Small-Area Applications Using 1990 Census Transportation Planning Package: Gainesville, Florida

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The 1990 Census Transportation Planning Package (CTPP) was a valuable resource for the Gainesville Urbanized Area during the recently completed development and adoption of the 2020 Transportation Plan. The CTPP provided detailed information about socioeconomic and travel characteristics that was unavailable from other sources. These data were of value during several stages of development of the plan, which was adopted by the Gainesville Urbanized Area metropolitan planning organization on December 14, 1995. A case study of how the CTPP was used for the Gainesville Urbanized Area in its long-range transportation planning efforts is presented. The focus is on how the CTPP was used to validate the travel demand model in preparation for the development and evaluation of multimodal alternatives for the Gainesville Urbanized Area 2020 Transportation Plan.

Alachua County is a mostly rural county in north central Florida with a population in 1990 of 181,600. Of the nine incorporated cities in Alachua County, Gainesville is by far the largest, with a 1990 population of 84,800. Unincorporated Alachua County had a 1990 population of 83,100. Although Alachua County's economy is based on agriculture and correctional facilities, Gainesville is the major urban center in an 11-county region. Gainesville is home to the 35,000-student University of Florida and a major health care and regional state administrative center. The nearest major population centers are Jacksonville and Orlando, both more than an hour's drive away. Figure 1 identifies Gainesville and Alachua County within the state of Florida.

Beginning in early 1994, the Gainesville Urbanized Area metropolitan transportation planning organization (MTPO), in coordination with the Florida Department of Transportation (FDOT), embarked upon the development of a countywide travel demand forecasting model in preparation for the upcoming update of the urban-area long-range transportation plan. To coincide with data available from the 1990 census, the MTPO and FDOT chose 1990 as the base year for the model validation effort. The travel demand forecasting model in use before this study had been developed and validated for the Gainesville metropolitan area only. The Gainesville MTPO and FDOT hired JHK & Associates to conduct the countywide model validation. JHK was subsequently hired by the MTPO to prepare the Gainesville Urbanized Area 2020 Transportation Plan.

With development continuing to encroach into rural Alachua County and passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, the Gainesville MTPO and FDOT determined that a countywide, multimodal travel demand model would be needed to be able to effectively evaluate the impacts of future growth and to test alternatives other than adding roadway capacity. In addition, with an involved and interested public, the presence of the University of Florida, and very competent professional staff, the Gainesville

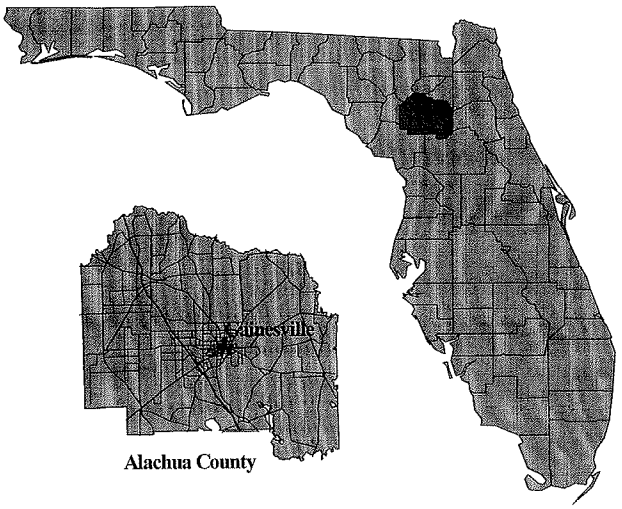

FIGURE 1 Gainesville, Florida, and vicinity.

area has done much to emphasize planning for nontraditional travel modes, including bicycling, walking, and on-campus transit service. As a result, the 2020 Transportation Plan would need to effectively address the need for improvements to these modes.

It should be noted that the staff for the Gainesville MTPO's long-range planning efforts consists of the director of transportation planning and two transportation planners from the North Central Florida Regional Planning Council. FDOT maintains a Gainesville urban office, in which a regional planning administrator and two transportation planners are located. With the small number of staff assigned to various planning studies, there was a strong need for available data sources like the census to provide needed inputs into the development of the Transportation Plan.

Applications of Census Transportation Planning Package

The Census Transportation Planning Package (CTPP) was used for a variety of applications during both the model validation effort and the update of the Transportation Plan for 2020. This section presents a discussion of the main CTPP applications, limitations, or problems encountered with the data and results of the applications.

Model Validation

The Alachua County model was developed for a base year of 1990 (*1–3*). Model validation consists of developing and updating travel demand parameters used in the traditional four-step travel demand forecasting process consisting of trip generation, trip distribution, mode choice, and trip assignment. These parameters include trip generation rates, trip length frequency distribution curves, automobile occupancy factors, and so forth.

During model validation, the Topologically Integrated Geographic Encoding and Referencing (TIGER) File was used to develop the network and traffic analysis zone (TAZ) boundaries for the portion of the county outside the Gainesville metropolitan area boundary, which had been the study area for the previous long-range plan. Census data were used for the following major applications:

- Developing socioeconomic data inputs for the travel demand model;
- Calibration of trip generation rates for home-based-work (HBW) trips;
- Reasonableness checks of average trip lengths for the journey to work;
- Providing documentation for HBW automobile occupancy factors; and
- Developing a methodology to estimate the number of bicycle trips made in the urbanized area.

Each of the above items is briefly described below, with more detailed discussions of the calibration of HBW trips and bicycle trips.

Socioeconomic Inputs

Census data were used by MTPO and local government staff in the development of the socioeconomic data by TAZ for the travel demand model. These data include population by household size and automobiles available and employment information by type (commercial, service, industrial, and total). Preparation of the TAZ-level socioeconomic data was delayed for several months while staff waited for the release of CTPP Urban Element, Parts 1 (Place of Residence) and 2 (Place of Work). In lieu of the CTPP data, local sources were used for the arduous process of developing the data. About halfway through this process, the Census Bureau provided a CD-ROM version of CTPP, Parts 1, 2, and 3.

Upon review of the place-of-residence data, local government staff determined that there were serious flaws in allocation of these data to TAZs, and much of the population information was provided from local sources. Although the Census Bureau did a reasonably good job of coding place-of-residence data to larger geographic areas (e.g., to the University of Florida or to the cities and places within the county), local government staff found that the TAZ-level geocodes were not accurate. However, the CTPP data on automobiles available and household size were used almost without modification, because the CTPP was the only available source for this

information. JHK & Associates made some reasonableness checks of these automobile ownership percentages, and although a few adjustments had to be made, the data were considered accurate.

Employment data by TAZ from the CTPP, Part 2, was the best source of this information for local government planners, so not much was changed. MTPO staff collapsed several categories of employment by occupation into the three required by TRANPLAN, the standard travel demand forecasting software used in Florida. However, some errors were noted during the validation data review process. For example, some 15,000 employees (about two-thirds of the entire complement of the University of Florida's faculty and staff) were coded to a single TAZ located across the street from the university campus, and nearly 1,000 service and commercial workers were coded to the TAZ containing Sorority Row. Several other changes were made in the TAZ allocation of employment data during this review process, but the CTPP data remained largely intact.

It should be noted that because of several inaccurate codings and the problems encountered by local government staff with the information on place of residence, a great deal of effort was spent developing and reviewing the 1990 base year socioeconomic data. In this regard, having the CTPP proved to be marginally helpful because it provided information unavailable from other sources; however, it did not result in any appreciable time or cost savings.

Calibration of HBW Trip Rates

During the validation process, it was noted that the travel demand model was underassigning trips on the highway network for most of the urbanized area. This was particularly evident on the more affluent west and north sides of Gainesville. The last travel characteristics survey for Gainesville, upon which the default trip generation rates are based, was conducted in 1971. On the basis of this review of link volume-to-count ratios, the 1990 CTPP was consulted to determine if changes in work trip rates were justified. As described below, the CTPP was used to calibrate the HBW trip generation rates used in the forecasting process.

HBW trip productions for Alachua County predicted by the model were compared with data obtained from the 1990 CTPP. The census identified the number of people living in Alachua County, the total number of employees in the county, and the number of employees who live and work in the county. On the basis of those breakdowns, the census shows that approximately 16,500 of the people employed in Alachua County live outside the county. In addition, the census identifies the number of one-way journey-to-work (JTW) trips made by Alachua County residents. To account for the trip from work to home and chained trips, the census JTW trips were multiplied by a factor of 1.85 to obtain estimated HBW trips. This conversion factor was estimated for Alachua County but was based on the procedure used in the Census Applications Workshops case study application showing how to convert census JTW totals into HBW trips.

Based on this comparison, the total HBW productions were estimated to be about 142,000 trips per day. The standard travel demand model trip generation rates for Gainesville resulted in the generation of about 102,400 daily HBW trips. Therefore, the HBW trip generation rate was uniformly increased by 40 percent for all the cells in the cross-classification table to reflect census survey results. Checks of the CTPP tables were made to determine if the increase should vary by household size and automobiles available. These checks indicated no justification to weight the increase by different automobile ownership or household size characteristics. The trip rate adjustment is as follows:

- Alachua County total employment, 93,006;
- Alachua County resident employees, 76,615;
- JTW to HBW adjustment factor, 1.85;
- 1990 CTPP HBW trips, 141,738;
- 1990 model-estimated HBW trips, 102,430; and
- HBW trip rate adjustment factor, 1.40.

The result of this increase in the HBW trip generation rates was a much improved volume-to-count ratio along screenlines. These improvements were most noticeable for northwest and southwest Gainesville. It was believed that additional increases in trip rates were needed to improve model results. Without data justifying increases in trip rates for other trip purposes (such as shopping or school), however, these adjustments were not made. Thus, a limiting aspect of the CTPP is that only JTW trips are included.

Automobile Occupancy and Trip Length Reviews

Because a household survey had not been conducted recently in Alachua County to determine travel characteristics such as automobile occupancy rates, it was necessary to borrow automobile occupancy factors from the CTPP and similar study areas. There are eight trip purposes in the travel demand forecasting model used in the county: home-based-work (HBW), home-based-shopping (HBS), home-based-social/recreational (HBSR), home-based-other (HBO), non-home-based (NHB), truck-and-taxi (TT), internal-external (IE), and external-external (EE). Only the first five of the above-listed purposes are included in the mode choice module of the model chain. The CTPP Statewide Element was used to obtain an automobile occupancy factor of 1.09

for HBW trips in Alachua County, and the other factors were borrowed from other study areas with similar characteristics.

In addition to the trip generation check described previously, this comparison of model results and CTPP data was made for the trip distribution step. All TAZs in the county were aggregated into 10 districts, and district-to-district travel flows for HBW trips were reviewed to determine how well the trip distribution model was performing relative to observed data from the census. However, because of inaccuracies in the coding of census survey responses to TAZs in Alachua County, the CTPP was used only as a benchmark, and not to make specific adjustments in the HBW trip lengths. This exercise was useful in making reasonableness checks of trip lengths and general distribution among districts.

The CTPP reported average JTW travel times of 22.5 min for Alachua County and 15.9 min for Gainesville. These travel times were used to adjust trip impedances for the HBW trips until a better calibration was achieved.

Because TRANPLAN uses a single set of friction factors for each trip purpose, the distribution model assumes that trip length propensities are equal throughout the county. This assumption makes distribution difficult in Alachua County, where the presence of the University of Florida and its related development affects trip lengths on the east and west sides of the urbanized area.

The model is limited in its ability to distinguish between residents living on the east side of Gainesville, who are not likely to make many trips related to the university and the central business district (CBD), and those living on the west and northwest sides of town, where most university students, faculty, and white-collar CBD employees tend to live. In fact, a review of the socioeconomic data from the CTPP showed that there is little in the model inputs to distinguish between university students and less affluent residents of the city's east side. The model socioeconomic categories do not distinguish students from other components of the population. Thus, longer average trip lengths and more congestion on the west side tend to discourage trips into the university and CBD from the west, whereas the opposite conditions on the east side encourage trips to those areas. In addition, more employment opportunities are available on the west side, so trips that might be destined for the university and CBD are satisfied closer to the place of residence.

Bicycle Trip Analysis

One of the unique elements of the Alachua County study area is the relatively large number of trips made by bicycle, particularly in and around the University of Florida. According to census JTW data, about five times more trips are made by bicycle within the study area than are made by public transit. Thus, the treatment of bicycle trips in the model validation process was an important consideration for this study area.

The process used to incorporate bicycle trips into the model validation process is summarized below. The 1990 census, along with the Bicycle Screenline Survey conducted in 1988, indicated the number and purpose of bicycle trips made in Alachua County. The latter survey was designed to obtain information about bicyclists' travel characteristics in Gainesville. It is important to note that the trip generation step in the standard model chain only recognizes trips made in vehicles (either automobiles or buses). In Florida the household survey data used to develop trip generation rates do not include person trips, such as those made by walking or bicycle. Thus, adjustments to the four-step modeling process to reflect bicycle trips must be made external to the travel demand model process.

The first step in the process was to obtain JTW data from the 1990 CTPP. Table 3-1 in the CTPP Urban Element provides JTW trips by travel mode used (including bicycle) at the TAZ level. These data allowed the identification of the number of reported bicycle trips from the origin or place of residence to the trip destination or place of work. Each trip origin and destination corresponds to a particular TAZ in the county. The CTPP is the only source of bicycle trip origin and destination data for Gainesville TAZs.

The second step involved building HBW and nonwork bicycle trip tables in the countywide transportation planning model, which entailed the creation of a matrix showing origin TAZ to destination TAZ and the number of trips made between each. One of the key assumptions for the analysis was that nonwork trip origins were essentially the same as HBW origins. This assumption was necessary because the CTPP data only included work trips. Nonwork trips include trips to school; primary bicycle trip destinations are the University of Florida and Santa Fe Community College. The nonwork trip table was then adjusted for all other trip purposes using 1988 data from the Bicycle Screenline Survey.

The 1988 Bicycle Screenline Survey results (also used in the 1985 model validation) contained the following allocation of bicycle trips by purpose: work trips, 12.8 percent; shopping trips, 6.3 percent; trips to school, 33.2 percent; social-recreation trips, 10 percent; trips to home, 31.3 percent; and other trip purposes, 5 percent.

Next the bicycle trips were multiplied by 2 to reflect the trip from work and school to home. The census provides data only on trips made from home to work, so an assumption was made that a return trip was also being made (it was assumed that trip chaining and other factors used in the 1.85 conversion factor would be less likely to occur for bicyclists than for automobile drivers). The two trip tables (HBW and HBNW) were then assigned to the

travel demand model's 1990 base year network to estimate bicycle volumes on each roadway link.

The Gainesville MTPO conducts an annual count of bicyclists at several key locations around the University of Florida and elsewhere in the metropolitan area. The HBW and nonwork bicycle trip volumes estimated through these steps were compared with the actual bike counts taken from the MTPO's Bicycle Usage Trends Program for 1990. Rather than a comparison of each count station, screenlines were established on major arterial roadways around the campus to allow for variances. Although some variations were noted, accuracy of the estimated volume was within 10 percent. It was therefore not necessary to further adjust the bicycle trip tables to match bicycle counts along the screenlines.

This process resulted in an estimated mode share of bicycle trips of about 6 percent of all person trips, which was consistent with the bicycle mode share found in the census JTW data. The trip generation rate file in the model does not include trips performed by nonmotorized modes of transportation such as bicycles and walking. Therefore, bicycle trips were not used to adjust traffic volumes in the validation year. In other words, traffic volumes were not reduced to account for the bicycle trips.

However, using the information developed for this analysis, bicycle trips were used to adjust the future year 2020 forecast of single-occupancy-vehicle (SOV) trips accessing the University of Florida campus. Two of the needs plan alternatives assumed that many SOV trips would shift to bicycle trips in the future because of increasing parking constraints on campus. Therefore, the non-automobile-oriented needs plan alternatives reduced the SOV trips accessing the university and increased bicycle trips to reflect parking limitations on campus.

Other Checks

During model validation and the transportation plan update, several other checks were made using CTPP data. Several maps were plotted using CTPP data showing automobiles available per household and persons per household for TAZs in the study area as a way to check the accuracy of the socioeconomic inputs and the trip distribution results. In addition, comparisons were made showing TAZs with comparable bus and automobile average travel times to assist in the evaluation of the mode choice model.

Usefulness of Census Data

The availability of detailed socioeconomic and JTW travel characteristics for Gainesville was essential to the development and adoption of the 2020 Transportation Plan for the Gainesville Urbanized Area. As described in this paper, the CTPP was particularly helpful in providing this information at the TAZ geographic level for the Alachua County model validation study. Several adjustments were made to improve the ability of the travel demand forecasting model to produce reasonable results. The justification for making these adjustments, particularly the increase in the HBW trip generation rates, would not have been available without JTW data. The result would have been a less accurate travel demand forecasting tool.

It should be underscored that the last household travel survey for Gainesville was conducted in the early 1970s. Limited staff and financial resources required that the 1990 census be used to identify key travel parameters to improve the accuracy of the forecasts. Although census data proved to be extremely helpful, the unique trip-making patterns of the Gainesville metropolitan area resulted in a very difficult model validation process. The University of Florida is a major influence on travel patterns, and standardized travel parameters required by the FDOT modeling procedures were not reflective of these unique characteristics. A household travel survey conducted concurrently with the 2000 census would be a tremendous help in assessing the community's travel patterns for the next model validation study, transportation plan update, and future corridor studies.

The ability to use the CTPP lent additional credence to the MTPO's planning effort. The Gainesville MTPO's citizens and technical advisory committees provided close input into the development of the long-range plan and were skeptical of the model's ability to predict future travel patterns. The census data were instrumental in achieving a higher level of support from those committees. The Citizens Advisory Committee was particularly interested in the bicycle trip analysis, and the ability to incorporate that methodology into the development and evaluation of alternatives was key to the success of the project.

Without the census data described in this paper, it can be safely stated that the planning effort would have been less refined, would have had less public support, and likely would have resulted in a different transportation plan than the one adopted. Ultimately, the Gainesville MTPO adopted a financially constrained 2020 Transportation Plan that contains major transit service improvements, emphasizes nonmotorized transportation improvement needs, and addresses economic development issues (*4*,*5*).

Summary

JHK & Associates, under contract to the Gainesville MTPO, developed and validated a countywide multi-

modal travel demand forecasting model for Alachua County using 1990 as the base year. This model served as the basis for the preparation of the Gainesville Urbanized Area 2020 Transportation Plan, also prepared by JHK under contract to the MTPO. The plan was adopted in December 1995. The 1990 census was a key resource in the development of the validated base year model and in the preparation of non-automobile-oriented alternatives for the 2020 Transportation Plan.

Without the availability of the census JTW data and socioeconomic summaries at the TAZ level, the trip generation rate adjustments and bicycle analysis methodology incorporated into the planning effort would likely not have occurred. The only other source of information for those kinds of data is a regional household travel survey, which was not in the funding plans of FDOT or the MTPO.

Limitations of the CTPP data were primarily its geocoding problems, particularly at the place-of-residence end. Although problems were also encountered at the employment end, local planners had little to compare these data with and were much more familiar with the population and housing information at the TAZ level. If not for the geocoding problems, additional uses of the data to further adjust trip length frequencies could have occurred.

The applications presented in this paper are not unique to Gainesville, although only a few small urban areas are host to a major university. Thus, although some applications of the data were unique to Gainesville, the methods employed and analysis undertaken could easily be transferred to other urban areas.

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