lower rates of auto ownership but greater reliance on shared car services, for example.
- It is also believed that multi-generation households are on the rise and young adults are more likely to stay with their parents after college. These changes would change the joint trip making activities and need to be understood quantitatively for transportation planning. The survey can provide needed insights into as their auto ownership and availability arrangements.
- Southeast Florida was a main destination of retirees from the northeast and mid-western states. The high-rises on the coast area and senior citizens communities were tailored for them. Now, their properties are absorbed by new immigrants and year-round residents. The travel activities of the new residents are different from those of the previous occupants. Information from a household travel survey can inform the development of transportation plans for the new residents.
- Changing travel choices. The universe of transportation options has changed since 2000, and is expected to continue evolving in future years. Road pricing for example is changing from the fixed tolls traditionally charged on the Florida Turnpike to managed lane concepts where tolls vary dynamically in response to congestion. In fact, it is expected that the majority of new, limited-access capacity in the region will be deployed as managed lanes. And as tolls escalate with increasing congestion, it will be important to understand the extent to which motorists will be willing and able to form carpools to avoid paying the tolls on managed lane facilities. Facilities like the I-95 managed lanes offer benefits not just to drivers but also to transit users because of the ability to run reliable, point-to-point express bus services. The success of the I-95 express bus services shows that there is a strong market for these types of transit services, beyond the traditional transit-captive market. At the same time, youth are delaying the time at which they get a driver's license, and the younger generations are believed to be less auto-centric. Further, the population growth in Southeast Florida is driven heavily by foreign immigrants, who are more accustomed to transit. Household surveys help to quantify the increased reliance on parent escorting, shared-vehicle arrangements (Zipcar-type services), propensity to walk and bike, and propensity to use transit.
- Changing sensitivities to travel cost and travel time. Just as travel choices change, the perceptions about the relative convenience and cost of these choices also changes over time. For example, with the near ubiquity of SUNPASS transponders, it has been hypothesized that motorists are less sensitive to the real cost of each toll trip. It has been shown in other regions that people who pay for their tolls with electronic transponders exhibit, on average, a higher value of time or willingness to pay, after controlling for factors like income, trip purpose, and gender. Moreover, it has been found that travelers on the I-95 express lanes perceive a higher

rate of travel time savings than they actually realize, and it is reasonable to assume that their willingness to pay is influenced by their perception more so than by the real time savings. Whether these perceptions will remain as experience with the facility grows is an important factor in understanding the long-term financial viability of these types of facilities.

Continuing the effort started in 2000 with SEFRTCS is an important contribution towards understanding the changing nature of travel patterns, directly in support of the planning mission of the region's metropolitan planning organizations. This effort goes well beyond the development of travel demand models. Models are just a simplified representation of travel behavior. If our understanding of travel behavior in the region is flawed or incomplete, not only is the model going to reflect such flaws, but transportation policies and planning activities are going to be based on an erroneous understanding of how current policies influence travel behavior. The next sections of this paper discusses the household travel surveys conducted in other large metropolitan areas, alternative data sources, and finally outlines a proposal for the next Southeast Florida household travel survey.

3.3 Recent Household Travel Surveys in Large Metropolitan Areas

Household travel surveys have been conducted in the United States since the 1960s, and are now conducted in practically all medium and large size metropolitan regions of the United States at approximately 10 to 15 year intervals (Hartgen and San Jose, 2009). To illustrate standard practice at MPOs similar in size to the Southeast Florida region, Table 1 shows the sample sizes achieved on household surveys for the ten largest metropolitan regions in the United States in the past 20 years. In this period at least one and oftentimes two surveys of at least 5,000 households were conducted in these metropolitan regions. The typical sampling rate is 1 in every 400 households (0.25%).

While there are many similarities in the design of these surveys, each survey is tailored to the specific requirements of the sponsoring agencies as well as to the characteristics of the survey population. The following three examples illustrate approaches that are relevant to the design of a household survey for the Southeast Florida region. In particular, in planning the next survey, the following lessons learned from prior work are important considerations:

- a. Trip under-reporting occurs whenever respondents are asked to report their travel. It can be more significant when more than one day of travel is reported, due to respondent fatigue. It has become common practice to equip a small fraction of households or persons with vehicle or wearable GPS units. The logs from the GPS units are converted to trips and compared to the reported trips, so that factors can be developed to correct for under-reporting. It has been found that under-reporting is not limited to short and/or non-motorized trips; instead the issue cuts across all types of trips, and sometimes even entire tours are missed by respondents.
- b. Providing multiple ways to recruit households and retrieve the diary information is important to increase the likelihood of obtaining data from all types of households.
- c. Spatial stratification of the sample design is critical to ensure adequate representation across the entire region. Sample designs that are strictly proportional to population tend to under-represent travel behavior in the less urban areas of the region. This can be a significant shortcoming if these are the areas that are expected to develop faster in future years.
- d. Over-sampling infrequent populations (for example high income zero car households) and/or important but infrequent travel behaviors, such as use of certain transit modes, is critical to ensure adequate representation for planning and modeling analyses. Over-sampling improves the efficiency of the sample – more information is available for the same overall sample size.

- e. The questionnaire must be tailored to the planned uses of the data. Much of the information asked for in a household travel survey is standard. But some questions are optional, and since the length of the survey affects completion rates and cost, careful planning is required to ensure that the survey meets all needs in a cost effective manner.
- f. The survey period and survey days must also respond to the intended uses of the data. Most surveys exclude weekends, summer months and holidays because travel during these days is considered atypical. In particular, if the data are primarily intended to understand weekday travel behavior, then all atypical days must be identified so no households get assigned to report travel on these dates.

3.3.1 New York – New Jersey 2010-2011 Household Travel Survey

The 2010-2011 Regional Household Travel Survey (RHTS) obtained a sample of more than 18,000 households in 28 counties in New York, New Jersey and Connecticut -- the 3-state region modeled in the New York Best Practice Model (NYBPM). Its design accounted for the very large size of the region (7.9M households), and the unique diversity of its demographics, transportation systems, travel choices and behavior. The survey design plan aimed at obtaining within the resources available to implement the survey, as efficient, robust and rich a sample dataset as possible for effective use by the New York Metropolitan Transportation Council (NYMTC) and other agencies in the region for ongoing travel forecasting model development activities in the region (Donnelly, 2010).

The data will be used for primarily for the enhancement of the NYBPM, but also for transportation planning, analysis, research, and policy. The new RHTS is needed to update the current profile of travel in the region, resulting from the changes that have occurred in the region during the 12 years since the last survey of its type. This new survey provides information for gaining an in-depth understanding of activity patterns and all modes of travel behavior for households and individuals within the modeled area. The sample data to be obtained in the survey are being collected primarily to support the update and extension of the NYBPM, and specifically to provide the basis for the estimation and calibration of a new robust and rigorously developed set of activity/travel behavior model components. This regional travel data base and the enhanced modeling tools it will support will be used to conduct policy analysis and realistically forecast future travel behavior for a variety of planning scenarios.

The sample was designed as a stratified random sample, to ensure adequate representation of all counties in the final sample, as well as to capture important but infrequent travel behaviors, including:

- Long (20+ miles) and very long (50+ miles) distance trips within the region
- Work trips to Manhattan and to counties other than where the worker resides
- Selected travel modes that are important for planning purposes but exhibit overall small shares, such as premium bus, ferry, light rail and drive access to subway.

Table 3-1. Household Travel Surveys in the Largest U.S. Metropolitan Areas

Region	Survey Year	Region Households ¹	Sample Size (completed households)	Average Sampling Rate	Cost ² (nominal \$)
New-York / New Jersey Metropolitan Area	2010-2011	7,783,415	18,965	0.24%	
	2001	7,383,602	13,243	0.18%	
	1997-1998	6,563,900	10,971	0.17%	\$133
Southern California Metropolitan Area	2012	8,074,093	20,043	0.25%	
	2000	7,130,472	16,939	0.24%	\$176
	1991	6,702,856	36,037	0.54%	\$83
Chicago Metropolitan Area	2007-2008	3,761,312	14,315	0.38%	\$161
	1988-1991	3,147,530	19,314	0.61%	
Southeast Florida (Miami – Broward – Palm Beach)	2008	2,453,530	2,670	0.11%	
	2000	2,149,749	5,067	0.24%	\$89
Philadelphia – Delaware Valley Metropolitan Region	2001	2,510,013	5,677	0.23%	\$279
	1988	2,318,532	1,567	0.07%	
Dallas Metropolitan Area	2008	2,469,827	5,900	0.24%	
	1996	1,708,200	3,996	0.23%	\$161
Houston – Galveston Metropolitan Area	2008	2,220,075	5,810	0.26%	\$63
	1996	1,547,300	2,443	0.16%	\$73
Washington D.C. Metropolitan Area	2007	2,163,663	11,578	0.54%	\$143
	1994		4,865		
	1988	1,633,191			
Atlanta Metropolitan Area	2011	2,065,336	10,278	0.50%	
	2001	1,638,535	8,069	0.49%	\$186
	1991	1,202,167	2,138	0.18%	\$112
San Francisco Bay Metropolitan Area	2012	2,785,948	7,896	0.28%	
	2000	2,552,402	15,064	0.59%	\$100
	1996		3,678		\$136
	1990	2,250,970	9,359	0.42%	

¹United States Census Bureau. *Intercensal Estimates of Housing Units for Counties*.

²Source: Hartgen, D.T. and E. San Jose. (2009). "Costs and Trip Rates of Recent Household Travel Surveys". Cost per completed sample depends on multiple factors, including the sample design, sample frame, length of questionnaire, sampling period, sampling methods, and sample size, among others.

A statistically based minimum sample size was established to provide county-level profiles of population and travel characteristics. The primary purpose of having a prescribed minimum number of sampled households in each county is to ensure that a basic profile of travel by the residents of each county can be developed from the data with what will be accepted as reasonable levels of sampling errors. These profiles are for descriptive reporting of measures of interest to each county jurisdiction and can be related to other data commonly reported by jurisdiction.

In addition, two over-sampling schemes were developed to identify subareas expected to exhibit different travel behaviors, and in this way improve the efficiency of the household survey beyond what is possible with just county-based sampling. One of the over-sampling schemes considers the density of residential and commercial development, while the other considers transit accessibility. Household sample quotas were established for each of eleven area types (based on density and type of development), and four transit accessibility types.

The final sample design combines the county minimum, long distance, work trip location, transit mode, area type and transit accessibility criteria to define household sampling rates for census tracts in the region, eventually classified into 21 groups, by their sampling rate.

3.3.2 California 2012 Household Travel Survey

The 2012 California Household Travel Survey (CHTS) was a multi-modal study of the demographic and travel behavior characteristics of residents across the entire State of California (NuStats, 2012). Detailed travel behavior information was obtained from over 42,000 households, surveyed throughout the entire year including weekdays, weekends and holidays. The survey was sponsored by the California Department of Transportation, the California Strategic Growth Council, the California Energy Commission, and the Metropolitan Planning Organizations of Southern California, the San Francisco Bay Area, and the Monterey Bay Area, among other local planning organizations.

The main objectives of the survey included:

- Develop and update transportation models to meet statutory federal and state requirements
- Collection of data on use of all travel modes and tolled facilities
- Proper targeting of long distance travel
- Accurate representation of weekday and weekend travel
- Detailed data on vehicle acquisitions, parking choices, work schedules and flexibility, and active transportation

Key aspects of the CHTS survey and sample design include:

- Address-based sampling frame
- GPS sub-sample, with approximately 12% of all households equipped with a vehicle GPS or a wearable GPS in addition to the standard trip reporting diary
- Multiple recruitment and data retrieval modes, including computer-assisted telephone interviewing (CATI), internet-based via the CHTS website, and U.S. postal service.
- Stratified probability sample that ensured adequate representation from urban and rural areas, and over-sampling of hard-to-reach populations including large households (5 or more persons), low income households (\$25,000 or less), young population, Hispanic population, and zero-car households.
- Household, person, vehicle, trip and out-of-home activity questions

3.3.3 Atlanta 2012 Household Travel Survey

The purpose of the 2011 Regional Travel Survey (RTS) was to improve the Atlanta Regional Council travel demand forecasts, in both its aggregate four-step trip-based model and its disaggregate activity-based model. The goal was to obtain demographic and trip data from a minimum of 10,000 households, including a subsample of 1,000 households that would also provide global positioning system (GPS) data. The final data set contains information for 10,278 households, of which 1,061 households also provided GPS data (PTV NuStats, 2011).

The survey was conducted between February 2011 and October 2011, with a break during the summer. Households were randomly assigned to report travel during non-holiday weekdays only, so that each weekday comprises approximately one-fifth of all reported travel.

A dual sampling frame approach was used that combined the strengths of two sampling frames—Address-based frame and Listed Residential frame. The listed residential frame includes telephone numbers for which the name and address associated with the telephone number are known. The advantage of this frame is the ability to directly reach households and secure their participation in the survey in a direct and active approach. Unlisted numbers and households without landlines are covered by the address-based frame, which includes all addresses with U.S. postal service delivery.

The sample was stratified along two dimensions: area type, which correlates with population and employment densities, and transit use. Areas of the region where households have a higher than average likelihood of using transit were identified partially using data from the 2009 On-Board Survey, supplemented with areas within half a mile of a rail station. Households in the CBD, urban areas and high transit use areas were over-sampled. In addition, stratification by household size and number of workers in the household was used to ensure adequate representation across both characteristics. The sample was monitored to ensure adequate representation of zero car households, low income households, large households and Hispanic households.

3.4 Alternative Travel Pattern Data – Uses and Limitations

There are several other sources of travel pattern data, besides household travel surveys. It is important to understand that they complement, rather than replace, the information provided by a household survey. While these sources can be substantially less expensive than a household survey, none of them offers the richness of detail provided by a household survey.

3.4.1 Census Transportation Planning Package (CTPP)

The CTPP is a set of special tabulations designed by transportation planners using large sample surveys conducted by the Census Bureau. From 1970 to 2000, the CTPP and its predecessor, the Urban Transportation Planning Package (UTPP), used data from the decennial census long form. The long form has now been replaced with the American Community Survey (ACS). The first CTPP available for TAZ geographies will be based in the 2006-2010 ACS, and is expected to be released in October 2013.

CTPP provides three different sets of tabulations:

- Characteristics of households and workers by place of residence
- Characteristics of workers by place of work
- Worker flows between home and work

The worker flow tabulations are of special interest for transportation planning and travel demand modeling because they are the most comprehensive TAZ-based tabulations of work travel patterns.

Since CTPP is based on large sample surveys, its tabulations tend to be more reliable than data from a household survey at small geography levels. This makes these tabulations particularly useful for model calibration purposes. The one important caveat of the CTPP worker flow tabulations is the degree to which observations are suppressed to protect respondent confidentiality. For example, in the 2000 CTPP worker flow tabulations for the Southern California region, approximately one-half of all observations were suppressed from the worker flows by household income tabulations. The degree of suppression varies from region to region and by survey year, so the extent to which suppression will affect the usefulness of the Southeast Florida 2006-2010 worker flow tabulations remains to be ascertained.

CTPP tabulations cannot be used for model estimation because the individual trip, person or household records are not provided; only summaries of the data at TAZ level and for pre-established attributes are available.

It should be understood that CTPP provides information on the typical workplace location, and not on work trips or work tours on any given day. To be sure, the majority of work trips are to the usual workplace, for people with fixed work place locations. CTPP does not provide any information on non-work travel, which constitutes two-thirds or more of all weekday trips.

3.4.2 Longitudinal Employer - Household Dynamics (LEHD)

LEHD is a Census Bureau program that combines data on employers and employees from the Quarterly Census of Employment and Wages (QCEW, also known as Employment and Wages or ES-202 data) and unemployment insurance wage records with the data on workers' residence from censuses and surveys, to develop a partially synthetic data about workers' residential patterns (worker flows) at very detailed geographical levels. The LEHD worker flows product is similar to the CTPP worker flows, but they are available at finer spatial detail (census blocks), and are produced every year.

It is important to keep in mind that the worker flow tabulations are partially synthetic. The Census Bureau applies statistical techniques to "disclosure proof" the block-level tabulations, essentially introducing controlled statistical noise into the estimates to prevent the identification of individuals (Abowd et al., 2002).

Certain categories of employment are not reported in the QCEW or UI records and therefore these workers are not represented in the LEHD data. Jobs exempt from unemployment insurance, whether by federal or state laws, are not included. The Florida Statutes, Title XXXI, Chapter 443.036 define categories of employment exempt from Florida unemployment insurance. Examples include real estate agents remunerated by commission only, barbers, domestic service employment, small fishing operations, and physical therapists working under contract with home health agencies, among many other occupations. Independent contractors are not included in LEHD either.

The worker flow patterns obtained from the Florida 2010 LEHD data showed longer distances between home and work, on average, than similar patterns derived from NHTS 2008 and ACS 2006-2010. As shown in the table below, in relative terms, LEHD indicates nearly twice as many workers that work in a county other than their residence county, compared to ACS. It is clear that there are employment coverage differences between these two sources (2.5 million according to ACS, 1.9 million according to LEHD). But more importantly, these coverage differences appear to introduce a bias in the LEHD worker flow distribution, which results in much larger estimates of workers who work outside their residence county in LEHD and in ACS. Whether these differences in the relative distribution of workers stem from the locational nature of the non-covered employment, or from the methods employed to synthesize LEHD worker flow data, is unknown.

Table 3-2. Southeast Florida Worker Flows

Data Source	Residence County	Work County					
		Miami-Dade	Broward	Palm Beach	Miami-Dade	Broward	Palm Beach
ACS 2006-2010	Miami-Dade	1,060,000	71,400	4,600	42.3%	2.8%	0.2%
	Broward	126,700	640,000	53,200	5.0%	25.5%	2.1%
	Palm Beach	8,000	46,300	498,000	0.3%	1.8%	19.9%
LEHD 2010	Miami-Dade	695,900	103,000	26,300	37.0%	5.5%	1.4%
	Broward	138,100	447,100	61,500	7.3%	23.7%	3.3%
	Palm Beach	29,200	65,200	316,400	1.6%	3.5%	16.8%

Excludes workers who live or work outside of the three-county Southeast Florida region.

3.4.3 Cellular Device Data

AirSage, an Atlanta, GA based private company, provides trip flow products derived from cellular device (phones and tablets) signals. Using proprietary algorithms, AirSage tracks the signals recorded by cellular towers from individual devices as the phone/tablet moves over space, and converts these signals into individual trips. While the signals are anonymous, unique devices are identified and tracked over multiple days, allowing the identification of patterns in the device movements, such as the location of home and work places. The main advantage of the cellular device data is its large sample size and coverage. The sample size varies by location but it is typically several orders of magnitude larger than a household survey. Millions of phone signals can be synthesized in a relatively short time and low cost to provide trip flow patterns over virtually any spatial level of detail used in transportation analysis. The data can be segmented by day of the week or time of day to provide the necessary level of detail. The main disadvantage of these data is that they do not provide any information about the people making the trips. Attributes such as household income, auto availability, household size, age, gender, occupation, ethnicity, employment status, work flexibility, etc., which are important for transportation planning, cannot be correlated with the trip flow data.

Some characteristics of the trips themselves may be inferred. Work and school trips can be inferred from multiple days' worth of data by correlating the location of the longest stop of the day (other than home) to land use data. It may be possible to infer the purpose of other trips by correlating the location of trip ends to parcel-based land use data. Similarly, some information about travel mode may be inferred from the speed at which the device moves over space. The algorithms are proprietary so their performance cannot be independently verified.

Because origin-destination travel patterns at small spatial levels are very costly to obtain using person surveys, due to the large sample sizes required to achieve statistical significance, the cellular device data offers a good, inexpensive way to supplement the data collected with traditional household surveys. This technology however cannot at this time provide the comprehensiveness and richness of information critical for many transportation planning activities, such as travel demand modeling. Instead, these data can be thought of as replacing and extending the traditional project level origin-destination intercept surveys that are often conducted to obtain segment-specific travel patterns.

3.4.4 Transit On-Board Surveys

Transit on-board surveys are a type of intercept study that captures detailed trip-level information from people while they ride a transit vehicle or wait at a rail station. On-board surveys are the preferred way

for conducting large sample size surveys of transit users because the vast majority of household travel surveys are very inefficient at finding transit users. Household travel surveys are inefficient because the region-wide share of transit users in all U.S. metropolitan areas, except New York, is typically in the order of less than 2% to 3%.

The primary disadvantage of an on-board survey relative to a household survey is that, because they are intercept surveys, typically they record only information about the trip that was intercepted, as opposed to complete day-long trip diaries. Trip-level information is necessary but not sufficient for the development of an activity-based model like SERPM7. In addition to trip level information, tour-level information is also required. For example, with trip-only data little if anything is known about the mode used on the return trip, let alone about access and egress mode, wait time, etc. For this reason on-board surveys supplement, but do not replace, the transit component of household travel surveys. The recommended approach is to oversample transit users in the household survey, by targeting households located within close proximity of rail stations, and other transit-user rich areas, as identified in Census data.

4 Recommended Approach for a Southeast Florida HTS

The following guidelines are intended to broadly define desirable characteristics of the next Southeast Florida Household Travel Survey. They are not intended to obviate the need for a detailed survey design proposal, as may be provided by a survey firm, but rather as guidance for planning purposes.

4.1 Sampling Frame

The preferred sampling frame is an address-based frame, such as the address databases maintained by the U.S. Postal Service. An address-based frame offers better coverage than a listed telephone-based frame, because the latter miss unlisted numbers and households without landlines. A second important advantage of an address-based frame for a household travel survey is the ability to sample households by attributes of their location, such as proximity to rail stations and development density, and to include Census data in the sample design. In this way, an address-based frame can more efficiently identify populations that are important for transportation planning purposes yet relatively infrequent in the overall population, such as transit using households, low income households, zero-car households, and households of certain ethnicities. Efficient sampling and over-sampling of targeted populations can reduce the overall sample size of a household survey while improving the quality of data collected.

Recruitment is conducted primarily via phone, but can be supplemented as needed with mail and even in-person visits, particularly to improve the participation rate of hard-to-reach populations.

4.2 Survey Methods

The preferred data collection modes are computer-assisted telephone interviews (CATI), computer-assisted self-complete interview (CASI) or web surveys, and Global Positioning System (GPS) –based methods. These methods yield higher quality data than mail-back self-complete paper questionnaires because they have built-in checks that flag inconsistent/illogical responses and force respondents to correct their data in real time. GPS-based methods are extremely useful to measure and correct for trip under-reporting, when used in conjunction with trip diaries. GPS technologies can also be used to replace trip diaries, greatly relieving the reporting burden placed on survey participants. In this instance, the GPS-derived trip log is shown to participants for eliciting, *a posteriori*, all relevant details of the

recorded trips. The GPS devices can be vehicle GPS or person (wearable) GPS; in both cases the devices are loaded to each household for a certain period of time and the surveys are staggered over time so that each device can be used multiple times.

In order to maximize the return on the household survey cost, follow-up surveys may be conducted on a sub-sample of survey participants to probe certain questions in more detail. For example, a Stated-Preference survey can be administered to a subsample of participants, to gather data useful for understanding willingness-to-pay or deriving value of time distributions. Other specialty studies that are of interest only over a specific cohort of the general population could be piggybacked on the household travel survey sample. This can include, for example, studies of housing affordability and discrimination conducted on low income or other minority residents, studies of fuel efficiency and vehicle purchase behavior, studies of typical travel patterns and residency patterns of seasonal residents, among others.

To improve data completeness, a household observation shall be deemed complete when all members of the household report activity/travel diaries. Persons older than 16 years old shall be required to report their own travel, while younger persons can have their travel reported by proxies. Since MPOs and the DOT are primarily concerned with planning for typical weekday travel demand, it is most cost-effective to collect only non-holiday weekday travel diaries.

4.3 Sample Size

There are two essential and distinct aspects of how the survey data are used for transportation planning and model development:

4.3.1 Statistical and Comparative Analysis of Travel Patterns

The survey data should support detailed analysis of travel patterns across a wide range of population attributes, as well as at small enough geographic levels to provide useful information for planning studies. When expanded, the survey data need to provide reliable estimates of trip and tour frequencies segmented by mode, purpose, time of day, and origin-to-destination patterns, and also segmented by population cohorts (income, ethnicity, auto availability, occupation, gender, age, work status, etc). For this planning objective, the larger the overall sample is the less sampling error there is, and the more reliable are the observed travel patterns that the survey can yield -- both overall and for important travel market segments (or "cells") which will grow proportionately to the overall sample. There are, however, continuously diminishing returns in the improvement of sample reliability with increasing the size of the sample. The marginal costs also increase almost linearly, with a fixed cost per household added. From this perspective, the overall sample sizes result, to some extent, from balancing resources and survey costs with the desired standard errors for calculating average travel pattern measures. The development of calibration target values for model calibration is an example of the types of aggregate travel measures that can be generated from a household travel survey.

4.3.2 Statistical Estimation of Choice Models

The survey data will also allow estimating the behavioral relationships that comprise the core choice models of SERPM7. Statistical efficiency and accuracy in the estimation of discrete choice models come from adequate sample sizes for each model to estimate, and adequate representation of the range of observed choices, in particular low incidence cases. It is important to understand the expected frequency of low incidence behaviors, such as kiss-n-ride to transit in the mode choice model, or very long trips in the destination choice models. Such "rare" behaviors have relatively very small shares of overall regional travel and are hard to capture in useful numbers in a strictly proportional sample. These

behaviors need to be oversampled in some manner, unless a reliable and comprehensive secondary data source such as an on-board survey is available.

4.4 Sample Design

The following observations are offered to guide the development of a sample design plan for SERPM7:

- Segmentation by spatial location, such as 5-6 subareas within each county, is helpful to attain adequate representation of households throughout the entire model region.
- The sample design shall account not only for spatial representativeness, but also aim at collecting sufficient samples across a wide range of population attributes. This can be achieved by stratifying the sample using criteria such as density of development, transit accessibility, commute pattern, household size, household income and/or household workers. In addition, the sample design must be supported by multiple sample control tables, which need to be actively monitored during the household recruitment stage.
- SERPM7 operates with individual persons within the household rather than the household segments pertinent to a four-step model. In this regard, segmentation by person type is essential. SERPM7 recognizes 8 person types that are characterized by very different travel behavior (full-time worker, part-time worker, university student, non-worker of active age, retiree, driving-age school child, pre-driving-age school child, pre-school child).
- In order to capture important but infrequent behaviors in a cost-effective manner, it may be necessary to over-sample certain populations. Such infrequent behaviors may include zero car households, transit users, long commutes, and toll road users, among others. Similarly, some consideration may need to be given to sampling populations that tend to refuse participation at higher than average refusal rates.
- University students always represent a “thin” segment and special provisions may have to be made to ensure that university students living in dorms and non-family households (rent apartments) are present in the sample in sufficient numbers. Part-time students represent an important fraction of the adult student population in Southeast Florida, and it is anticipated that they exhibit significantly different travel patterns than the typical four-year college student. To the extent that accurate representation of college student travel patterns is important for the next generation of SERPM, the sample design shall include a plan for sampling the student population.
- SERPM7 operates with tours as the main unit of travel. In this regard, number of tours in the household survey rather than number of trips is the ultimate measure of the sample size.
- SERPM7 requires detailed segmentation by travel purpose (work, university, school, escorting, shopping, other household maintenance, eating out, visiting relatives and friends, other discretionary, and work-based).

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