Enhancing State and MPO Transportation Planning Using National Household Travel Survey Add-On Data: The Wisconsin Experience

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Abstract

The paper showcases the applications of the 2001 NHTS Wisconsin add-on data in modeling statewide and urban passenger travel demand. Specifically, the paper presents the methodology and some preliminary results from best-practice traditional travel demand models. Since the 2001 NHTS add-on data collection for Wisconsin focused both on individual Metropolitan Planning Organization (MPO) regions and on the state as a whole, the urban area models and the statewide model are developed using a consistent source of travel data. The same level of consistency was adopted in developing the urban and statewide zone systems and networks.

The paper describes how specific NHTS data are used in the trip generation, distribution and mode choice phases of the modeling process. As an example, cross-classification analyses are based on a household's reported trip making and socioeconomic characteristics, attraction equations are developed by purpose and urban area, traditional gravity models are derived from the trip length distribution, mode choice models including motorized and non-motorized trips are under development for the larger urban areas in Wisconsin, and mode choice and destination choice models are estimated for long distance travel.

The ultimate value of the NHTS data and the models that are developed is reflected in the expected use of these models to support the MPO and statewide planning processes and policy decision-making. At the statewide level, the data and modeling will be used to help make decisions about the new Connections 2030 long-range transportation plan. In the urban areas, the NHTS data and the developed models will be used to develop the MPO's long range transportation plans and to help evaluate the tradeoffs between a range of proposed transit and highway projects, address questions about air quality conformity, and provide the planners with a valuable tool to evaluate "what if" questions.

Keywords: Travel demand forecasting, statewide models, urban area models, data analysis, National Household Travel Survey (NHTS)

INTRODUCTION

The Wisconsin Department of Transportation (WisDOT) assists Metropolitan Planning Organizations (MPOs) with developing and maintaining urban travel demand models in ten urban areas in Wisconsin. Only the MPO for the largest urban area in the state, the seven-county Milwaukee region in southeastern Wisconsin, has the staff and resources to do all of their own travel modeling and planning. They also collect their own household travel survey data roughly every ten years for major travel model updates. Of the other ten urban areas, only Madison has a travel demand model based on a household travel survey conducted in the 1990s.

The travel demand models for the other nine urban areas were originally based on transferred models, a range of different data sources, and travel surveys (some of which were conducted in the 1960s). Furthermore, previous generations of statewide travel demand models were developed without the benefit of a statewide travel survey. Given the lack of existing household level travel data in Wisconsin, both at the statewide and urban area level, and given the complexity of collecting for so many urban areas, WisDOT decided to participate in the 2001 National Household Travel Survey (NHTS) by collecting a major add-on sample. The NHTS add-on sample covers the entire state of Wisconsin and at the same time collects enhanced samples for ten urban areas in the state. The resulting unweighted sample of about 17,000 households yields a total of almost 160,000 daily trips and a total of more than 40,000 long distance trips providing the most critical input to both the statewide and the MPO modeling efforts (Table 1).

Objectives of the Statewide Model

The objective of the statewide model is to develop an updated policy-sensitive model of passenger and freight flows in the state of Wisconsin to support system planning analyses at a statewide level and to identify the passenger and freight traffic potential by mode along key corridors in the state. The statewide model will be used to support the update of the Wisconsin long-range transportation plan, Connections 2030, and has the following key features:

- The analysis of daily and long-distance passenger flows is based on travel data included in the NHTS add-on sample for Wisconsin while the freight model is based on commodity flow data;
- Passenger and freight flows are assessed using models, a zone system, and a network that provide the required level of policy sensitivity to help address “what if” corridor-level investments;
- The level of detail incorporates key corridors in the state and reflects the current and future operation of multiple passenger and freight modes in each corridor;
- Updated and detailed networks of both freight and passenger movements are coded to account for the potential of diverting passenger and freight traffic to other parallel facilities or corridors;
- Updated 2000 data and 2030 forecasts are used to revise the underlying socioeconomic, land use, and network data that form the backbone of the statewide model system; and
- A single software platform is used to streamline all of the model components and act as a decision support system for the WisDOT.

Objectives of the MPO Models

The primary objective of developing models for nine individual urban areas in Wisconsin was to support the long range transportation planning process for each MPO. In particular, the MPO model development project includes models for the urban areas of Madison, Janesville, Beloit, Green Bay, Appleton, Oshkosh, Fond du Lac, LaCrosse and Eau Claire. The most important features of these urban area models can be summarized as follows:

- The NHTS add-on sample for Wisconsin is used as the primary source of data for all passenger movements to, from and within each MPO’s boundaries (Figure 1);
- A single software platform is used for all MPO models to ensure consistency both among the MPO models and with the statewide model;

- Urban area models use outputs from the statewide model for all movements that are external to the each MPO's study area;
- The zone system and networks for the MPOs are consistent with but more detailed than the statewide model components; and
- The passenger modeling process follows the more traditional four-step process for urban models and is supplemented by a freight model component for each MPO.

The Critical Role of the NHTS Survey Data

The NHTS add-on was viewed as a unique opportunity to significantly enhance both statewide and MPO transportation planning efforts by making them data-driven and by developing both statewide and urban travel models based on a consistent set of high quality household travel survey data. Consistency is a common theme that applies to the development of the zone system and networks, the estimation of the different models, the software platform, and the linkages to the Traffic Analysis Forecasting Information System (TAFIS), a WisDOT management system that stores traffic information and predicts traffic flows in the future.

The NHTS add-on sample is a customized data collection effort at different levels of geographic detail that allows the development of consistent models both at the statewide level and the urban area level. This paper describes how we are using NHTS data in the trip generation, distribution, and mode choice phases of the modeling process. It also discusses how the NHTS data and the developing models will be used in both statewide and urban area planning processes and policy decision-making.

LITERATURE REVIEW

The need for understanding the travel patterns in an urban area dates back to the 1960s and led to the development of the early aggregate urban travel models. The need for intercity models that would quantify the magnitude and the determinants of longer distance travel at a major corridor level, such as the Northeast corridor, emerged roughly at the same time. However, the impetus for developing statewide models has seen an increasing emphasis over the past ten years reflecting the need of state DOTs to better understand the determinants and magnitude of passenger and freight travel patterns in a broader corridor-level context.

The state of the practice of statewide models is documented in a report for FHWA prepared by Horowitz (*1*). This report summarizes approaches for estimation and calibration, outlines different data sources and then discusses in more detail, statistical methods used for passenger and freight forecasting. The report also discusses empirical work by different consulting firms on the statewide models for Michigan (*2*), Kentucky (*3*), and New Hampshire (*4*) among others, and proposes a set of best practice methods to use in freight and passenger statewide modeling efforts. The report also documents earlier work by Koppelman (*5*) on the structure and estimation of intercity models, Brand et al (*6*) on forecasting high speed rail ridership, and Miller (*7*) on review of intercity models.

The recent TRB-sponsored conference on statewide models held in August 2004 in Florida, offered an excellent overview of past and ongoing modeling efforts at a statewide level. A number of states have recently developed or are currently developing statewide models. The differences among these statewide models can be summarized and grouped under the following broad categories:

- The extent of the study area beyond the state boundaries and the way "external" trips are treated in the model;
- The level of zonal and network detail and the degree to which the MPO models are integrated in the statewide model;
- The nature of the modeling approach where a more traditional trip-based modeling approach is used compared to a tour-based approach; and

- The extent to which a freight model is included along with a passenger model in the analysis framework.

The literature on urban area models is considerably broader and dates back to the early 1960's. A recent summary of methods and data sources is provided by the National Cooperative Highway Research Program (NCHRP) Report 365 (*8*) which provides a thorough review of four-step estimation techniques for urban areas and discusses transferable parameters that can be used in simple analyses.

The existing body of literature on statewide and MPO travel models is large and includes all aspects of estimation, calibration and validation. There appears to be a general consensus among the practitioners and researchers regarding the need for customized, area-specific data for better understanding travel behavior. The NHTS add-on data seek to address this need and provide a powerful tool for addressing transportation policy questions at varying levels of geography.

NHTS 2001 WISCONSIN ADD-ON SAMPLE

The importance of local data for better transportation planning is widely acknowledged. Previous unavailability of such data has limited in-depth transportation planning studies at both the statewide and regional levels in the State of Wisconsin. The NHTS 2001 Wisconsin add-on data fill in this "data vacuum" and constitute a powerful information tool for better addressing the state's transportation problems. This section examines the NHTS 2001 Wisconsin add-on data set in detail and sets the stage for the statewide and MPO model estimation described in the next section.

Survey Components

The 2001 Wisconsin NHTS add-on survey was conducted over a one-year period from May 1, 2001 through May 6, 2002 (*9*). The survey included only the civilian, non-institutionalized population in Wisconsin and a small part of Minnesota that adjoins La Crosse, Wisconsin. Fraternity and sorority houses were also surveyed provided the residence included less than 10 members. Medical institutions, prisons and barracks on military bases were excluded from the sample. The NHTS defined household members as people who considered the sampled household as their primary place of residence. Data collected as part of the NHTS are classified into six broad categories and data files:

- Household File: Household information including size, structure, income level, and characteristics of the geographic area in which the household is located;
- Person File: Household member demographic and economic information including age, sex, race, education level, and work-related characteristics;
- Auto File: Household vehicle information including year, make, model, and annual miles traveled;
- Daily Travel: Information on one-way trips taken during a designated 24-hour period (the household's travel day) such as the start and end time of the trip, length of the trip, composition of the travel party, mode of transportation, purpose of the trip, the location of the destination, and the specific vehicle used (if a household vehicle). These trips will be referred to as "daily trips" in the balance of this paper;
- Long Distance Travel: Information on the round-trips taken during a four-week period (the household's travel period) where the farthest point of the trip was at least 50 miles from home, including the farthest destination, mode, purpose, and travel party information. These trips will be referred to as "long distance trips" in the remainder of this paper; and
- Most Recent Long Distance Travel: Information on the most recent long-distance trip by any mode if no long-distance trips were made during the four-week travel period.

Figure 1 shows the geographic distribution of the households surveyed as part of the NHTS. As indicated, most of the urban regions in the state were sampled at a higher rate in comparison to the rural parts. The distributions are generally similar for all the geographic sub-regions in the state. A total of about 17,000 household

records were available for analysis. These households corresponded to a total of about 40,000 person records, 160,000 daily trip records and 40,000 long distance trip records. Table 1 shows the breakup of these household, person, daily and long distance trip records by each urban sub-region in the state. The numbers shown in Table 1 point to the utility of NHTS as a data source for both statewide and urban transportation planning. Apart from offering a comprehensive database of observed travel behavior in the entire state of Wisconsin, the NHTS provides sufficient data to focus on any given urban region in the state.

Survey Weights

The NHTS data provided appropriate weights to enable population-level analysis. Different weighting procedures were adopted for the household, person and trip information. A complete analysis with details on survey weights is presented in Chapter 5 of the *2001 NHTS User's Guide* (*9*). Table 1 shows the weighted estimates of households, persons, daily, and long distance trips by each sub-region. The NHTS Wisconsin add-on sample represents a total of about 2.1million households, 5.3 million individuals, 7.4 billion "daily trips" per year, and 70.5 million long distance trips per year.

Data Characteristics

The survey weights have been used to examine household and trip data characteristics in greater detail for each sub-region. This section presents some key household and trip statistics relevant to statewide and MPO trip generation analysis discussed in Section 4. Figure 2 shows the distribution of households by household size, number of workers, and vehicle ownership categories, respectively. Table 2 indicates that an average household in most of the sub-regions in Wisconsin has about 2.4 members, 1.4 workers and 2 vehicles.

Figure 3 shows the distribution of daily and long distance trips produced by each sub-region each year. The daily trips are disaggregated by six trip purposes – home based work, home based shopping, home based social/recreational, home based school, home based other and non home based. As already mentioned, the southeastern Wisconsin seven-county region, which contains the state's largest urban area in Milwaukee, was not separately sampled in the NHTS add-on, and therefore, has not been included in this plot. However, the Dane County region that contains Madison, the second largest urban area in the state, has been given due priority in the sample. Figure 3 clearly shows Dane county region to be the largest producer of annual daily and long distance trips among all the urban regions shown.

The area-specific household, person and trip information presented here, and the accompanying weights for population-level analysis render the NHTS as a comprehensive transportation database for travel demand modeling.

Geocoding

The NHTS 2001 deems the confidentiality of the survey respondents as critical. This consideration has been given priority in analyzing and geocoding the data for Wisconsin statewide and MPO model estimation. While the underlying data for both the MPO and statewide models are the same, the household, person, daily trip and long distance trip files were geocoded by WisDOT staff both to the statewide and the MPO zone systems. It should be noted that:

- Detailed latitude and longitude data for the daily and long distance trip ends were available for locations within Wisconsin. However, data for non-Wisconsin locations were not as detailed;
- The latitude and longitude information may not necessarily represent the true geographic location of the trip ends.

The geocoding phase associates a statewide zone and an MPO zone to each household and trip end, creating a database that is ready for analysis and estimation.

OVERVIEW OF THE STATEWIDE AND MPO MODELS

The NHTS 2001 add-on enables transportation planning analysis at different levels of geography. This section presents some preliminary findings from the ongoing Wisconsin statewide and MPO travel demand model development projects. The NHTS data serves as a common denominator for both these efforts, thereby facilitating a consistent process for estimation, calibration, and validation of models at both Statewide and MPO levels. Figure 4 summarizes the statewide and MPO travel demand modeling processes and shows the communication and interactions between the two model systems.

Elements of the Statewide and Urban Models

In addition to the consistency in travel behavior data fostered by the NHTS, the statewide and urban models were also designed to provide consistency in terms of the study area, zone systems, the highway network, the software platform for model application, and developing critical linkages with existing databases and management systems that are currently being used by WisDOT. A brief description of each model element is provided below:

Study Area

The state of Wisconsin constitutes the primary study area for the statewide model and is treated at a great level of geographic detail. The freight model, not discussed in this paper, focuses on a much larger area encompassing all the counties in Wisconsin, the Bureau of Economic Analysis (BEA) districts outside the state, and also a few of the border zones in Canada and Mexico. The daily passenger model has a narrower and more detailed focus, with the zone system extending to a buffer of two to three counties in the neighboring states of Minnesota, Iowa, Illinois and Michigan (Figure 5). The long distance passenger model considered destinations to anywhere in the United States in addition to the detailed Wisconsin zones. Finally, the study areas for the individual urban area models were defined by each MPO to reflect the boundaries of each Metropolitan Planning Organization.

Zone System

Although there are different levels of detail in developing the zone system for the statewide and the MPO models, a consistent approach was used to allow the transfer of data between the statewide and the MPO levels. The statewide zone system was developed around the DOT's City/Village/Town database and was designed so that the individual MPO zones "nest" within the 1,642 statewide zones. Figure 6 shows the statewide zone system and highlights the more detailed Madison system of more than 700 zones used for the urban model nested within the statewide zones.

Highway Network

The highway network was developed using the topography of the Wisconsin System of Local Roads (WISLR) database and the attributes of the State Trunk Highway Network (STN) maintained by the WisDOT. The correspondence with both databases was critical in ensuring consistency with WisDOT databases and providing linkages to the DOT's management systems.

Software Platform

The reliance on a common software platform further facilitates the common "look and feel" of the statewide and the different MPO models. The common platform is expected to foster increased utilization of the models, enhance cooperation among DOT and MPO staff, and foster a model users group within the state.

Linkages with Management Systems

The zone system, highway and transit networks, and all of the individual model components were built with the objective of ultimately linking to decision support tools such as TAFIS already in place at the Department. This was

an important consideration in the effort to make the statewide model part of the existing analysis processes at WisDOT.

Examples of Model Estimation

The more or less parallel development of the statewide and the individual MPO models also ensured that a set of common modeling procedures would be used in the model estimation and model application process. Best practice elements of the trip-based approach to modeling are used to model the base- and future-year flows on the statewide and MPO study areas. As indicated in Figure 4, both the statewide and MPO daily trip models use a sequential four-step process, with some differences such as the estimation of destination choice models for long distance travel or the estimation of detailed mode choice models for selected urban areas reflecting the different needs of various parts of the study area.

Trip Generation

The daily trip generation phase comprised two separate steps: trip production and trip attraction. The trip production step used a cross-classification methodology to derive the production rates for each trip purpose. The cross-classification variables were determined using a detailed Analysis of Variance (ANOVA) procedure that indicated the most important explanatory variables by trip purpose. The trip production rates were determined by computing ratios of trips produced in each cross-class category to the number of households in the corresponding category. Some of the cross-class categories such as the 2-worker and 0-vehicle category, had very few observations from the NHTS sample. The trip production rates derived for such categories, therefore, needed smoothing by combining with similar cross-class categories, like for example, the 2-worker and 1-vehicle category. Final trip production rates were computed for each geographic region ensuring consistency in model estimation at the statewide and MPO levels. Table 3 shows the production rates for home based work trips for each geographic region.

The Trip Attraction procedure utilized a regression analysis methodology to derive purpose-specific rates. The NHTS trip data were used to summarize the attractions to each model zone. The employment information necessary for regression was derived from the Place of Work data released as part of the Census Transportation Planning Package (CTPP). The following sets of linear regressions were developed by purpose:

- A first set of equations for the entire state of Wisconsin;
- A second set of equations for the urban and rural areas separately; and
- A final set of linear regressions for each of five geographic regions.

The National Cooperative Highway Research Program (NCHRP) Report 365 (*8*) provided insights into the choice of most relevant employment variables for explaining purpose-specific number of attractions. Table 4 shows the results of the regression analysis by geography. The estimation of regression equations by geography has ensured a consistent estimation procedure between the statewide and MPO models.

Trip Distribution

A traditional gravity model procedure was adopted for trip distribution. The geocoded NHTS data were used in conjunction with the network skim times to derive observed trip distribution curves. Initially, NCHRP 365 procedures were used to arrive at a preliminary set of friction factors for each purpose. These friction factors were then iteratively refined by comparing the predicted trip length distribution with the observed trip length distributions. Figure 7 shows the results from the trip distribution procedure for the home base work trip purpose. The NHTS data serve as a reality check for the predicted trip length frequencies and provide the means for validating the trip distribution model as a stand-alone item.

Mode and Destination Choice

A set of mode choice models are being developed for the long distance travel market. These models are developed to help support “what if” analyses and the WisDOT’s decisions related to supporting bus service around the state and intercity rail service. Traditional measures of in-vehicle travel times, access and egress travel times, frequency

of service, transit fares, and the availability of a one-seat ride for destinations around the state are used as explanatory variables. The two future-year scenarios for bus service that have been developed for evaluation include an "essential mobility" scenario for bus service covering all municipalities with a population over 10,000 people and a "bus feeder" service to complement the proposed high speed rail network.

Similarly, mode choice models will be developed for the larger urban areas under study. The mode choice model is developed in part to address and evaluate the proposals for a fixed guideway enhanced transit solution that has been studied for Madison over the past five years. Nonmotorized modes will be included in the model to account for the high incidence of walking and biking in this urban area.

A destination choice model has also been estimated to quantify the travel patterns for the long distance trips. The strength of this model is its improved policy sensitivity compared to the traditional gravity models that are used for the shorter daily trips. Separate destination choice models have been developed by trip purpose and take into account:

- Measures of O-D impedance and eventually the composite utility from the mode choice model,
- Measures of zonal attractiveness such as a zone's area and different types of employment by purpose; and
- Regional constants to reflect the attractiveness of zones with greater concentration of activities not captured by the employment variables.

Model Validation

The validation of the statewide travel demand model system is currently under development, focusing on each of the steps of the modeling process. Most importantly, the development of the trip table is examined to ensure that the influence of Chicago and Twin Cities, two major metropolitan areas just outside the Wisconsin boundaries, is properly accounted for by the model. Some of the data sources that are used in model validation include:

- Estimates of total trip making and district to district origin-destination patterns;
- Comparisons of observed and modeled flows along a total of twenty screenlines with seven north-south and thirteen east-west screenlines dissecting the state;
- Analyses of origin-destination travel surveys at key locations in the boundaries of Wisconsin with the upper peninsula of Michigan, Minnesota, Iowa, and Illinois;
- Ridership information for bus and rail routes; and
- Comparisons of modeled flows with automatic traffic recorder and TAFIS passenger and truck traffic counts collected at individual locations around the state.

SUMMARY AND CONCLUSIONS

The desire to make both the statewide and MPO planning processes more data-driven and the lack of existing household-level travel data in Wisconsin, prompted the WisDOT to participate in the 2001 NHTS by collecting a major add-on sample, both at the statewide and urban area level.

This statewide travel survey dataset and the enhanced samples for selected urban areas have provided a rich source of data to observe travel patterns for Wisconsin as a whole and to measure differences and similarities across the urban and rural parts of the state. The geocoded origin-destination travel data are used to develop both statewide and urban area travel demand models, which are still very much works-in-progress. Having a solid base of data for the development of the various models, developing them on a consistent basis across the urban areas in the state, and nesting the urban models with the statewide model should all go towards significantly enhancing the confidence of the various stakeholders in the models and for their use in the transportation planning process.

The analysis of the NHTS add-on database has so far documented considerable similarities in travel characteristics across urban areas in Wisconsin, although typically residents in each urban area like to consider themselves unique in some ways. WisDOT did not have a consistent database to make these comparisons to identify whether more similarities than differences existed with regard to travel patterns and characteristics across different areas in the state. Therefore, WisDOT decided to collect enhanced samples for each of the urban areas it directly assists in travel model development to help ensure the buy-in of the MPOs as partners in this consistent and nested approach to travel model updates. If WisDOT participates as an add-on in the next generation NHTS, it would likely do so at a significantly smaller scale by consolidating the urban area samples.

The likely use of the completed travel demand models by each MPO will largely depend on the issues that each MPO seeks to address in their urban areas. Because the NHTS was a revealed preference survey (and not a stated preference survey), the models cannot be directly used to estimate the demand for new modes of transportation, such as commuter rail, trolleys, etc., that do not currently exist. However, the models will provide a level of detail on the existing origins and destinations of trips, by trip purpose, to indicate the most promising corridors for such alternative modes, if considered.

At the statewide level, WisDOT plans to use the statewide travel model extensively in testing alternative transportation initiatives for the new Connections 2030 long-range multi-modal transportation plan. One example relates to estimating future heavy truck traffic on Wisconsin highways from a new major inter-modal rail facility managed by Union Pacific Railroad across the border in Illinois (northwest of Chicago).

In summary, the range of the "what if" type questions that can be addressed is limited only by the nature of the revealed behavior travel data which deal with existing modes of transportation. The NHTS add-on sample provides a solid travel database that provides the WisDOT with a complete picture of travel patterns in the state and enables the analyst to focus on travel patterns within each urban area in the state. The availability of this rich data source provides a high level of confidence in model development and the results of the alternatives testing than previous efforts based on weaker and not necessarily consistent data collection efforts.

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Figure 1. Geographic Distribution of Households Surveyed by the NHTS Wisconsin Add-On

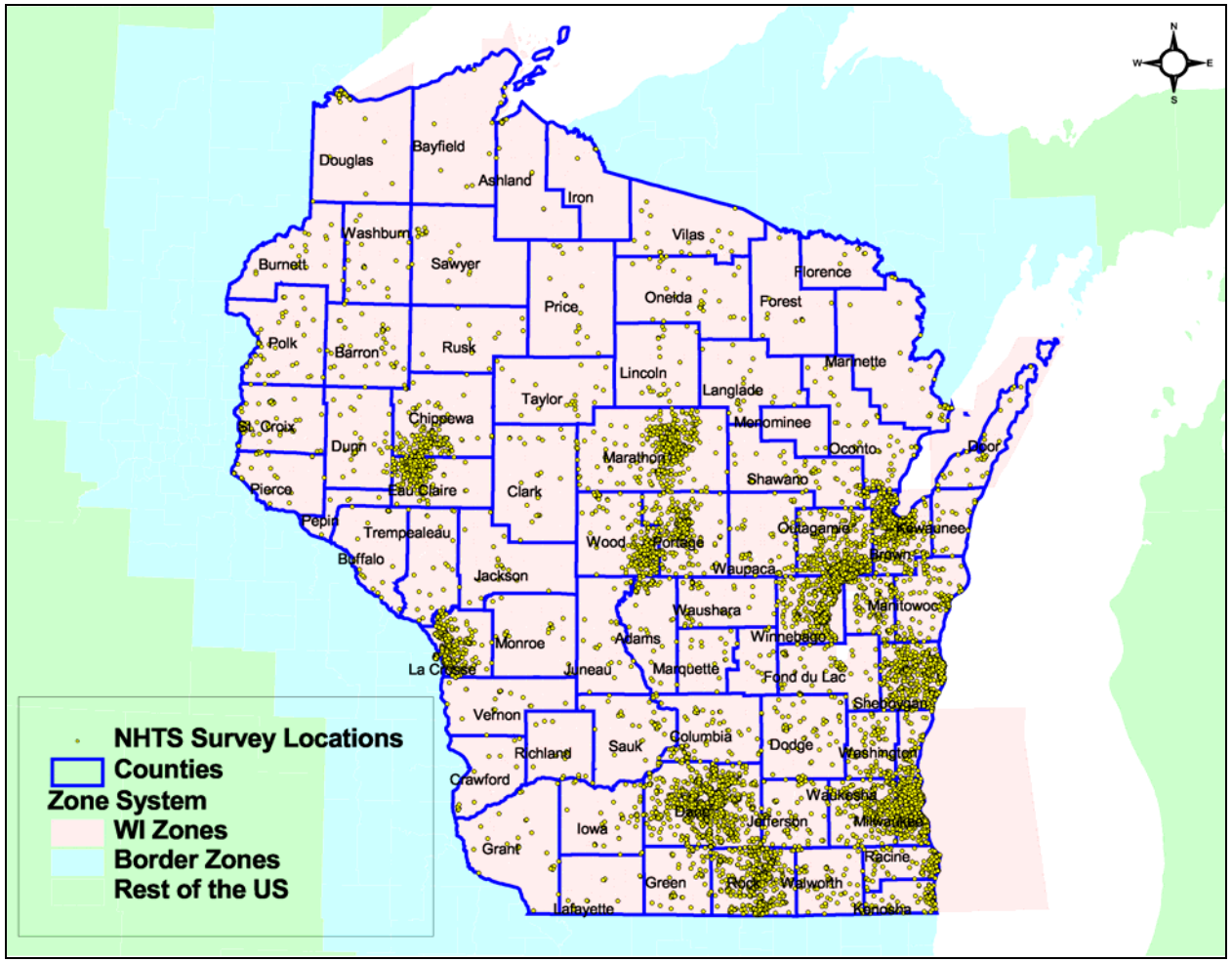
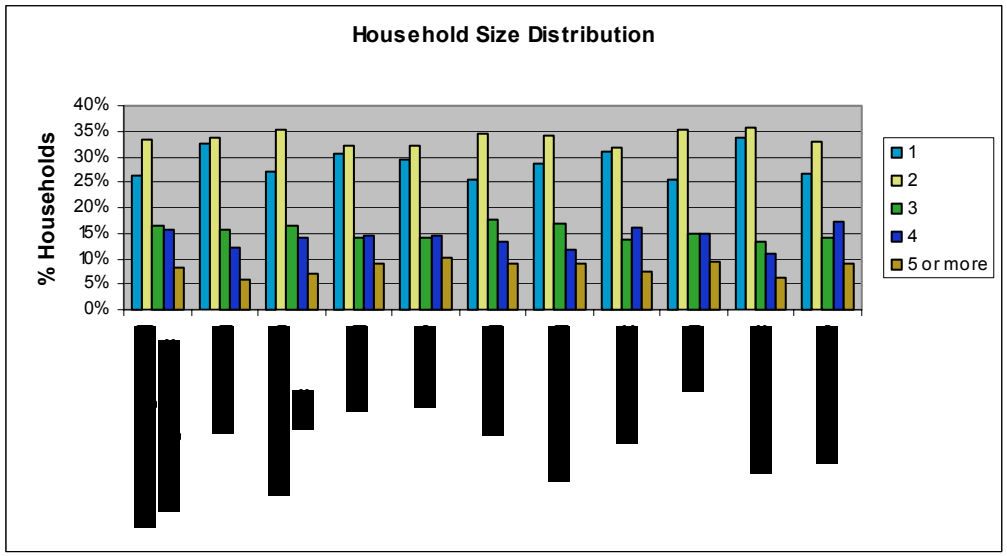
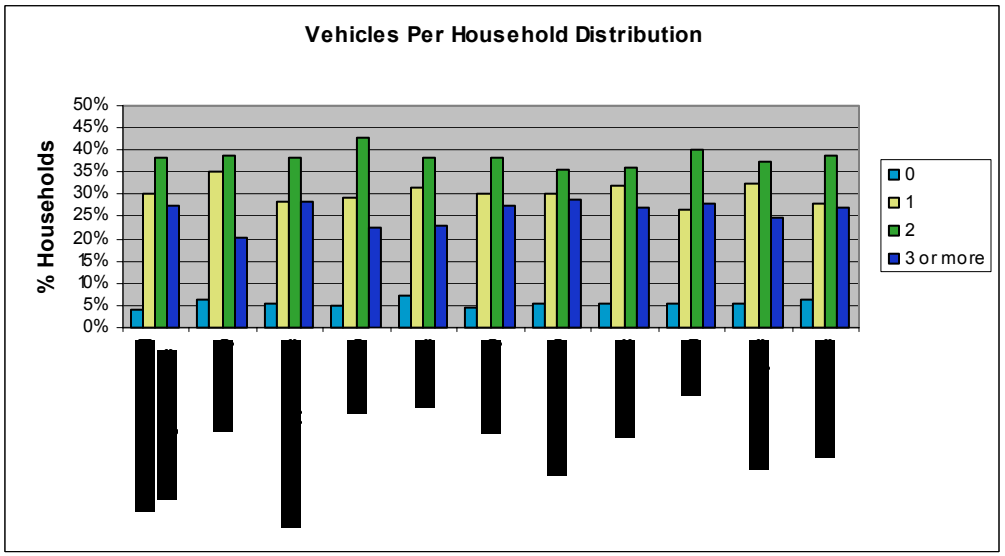


Figure 2. Household Characteristics by Sub-Region





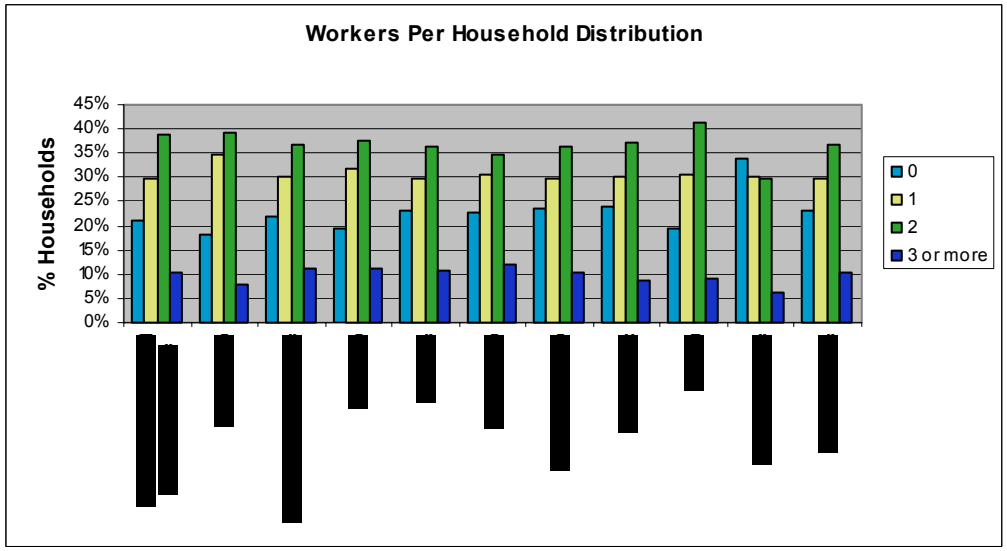
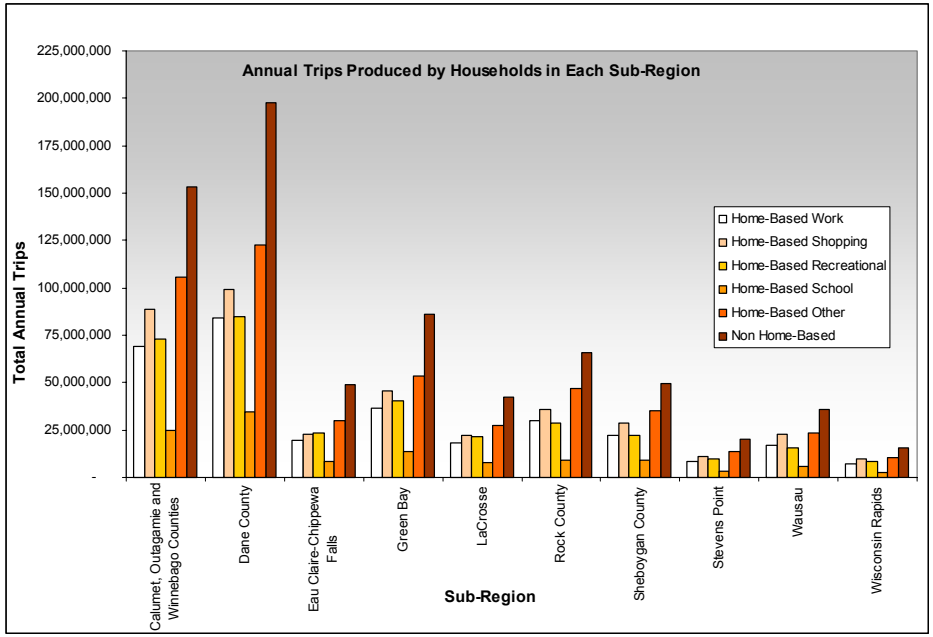


Figure 3. Annual Daily and Long Distance Trips Produced by Households in Each Sub-Region



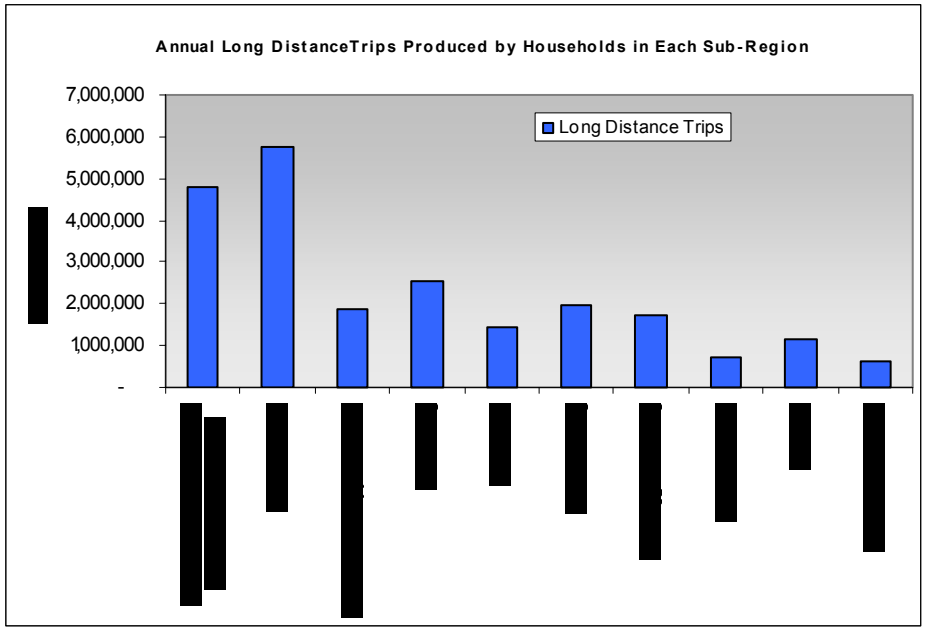


Figure 4. Statewide and MPO Travel Demand Modeling Processes

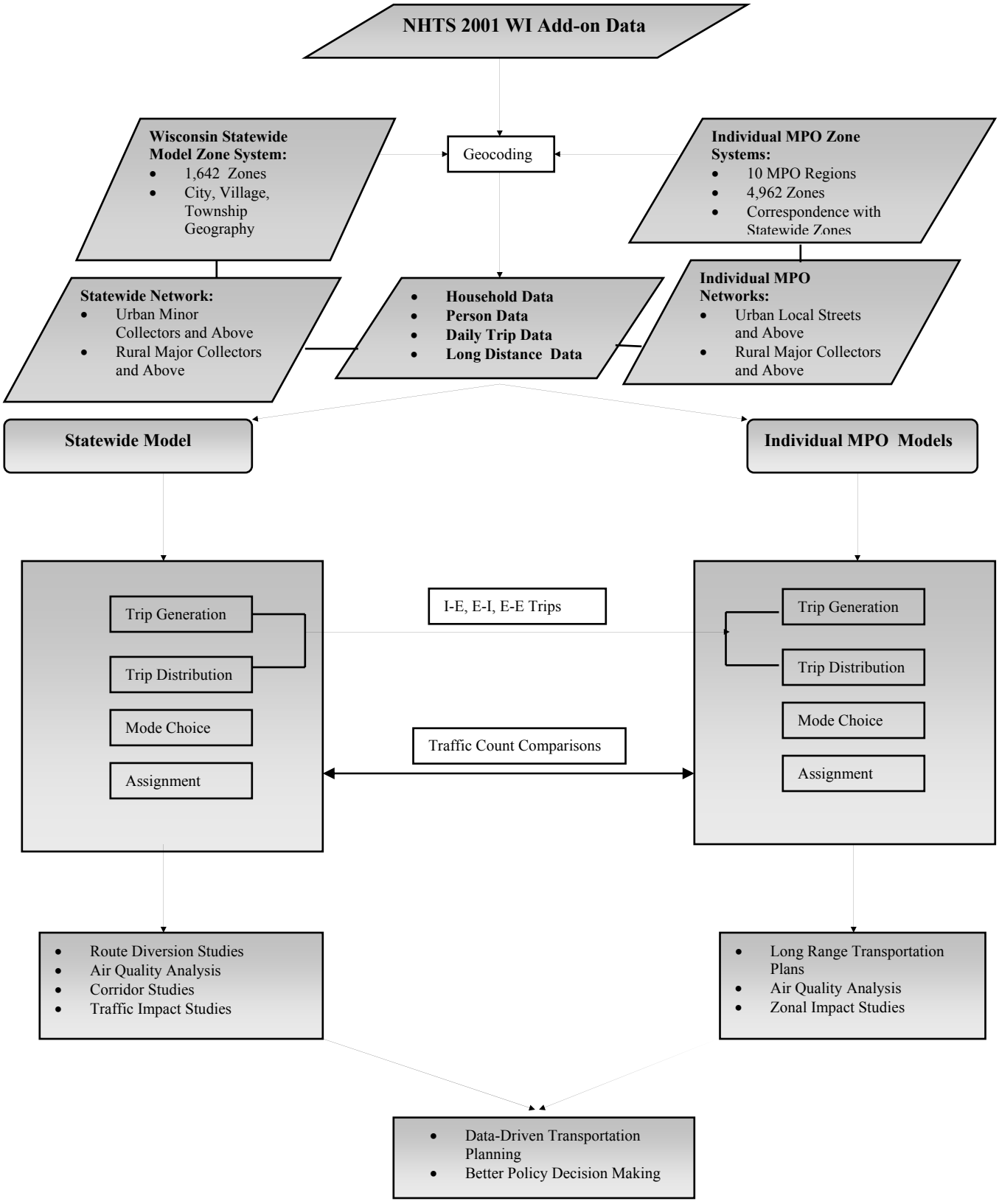


Figure 5. Statewide Passenger Model Zone System

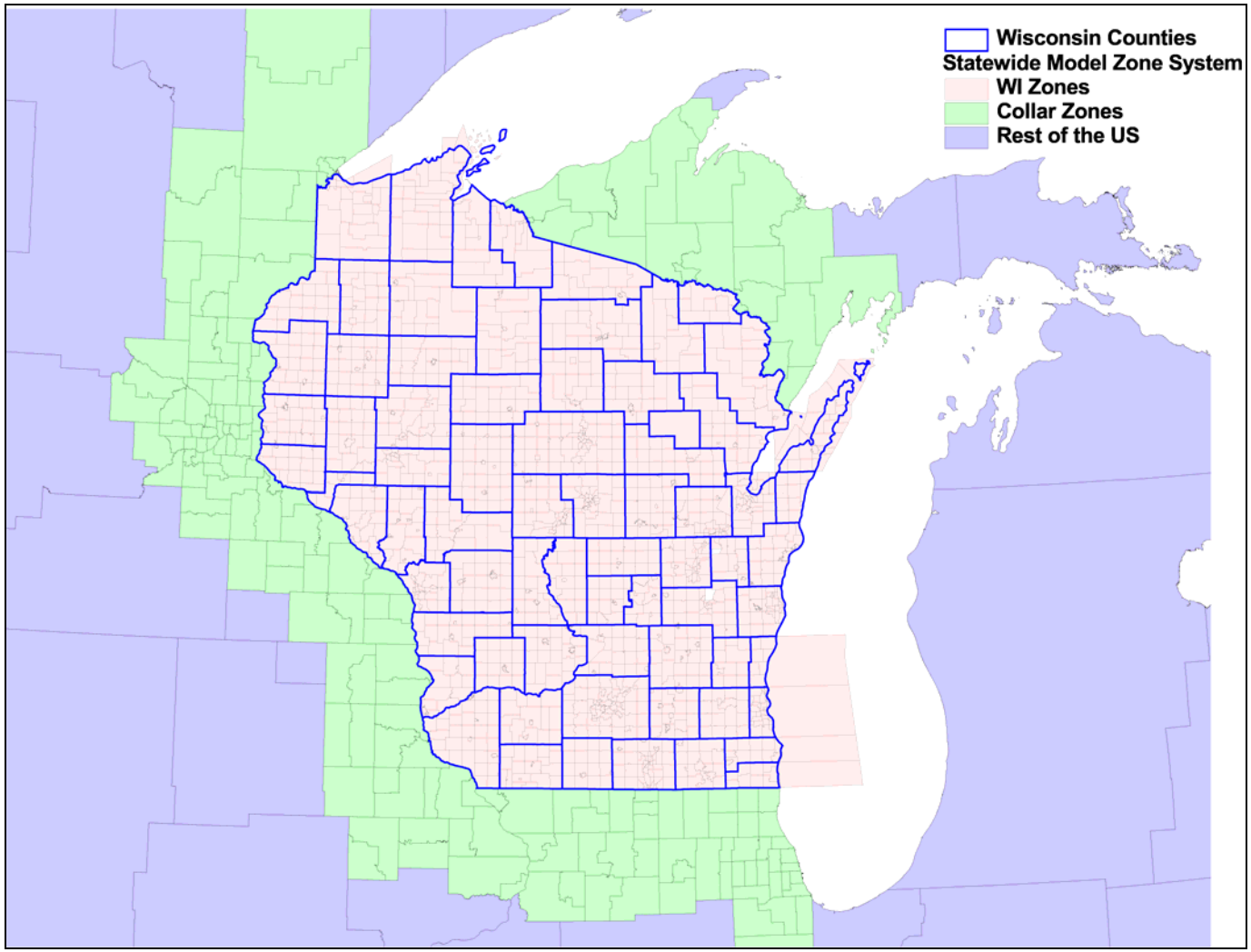


Figure 6. Dane County Statewide and MPO Zone System Relationship

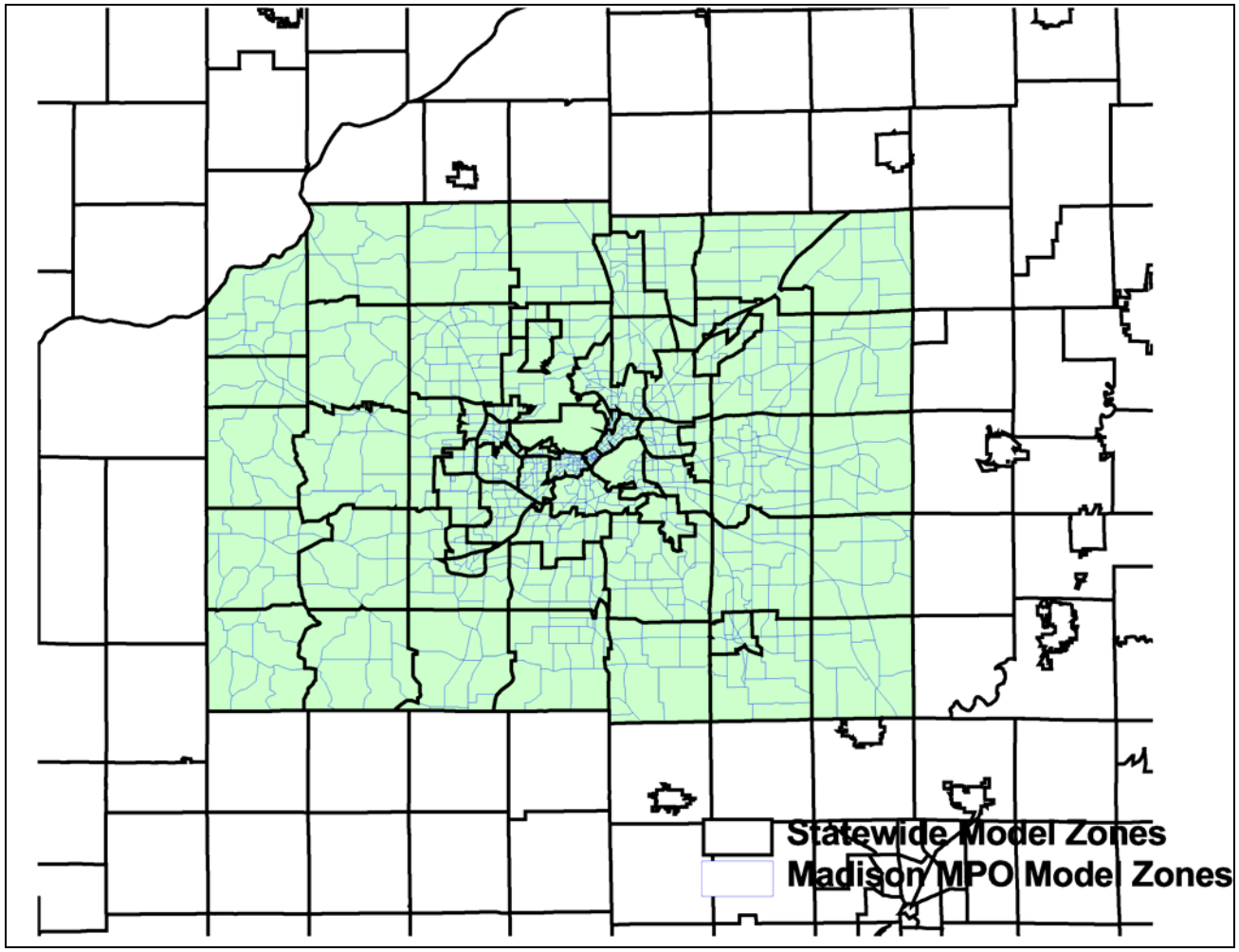


Figure 7. Home Based Work - Observed Vs Predicted Trip Length Distributions

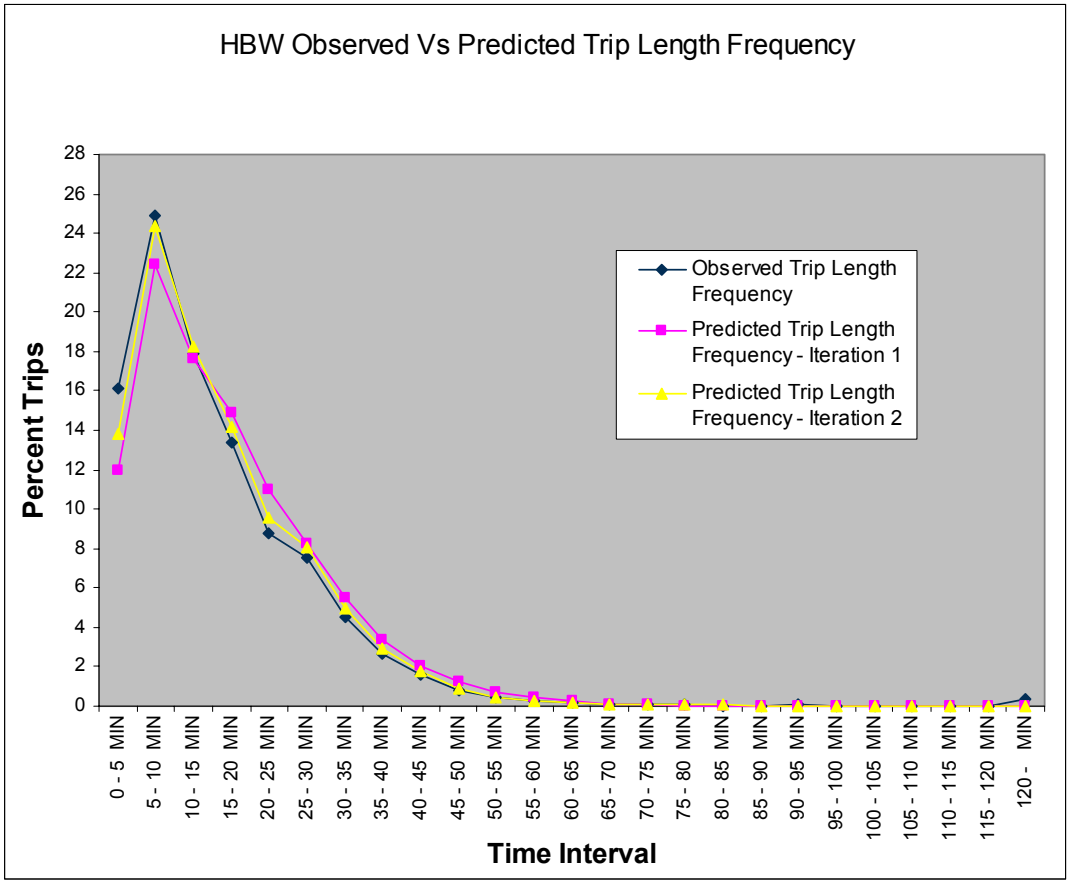


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Table 1. NHTS Households, Persons, Daily and Long Distance Trips by Sub-Region

Sub-region	Number of Households Interviewed	Weighted Household Count	Persons Interviewed	Weighted Person Count	Daily Trips Reported	Weighted Annual Daily Trips	Long Distance Trips Reported	Weighted Annual Long Distance Trips
Calumet, Outagamie and Winnebago Cnty	2,403	136,300	5,613	343,486	22,928	514,224,111	6,004	4,818,320
Dane County	2,841	173,184	6,210	406,064	26,351	623,443,766	6,601	5,766,687
Eau Claire-Chippewa Falls	1,140	43,976	2,587	107,012	10,175	153,104,360	3,324	1,880,793
Green Bay	1,430	74,176	3,259	181,786	13,584	275,506,985	3,348	2,526,418
LaCrosse	1,090	41,147	2,510	99,136	10,419	146,685,536	2,884	1,498,387
Rock County	1,569	59,126	3,618	148,867	14,746	216,498,442	3,670	1,978,361
Sheboygan County	1,363	43,770	3,114	109,128	12,980	166,609,992	3,954	1,737,625
Stevens Point	586	18,310	1,344	45,142	5,597	66,004,214	1,599	714,746
Wausau	983	33,357	2,318	84,759	9,081	120,932,938	2,599	1,147,915
Wisconsin Rapids	400	16,095	851	39447	3,247	54,025,361	1,010	646,583
Balance of State	3,160	1,214,034	7,592	3,066,018	28,544	4,184,016,538	7,703	40,466,652
Total - All Regions	**16,965**	**1,853,475**	**39,016**	**4,630,845**	**157,652**	**6,521,052,243**	**42,696**	**63,182,487**
Unspecified	645	270,435	1,544	649,586	6,126	892,977,942	1,315	7,331,078
Total	**17,610**	**2,123,910**	**40,560**	**5,280,431**	**163,778**	**7,414,030,185**	**44,011**	**70,513,565**

Table 2. Average Household Size, Workers and Vehicles

Sub-region	Mean Household Size	Mean Workers Per Household	Mean Vehicles Per Household
Calumet, Outagamie and Winnebago Counties	2.50	1.42	2.05
Dane County	2.28	1.39	1.84
Eau Claire-Chippewa Falls	2.44	1.40	2.12
Green Bay	2.43	1.43	1.93
LaCrosse	2.52	1.39	1.93
Rock County	2.51	1.38	2.10
Sheboygan County	2.44	1.35	2.06
Stevens Point	2.39	1.34	2.03
Wausau	2.53	1.43	2.06
Wisconsin Rapids	2.24	1.10	1.96
Balance of State	2.53	1.37	2.04

Table 3. Trip Production Rates by Geography

MPO Region	Trip Production Rates by Geographic Sub-Regions												
	Workers by Autos												
Daily Trip Rates	0 Workers - 0 Autos	0 Workers - 1 Autos	0 Workers - 2 Autos	1 Workers - 0 Autos	1 Workers - 1 Autos	1 Workers - 2 Autos	2 Workers - 0 Autos	2 Workers - 1 Autos	2 Workers - 2 Autos	3 Workers - 0 Autos	3 Workers - 1 Autos	3 Workers - 2 Autos	Total
Appleton/Oshkosh/Green Bay	0.03	0.03	0.03	0.94	1.08	1.41	2.13	2.62	2.80	2.56	3.64	5.14	1.97
Madison	0.01	0.01	0.01	0.94	1.17	1.36	2.13	2.74	2.80	2.56	3.64	5.06	1.90
All Other MPO regions	0.06	0.06	0.06	0.94	0.95	1.49	2.13	2.33	2.72	2.56	3.64	4.60	1.80
SEWRPC Region	0.05	0.05	0.05	0.94	1.24	1.71	2.13	2.26	2.78	2.56	3.64	4.77	1.87
Rest of the State	0.06	0.06	0.06	0.85	1.04	1.37	2.13	2.68	2.68	2.56	3.64	4.57	1.89
Total	0.05	0.05	0.05	0.92	1.13	1.49	2.13	2.24	2.76	2.56	3.64	4.71	1.88

Table 4. Trip Attraction Rates by Geography

Purpose	Variables	Appleton/Oshkosh/Green Bay	Madison	SEWRPC	Other MPOs	Rest of the State	Urban	Rural	Statewide
	Number of TAZs	*74*	*66*	*102*	*192*	*1,208*	*434*	*1,208*	*1,642*
HBW	**Total Employment**	1.397	1.244	1.145	1.171	1.505	1.177	1.505	1.206
HB Shopping	**Retail Employment**	7.803	7.775	8.969	6.671	6.777	8.415	6.777	8.169
HB Recreational	**Households**	1.030	0.869	0.427	0.818	0.891	0.497	0.891	0.522
	Arts, Ent, Rec, Acco, Food	3.062	2.614	2.998	1.931	1.473	3.134	1.473	3.025
HB Other	**Households**	1.023	1.069	1.194	1.100	1.361	1.137	1.361	1.138
	Retail Employment	0.664	0.664	0.664	0.664	0.664	0.771	0.771	1.110
	Service Employment	1.268	0.594	0.393	0.870	1.189	0.516	1.152	0.508
HB School	**Population**	0.259	0.133	0.225	0.260	0.285	0.168	0.285	0.175
	Education, Health, Social Services	0.496	1.573	0.403	0.496	1.001	1.046	1.001	1.059
NHB	**Households**	1.327	0.823	0.725	0.908	0.802	0.682	0.802	0.733
	Retail Employment	8.479	7.450	6.471	6.842	1.007	7.009	1.007	6.525
	Service Employment	0.518	1.285	0.833	0.891	3.347	0.974	3.347	1.041