
Appendix B: Travel Demand Model Review and Documentation

Traffic Analysis Zone Development

Socioeconomic Data Collection and Analysis Methodology

The RPC develops several estimated and projected data variables. However, not all variables are reported due to the relevance of the data. Since the ultimate purpose of the data is for use as inputs into the regional traffic assignment model, only seven variables exist for use in the model. These primary variables include the following:

- Total households
- Occupied households
- Total employment
- Retail employment
- Median household income
- School enrollment
- University enrollment

In the course of developing these variables other variables are projected as well though they are not included in the published projections report, nor are they included in the datasets for modeling. These variables are necessary, however, in the course of the projections methodology in order to accurately calculate the reported variables. These variables are reported at the county level, though not sub-county, and they are as follows:

- Total population
- Group quarters (institutionalized) population
- Housing occupancy rates
- Housing vacancy rates
- Household size

Base Counts

For interim years between decennial census data collection efforts, the RPC uses a residual component methodology in order to estimate population and housing. This basic process uses known population and housing data provided by the Census, and makes adjustments based on changes in housing stock. At the county level, total population and household estimates are based on estimates produced by the Census Bureau, and in some cases by state demographers. At the sub-county level, change is estimated based on sources including local estimates, trends in issued housing permits, and trends in consumer counts from purchased data. A base year dataset for the year 2000 was developed in the geographic information system (GIS) by overlaying the 2000 TAZ geography over the 2000 Census block layer. Using a percentage share density model, the necessary data variables were then extracted from the block data into the zonal layer. Once the block statistics were, in effect, converted into zonal statistics, the resulting zonal attribute table was exported from the GIS into a spreadsheet for continued analysis.

Projected Counts

Future year counts were modeled using a detailed method of trend extrapolation and a comprehensive review process incorporating GIS. Historical growth patterns, known residential and commercial developments, and probable areas of residential and commercial growth expansion were the primary components used to model future year patterns. For each pattern, appropriate mathematical formulas were used for extending the trend into the future. Obvious and inherent problems with this methodology, such as sub-county areas that reflect absurdly high growth or extreme negative declines, were singled out and reviewed. Once the county and sub-county projections were patterned, each variable was mapped and reviewed in GIS. Where county and sub-county forecasts were available through primary and secondary data sources, comparisons were made to ensure that the accuracy and relative continuity of the data was consistent.

Population and Housing

For 2002, county population and housing estimates were based on Census Bureau estimates provided at state and county levels, combined with state produced county estimates and housing permit data collected from April 2000 through December 2002 at the street address level. Totals between these sources were weighed for accuracy against the housing permit data, and likely county “target totals” were selected. Sub-county level estimates were based on local estimates using the collected housing permit data by geocoding each address in the GIS with the 2000 Census TIGER-Line street files, then overlaying the resulting point coverage with the planning district, census tract, and TAZ geographic layers and calculating the totals for each geographic unit. The resulting total gives an estimated total housing unit count. For the 2002 base-year dataset, the 2000 Census vacancy rates were then applied to estimate occupied households. Non-group quarters population was then estimated by applying household size totals to the occupied housing data, and total population was calculated by adding in the institutionalized population as reported in the 2000 Census. The resulting totals were then compared with census, state, and other primary data sources to ascertain accuracy and confirm the county target totals.

The 2030 projection focuses on housing. Comparisons between primary and secondary data suppliers of county projections were used to access probable target totals. Secondary variables, such as household size, and vacancy and occupancy rates, were projected using trend extrapolation at sub-county geographies and applied to the projected housing totals to obtain totals for occupied households and non group quarters population. Increased housing unit removal, in areas where the trend extrapolation method reflected slow demolition rates, was calculated by first comparing municipal demolition trends with the age of the housing stock, and a formula applied to units over sixty years old where median household income was particularly low. The group quarters population was projected using a cohort survival formula (to reflect the growing senior population), and the totals incorporated into the zonal dataset where known institutions were located from the 2000 Census and where known institutions will be located. The combined non group quarters population and the group quarters population variables equal total population.

School and University Enrollment

Enrollment totals indicate primary areas of continued vehicle trip generation in transportation modeling. School enrollment totals were collected directly from the area school systems, as was the enrollment totals for the local universities. The data was first collected into a spreadsheet, then geocoded in the GIS system using the 2000 TIGER-Line files. The resulting point coverage was then overlaid with the 2000 TAZ layer, joined with TAZ attribute table in

order to ensure accurate zonal coding, then exported and joined with the population and housing data. In addition to both public and private schools and universities, large preschools and adult education centers were included in the dataset for trip generation purposes within the regional traffic assignment model.

The projected number of school and university enrollment totals was computed by applying a traditional cohort-component analysis based on county population trends. The resulting data reflects the increase in the senior population and a relatively constant percentage of school age population. The percentages were compared with other data sources for projected school age population for verification. University enrollment projections were tallied from university sources. School and university data was geocoded in the GIS to assign appropriate TAZ numbers then exported into the dataset. Future school locations were determined based on known developments and probable future locations identified by county officials.

Median Household Income

Income estimates and projections reflect the census money income definition, and are produced for both current dollar values and future year values. The current estimates are collected from purchased data sources that use estimates based on a combination of:

- 1) Change in consumer financial information from an external Consumer Marketing Database,
- 2) Change in income summarized from an external consumer household database, and
- 3) Estimates and projections of trends occurring between decennial census years.

All data is reported by census tract. Therefore, each zone within a tract is assigned the median income total for that tract.

Median household income projections were calculated by applying the rate of increase from other projected income categories reported in primary data sources for counties, and applying that percentage change to median household income by census tract. The data is reported in both constant dollars and projected dollars, which reflect expected changes due to inflation and cost of living. The tract level projections are then applied to each zone within individual census tracts.

Employment Data

Current year employment statistics are updated continuously by the RPC and maintained in an Employment File Database, which contains information, including employment totals and industry type, on over 23,000 businesses within Jefferson and Shelby counties. The information is collected and maintained in order to track business trends and place-of-work employment statistics for transportation planning. This data is easily manipulated within a spreadsheet and is reported at all geographic levels used by the regional traffic assignment model. The data variables for total and retail employment were queried from the database and added to the estimated census variables in the 2002 base-year dataset.

Total and retail employment projections were calculated using the trend extrapolation method and applying data pertaining to known and probable commercial developments. Much of the developments information was reported in square feet or acres, and was converted to employment totals through a standard formula of employment densities as published in the *Trip Generation Studies Report* by the Institute of Transportation Engineers. The county totals were

compared to historical ratios of population and housing in order to verify the accuracy and consistency of employment change.

Existing + Committed (E+C) Networks

E+C = Existing + Committed, base year for testing that includes projects opened to traffic and committed to funding in 2002. **Improved** = Model year networks coded with all system improvements. **NB**= Model year networks with appropriate socio-economic data but without highway improvements.

Highway Network Development

The existing modeling network is formatted for use with the TranPlan modeling software. The package is supplied to the Regional Planning Commission of Greater Birmingham by the Alabama Department of Transportation and has been the software in use since 1997.

The most recent modeling work was performed for the 2020 Birmingham Area Long Range Plan, this effort benefited by the work done for the Strategic Regional Multimodal Mobility Plan in 1998. This same modeling stream was updated in November of 2000 to include the addition of a capacity project on I-59, the resulting modeling output was the basis of the amended 2020 Long Range Plan Update adopted by the Birmingham MPO in February 2001 and continued with the plan update for the 2025 LRTP IN June 2002. The adopted plan 2025 LRTP was reviewed by the United States Environmental Protection Agency (Region 4) and satisfied the requirements of 40 CFR Section 93.119.

The 2030 Birmingham Area Long Range Plan update was built upon the foundation of the existing modeling efforts. This modeling effort required additional efforts to bring the network connections up to date with the 2000 census Traffic Analysis Zones. The network data files were reviewed for accuracy and additional projects recommended by project sponsors were added to the future year scenarios.

Modeling networks were constructed for the years of 2002, 2009, 2015, 2025 and 2030. The model years are determined through negotiation with the conformity partners during their quarterly meetings. The model year results are the basis of analysis demonstrating that the implementation of the currently approved Transportation Improvement Program (TIP) and the proposed 2030 Long Range Transportation Plan (LRTP) developed in compliance with Title 23 and Title 49 of United States Code meet the conformity requirements set forth in the Clean Air Act (CAA).

HPMS Reported VMT

The Federal Highway Performance Monitoring System (HPMS) reports vehicle miles traveled for Jefferson and Shelby counties for Interstates through Collectors at 26,626,803; the base year model assigns 27,148,204 for the same functional classifications of highways. The model assignment is within 2% of the HPMS data. **Table B-1** indicates the VMT growth derived from the modeling process through 2030.

Table B-1: LOS by Volume/Capacity Ratio					
Model Network Years Evaluated	LOS A & B	LOS C	LOS D	LOS E	LOS F
	<.75	.75 - 0.99	1.00- 1.09	1.10- 1.24	>1.25
E+C	86.9%	7.3%	1.7%	1.8%	2.3%
2009	84.7%	8.4%	2.4%	1.7%	2.7%
2009 NB	82.9%	8.0%	2.8%	2.2%	4.1%
2015	84.5%	7.6%	2.1%	2.4%	3.4%
2015 NB	78.9%	9.1%	2.4%	3.2%	6.4%
2025	80.4%	9.3%	2.1%	2.9%	5.3%
2025 NB	72.0%	9.2%	3.5%	4.8%	10.4%
2030	77.6%	9.8%	3.2%	2.8%	6.6%
2030 NB	68.3%	8.9%	3.6%	5.1%	14.1%

VMT Growth

Vehicle miles traveled continues to grow, from 27 million plus miles in the base year to over 46 million miles in 2030, an increase of 72% over 28 years or 2% per year. **Figures B-1 and B-2** illustrate this more clearly.

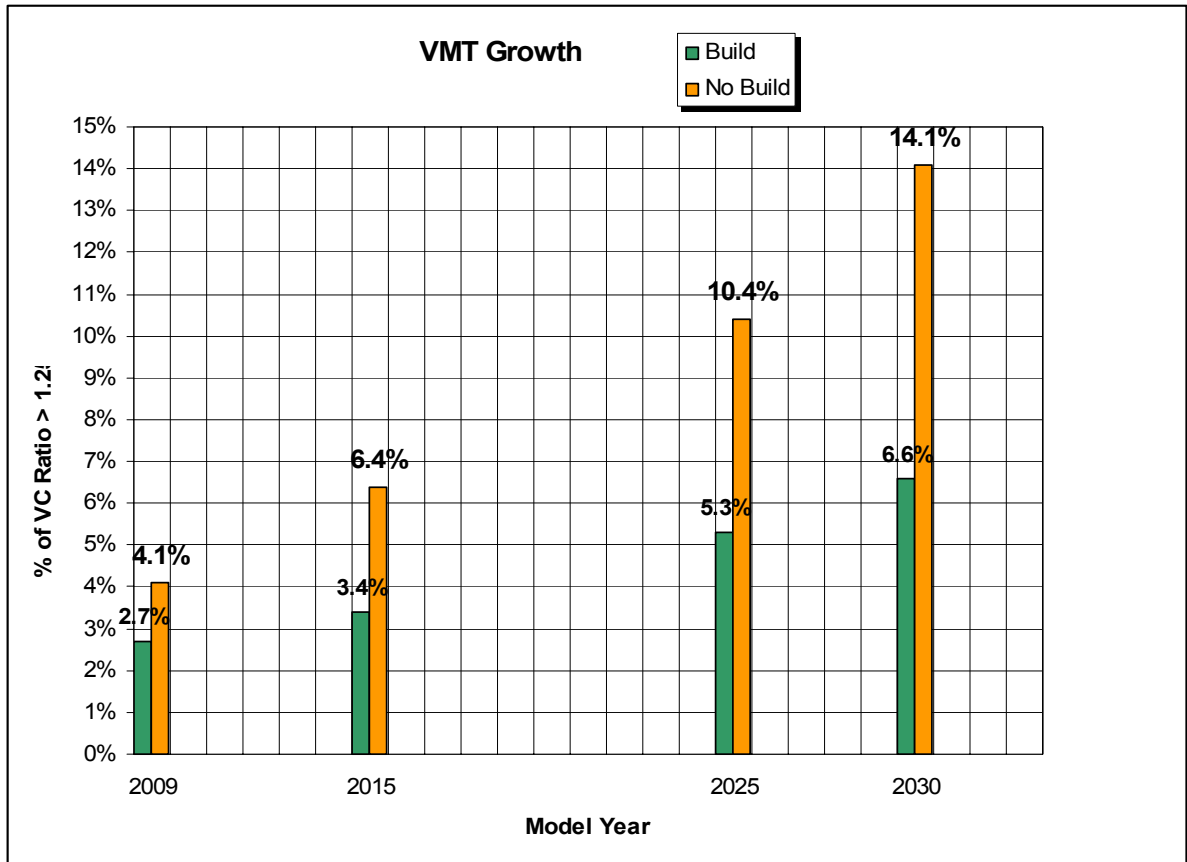


Figure B-1: Congested VMT Growth by Conformity Year (No-Build vs. Build)

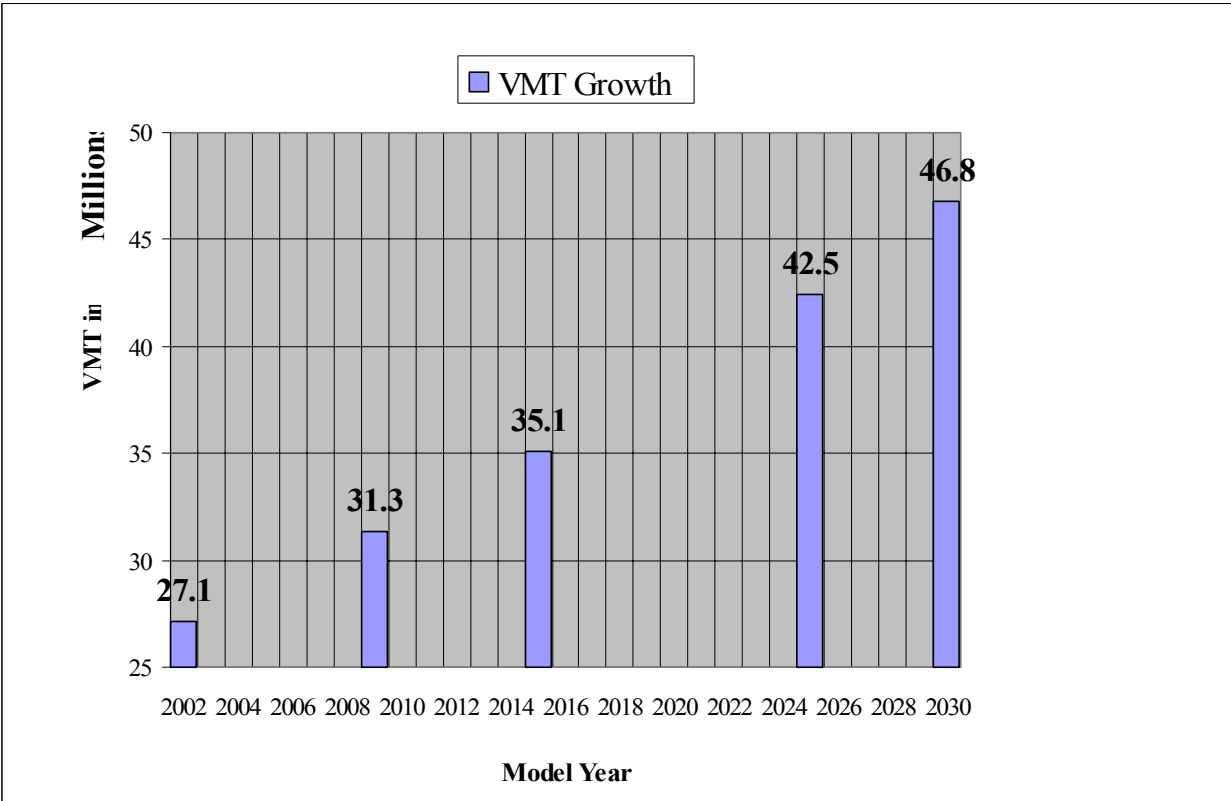


Figure B-2: VMT Growth by Conformity Year

Validation Parameters

The following parameters were reviewed to validate the Existing + Committed Network (Model Year 2002):

- HPMS reported VMT
- Ground Count Comparison
- Screenline Comparison

HPMS Reported VMT

The Federal Highway Performance Monitoring System (HPMS) reports vehicle miles traveled for Jefferson and Shelby counties for Interstates through Collectors at 26,626,803; the base year model assigns 27,148,204 for the same functional classifications of highways. The model assignment is within 2% of the HPMS data. **Table B-2** identifies the VMT growth derived from the modeling process through 2030.

Ground Count Comparison

A reasonable measure of comparing traffic assignments is the percent error, that is the total assigned traffic volumes divided by the total counted traffic volumes (ground counts) for all the links that have counted volumes. The percent error region-wide is less than 6 percent, in this case 251,514/276,572 or 9.98%. Total VMT as reported above is within 2% of the regional numbers.

Volume Group	# of Sections	Average Count	Model Assignment	% of Average Count
1 - 5000	1261	2599	3176	22%
5001 - 10000	612	6882	7469	9%
10001 - 20000	356	13608	13398	-2%
20001 - 30000	134	25019	26949	8%
30001 - 40000	59	33816	41791	24%
40001 - 50000	34	44271	49896	13%
50001 - 60000	18	54657	62388	14%
60001 - 100000	41	70616	71632	1%
Totals	2,515.00	251,468.00	276,699.00	10.0%

Table B-3: Ground Counts vs. Model Volumes

Screenlines

This model validation effort used 16 screen lines to assess the model's performance in corridors throughout the region. The accuracy sought for this validation was volumes within 20 percent of the observed ground count; the screenlines used are described below and illustrated in **Table B-4**.

Screenline = 1, I-65 and US-31 and parallel routes north and southbound at a point north of Exit 275 near Morris and Kimberly.

Screenline = 2, I-65 and US-31 and parallel routes north and southbound at a point south of Exit 272 near Gardendale.

Screenline = 3, SR-75 and SR-79 and parallel routes north and southbound at a point north Carson Rd. near Tarrant.

Screenline = 4, , I-59 and US-11 and parallel routes north and southbound at a point north of Exit 141 near Trussville.

Screenline = 5, , I-59 and US-11 and parallel routes north and southbound at a point north of route interchange with I-459.

Screenline = 6, SR-79, US-11 I-59 and I-20 and parallel routes west of I-59 and east of the Birmingham airport.

Screenline = 7, I-459, I-20 and parallel routes east of the Birmingham airport.

Screenline = 8, I-65, US-31, CR-47 and US-280 north and southbound and at the outer range of the study area.

Screenline = 9, I-65, US-31, CR-29 and US-280 north and southbound and immediately outside of I-459.

Screenline = 10, I-65, Columbiana Rd. and US-31, north and southbound.

Screenline = 11, CR-12(Smokey Rd.) SR-199 and CR-17, Columbiana Rd. and US-31, north and southbound.

Screenline = 12, I-59 and US-11 and parallel routes east and west at a point south of Exit 112.

Screenline = 13, I-59, Valley Rd., US-11 and Jefferson Ave. and parallel routes east and west at a point south of Exit 119.

Screenline = 14, SR-269, US-78 and parallel routes east and west at a point west of I-59.

Screenline = 15, Cross town CBD East/West Travel.

Screenline = 16, Cross town CBD North/South Travel.

The results of the screenlines are:

Screenline Number	Assignment	Count	Ratio Assignment to Count
1	95,062	90,534	105%
2	76,187	75,832	100%
3	51,916	42,602	122%
4	46,382	49,110	94%
5	74,188	72,010	103%
6	183,661	162,024	113%
7	136,880	119,442	115%
8	82,210	76,560	107%
9	105,964	89,360	119%
10	339,284	307,190	110%
11	12,792	13,267	96%
12	80,102	94,724	85%
13	120,862	119,490	101%
14	51,552	63,602	81%
15	32,322	35,551	91%
16	45,913	46,520	99%

Table B-4: Screenline Assignment

The results of the comparisons of HPMS data, ground count comparisons and screenlines indicated that the model is operating at an acceptable level for this plan update. The work being accomplished under the Downtown Alternative Analysis/Draft EIS (In-Town Transit Partnership) will again examine these same parameters in detail. Additionally the Birmingham Area Alternative Analysis will add the dimension of a calibrated base transit alternative to the modeling mix and a possible long-range transit project.