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Traffic Forecasting on Trunk Highways in Nonmetropolitan Areas: A Survey of State Practice

The purpose of this TRS is to serve as a synthesis of pertinent completed research to be used for further study and evaluation by MnDOT. This TRS does not represent the conclusions of either CTC & Associates or MnDOT.

Introduction

Traffic forecasting plays an important role for MnDOT in corridor planning, geometric design, pavement design, safety analysis, benefit/cost analysis, access management, and environmental analysis and mitigation. In previous decades, Minnesota has seen steady growth in vehicle miles traveled. However, in recent years VMT growth in Minnesota has been flat and declined by 0.5 percent from 2009 to 2010.

MnDOT is interested in learning how other states are dealing with what appears to be a nationwide trend in a leveling off or decline in VMT, and what forecasting methods are used by state DOTs to project traffic volumes in nonmetropolitan areas with a population under 50,000.

Summary

To gather information about state DOT traffic forecasting practices used to project traffic volumes in nonmetropolitan areas with a population under 50,000, we distributed a brief online survey to members of the AASHTO Standing Committee on Planning.

In **Survey of Current Practice**, we summarize the 30 responses to the survey. (Another respondent, Rhode Island, provided an email response in lieu of completing the survey, noting that all of Rhode Island is within the Providence metropolitan area, with planning performed by the state's metropolitan planning organization. Rhode Island DOT has no forecasting procedures for nonmetropolitan areas.)

Most survey respondents use linear regression models to estimate future traffic volumes. Slightly more than a quarter of these states use additional regression models to complement or supplement linear regression. Responding states use a variety of software models in their forecasting programs, with Caliper Corporation's TransCAD and Citilabs' Cube Voyager products cited most frequently by respondents. A few states reported the use of multiple models.

Socioeconomic variables are widely used by survey respondents when forecasting future traffic volumes, with data on total population, employment and households most frequently cited by respondents. Slightly less than half of respondents apply minimum growth factors; a similar percentage applies different growth rates to heavy commercial traffic and total traffic volume. Maximum growth factors are less commonly used by respondents. The most frequently cited time period used in projecting traffic volumes is 20 years. Forty percent of respondents prepare 30-year forecasts.

Twenty-three respondents noted a flattening or decrease in VMT. Eleven states are considering changes in the methodology used to forecast traffic volumes to address this trend or have already adopted changes. Changes in growth rates and statewide models are most often cited by respondents wishing to reflect a decrease in VMT in their forecasting methodology.

The **Survey Results** section of this report presents the full text of all survey responses.

Project Technical Advisory Panel Members

The project team overseeing this project includes:

Chu Wei, Technical Liaison—MnDOT
Shirlee Sherkow, Project Coordinator—MnDOT
Lynne Bly, Technical Advisory Panel—MnDOT
Gene Hicks, Technical Advisory Panel—MnDOT
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James McCarthy, Technical Advisory Panel—FHWA
Jim Miles, Technical Advisory Panel—MnDOT
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Survey of Current Practice

We distributed a brief online survey to the members of the AASHTO Standing Committee on Planning to gather information about member agencies' forecasting methods to project future traffic volumes in nonmetropolitan areas (population under 50,000) and perform VMT trend analysis. The survey consisted of the following questions:

1. Please indicate the methodology(ies) used in your agency's program to estimate future traffic volumes.
    1a. Does your agency use a modeling software program to estimate future traffic volumes?
2. How many years of historical data does your agency use when forecasting future traffic volumes?
3. Please indicate the social and economic variables included in your agency's traffic forecasting methodology.
    3a. If socioeconomic variables are included in your agency's traffic forecasting methodology, please describe how they are employed.
4. When forecasting traffic volumes, does your agency apply:
    4a. A minimum annual growth factor?
    4b. A maximum annual growth factor?
5. Does your agency apply different growth rates to heavy commercial traffic versus total traffic volume?
6. Please indicate the time periods included in your agency's projections of future traffic volumes.
    6a. Please describe why your agency has selected these time periods for your projections of future traffic volumes.
7. Has your state experienced a flattening or decrease in VMT in nonmetropolitan areas?
8. If your state has experienced a flattening or decrease in VMT in nonmetropolitan areas, is your agency considering changes in the methodology used to forecast traffic volumes, or have changes already been adopted?
9. Please provide details on any of your answers or additional comments.

We received survey responses from 30 state transportation agencies:

- Arizona
- Colorado
- Connecticut
- Florida
- Illinois
- Iowa
- Kansas
- Kentucky
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Mexico
- New York
- North Carolina
- North Dakota
- Oregon
- Pennsylvania
- South Dakota
- Texas
- Utah
- West Virginia
- Wisconsin
- Wyoming

A respondent from Rhode Island provided an email response in lieu of completing the survey, noting that Rhode Island is within the Providence metropolitan area, with planning performed by the state's metropolitan planning organization. Rhode Island DOT has no forecasting procedures for nonmetropolitan areas.

See **Survey Results** beginning on page 10 for the full text of all survey responses.

The survey gathered information in four topic areas related to traffic forecasting practices in nonmetropolitan areas with a population under 50,000:

- Methodologies and tools used to estimate future traffic volumes
- Data and factors used in forecasting
- Projection time periods
- Flattening or decrease in VMT

Key findings from the survey follow.

Methodologies and Tools Used to Estimate Future Traffic Volumes

Below is a summary of respondents' use of regression models to estimate future traffic volumes in nonmetropolitan areas.

Regression Models Used to Estimate Future Traffic Volumes

Methodology	State
Box-Cox linear regression	Wisconsin
Cubic regression	New Mexico
Least squares regression	Arizona, Kansas, New Mexico, Pennsylvania
Linear regression	Arizona, Connecticut, Florida, Illinois, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New York, North Carolina, North Dakota, Oregon, South Dakota, Texas, Utah, West Virginia, Wisconsin, Wyoming
Logistic regression	Arizona, Wisconsin
Multinomial regression (for mode split)	Connecticut
Nonparametric regression	Florida, Kentucky

All responding states but four—Colorado, Maryland, New Mexico and Pennsylvania—use linear regression models to estimate future traffic volumes.

Seven states make use of multiple regression models:

- Arizona (least squares, linear, logistic)
- Connecticut (linear, multinomial)
- Florida (linear, nonparametric)
- Kansas (least squares, linear)
- Kentucky (linear, nonparametric)
- New Mexico (cubic, least squares)
- Wisconsin (Box-Cox, linear, logistic)

Respondents reported other methodologies used to forecast traffic volumes, including:

- Growth rate from similar sites (Nevada)
- Historical trend analysis (Colorado)
- Linear or parabolic growth rates based on the knowledge of local growth patterns (Maryland)
- Statewide or travel demand models (Arizona, Maine, Massachusetts, North Carolina, Oregon, Wisconsin)

The table below summarizes respondents' use of software models or programs to estimate future traffic volumes in nonmetropolitan areas.

Software Models or Programs Used to Estimate Future Traffic Volumes		
Vendor	**Model/Program**	**State**
Caliper Corporation	TransCAD http://www.caliper.com/tcovu.htm	Iowa, Mississippi, Montana, Nevada, Wyoming
Citilabs	Cube Voyager http://www.citilabs.com/products/cube/cube-voyager	Maine, Maryland, New York, Utah
Citilabs	TP+ (legacy system) http://www.citilabs.com/support-amp-services/services/citilabs-services	Maryland, Wisconsin
Citilabs	Tranplan (legacy system) http://www.citilabs.com/support-amp-services/services/citilabs-services	Connecticut
IHS Global Insight	Statewide VMT macroeconomic forecasting model http://www.ihs.com/industry/transportation-shipping/index.aspx	New York
PTV America	VISUM http://www.ptvamerica.com/software/ptv-vision/visum/	New Mexico
Not specified	Statewide or travel demand models	Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Oregon, Texas
Not specified	Three- or four-step gravity model (for use in urban areas where the model boundary extends past the urban boundary)	Texas

Other observations from survey respondents include:

- A statewide modeling program is in development and nearing completion in Arizona.
- Connecticut DOT is investigating TransCAD and Cube to replace its Tranplan software.
- Florida DOT uses its own software program; Pennsylvania DOT uses a consultant software that employs linear and lane miles as well as socioeconomic values.
- Oregon DOT has fairly advanced modeling tools for areas below 50,000 population as well as a fully integrated statewide economic/land use/transport model.
- Only four states—Colorado, Illinois, Kansas and South Dakota—report no use of modeling software to forecast traffic volumes.

Data and Factors Used in Forecasting

Volume of Historical Data

We asked respondents how much historical data is used when forecasting future traffic volumes. Slightly more than half of respondents use 11 to 20 years of historical data. See below for a summary of responses.

Fewer than 5 years: New Mexico

5 to 10 years: Connecticut, Kentucky, Maryland, Nevada, North Dakota, South Dakota

11 to 20 years: Arizona, Colorado, Florida, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New York, North Carolina, Oregon, Pennsylvania, Texas, West Virginia

21 to 30 years: Illinois, Iowa, Kansas, Missouri, Utah, Wisconsin, Wyoming

Socioeconomic Variables

The table below summarizes the frequency with which respondents reported use of socioeconomic variables to forecast future traffic volumes.

Frequency of Use of Socioeconomic Variables in Forecasting Future Traffic Volumes

Socioeconomic Variable	Response Percent	Response Count
Total population	78.6%	22
Employment	75.0%	21
Households	75.0%	21
Personal income	32.1%	9
Labor force	21.4%	6
Gas prices	14.3%	4
Unemployment rate	10.7%	3
Motor vehicle registration	10.7%	3
Fuel consumption	7.1%	2
Driving age population	7.1%	2
Population age 16 and older	7.1%	2
Population age 65 and older	7.1%	2

Respondents reported using other socioeconomic variables, including:

Population

Birth rate (Wisconsin)

Households

Breakdown of households (Maine)

Household size (Connecticut, Maine)

Trip Making

Recreational trip generation (lodging beds, restaurant seats, campsites, park acres) (Maine)

Trip rate (Wisconsin)

Commercial

Business (basic, retail and service) (Texas)

Commercial tax base (Arizona)

Industry type (Wisconsin)

Vehicles and Drivers

Auto availability (Maine)

Licensed driver (South Dakota)

Vehicle ownership (Wyoming)

Vehicles per household (Connecticut, Wisconsin)

Employment

Employment/nonretail (Connecticut)

Employment/retail (Connecticut)

Number of employees by job type (Maine, Maryland)

Other

Land use/planned development (Arizona, Mississippi)

School enrollment (Wyoming)

Socioeconomic variables are being used to:

- Analyze trends (Arizona, Illinois)
- Determine impact on current traffic (Illinois)
- Determine trip generation/trip distribution/trip attraction (Maryland, Michigan)
- Develop growth profiles (Minnesota)
- Influence choice of growth rate (Kansas)
- Serve as inputs to travel demand or statewide models (Iowa, Kentucky, Maine, Massachusetts, Michigan, Mississippi, New Mexico, New York, Oregon, Pennsylvania, Utah)

Only four states—Colorado, Florida, Missouri and Nebraska—do not report the use of socioeconomic variables in their agencies' traffic forecasting methodology.

Growth Factors

Slightly less than half of respondents use a minimum growth factor in their forecasting models. Listed below are those states citing the use of a specific percentage.

Minimum Growth Factors Used in Forecasting Future Traffic Volumes

Factor	State
0%	Oregon
0.5%	Kansas, Maine, Massachusetts, Minnesota, Nevada, Wisconsin
0.5% to 1%	Missouri
1%	Montana
2%	Texas

Some respondents provided details about their use of a minimum growth factor:

- Oregon DOT uses 0 percent where traffic growth has declined or not changed.
- Kansas DOT does not show flat or declining volumes even when trends suggest it.
- The 0.5 percent minimum growth factor now in use by Massachusetts DOT has been higher.
- If an area has seen a slight decrease in traffic in the past 20 years and new projections are needed for a new project, Missouri DOT uses a growth rate of 0.5 percent to 1 percent to project future traffic.
- In Texas, a minimum of 2 percent growth is applied if the regression analysis shows less than 2 percent. If an extenuating circumstance exists, less than 2 percent may be applied (for example, a corridor is built out, land use restrictions, base closures or a major plant closing).
- Connecticut DOT does not apply a growth factor for traffic projections. Instead, traffic projections are the result of socioeconomic and other factors such as capacity and speed restraints on highway links, and an iterative traffic assignment process that is factored to the Highway Performance Monitoring System in a post processor.

Approximately one-quarter of respondents use maximum growth factors. Four of the eight states reporting the use of maximum growth factors cited specific percentages:

- Massachusetts—1.5 percent
- Minnesota—3 percent
- Montana—3.5 percent
- Texas—5 percent

Heavy Commercial Traffic Volumes

Forty percent of respondents apply different growth rates to heavy commercial traffic and total traffic volume. Below are descriptions of respondents' use of these factors.

- **Arizona.** Different factors are applied at the statewide modeling level, not at a more micro level.
- **Maryland.** When it is apparent that local or regional growth will change the ratio of commercial traffic-producing industries in the overall development mix, the state does consider how this will impact the percentage of commercial traffic. The new Maryland Statewide Travel Model has a freight component that enhances the state's ability to quantify this factor.
- **Nevada.** There are four methods for truck traffic forecasting that can be applied based on the availability of data and the nature of the project location.
- **New Mexico.** Data from FAF3—the third generation of the Freight Analysis Framework—is used to forecast future internal-external, external-internal and external-external truck trips.
- **Oregon.** Different factors are used only for the statewide integrated model for freight analysis.

Projection Time Periods

The table below summarizes the time periods respondents reported using in projections of future traffic volumes.

Time Periods Used in Projections of Future Traffic Volumes

Time Period	Response Percent	Response Count
20 years	86.7%	26
10 years	46.7%	14
30 years	40.0%	12
25 years	33.3%	10
15 years	26.7%	8
5 years	20.0%	6
40 years	16.7%	5
35 years	13.3%	4
50 years	3.3%	1

Respondents were asked to provide their agencies' rationale for the use of specific time periods in traffic volume projections. The most commonly cited reasons include:

- Pavement/project design (Colorado, Florida, Kansas, Kentucky, Maine, Minnesota, Mississippi, Nebraska, New York, North Dakota, Texas, West Virginia)
- Required for long-range transportation plan (Colorado, Connecticut, New Mexico, Oregon)
- FHWA standards (Arizona, Maryland, Michigan)
- Required for statewide model (Maine, Michigan, Utah)

The table below compares the number of years of historical data used with the number of years agencies project into the future when forecasting traffic volumes. We found no direct correlation between the two types of data.

Comparing Historical Data Used and Time Periods Included in Projections in Forecasting Traffic Volumes

Years of Historical Data	State	Projection Time Periods (in years)
Fewer than 5 years	New Mexico	10, 15
5 to 10 years	Connecticut	5, 10, 15, 20, 25, 30, 35, 40
	Kentucky	10, 20, 25, 40
	Nevada, North Dakota, South Dakota	20
	Maryland	20, 25, 30
11 to 20 years	Massachusetts, Michigan	5, 10, 15, 20, 25
	Arizona	5, 10, 15, 20, 25, 30
	Oregon	5, 10, 15, 20, 25, 30, 35, 40, 50
	Nebraska	10, 20
	Mississippi, New York	10, 20, 30
	Maine	10, 12, 20, 25
	Florida	15, 20, 25
	Minnesota, Pennsylvania, West Virginia	20
	Colorado, Texas	20, 30
	North Carolina	25, 30, 35
21 to 30 years	Illinois	5, 10, 15, 20
	Wisconsin	5, 10, 15, 20, 25, 30, 35, 40, 50
	Utah	10, 20, 30
	Kansas	10, 20, 30, 40
	Missouri, Wyoming	20
	Iowa	30, 35, 40

Note: Montana DOT did not respond to the question with regard to the volume of historical data used to project future traffic volumes but did indicate that the agency uses 20 years as its projection time period.

Flattening or Decrease in VMT

Of the 23 states reporting a flattening or decrease in VMT, several noted fuel prices and the recent recession as possible causes for a decrease in VMT. Other observations from states reporting a flattening or decrease in VMT include:

- **Arizona.** Research is needed to confirm that the flattening in VMT in nonmetropolitan areas is due mainly to rising gas prices and reduced population growth rates.
- **Kansas.** Very rural areas not close to Interstates have seen declines of up to 1 percent.
- **Maine.** As long ago as 1998, Maine's statewide model forecasting process foresaw a flattening of VMT growth. The state recorded its highest recorded statewide VMT in 2006. The state's 2011 VMT was equivalent to 2000 VMT. Slow growth in population and employment drove the flattening of VMT growth.
- **Maryland.** Statewide rural VMT has been flat overall from 2007 to 2011.

- **Minnesota.** In previous decades, Minnesota has seen steady growth in VMT. Since 2004, VMT growth in Minnesota has been virtually flat, and from 2010 to 2011 it declined by 0.2 percent.
- **Pennsylvania.** VMT was decreasing when the recession began but recently started to climb.

Seven states—Florida, Montana, New Mexico, North Dakota, South Dakota, Texas and Wyoming—reported no flattening or decrease in VMT in nonmetropolitan areas.

Eleven states—Connecticut, Illinois, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, New York, North Carolina and Oregon—are considering changes in the methodology used to forecast traffic volumes to address flattening or decreasing VMT, or have already adopted changes. A summary of the changes reported or contemplated appears below.

Changes in growth rates

- The only recent change implemented by Illinois DOT is the lowering of growth rates.
- Iowa DOT tends to be a bit more conservative when selecting a growth rate.
- In North Carolina, recent trends are considered in determining growth rates to use in models.

Changes in statewide models

- Michigan DOT has updated socioeconomic data for the statewide model to reflect lesser growth in households and employment.
- Adopted changes are being reflected in Oregon DOT's statewide economic model.
- The Global Insight model used by New York State DOT will be updated in 2014 after all data from the 2000-2010 decennial census have been built into the county-level demographic-economic models.
- Connecticut DOT's entire travel demand model will be updated in the near future; changes to reflect flattening or decreasing VMT may be included in the update.

Considered changes

- Kansas DOT has chosen not to forecast declining VMT.
- MnDOT will use results of this survey to inform possible changes in traffic forecasting methods.

Other comments

- As a small state, Massachusetts has not made a significant distinction between metropolitan and nonmetropolitan areas in terms of net traffic growth. A recently completed statewide travel survey will provide much more information about travel patterns, including any significant differences between densely versus nondensely populated areas.

Survey Results

The full text of each survey response is provided below. For reference, we have included an abbreviated version of each question before the response; for the full question text, please see page 2 of this report.

Arizona

Contact: Susan Kanzler, GIS and Statistical Analyst, Data Section, Arizona Department of Transportation, skanzler@azdot.gov, (602) 712-7447.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Least squares regression
   Linear regression
   Logistic regression
   A statewide modeling program is in development and nearing completion. This is being done through our Travel Demand Modeling group.

1a. **Modeling software program:** This is still in the beta testing phase. Results currently serve as regional control totals.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Unemployment rate
   Total population
   Other: Commercial tax base as one indicator of potential growth. Also land use, especially ownership, and planned development.

3a. **How are socioeconomic variables employed?** Population, using census and state-mandated estimates, is projected and current traffic-to-population ratios are projected. Otherwise, mainly for trend analysis.

4a. **Apply a minimum annual growth factor?** Yes. Used as a reasonableness check, not a blanket application.

4b. **Apply a maximum annual growth factor?** Yes. Roadway capacity and population growth for the state serve as a reasonableness checks.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. At the statewide modeling level, not at a more micro level.

6. **Time periods included in projections:**

   5 years
   10 years
   15 years
   20 years
   25 years
   30 years

6a. **Why these time periods?** Horizons used are based on the needs of the engineers and their individual projects. Statewide projections as a whole consider the mandates of federal programs, such as HPMS [Highway Performance Monitoring System].

7. **Flattening or decrease in VMT?** Yes. While Interstate traffic is comparatively stable, the trend in VMT in nonmetro areas has flattened. Research is needed to confirm, but this appears to be due mainly to rising gas prices and reduced population growth rates.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** For additional information on the statewide model, Dr. Deng Bang Lee, of the Travel Demand Modeling Group, Multimodal Planning Division, should be contacted [dlee@azdot.gov, (602) 712-8871].

Colorado

Contact: Mehdi Baziar, Mobility Analysis Manager, Colorado Department of Transportation, mehdi.baziar@dot.state.co.us, (303) 757-9047.

1. **Methodology(ies) used to estimate future traffic volumes:** Historical Trend Analysis.

1a. **Modeling software program:** None.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:** None.

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**
   20 years
   30 years

6a. **Why these time periods?** Pavement and other design purposes and long-range transportation plan.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Connecticut

Contact: Judy Raymond, Transportation Supervising Planner, Connecticut Department of Transportation, judy.raymond@ct.gov, (860) 594-2032.

1. **Methodology(ies) used to estimate future traffic volumes:**
   Linear regression
   Other: Multinomial regression for mode split. Combined with shared ride (occupancy data) provides for vehicular travel volumes.

1a. **Modeling software program:** Yes. Currently using Tranplan and Fortran. Just starting to update travel demand model. Investigating new software. TransCAD or Cube are the two leading choices to date.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**
   Employment
   Labor force
   Personal income
   Households
   Total population
   Employment is further subdivided into retail and nonretail; household size; number of vehicles (0, 1, 2, 3+ vehicles) per household income; ADT's [average daily traffic].

3a. **How are socioeconomic variables employed?** Population and employment are projected for 2020, 2030 and 2040. Along with number of households, household size, household income, vehicles per household income category, thru trips, truck trips, transit projections, new Production/Attraction trip generation tables are established for 2020, 2030 and 2040 modeling years. For years in between, trip generation data is interpolated. All these input files are produced prior to running any model runstreams.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

5 years
10 years
15 years
20 years
25 years
30 years
35 years
40 years

6a. **Why these time periods?** The CT DOT acts as the MPO [metropolitan planning organization] for air quality regional conformity; therefore, 2040 is the horizon year for regional long-range plans, the other years act as interim years as well as future dates for project alternative analysis. Currently, have PM [particulate matter] 2.5 budgets for 2017 and 2025. Ozone budgets are for 2009 currently, but will be updated when new SIP [state implementation plan] MOVES [Motor Vehicle Emission Simulator] budgets are established.

7. **Flattening or decrease in VMT?** Yes. Due to recent economic recession, the VMT in the entire state has declined over the past few years.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. Entire travel demand model will be updated in the near future, so this might be a possibility.

9. **Details or comments:** CT DOT does not apply a growth factor for traffic projections. Instead, traffic is the result of all the factors noted previously as well as capacity and speed restraints on highway links and a 20 iterative traffic assignment process, which is factored to HPMS in a post processor.

Florida

Contact: Richard L. Reel Jr., Traffic Data Manager, Florida Department of Transportation, richard.reel@dot.state.fl.us, (850) 414-4709.

1. **Methodology(ies) used to estimate future traffic volumes:**

Linear regression
Nonparametric regression

1a. **Modeling software program:** FSUTMS (Florida Standard Urban Transportation Modeling Software).

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:** [No response.]

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

15 years
20 years
25 years

6a. **Why these time periods?** We forecast 15 years for resurfacing jobs, and 20 to 25 years for new construction, add lanes, or reconstruction jobs.

7. **Flattening or decrease in VMT?** No.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** Project traffic forecasters use the projections developed by the modeling section wherever these are available (usually urban areas). The person at FDOT with knowledge of the urban area models and FSUTMS is Vidya Mysore of the Systems Planning Office [vidya.mysore@dot.state.fl.us, (850) 414-4924].

Illinois

Contact: Ryan Petersen, District 7 Traffic Studies Unit Chief, Illinois Department of Transportation, ryan.petersen@illinois.gov, (217) 342-8247.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** None.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Unemployment rate
   Gas prices
   Total population

3a. **How are socioeconomic variables employed?** Socioeconomic variables are not documented in the traffic forecast. The variables are used as a reference to determine the impact they have on the current traffic, as well as how their historical growth compares to the historical traffic growth. At specific locations, these variables are used to help predict future trends.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. Usually the same growth rates are used, but in specific locations a different factor may be used. If heavy commercial traffic is expected to grow at a different rate, two separate growth rates are used and the reason for the HC [heavy commercial] growth rate is documented in the forecast.

6. **Time periods included in projections:**

   5 years
   10 years
   15 years
   20 years

6a. **Why these time periods?** A few years ago, everyone in the district that uses the traffic forecast was asked what data they need on the forecast. The forecast time periods selected cover all the needs at the district. A 30-year projection may possibly be added sometime in the near future.

7. **Flattening or decrease in VMT?** Yes. A decrease in VMT was experienced statewide.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. The only changes that have occurred are the lowering of the growth rates. Due to the decrease in traffic the past few years, future growth at some locations is not expected to be as high as once predicted.

9. **Details or comments:** [No response.]

Iowa

Contact: Phil Mescher, Transportation Planner, Iowa Department of Transportation, phil.mescher@dot.iowa.gov, (515) 239-1629.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** The Iowa DOT has a statewide travel demand model using the TransCAD software platform. It currently forecasts cars and trucks and is now being expanded to include passenger/freight rail and commodity flow.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population

3a. **How are socioeconomic variables employed?** The socioeconomic variables are inputs into the travel demand model. The model is one tool used to assist in forecasting traffic. Also used are traffic growth trends.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   30 years
   35 years
   40 years

6a. **Why these time periods?** As a rule of thumb it is felt that you should look back in history about the same number of years as you are trying to project into the future. This helps to smooth out pockets of significant traffic growth or decline, which provides more of an average over time. This helps to prevent significant over/under forecasting of traffic.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. Not really a major change in the methodology but we now tend to be a bit more on the conservative side when selecting a growth rate.

9. **Details or comments:** [No response.]

Kansas

Contact: David Schwartz, Models & Forecasting Manager, Kansas Department of Transportation, davids@ksdot.org, (785) 296-7441.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Least squares regression
   Linear regression

1a. **Modeling software program:** None.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population

3a. **How are socioeconomic variables employed?** Not directly factored in, but may influence the choice of a growth rate or number of vehicles using a given driveway or minor street.

4a. **Apply a minimum annual growth factor?** Yes. 0.5%. As a "safety factor," we don't show flat or declining volumes even when trends suggest it.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   10 years
   20 years
   30 years
   40 years

6a. **Why these time periods?** For calculating equivalent single axle loads for pavement design. Most projects require a 20-year design forecast. Occasionally where the design is "ultimate," we may forecast up to 40 years out.

7. **Flattening or decrease in VMT?** Yes. Very rural areas not close to Interstates have seen declines of up to 1%.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. We have considered it, but in case of a change in paradigm we have chosen not to forecast decline.

9. **Details or comments:** [No response.]

Kentucky

Contact: Lynn Soporowski, Transportation Engineering Branch Manager, Kentucky Transportation Cabinet, lynn.soporowski@ky.gov, (502) 564-7183.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Linear regression
   Nonparametric regression

1a. **Modeling software program:** KYTC has a statewide model as well as county models. A model is used to estimate future traffic when conducting scenario analysis, such as a new bypass.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**

   Employment
   Motor vehicle registration
   Households
   Total population

3a. **How are socioeconomic variables employed?** They are used in the transportation modeling. KY State Data Center (KY Census Agency) also uses socioeconomic factors when predicting future populations. KYTC uses KY SDC for population trends.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. A separate Truck Growth Rate is applied to truck traffic. Essentially we grow passenger vehicles and commercial traffic separately.

6. **Time periods included in projections:**

   10 years
   20 years
   25 years
   40 years

6a. **Why these time periods?** Most traffic forecasts use design year then add 20 years for future. Interim years (+15 or +25) may be added for phased construction. Out years of +30 or +40 are used when pavement lifecycle costs are evaluated. We find that Planning, Environmental, Design and Maintenance differ in years needed.

7. **Flattening or decrease in VMT?** Yes and no. We have begun to analyze the area available for build-out as part of the model inputs. Some areas have adopted a service boundary thus limiting sprawl.

   Note: We contacted Ms. Soporowski to obtain clarification of this response. Kentucky is experiencing a localized rather than statewide flattening or decrease in VMT in nonmetropolitan areas, with flattening or decreases most typically occurring in agricultural regions and areas where high-sulfur coal mining is on the wane. Ms. Soporowski notes that growth did not bounce back as quickly in these nonmetropolitan areas after 2008, which marked a low point in VMT growth for the state.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes and no. We have begun to analyze the area available for build-out as part of the model inputs. Some areas have adopted a service boundary thus limiting sprawl.

9. **Details or comments:** Central office depends heavily on local information from district offices and rural planning agencies. Community Comprehensive Plans are used to estimate future land use and build-out.

Maine

Contact: Edward W. Hanscom, Chief Transportation Analyst, Maine Department of Transportation, ed.hanscom@maine.gov, (207) 624-3320.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Linear regression
   Statewide travel demand model

1a. **Modeling software program:** Statewide Model: Cube.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Labor force
   Households
   Total population
   Statewide Model: Auto availability and household size; breakdown of households; employment breakdown (retail, service, industrial, residual); recreational trip generation (lodging beds, restaurant seats, campsites, park acres).

3a. **How are socioeconomic variables employed?** Statewide Model: Variables are used in four-step process to estimate baseline and future trip generation and VMT growth factors derived from these model outputs.

4a. **Apply a minimum annual growth factor?** Yes. For project-specific design volumes, straight-line future growth less than 0.5%/yr would almost never be used.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Trends in truck volume growth are tracked separately and sometimes the growth factor for trucks is higher than the growth factor for general traffic.

6. **Time periods included in projections:**

   10 years
   20 years
   25 years
   12 years for certain paving projects

6a. **Why these time periods?** 10, 12 and 20 are based on the design year of project; 25 is for the Statewide Model planning horizon.

7. **Flattening or decrease in VMT?** Yes. Our highest recorded statewide VMT occurred in 2006. Our 2011 VMT was equivalent to 2000 VMT.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** Regarding question 8, our Statewide Model forecasting process, as long ago as 1998, foresaw a flattening of VMT growth. Slow growth in population and employment drove the flattening of VMT growth.

Maryland

Contact: Scott Holcomb, Travel Forecaster, Maryland State Highway Administration, sholcomb@sha.state.md.us, (410) 545-5647.

1. **Methodology(ies) used to estimate future traffic volumes:** For roadways not adequately represented in regional MPO models or our Maryland Statewide Travel Model (MSTM) our forecasters typically use linear or parabolic growth rates based on the knowledge of local growth patterns.

1a. **Modeling software program:** The metropolitan areas and some rural areas are covered by TP+ travel demand models maintained by the regional MPOs. Our agency has recently developed the MSTM (Cube platform using Voyager) that covers the entire state and surrounding areas. While still in the testing phase, it is being used by our forecasters on a case-by-case basis, particularly in rural areas not covered by the MPOs.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**

   Employment
   Personal income
   Households
   Total population
   Number of employees by job type

3a. **How are socioeconomic variables employed?** They primarily come into play in the trip generation and trip distribution phases impacting trip productions and attractions, average trip lengths by trip type, etc. This is more formally done when the models are used but also considered when manual trip rates are used.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. When it is apparent that local or regional growth will change the ratio of commercial traffic producing industries in the overall development mix, we do consider how this will impact the percentage of commercial traffic. The new MSTM has a freight component that enhances our ability to quantify this.

6. **Time periods included in projections:**

   20 years
   25 years
   30 years

6a. **Why these time periods?** Socioeconomic variables are generally forecast by the local agencies and MPOs in these increments. These are also the time frames that FHWA expects our agency to forecast out to in project documentation.

7. **Flattening or decrease in VMT?** Yes. A review of VMT statistics for Maryland from 2007 to 2011 shows that statewide rural VMT has been flat overall. However, this will vary by specific location depending on local growth patterns.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Massachusetts

Contact: Bob Frey, Director of Planning Systems Information, Massachusetts Department of Transportation, bob.frey@state.ma.us, (617) 973-7449.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Linear regression
   Apply growth percentages from traffic model to current counts

1a. **Modeling software program:** Statewide travel demand model, with base year of 2010, and forecast years of 2017, 2020, 2025 and 2035 (years tied to air quality conformity requirements).

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population

3a. **How are socioeconomic variables employed?** SE [socioeconomic] variables are forecasted at the state and regional level by DOT, then for the town level by regional/county planning commissions. Then disaggregated to TAZ [transportation analysis zone] level and input into the statewide model for each forecast year.

4a. **Apply a minimum annual growth factor?** Yes. Currently it stands at 0.5%; historically it was higher.

4b. **Apply a maximum annual growth factor?** Yes. Currently, we typically don't go over 1.5%; historically, it has been greater, but traffic growth has slowed overall in our state.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   5 years
   10 years
   15 years
   20 years
   25 years

6a. **Why these time periods?** These are milestone years for AQ [air quality] conformity requirements, we consider anything beyond 20-25 years to have limited value in terms of accuracy...

7. **Flattening or decrease in VMT?** Yes. Statewide VMT has begun to flatten out in the past 5-7 years here in Massachusetts.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. Changes/adjustments have already been made, as described previously.

9. **Details or comments:** Massachusetts is a small state. So far we don't distinguish too much between metro and nonmetro areas in terms of net traffic growth. But we just completed a statewide travel survey which will give us much more information on travel patterns, including any significant differences between densely versus nondensely populated areas.

Michigan

Contacts: Karen Faussett, Amy Lipset, Transportation Planners, Michigan Department of Transportation, faussettk@michigan.gov, lipseta@michigan.gov, (517) 335-2956.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** In some instances the statewide model is used to obtain traffic volume growth rates.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Personal income
   Households

3a. **How are socioeconomic variables employed?** The above variables are used in trip generation and attraction in the statewide model.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. If the location is a heavy commercial corridor, there are times when we will apply a slightly higher growth rate specifically to the commercial traffic.

6. **Time periods included in projections:**

   5 years
   10 years
   15 years
   20 years
   25 years

6a. **Why these time periods?** Using five-year increments in the statewide model allows for flexibility when forecasting different time periods. Project-level traffic forecasting usually follows a 20-year time frame based on FHWA standards.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. Socioeconomic data for the statewide model has already been updated to reflect lesser growth in households and employment.

9. **Details or comments:** [No response.]

Minnesota

Contact: Chu Wei, Traffic Forecast Engineer, Minnesota Department of Transportation, chu.wei@state.mn.us, (651) 366-3851.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** Yes. In the MPO's area, travel demand modeling uses information such as roadway and transit networks and population and employment data to calculate future traffic.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Labor force
   Households
   Total population

3a. **How are socioeconomic variables employed?** We looked at socioeconomic data by county from 1992 to 2007. We analyzed population, labor force, employment and number of households. From these inputs, we categorized the counties into one of the four growth profiles—high, medium high, medium low and low. Now the analyst will have the option of applying a factor based on the socioeconomic data for that county to the Base and Forecast year projections derived from the linear regression analysis.

4a. **Apply a minimum annual growth factor?** Yes. 0.5%; we do not show flat or declining traffic volumes.

4b. **Apply a maximum annual growth factor?** Yes. 3%.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** A 20-year forecast for project-level forecast.

7. **Flattening or decrease in VMT?** Yes. In previous decades, Minnesota has seen steady growth in VMT. However, since 2004 VMT growth in Minnesota has been virtually flat and from 2010 to 2011 it declined by 0.2%.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. We have considered it. The results of this survey will give us a direction of next phase to improve on the accuracy of traffic forecast.

9. **Details or comments:** [No response.]

Mississippi

Contact: Trung Trinh, Transportation Planner, Mississippi Department of Transportation, ttrinh@mdot.state.gov, (601) 359-7685.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** TransCAD for statewide travel demand model and small urban areas.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Households
   Land use

3a. **How are socioeconomic variables employed?** They are incorporated in the travel demand models.

4a. **Apply a minimum annual growth factor?** Yes. To account for unknown variables.

4b. **Apply a maximum annual growth factor?** Yes. For areas that experience a major increase due to additional traffic generators, that type of growth will not continue once the land use of the area has reached its limit.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   10 years
   20 years
   30 years

6a. **Why these time periods?** Those years are to provide data throughout the design period and for future needs analysis.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Missouri

Contact: Michael Teel, Transportation Management Systems Administrator, Missouri Department of Transportation, michael.teel@modot.mo.gov, (573) 751-6775.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** Metropolitan planning organizations do, and one of our seven districts occasionally does.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:** None.

3a. **How are socioeconomic variables employed?** Historical traffic growth patterns for regions.

4a. **Apply a minimum annual growth factor?** Yes. If an area has seen a slight decrease in traffic in the past 20 years and new projections are needed for a new project, a 0.5-1% growth rate will be used to project future traffic.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** Historical data.

7. **Flattening or decrease in VMT?** Yes. We have seen the national trends in Missouri as VMT seems to slow.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Montana

Contact: Alan Vander Wey, Planner, Montana Department of Transportation, avanderwey@mt.gov, (406) 444-7653.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** TransCAD.

2. **Years of historical data:** [No response.]

3. **Social and economic variables:**

   Employment
   Personal income
   Households

3a. **How are socioeconomic variables employed?** Households determine productions, employment determines attractions. Household income determines level of productions.

4a. **Apply a minimum annual growth factor?** Yes. 1%.

4b. **Apply a maximum annual growth factor?** Yes. 3.5%.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** [No response.]

7. **Flattening or decrease in VMT?** No.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Nebraska

Contact: Rick Ernstmeyer, Traffic Analysis Supervisor, Nebraska Department of Roads, rick.ernstmeyer@nebraska.gov, (402) 479-4520.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** [No response.]

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:** [No response.]

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   10 years
   20 years

6a. **Why these time periods?** Overlay projects are expected to last 10 years. For reconstruction projects, we forecast 20 years into the future.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Nevada

Contact: Xuan Wang, Transportation Analyst, Nevada Department of Transportation, xwang@dot.state.nv.us, (775) 888-7443.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Linear regression
   Growth rate from similar sites

1a. **Modeling software program:** TransCAD.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** Yes. 0.5%.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** There are four methods for truck traffic forecasting that can be applied based on the availability of data and the nature of the project location. The following are to be applied in the order listed below:
   - A historical trend projection analysis using historical truck AADT [annual average daily traffic] data is the recommended approach for forecasting future truck traffic when historical truck AADT data is available for the project location.
   - If historical truck data is unavailable for the project location, the availability of data for a location with similar characteristics to that of the project location is to be examined.
   - If historical data is unavailable for the project location, and a location with similar characteristics cannot be identified, the analyst is to use current truck traffic data from a location similar to the expected future year conditions of the project location.
   - If, after all of these options have been exhausted, suitable truck traffic data is still unavailable for forecasting, the analyst may apply the "truck traffic as a constant percentage of total traffic" method.

   In all, it is recommended that the analyst apply engineering judgment when forecasting truck traffic as the extent of historical data available for the regression analysis may be less, resulting in unreasonable

projections. The forecast truck AADT is to be examined for reasonableness and compared with the change in trend of other quantities, such as population, economic activity, and transportation demand for commodities.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** [No response.]

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** We have a traffic forecasting guidelines document. If you are interested, please let me know and I can email it to you. Thanks! [*Note*: Xuan Wang has not responded to our request for this document.]

New Mexico

Contact: Brian Degani, Engineering Coordinator, New Mexico Department of Transportation, brian.degani@state.nm.us, (505) 827-3244.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Cubic regression
   Least squares regression

1a. **Modeling software program:** VISUM is used as our travel demand modeling and network data management for multimodal analysis and provides a variety of assignment procedures and four-stage modeling components; a trip end-based model of cross classification [provides] outputs such as vehicle miles traveled and various other model outputs.

2. **Years of historical data:** Fewer than 5 years.

3. **Social and economic variables:**

   Employment
   Personal income
   Households
   Total population

3a. **How are socioeconomic variables employed?** Our model's socioeconomic-demographic data drives our statewide model for both base and forecast years for our MPO and City models. Demographic data for both our base and forecast years for each of the previously established trip generation variables of Total Households (TOTHH), Retail Employees (RETAIL), Service Employees (SERVICE), Other Employees (OTHER), and Total Workers (TOTWKS) was derived from the MPO and City submodels. This data was either derived directly or interpolated if the model years were not consistent. Each submodel contained a unique set of independent trip generation variables which were aggregated to the model's variables before interpolation.

4a. **Apply a minimum annual growth factor?** Yes. Traffic for the 2020 and 2030 future years uses the land use and demographic data sets with the different growth assumption options.

4b. **Apply a maximum annual growth factor?** Yes. Traffic for the 2020 and 2030 future years uses the land use and demographic data sets with the different growth assumption options.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. FAF3 [Freight Analysis Framework, third generation] data was used to forecast future internal-external, external-internal, and external-external truck trips. To forecast these trips, the FAF3 network, which includes truck volume forecasts from 2007 to 2040, was imported. Each of the links that crosses into New Mexico in the FAF3 network was analyzed to derive growth factor multipliers for use in the forecasts.

6. **Time periods included in projections:**

   10 years
   15 years

6a. **Why these time periods?** Since our base year model was 2006, we determined that our future year forecast networks should be 2020 and 2030 to project out for our 25-year Statewide Long Range Plan.

7. **Flattening or decrease in VMT?** No.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]

New York

Contact: Lou Adams, Civil Engineer 3, New York State Department of Transportation, lou.adams@dot.ny.gov, (518) 457-8540.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** Citilabs has built a statewide travel demand model in Cube Voyager for us. We also have a statewide VMT macroeconomic forecasting model that Global Insight licenses to us.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

Employment
Gas prices
Households
Total population
The variables checked are in the context of the Citilabs model.

3a. **How are socioeconomic variables employed?** The Global Insight model is in the form of natural log of dvmt = natural logs of other variables with a constant and an error term. Independent variables are cost of travel, a function derived from driver age population, and a factor to cover substitution of communications for travel.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. Through traffic is handled separately from I-I [internal-internal], E-I [external-internal] and I-E [internal-external] in the Citilabs model.

6. **Time periods included in projections:**

10 years
20 years
30 years

6a. **Why these time periods?** Design service life of signals, pavement, bridges.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. The Global Insight model will be updated in 2014, once all the math from the 2000-2010 decennial censuses regarding that decade of change have been built into their county-level demographic-economic models.

9. **Details or comments:** [No response.]

North Carolina

Contact: Deborah Hutchings, State Traffic Forecast Engineer, North Carolina Department of Transportation, dhutchings@ncdot.gov, (919) 707-0966.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression. We have transportation models in some of the areas below 50,000 which are used. We also look at exponential trend lines.

1a. **Modeling software program:** Yes; see response to Question 1.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Labor force
   Personal income
   Households
   Total population
   It depends on the forecast; if we have a transportation model we use different variables than if we do not.

3a. **How are socioeconomic variables employed?** For nonmodeled areas, we look at population growth and projections and consider it. It is not directly utilized. We also generally consider the economic health of the area; for example, recently the economy has declined, and so has travel. In looking to the future, we generally consider how we anticipate the area to rebound.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   25 years
   30 years
   35 years
   We may do intermediate years if there is an event which will change travel patterns (for example, the opening of a nearby bypass).

6a. **Why these time periods?** For modeled areas, we typically use the horizon year of the model. In some instances, to provide 20 years beyond the opening date of the project, it is requested for further out. Our current default is 2035 or 2040, unless otherwise requested.

7. **Flattening or decrease in VMT?** Yes.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. We consider the recent trends in determining growth rates to use.

9. **Details or comments:** [No response.]

North Dakota

Contact: Terry Woehl, Transportation Engineer, North Dakota Department of Transportation, twoehl@nd.gov, (701) 328-3531.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** At first thought, I answered no because in the next few weeks, we will be taking possession of a "Regional" traffic model developed by one of our universities and we really don't have much experience with using it.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**

   Labor force
   Gas prices
   Fuel consumption
   Households
   Total population
   Our current system does not employ any of these variables.

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** Yes. A growth rate is applied based on historical traffic counts and a knowledge of the area being forecasted (i.e., truck generators, local development, etc.).

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. In some instances, depending on the makeup of the traffic stream usually through a different growth rate for ESALs [equivalent single axle loads] versus total traffic volume.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** Without extensive knowledge of the reason why I would offer that this is a typical pavement design life for NDDOT.

7. **Flattening or decrease in VMT?** No. North Dakota has seen its VMT increase in part due to the current oil play.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]

Oregon

Contact: Brian Dunn, Transportation Planning Analysis Manager, Oregon Department of Transportation, brian.g.dunn@odot.state.or.us, (503) 986-4103.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** Travel demand models, urban and statewide.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Employment
   Unemployment rate
   Labor force
   Gas prices
   Fuel consumption
   Personal income
   Households
   Total population
   Driving age population
   Population age 16 and over
   Population age 65 and over
   Depends on tool—travel demand model or statewide model.

3a. **How are socioeconomic variables employed?** Through travel demand modeling and integrated economic/land use/freight models.

4a. **Apply a minimum annual growth factor?** Yes. Zero percent where traffic growth has declined or has not changed.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Yes. Only for the statewide integrated model for freight analysis.

6. **Time periods included in projections:**

   5 years
   10 years
   15 years
   20 years
   25 years
   30 years
   35 years
   40 years
   50 years

6a. **Why these time periods?** Most regional transportation plans and NEPA [National Environmental Policy Act] projects require 25 years and interim years. Long-range land use and scenario planning may go up to 50 years out.

7. **Flattening or decrease in VMT?** Yes. The economic downturn has affected many areas of Oregon. Some rural communities have been flat for many years due to the timber economy.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** Yes. Changes have been adopted and we are working on furthering those in working with the statewide economic model.

9. **Details or comments:** Oregon is unique in that we have fairly advanced modeling tools for areas below 50,000 population. We also have a fully integrated statewide economic/land use/transport model.

Pennsylvania

Contact: Jeremy M. Freeland, Transportation Planning Manager, Bureau of Planning and Research, Pennsylvania Department of Transportation, jfreeland@pa.gov, (717) 787-2939.

1. **Methodology(ies) used to estimate future traffic volumes:** Least squares regression.

1a. **Modeling software program:** We use a consultant software that uses linear and lane miles along with socioeconomic values.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:**

   Personal income
   Households
   Total population

3a. **How are socioeconomic variables employed?** The consultant inputs those variables.

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years. Our factors are to be used up to 20 years.

6a. **Why these time periods?** We've seen that if you go beyond 20 years the values are much greater than expected depending on the volumes.

7. **Flattening or decrease in VMT?** Yes. When the recession first happened our VMT was decreasing but recently it's started to climb.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

Rhode Island
Contact: Bob Shawver, Administrator, Planning & Finance, Rhode Island Department of Transportation, rshawver@dot.ri.gov, (401) 222-2694, ext. 4224.

Mr. Shawver provided the following in lieu of completing the online survey:

> All of Rhode Island is within the Providence metropolitan area with planning performed by the state's MPO. Therefore, we have no forecasting procedures for nonmetropolitan area.

South Dakota
Contact: Jeff Brosz, Transportation Specialist, South Dakota Department of Transportation, jeff.brosz@state.sd.us, (605) 773-5439.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** None.

2. **Years of historical data:** 5 to 10 years.

3. **Social and economic variables:**

   Employment
   Motor vehicle registration
   Personal income
   Total population
   Licensed driver

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** [No response.]

7. **Flattening or decrease in VMT?** No.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]

Texas
Contact: Greg Lancaster, Transportation Analyst Supervisor, Texas Department of Transportation, greg.lancaster@txdot.gov, (512) 486-5126.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression. Depending on analyst request, other methods would be considered.

1a. **Modeling software program:** In urban areas where the model boundary extends past the urban boundary, a three- or four-step gravity model developed for planning purposes is used as part of the information to develop the future traffic. TxDOT also has a statewide model that can be used.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:** TxDOT requests information associated with the corridor on housing and business (basic, retail and service) development for existing and analysis year conditions. ITE Trip Generation Manual is used to assess impacts. This information is used to determine if traffic generation is required.

3a. **How are socioeconomic variables employed?** See response to Question 3.

4a. **Apply a minimum annual growth factor?** Yes. Generally speaking, a minimum of 2% growth is applied if regression analysis shows less than 2%. If an extenuating circumstance exists, less than 2% may be applied (for example, corridor is built out, land use restrictions, base closures or a major plant closing).

4b. **Apply a maximum annual growth factor?** Yes. Generally speaking, a maximum of 5% growth is applied if regression analysis shows more than 5%. If an extenuating circumstance exists, more than 5% may be applied (for example, greenfield project or a major plant opening).

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   20 years
   30 years
   Project or policy specific analyses do occur with unique forecast years.

6a. **Why these time periods?** Projection time periods are associated with pavement design period.

7. **Flattening or decrease in VMT?** No. Texas has 254 counties of which only around 70 are urban. Rural area VMT trends vary.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]

Utah

Contact: Walter Steinvorth, Planning Manager, Utah Department of Transportation, msteinvorth@utah.gov, (801) 965-3864.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** In addition to linear regression, we have developed a statewide travel demand model using Citilabs Cube software. It is a traditional four-step model.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Employment
   Motor vehicle registration
   Households
   Total population

3a. **How are socioeconomic variables employed?** We have a traditional four-step model with a trip generation model included. It is a cross-classification model for trip production and regression equations for trip attractions (the model will convert person trips to vehicle trips by using vehicle occupancy rates developed later in the model sequence).

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:**

   10 years
   20 years
   30 years

6a. **Why these time periods?** The urban models are inputs to the statewide model. The MPOs use these time periods for their planning. We also have a developed a four-year planning cycle with the MPOs where we produce a Unified Plan every four years. So we are all consistent in planning horizons.

7. **Flattening or decrease in VMT?** Yes. For the past decade, Utah has been a high-growth state. However, we are observing a decline or flattening in VMT. We think it is caused by increased fuel prices coupled with a recession economy.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** [No response.]

West Virginia

Contact: Gary Graley, Capital Program Development Section Head, West Virginia Department of Highways, gary.w.graley@wv.gov, (304) 558-9510.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** Modeling software is used for project specific networks only to estimate future traffic volumes.

2. **Years of historical data:** 11 to 20 years.

3. **Social and economic variables:** Total population.

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** Yes. Use growth factors from historic information to calculate growth.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** 20-year growth is used for project design. Other growth rates may be used in specific situations such as growing last year's count to the current year to use with other counts recently collected in the same area.

7. **Flattening or decrease in VMT?** Yes. Over the last couple of years, some locations throughout West Virginia have decreased in VMT. This is not the norm for the state.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** No.

9. **Details or comments:** The Department of Highways is currently monitoring the VMTs to see if the decrease is connected to the recent problems with the economy. We are optimistic the traffic volumes will begin increasing again.

Wisconsin

Contact: Jennifer Murray, Traffic Forecasting Section Chief, Wisconsin Department of Transportation, jennifer.murray@dot.wi.gov, (608) 264-8722.

1. **Methodology(ies) used to estimate future traffic volumes:**

   Box-Cox linear regression
   Linear regression
   Logistic regression
   We have a statewide and a few smaller travel demand models in more rural areas, so we'll look at those results as well and determine growth rates based on a comparison of the methods.

1a. **Modeling software program:** Cube TP+, our enterprise system for determining forecasts in less populated areas, is called Traffic Analysis Forecasting Information System [TAFIS], which spits out Box-Cox Model, Location-to-Location Model, Cook's D Statistic Model, Average Historic Proportion Model, and Specific Growth Rate Model.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population
   Driving age population
   Population age 16 and over
   Population age 65 and over
   Birth rate
   Industry type
   Vehicles per household
   Trip rate

3a. **How are socioeconomic variables employed?** Underlying Box-Cox methodologies rooted in socioeconomic concepts. We look at other trends that might impact how we conduct forecasts regularly. Our VMT calculation also helps us understand the direction of more recent past trends (that uses fuel consumption as one of the factors).

4a. **Apply a minimum annual growth factor?** Yes. 0.5%.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** Sometimes; depends on the forecast and the type of traffic counts we get to produce the forecast. We often consult the Automated Traffic Recorder sites and do some analysis on the data.

6. **Time periods included in projections:** Again, depends on the forecast and the type requested. We can go out 50 years with our TAFIS data, if needed. All of the above are possible with our method.

6a. **Why these time periods?** It's up to the design engineer, corridor plan team lead or MPO director who is requesting the forecast from us to determine what year or years they would like.

7. **Flattening or decrease in VMT?** Yes. We don't have a lot of good traffic count data on non-STHs [state trunk highways] so it is very difficult to completely answer yes to your question.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]

Wyoming

Contact: Ryan Fisk, Transportation Planner/Analyst, Wyoming Department of Transportation, ryan.fisk@wyo.gov, (307) 777-4410.

1. **Methodology(ies) used to estimate future traffic volumes:** Linear regression.

1a. **Modeling software program:** TransCAD.

2. **Years of historical data:** 21 to 30 years.

3. **Social and economic variables:**

   Employment
   Households
   Total population
   Vehicle ownership
   School enrollment

3a. **How are socioeconomic variables employed?** [No response.]

4a. **Apply a minimum annual growth factor?** No.

4b. **Apply a maximum annual growth factor?** No.

5. **Apply different growth rates to heavy commercial traffic versus total traffic volume?** No.

6. **Time periods included in projections:** 20 years.

6a. **Why these time periods?** Agreement with communities.

7. **Flattening or decrease in VMT?** No. Our communities are mostly impacted by energy development and/or tourism.

8. **Changes in forecasting methodology adopted or considered in response to flattening or decrease in VMT?** N/A.

9. **Details or comments:** [No response.]