Wisconsin Department of Transportation

Transportation Planning Manual

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Chapter 9: Traffic Forecasting, Travel Demand Models and Planning Data

Section 1 – General Forecasting Protocols and Procedures

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1.1 Introduction and Purpose

The Wisconsin Department of Transportation (WisDOT) has produced transportation forecasts and analyses for many years. Over the course of the last 20 years, WisDOT has refined techniques, developed policies and standardized procedures that have guided transportation analyses. Today, several sophisticated models and tools exist to forecast travel on Wisconsin’s transportation system. Chapter 9 - Traffic Forecasting, Travel Demand Models and other Planning Data outlines WisDOT’s forecasting process, from input assumptions to final output results. It explains why data quality matters, and where data quality might affect the accuracy of travel and traffic projections.

The purpose of this chapter is to formalize and standardize the process, requirements, and background information used to do traffic forecasting and multimodal travel projections in Wisconsin. It also serves as a reference for all parties who use traffic forecasts and travel demand estimation techniques in the corridor planning and project development processes. The ultimate goal of Chapter 9 - Traffic Forecasting, Travel Demand Models and other Planning Data is to communicate a high quality, streamlined process while making WisDOT procedures more transparent and accessible to a wide array of users.

This chapter:

- Compiles forecasting documentation and provides applicable links to WisDOT resources, such as the WisDOT Facilities Development Manual (FDM) where more information can be found
- Serves as a record of policies, standards, and guidelines
- Clarifies WisDOT expectations and procedures

Updates to this chapter will be made on an ongoing, as-needed basis. The chapter will change as policy, procedures, and/or work processes change within the Wisconsin Department of Transportation. Questions, comments, and other concerns on Chapter 9 - Traffic Forecasting, Travel Demand Models and other Planning Data can be directed to:
1.2 Reasons for Forecasts and Travel Analysis

Transportation forecasting is the process of estimating the number of people or vehicles that will use a specific transportation facility in the future. Transportation forecasts can be utilized in a variety of different situations and with different modes of transport, from estimating traffic volumes on a specific segment of road or highway to estimating ships in a port or passenger volumes on a city’s buses.

Forecasts explain what the needs of the future might be and provide benchmarks for proper design and efficient transportation system operation. Transportation forecasts are fundamentally important inputs in developing infrastructure – from developing overall transportation policy, to planning studies, to the engineering design of specific projects. Example applications of forecast information include:

- Development of infrastructure capacity and design calculations (e.g., the operations of an existing or proposed roadway or bridge, or the thickness or type of roadway pavements)
- Estimation of the financial and/or social viability of projects (e.g., developing benefit-cost analyses and/or social impact assessments)
- Calculation of environmental impacts, such as air and noise pollution

As noted in Section 1, Subject 3, travel analysis and traffic forecasts occur during long-range planning and during project development. WisDOT’s Traffic Forecasting Section provides expertise in the following analysis activities:

- Highway traffic forecast assumption development and completion
- Regional travel demand and forecasting model development
- Travel and origin-destination survey implementation
- Vehicle miles of travel estimation
- Special studies and analysis, including but not limited to
• Traffic impact analysis (TIA) review
• Seasonal factor review and update used to convert 48-hour traffic counts to estimates of Average Annual Daily Traffic (AADT)
• Peak and design hour factors development
• Heavy truck classification estimation
1.3 Roles and Responsibilities for WisDOT Forecasting

The traffic forecasting section is the overall WisDOT business area lead in forecasting travel and conducting future travel analysis. The traffic forecasting section is physically located in WisDOT’s Central Office in Madison and is part of the Bureau of Planning and Economic Development (BOPED) in the Division of Transportation Investment Management (DTIM). WisDOT’s Southeast Region planning unit also directs traffic forecasting activities out of its unit, specifically for the Southeast Region. Traffic forecasting in the Central Office directs overall forecasting polices and implements travel analysis procedures. It conducts overall review and final approval of all forecasts. The traffic forecasting section mission is:

*to add value to department planning, design and operations by transforming a wide array of traffic, demographic and economic data into traffic forecasts and related travel information essential to engineers, intercity and urban planners, project programmers and policy makers.*

One part of the forecasting section responsibilities is to conduct highway traffic forecasts. Several transportation-related business areas use traffic analysis and forecasts. During long-range planning activities, Metropolitan Planning Organizations (MPOs) and WisDOT planners utilize forecasts to develop long-range transportation plans. Highway level-of-service criteria is discussed with highway programming and determined through predicted future conditions of travel demand. MPOs may also conduct analysis in urbanized areas with travel demand models to continually address transportation needs in their region. To demonstrate air quality conformity, forecasts of regional travel criteria affecting air emissions are compiled by WisDOT traffic forecasters and MPOs for the Environmental Protection Agency through the Wisconsin Department of Natural Resources.

WisDOT roadway traffic analysis occurs during planning and engineering. As transportation plans move to the project level, WisDOT region planners and project development engineers examine project scope and constraints with forecasted values. Forecasts provide a more detailed analysis of transportation mobility
needs versus constraints. For example, during highway projects, engineers use traffic forecasts to implement more accurate designs; to better analyze intersection controls; to calculate roadway throughput; and to conduct pavement analysis.

It is WisDOT policy to utilize the traffic forecasting section and Southeast Region forecasters to participate in forecasting procedures for all modes of travel. While some analysis occurs at the region planning or MPO level (and in the Southeast Region, traffic forecasts are conducted in the planning section), WisDOT’s Central Office Traffic Forecasting Section conducts overall review and final determination of approval of all forecasts. Traffic forecasting maintains a record of approved forecasts for a minimum of five years. All forecasts should be submitted to the traffic forecasting section for review and approval. To ask for a forecast review, use form DT1594. To submit a forecast request, use form DT1601.

Figure 1.3.1: All traffic forecasts are centralized
1.4 WisDOT Roadway Traffic Forecasting

Each year, WisDOT completes hundreds of roadway traffic forecasts for corridor plans and projects. It is WisDOT policy to use a standard, multi-step traffic forecasting process and procedure to develop roadway traffic forecasts.

1.4.a. Process

As stated in WisDOT FDM Section 3-10-10, highway traffic forecasts are used for several reasons including to determine design standards, structural requirements and level-of-service analysis. It is WisDOT policy to conduct roadway forecasts on most federally-funded projects and state-funded local bridge projects. It is WisDOT policy that federally-funded local program construction projects, with average annual daily traffic volume of more than 500 vehicles, should be reviewed or conducted by WisDOT’s Traffic Forecasting Section or Southeast Region Traffic Forecasters, for Southeast Region projects. Accordingly, WisDOT policy requires forecasts for the following planning or project improvement types:

- Resurfacing
- Pavement replacement
- Reconditioning
- Reconstruction
- Capacity expansion
- Bridge replacement
- Access control
- Corridor studies

If a state or local bridge or roadway project has documented proof of a current average annual daily traffic volume of less than 500, a WisDOT traffic forecast is not required. Designers can provide their own
forecast. Designers may also request a forecast or review for projects under 500 if they do not possess the traffic expertise to perform the forecast.

If a bridge is not being expanded or replaced, then a forecast is not required. WisDOT FDM Section 3-10-10 exempts bridge rehabilitation projects. If significant traffic control is necessary, then a traffic forecast request should be submitted if it will help with project implementation. Because the life cycle of a bridge exceeds 30 years, it is important to design the bridge to accommodate increased traffic due to local development and to accommodate things like agricultural implements that might utilize the bridge.

In general, if local land use or development is anticipated to occur in the next five years and the traffic volume on the roadway is expected to exceed 500 AADT, then a forecast should be discussed with the department’s region traffic forecasting contact, who will determine whether to conduct a forecast. The region contacts are listed in Table 1.4.2.

Additionally, it is WisDOT policy to conduct forecasts at least twice during the life cycle of a project—once during project scoping/concept definition and then during data gathering of the final design. Please see WisDOT’s FDM 3-1 Attachment 1.1; FDM 3-5-3 Attachment 3.2 Project Scoping Checklist; FDM 3-20-5 Data Gathering.

It is imperative that designers request a forecast (and counts if needed) early in the life of a design project. Traffic data and forecasts will affect a project's pavement design, traffic analysis (if required), design study report, preliminary plans, project specifications and project cost estimates. WisDOT requires forecast documents for the project development process follow standard review and approval procedures.

WisDOT’s Central Office Traffic Forecasting Section conducts overall review and final determination of approval of all forecasts. This assures a consistent methodology is utilized (for more information on roles and responsibilities, see (Section 1, Subject 3). To request a forecast review, use form DT1594. To request a traffic forecast to be completed by WisDOT, use WisDOT form DT1601. These forms are filled out by the requester (often the project consultant, region planning or region project engineer) in cooperation with the department’s region forecasting contact. The region contacts are listed in Table 1.4.2.
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<th>Region</th>
<th>Traffic Forecasting Contact</th>
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<tr>
<td>1 Southwest</td>
<td>MADISON/LA CROSSE - Jean Mancheski (F, LR, TC)</td>
<td>(608) 246-3807</td>
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<td></td>
<td>MADISON/LA CROSSE - Graham Heitz (TIA)</td>
<td>(608) 246-5362</td>
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<tr>
<td>2 Southeast</td>
<td>Robert Elkin (F)</td>
<td>(262) 548-8704</td>
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<tr>
<td></td>
<td>Art Baumann (TIA)</td>
<td>(262) 548-5626</td>
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<tr>
<td></td>
<td>Dan Malicki (TIA)</td>
<td>(262) 521-5285</td>
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<tr>
<td>3 Northeast</td>
<td>Matthew Halada (F)</td>
<td>(920) 492-7725</td>
</tr>
<tr>
<td></td>
<td>David Nielsen (TIA)</td>
<td>(920) 492-0148</td>
</tr>
<tr>
<td></td>
<td>Kim Heise (TC)</td>
<td>(920) 492-5985 or (920) 362-6360</td>
</tr>
<tr>
<td>4 North Central</td>
<td>WISCONSIN RAPIDS/RHINELANDER - Dave Meurett (F)</td>
<td>(715) 421-8348</td>
</tr>
<tr>
<td></td>
<td>WISCONSIN RAPIDS/RHINELANDER - Richard Handrick (TIA)</td>
<td>(715) 365-5716</td>
</tr>
<tr>
<td>5 Northwest</td>
<td>EAU CLAIRE - Richard Putzy (F, LR)</td>
<td>(715) 836-2893</td>
</tr>
<tr>
<td></td>
<td>SUPERIOR - Martin Forbes (F)</td>
<td>(715) 392-7964</td>
</tr>
<tr>
<td></td>
<td>EAU CLAIRE/SUPERIOR - Jeff Olson (TIA)</td>
<td>(715) 395-3031</td>
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Table 1.4.2: WisDOT Region Traffic Forecasting Contacts; (F) = Forecast Requests, (TIA) = Traffic Impact Analysis, (LR) = Local Road Count Info, (TC) = Traffic Counts

All appropriate data and attachments (including potential development information) are to be included in the forecast request to ensure a timely delivery or review of the traffic forecast. Once DT1601 or DT1594
are completed, the region traffic forecasting contact submits it and related attachments to the Central Office Traffic Forecast Section, Vu Dang; Traffic Forecasting, BOPED, DTIM; Phone: (608) 266-2571; Email: Vu.Dang@dot.wi.gov. Updates to WisDOT region forecasting contacts (see Table 1.4.2) should be sent to Vu Dang, as well. Table 1.4.2 will be revised on a continual basis in order to keep contact information current (last revised July 2013).

The traffic forecasting section (and WisDOT Southeast Region staff, in WisDOT Southeast Region) completes WisDOT's traffic forecasts. Sometimes consultants working for WisDOT complete portions of traffic analysis for plans or projects. In these cases, WisDOT policy is to coordinate efforts between the consultant staff and the traffic forecasting section. Most of the time, WisDOT will supply a base forecast, including turning movement forecasts. A WisDOT project number (ID) will be assigned and appropriately charged. WisDOT’s Central Office Traffic Forecasting Section conducts overall review and final determination of approval of all forecasts. Consultant forecasts should be submitted for review and approval to the regional contact using the DT1594 form.

To better understand how to fill out WisDOT form DT1601, see WisDOT FDM Section 3-10-10. Lack of data or an improperly filled out request form will be returned to the region traffic forecasting contact and will likely delay the process. Depending on complexity and traffic forecasting workload, it takes about four weeks to complete a forecast. Due dates of “as soon as possible” are not accepted, though all attempts to expedite a forecast will be made when resources allow.

1.4.b. Traffic Counts
WisDOT’s Bureau of State Highway Programs Data Management Section manages the statewide traffic count collection program. WisDOT uses current traffic counts or average annual daily traffic (AADT) as one of the main inputs to accurate roadway forecasts. WisDOT requires the use of the most recent count to develop the traffic forecast. WisDOT policy is to collect new traffic counts when the most recent count is more than three years old. Counts and forecasts performed by WisDOT are charged to the project and follow the improvement project agreement and normal cost sharing for design engineering. The project agreement should be consulted.

Depending on the situation and the type of forecast requested, traffic counts either exist in WisDOT enterprise data (called TRADAS) or exist in project data collection files at the region office. Mainline traffic counts are traffic counts that are on continuous segments of the roadway network. Turning movement traffic
counts are traffic counts at intersections; capturing the various types of turns occurring. All turning movement forecast requests must be accompanied by recent intersection traffic counts.

**Traffic Counts Newer Than Three Years**

AADT counts newer than three years should be attached to [DT1601](#) when a traffic forecast is completed or requested.

**New Traffic Counts**

If traffic counts do not exist, AADT counts (and sometimes other traffic counts) must be collected before a forecast can be completed. When counts are older than three years, the traffic forecast requester should follow WisDOT traffic count data collection standards. All efforts should be made to ensure that new traffic counts are completed including all factoring for axles, day of week, season, etc. before the [DT1601](#) is sent to traffic forecasting. Contact the Data Management Section at the Bureau of State Highway Programs for more information on factoring.

**1.4.c. Forecast Years**

Forecast development usually assumes at least a 20 year planning horizon beyond the estimated time of construction. Multiple forecasts in one area should be coordinated by the region traffic forecasting contact to ensure that mid-forecast and final forecast years are coordinated across several forecasts, when possible. Forecasts include future average annual daily volume projections, hourly design factors for highway geometric design, heavy truck classification estimates for pavement design, and turning movements for intersection improvements.

**1.4.d. Other Data Collection Requirements**

To minimize the need for re-work, as much information as possible should be included in the original forecast request regarding recent new developments, newly constructed local arterial/collector streets, and recent major business expansions or contractions. Other data to be included with form [DT1601](#) is listed in [WisDOT FDM Section 3-10-10](#), Data Collection Techniques.

When a request is made in a Metropolitan Planning Organization area, the process and tools to develop the traffic forecast are essentially the same. Typically a travel demand model and the Traffic Analysis Forecasting Information System are used for travel behavior analysis. Sometimes, consultation with the MPO or local unit of government assists in data gathering and future planning activities and can have some
effect on the forecasted output. See Section 10, Subject 4 for more information on travel demand model forecast techniques.

After a traffic forecast is prepared, other data elements including peak-hour information, truck percentages for the roadway, and other design parameters are investigated. See Section 40, Subject 1 for more information about the specific data elements of roadway traffic forecasting.

1.4.e. Roadway Traffic Forecasting Questions and Records of Older Forecasts

Discussions of upcoming forecasts between the design engineer and the traffic forecaster are also helpful when done well in advance of completing the forecast analysis. After a forecast is completed, if there are concerns or questions, please contact the traffic forecaster at the Central Office or in Southeast Region planning (if concerning a Southeast Region plan or project). There are situations where assumptions should be explained in detail. Many times the traffic forecasting contact will arrange a multilateral meeting or conference call to discuss the forecast. The traffic forecasting section does not adjust traffic forecasts based upon opinions. In the event the forecast question cannot be resolved, the traffic forecasting section chief will address the issue.

1.4.f. Types of Roadway Traffic Forecasts

Different types of roadway traffic forecasts are utilized in different situations. Forecasts are used for anything from determining future traffic volumes and turning movements at intersections (in order for traffic lights to have proper timing, for example) to providing traffic volumes and truck percentages so a roadway can be designed correctly for its capacity and material composition. Different types of forecasts are used to determine whether a future roadway should be planned for, designed, and built at a given location in order to accommodate future traffic volumes. Per WisDOT guidelines, several types of roadway forecasts exist, including but not limited to:

- Roadway mainline (daily and peak forecasts)
- Roadway turning movement (daily and peak forecasts)
- Roadway mainline and turning movement forecasts for special land use analysis
  - Traffic impact analysis (TIA)
  - Trip origin-destination or expansion analysis
  - Trip generation studies
  - Alternatives analysis
A forecast requester should review the needs of his or her project in order to properly submit the DT1601 form. The following section provides guidance and additional information regarding forecasts to the requester when he/she is determining the needs of the project. It also outlines forecast requirements.

**Standard Design Year Forecasts**

Standard design year forecasts (such as roadway mainline or turning movement forecasts) assume at least a 20 year projection into the future. Standard segment mainline forecasts are created with the Traffic Analysis Forecasting and Information System (TAFIS) and travel demand models (where available) and are the most basic type of forecast. If there is federal funding involved and the roadway traffic volume is more than 500 AADT, the following types of roadways require a forecast:

- Resurfacings
- Pavement replacements
- Reconditionings
- Reconstructions
- Capacity expansions
- Bridge replacements,
- Access control projects
- Corridor studies

**Model Alternative Forecasts**

Model alternative forecasts usually use the same 20 year projection as standard forecasts. Model alternative forecasts are often created with travel demand models alone. Changes to model components, create changes to the model iteration process. New traffic volume results become part of project alternatives screening. Common screening components include and are not limited to:

- Roadway number of lanes
- Roadway speed
- Roadway access, new alignments, and bridge locations affecting traffic analysis zone loadings

To compare project alternatives, model alternative forecasts are usually compared to the standard base forecast. Changes in assumptions or geometry are noted on the forecast report.
Traffic Impact Analysis: BASE Forecast and TIA DEVELOPMENT Forecast

A base traffic impact analysis (TIA) forecast is generally prepared if a proposed development is expected to generate more than 500 driveway trips during the peak hour, although region staff may determine that a forecast is required when the development generates more than 100 peak hour driveway trips (the threshold that triggers the need for a TIA). This forecast typically assumes a 30 year projection and forecasting techniques mimic the standard design year forecast process.

In addition to the base TIA forecast, to complete the TIA development proposal forecast, the number of trips generated by the proposed development in the peak hour must be added onto the base TIA forecast. To estimate site traffic that is added onto the base TIA forecast, several sources can be used:

- The Institute of Transportation Engineers (ITE) *Trip Generation Manual*
- A special study pertinent to proposed development showing future trip rates or individual company data
- Local data from comparable developments
- Other published references such as the *ITE Journal*
- A trip generation study or studies conducted at similar sites that are like the proposed development

When completed, the base TIA forecast and the TIA development forecast are compared for logical growth rates. The TIA development forecast report should note where the source data for the number of trips in the peak hour came from and if any special techniques or assumptions were used to generate the numbers.

Extended Forecasts

Extended forecasts show full build out or increases in growth over and above the base. In these types of forecasts, future year may be indefinite. Full build out may mean increases to land use over and above what is assumed in the travel demand model. WisDOT does not always create or analyze future traffic volumes using an extended forecast. Examples when WisDOT might use an extended design forecast include:

- In locations where projected base/standard design year volumes will meet the minimum level-of-service soon after the design year
To identify opportunities to make small construction investments to account for additional capacity that might be needed just beyond the design year

Examples that have been noted using this approach include proposals showing:

- A wider median, offset, lane, shoulder width and clear zone today, so that in the future it/they can be converted to a capacity lane
- A wider shoulder underneath bridges so a capacity lane can be added later without reconstructing the bridge
- Voluntary real estate preservation (not precluding future preferred alternatives) to prepare for the future additions of ramp turn lanes

The extended forecast may assume a 20 year up to a 40 year projection or may change population, employment, and land use growth projections. Traffic can be adjusted to test specific roadway carrying capacities or to test growth rates. Controlling factors that can be used to compare standard forecasts to extended forecasts include:

- Basic roadway data (number of lanes, speed, roadway alignment)
- Traffic conditions and level-of-service (access points, traffic lights, congestion, trip rates and others)
- Land use change (urban, suburban, or rural)
- Socioeconomics (population, average people in households, dwelling units and densities, employees and employment types, average autos per household, average daily person trips per household and others)
- Transportation mode (mode of travel to work, mode tradeoff analysis and others)
- Special-generators (big box retail, schools, universities, and others)

An extended forecast should contain notes that explain applicable forecast perimeters and/or the controlling factors.

**Standard Approach**

Regardless if it’s a standard, model alternative, TIA or extended forecast—WisDOT creates forecasts using a standard forecasting procedure across the State of Wisconsin. The Bureau of Planning and Economic
Development’s Traffic Forecasting Section records official forecasts in a database in Central Office. Anyone requesting forecast preparation must submit WisDOT DT1601 and pertinent information to WisDOT’s Region Forecasting Contact (see Table 1.4.2), who will submit the request to the traffic forecasting section. Anyone requesting forecast review and approval must submit WisDOT DT1594 and pertinent information to WisDOT’s Region Forecasting Contact (see Table 1.4.2), who will submit the request to the traffic forecasting section. Documented assumptions, context, and model changes used in the analysis or for any forecast submittal often include:

- A standard forecast report showing base and future year traffic
- Traffic data, including peak hour volumes and truck percentages
- Traffic forecast assumptions
- Special procedures or trip generation techniques
- Changes made during the analysis, including changes to roadway carrying capacity tests
- Control total determination procedures and reasonableness tests

Forecasts being used for a particular purpose should be compared against the standard design forecast. The traffic forecasting section (including the Southeast Region forecasters for forecasts in Southeast Region) will prepare, review and/or approve the forecast in a timely manner. If a forecast is revisited later, it will be imperative that the forecaster understand and be able to carry assumptions into future forecasts or analysis.

The following are examples of some of the forecasts completed by WisDOT’s Traffic Forecasting Section.
Roadway Mainline Daily Forecast
Roadway Mainline Forecast for Corridor Plan – Trip Origin-Destination or Expansion Analysis

Roadway Mainline Forecast for Alternatives Analysis
1.5 Related Policies: General Forecasting Protocols and Procedures

A summary of the WisDOT policies that were discussed in this section are:

It is WisDOT policy to:

- Use a standard, multi-step traffic forecasting process and procedure to develop roadway traffic forecasts. [WisDOT FDM Section 3-10-10](#)
- Conduct future travel analysis on roadways during corridor plan development; roadway resurfacing, pavement replacement, reconditioning, reconstruction, capacity and access control projects; and on bridge replacements.
- Utilize the traffic forecasting section and Southeast Region forecasters in the Southeast Region to participate in forecasting procedures for all modes of travel.
- Conduct forecasts at least twice during the life cycle of a project—once during project scoping/concept definition and then during data gathering of the final design. [WisDOT’s FDM 3-1 Attachment 1.1](#); [FDM 3-5-3 Attachment 3.2 Project Scoping Checklist](#); [FDM 3-20-5 Data Gathering](#).
- Roadway traffic forecast requests (DT1601) are discussed, conducted, and reviewed by the traffic forecasting section (in WisDOT’s Southeast Region traffic forecasts are conducted by the region planning staff); overall approval is by the traffic forecasting section using form [DT1594](#).
- Conduct forecasts on all federally-funded plans or projects (even local projects), and all state-funded local bridge projects that are currently more than 500 vehicles of average annual daily traffic and are not resurfacings.
- Receive requests for traffic forecasts using form [DT1601](#).
- Receive requests to review traffic forecasts done by others using form [DT1594](#).
- Maintain completed forecast records for a minimum of five years.
- Collect new traffic counts when the most recent count is more than three years old.
- Utilize traffic counts as one of the main methods for accurate forecasts and always use the most recent count to develop the traffic forecast.
- Conduct a meeting with the traffic forecasting section chief and other management as needed, in the event a forecast issue cannot be resolved.
Chapter 9: Traffic Forecasting, Travel Demand Models and Planning Data

Section 10 – Forecasting in Travel Demand Model Areas

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10.1 Introduction and Usage Areas

Travel demand models are sophisticated tools used to forecast future travel patterns. Current socio-economic data, roadway networks, trip rates, and other factors are used by the model to calculate the current and future travel patterns on a transportation system. Trip-making behavior analysis, completed utilizing the outputs from travel demand models, is input into long-range plans. Used with other planning tools, travel demand models can output a variety of data, including roadway traffic forecast information and deficiency characteristics.

10.1.a. Travel Demand Model Four-step Process

Wisconsin’s travel demand models are based on a classic four-step process that consists of:

- **Trip generation:** This step determines the frequency of origins and destinations of trips in each zone by trip purpose, typically as a function of household demographics and land uses, and other socio-economic factors.
- **Trip distribution:** This step pairs trip origins with destinations.
- **Mode choice:** This step calculates the proportion of trips between each origin and destination that use different transportation modes.
- **Traffic (route) assignment:** This step allocates trips between an origin and destination by a particular mode via different travel routes. Usually, route assignment is calculated under the assumption that each driver will choose the shortest travel time between origin and destination, subject to every other driver doing the same.

10.1.b. Metropolitan Planning Organizations and other Usage Areas

Fourteen MPOs exist in Wisconsin. These MPOs are responsible for transportation planning and programming activities in metropolitan areas that have more than 50,000 people. MPOs prepare long-range transportation plans, which require traffic forecasts with at least a 20 year planning horizon. WisDOT
coordinates with the MPOs to develop and maintain travel demand models as part of this process. This also supports a comprehensive approach to local, regional, and state transportation planning.

See Figure 10.1.1 for metropolitan planning areas and model locations. Chippewa-Eau Claire, La Crosse, and Dubuque have models that mirror the metropolitan planning area. Wausau, Janesville, and Beloit MPOs use travel demand models that mirror the boundaries in their respective counties rather than the smaller planning area boundaries. Madison utilizes a county-wide travel demand model, with the additional complexity of a mode-choice module. The MPOs located within WisDOT’s Northeast and Southeast Regions maintain regional travel demand models that encompass multiple MPO areas.

Travel demand models also exist in the non-MPO areas of Stevens Point, Wisconsin Rapids, and St. Croix County.
Figure 10.1.1: Travel demand models and Metropolitan Planning Areas in Wisconsin
Wisconsin’s travel demand models contain geographies called transportation analysis zones (TAZs). Each travel demand model has a unique TAZ system that aggregates land use activity at a scale comparable to U.S. Census block groups. The land use summary for each TAZ is used in the trip generation step of the model to determine its productions and attractions. Trip distribution converts the zonal productions and attractions to origins and destinations, while mode choice determines the method (transit or automobile) each trip will take. Trips are then routed along the transportation system in the traffic (and/or transit) assignment step of the model. The Dane County Model, Southeast Wisconsin Regional Planning Commission Model, and the Northeast Region Model are currently the only Wisconsin models that include a full mode choice and transit assignment component. Mode choice is accounted for with auto occupancy rates by trip purpose where transit options are available.

Currently Wisconsin’s travel demand models (except Dubuque, Duluth-Superior and the Southeast Region Planning Commission travel demand models) are coded with unique location identification codes that are integrated with WisDOT’s Traffic Data System (TRADAS). This allows traffic counts and other inputs to be entered more easily, and outputs to be extracted and compared with other forecasting methods (especially TAFIS, as described in Section 10, Subject 5).

Travel demand models have been developed:

- Using Citilabs’ Cube TP+ scripting platform to produce daily traffic forecasts
- Integrating National Household Travel Survey add-on data
- Using data gathered from the U.S. Census
- Using a traditional four-step model process
- Following MPO long-range plan update cycles

As stated in Section 1, Subject 4, the traffic forecasting section at WisDOT approves and stores a copy of all official roadway traffic forecasts in Wisconsin to make sure that reliable estimates of traffic movements are accounted for across the state. WisDOT travel demand models provide input into the traffic forecast, including origin and destination trip tables that can be used for input into traffic micro-simulations (e.g., Paramics, Corsim). See Section 1, Subject 4 and WisDOT FDM Section 3-10-10, for more information about roadway traffic forecasts.
10.2 Conditions for Model Use and Department Involvement

Urban travel demand models represent a significant investment by the State of Wisconsin. Once constructed, it is in the public’s interest to apply the models to their maximum potential. Primary users of the travel demand models include consultants, MPOs, and WisDOT regional staff, though the models are available for use to others, as well.

10.2.a. Conditions for Model Use

Wisconsin Department of Transportation has identified model standards and expected practices and procedures for model use. Those requesting release of MPO model data (termed, the user) from the Wisconsin Department of Transportation (referred to as, the department) should understand the purpose and limitations of each model before using the data.

These procedures are to be followed for every project and by every user, regardless of prior model usage or approval.

A. The user of model data shall complete a DT1599 form and submit the completed form to the department’s traffic forecasting section. The contact is:

Vu Dang  
Traffic Forecasting Section  
Wisconsin Department of Transportation  
Phone: (608) 266-2571  
Fax: (608) 267-0294  
Email: Vu.Dang@dot.wi.gov

B. The model input data and associated files as well as materials and data developed from the model should not be applied by the user beyond the intended use and agreed-upon terms in the DT1599 form.

C. Users of the model must obtain and maintain their own licensed copy of the platform software (i.e., CUBE Voyager).
D. The user shall not distribute the model or any files associated with the model to anyone outside the department, unless authorized by the department’s traffic forecasting section.

E. If the model socio-economic data needs to be amended or updated by the user, a written authorization must be obtained from the traffic forecasting section who will consult with the applicable Metropolitan Planning Organization.

F. Upon completion of its intended use, the user will agree to terminate the usage of the model(s) and all associated information and files unless other arrangements are agreed to by the department’s traffic forecasting section.

G. Upon completion of the project, the user agrees to provide copies of the final model files for the department and Metropolitan Planning Organization records. This includes, but is not limited to:
   a. All input files
   b. Executables
   c. Output files

H. The user agrees to deliver the items listed in Part G in the same file format obtained from the department or as specified by the department’s traffic forecasting section.

I. The user agrees to provide a document identifying all files edited and a description detailing how and why the files were modified.

J. The department accepts no responsibility for the results of the model application and/or model data maintained by the user.

K. Cooperation with the department (WisDOT region and the traffic forecasting section) is required throughout the course of a project and specifically recommended at the following phases of a project:
   a. Initial kick-off meeting: Review proposed project-level forecasting methodology and establishment of travel demand model assumptions
   b. First project meeting: Review model validation prior to draft forecasts
   c. Second project meeting: Draft and final forecast review, prior to presentation
   d. Final project meeting: Delivery of all model use documentation and electronically updated modeling files.

L. It is WisDOT policy that if a model change is deemed necessary (see Section 10, Subject 3), model files and elements will be transmitted to the department or vice-versa. Any model updates shall be consistent with the standardized model nomenclature outlined in Chapter 80, Subject 1, unless previously authorized by the department.
10.2.b Department Involvement

Valid assumptions lead to credible forecasts. WisDOT’s Traffic Forecasting Section requests project milestone meetings, as applicable and as indicated in Part K. The traffic forecasting section leads interim reviews and directs model application procedures. See Section 10, Subject 4 for more information.

WisDOT’s Central Office Traffic Forecasting Section conducts overall review and final determination of approval of all forecasts. It is WisDOT policy that any forecasts completed using the travel demand models or their outputs, without following the procedures outlined above, will not be considered for approval. Please see Section 1, Subject 3 for more information regarding roles and responsibilities during the traffic forecasting process.
10.3 Model Version Control

The Wisconsin Department of Transportation Traffic Forecasting Section is responsible for model version control on the travel demand models. The forecasting section houses and maintains the latest travel demand models. The department works closely with each MPO to develop and maintain each MPO’s regional travel demand model. The traffic forecasting section manages and approves all changes to the travel demand models in Wisconsin, except for Dubuque, Duluth-Superior, and the Southeast Regional Planning Commission travel demand models. All model requests and submittals should be made to the department. Coordinate all usage of the travel demand models with WisDOT traffic forecasting section as outlined in Section 10, Subject 2. Ongoing involvement from the MPOs on a variety of issues occurs.

10.3.a. Model Documentation

Travel demand models can change. Listing out the changes that have been made helps to eliminate confusion and increases user confidence in model results. It also minimizes duplicative efforts that may result from users not having a clear understanding of previous changes. Documentation is kept in a library of model updates at WisDOT’s Central Office Traffic Forecasting Section. Documentation occurs in three general areas, highway/transit, land use and model parameters. Documentation should clearly identify model version and the date the model was received from WisDOT and/or the MPO. WisDOT traffic forecasting will allow the use of graphics (i.e. area type, travel lanes, etc.) to support documentation of the model changes.

10.3.a.i. Network Updates

The transportation system should be accurately represented in the regional travel demand models. At a minimum, the transportation system should represent the system’s existing conditions. Committed projects in the model represent projects that have been approved and have the funding for implementation. MPOs are federally required to update their transportation improvement program (TIP) yearly and provide a coordinated listing of the short-range transportation improvement projects anticipated to be undertaken
within a five year time horizon. These are the committed projects. Project prioritization often occurs during TIP development.

Planned projects in the model are defined as projects that do not have approval or funding for implementation. The TIP can be used to determine the status of anticipated projects and for classification as committed or planned within the model. The planned transportation system should be consistent with the long-term vision outlined in the MPO’s long-range transportation plan, if the travel demand model is within an MPO planning area. Additional projects can be added and tested on a project-by-project basis to develop traffic forecasts and are often referred to as transportation alternatives. When conducting traffic forecasts, usually forecasts are developed for an MPO’s Existing plus Committed (E+C) network, but not for an MPO’s Existing plus Committed plus Planned (E+C+P) network.

WisDOT’s Traffic Forecasting approves changes to the network, after consultation with the region and the MPO. Input from local stakeholders is recommended, but not required. Documentation should reflect the inherent uncertainty of travel behaviors and decisions over time and the impact they can have on forecasts developed using the travel demand models.

Documentation of updates to the highway network should include but is not limited to the following:

- Addition or removal of roadway facilities
- Functional classification updates
- Travel lane updates
- User-speed overrides
- Newly committed and/or planned projects

10.3.a.ii. Land Use Updates

Land use assumptions developed for the MPO travel demand models are dynamic and continuously changing. Proper representation of the land use assumptions play a critical role in the model development and application. At a minimum, any changes to land use shall represent consistency with the local comprehensive plan. Employment, population, and/or housing numbers are often used as control totals in the travel demand modeling process. Municipal control totals shall be consistent with the local comprehensive plan and/or with data published by the Wisconsin Department of Administration’s Center for Demographic Services. The travel demand models that WisDOT manages use the future projected
Wisconsin Department of Administration’s Center for Demographic Services’ population figures as a control total for future year growth in the models.

WisDOT’s Traffic Forecasting Section approves land use changes in cooperation with the region and MPO staff. Often, better land use estimation occurs with local stakeholder input. Document land use changes to better recognize how the changes affect long-range socio-economic forecasts. Changes to the model land use data will ultimately change traffic forecasts.

Document land use changes clearly. Submit a table of existing and updated land use assumptions to WisDOT’s Traffic Forecasting Section when they have occurred. Document zonal adjustments or expansions with an illustration to better represent changes for traffic forecasting section approval.

Documentation of updates to the land use should include but is not limited to the following:

- Addition or expansion of zonal system (graphic required)
- Control total updates
- Household, employment or school enrollment updates
- Special generator updates or additions

**10.3.a.iii. Transit Network Updates**

Proper representation of transit routes and assumptions play a critical role in the development of ridership forecasts. At a minimum, transit updates shall be consistent with the latest service planning assumptions and be consistent with the plans developed by the appropriate transit agencies.

WisDOT traffic forecasting approves transit system updates with assistance and cooperation from the region, MPO, and input from local stakeholders. Documentation of model changes should reflect the inherent uncertainty of long range transit forecasts. Key uncertainties include these factors—transit accessibility, competing services, regional development assumptions, mode bias, and transit fares, all of which can impact forecasts developed using the travel demand models.

Documentation of updates to the transit network should include but is not limited to the following:

- Addition or removal of transit routes
- Mode
• Run time (i.e. service hours and bus speed)
• Headway
• Future service improvements

10.3.a.iv. Trip Generation and Distribution Updates
Calibrated model parameters represent estimated travel behaviors and choices in a mathematical context. Adjustments to model parameters should be completed in direct accordance with and submitted to WisDOT Traffic Forecasting Section due to the large impact they have on the model outputs. Submit tables providing the existing and updated model parameters. If model parameters are determined to have a significant impact on regional travel behaviors, a validation report must be submitted consistent with Section 10, Subject 3.b.

Documentation of updates to model parameters should include but is not limited to the following:

• Trip generation rates
• K-factors
• Friction factors
• Mode-choice coefficients
• Auto-occupancy rates
• Time of day factors
• Volume/delay coefficients

10.3.b. Validation Reports
Model validation refers to the application of a calibrated base year travel demand model, and the corresponding comparison between modeled results to observed data. A review of validation criteria enables a travel demand model user to determine if the model is performing at a level that produces appropriate results. The model should replicate observed travel behaviors without adversely affecting the ability to forecast the transportation project alternatives’ attributes or characteristics. Well-documented validation results provide travel demand modelers with information necessary to determine the amount of

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1 Model validation procedures rely heavily on information provided in the Travel Model Improvement Program (TMIP): Travel Model Validation and Reasonableness Checking Manual.
confidence that can be placed in the model outputs. WisDOT’s Traffic Forecasting Section expects model-wide or project level basis documentation.

Document inherent model limitations and provide a concentrated validation overview. An overview of updates and a corresponding validation report must be provided to WisDOT’s Traffic Forecasting Section to establish benchmarks for model performance.

In project documentation, fully disclose updates to regional, corridor, and site level corridor plans or projects and provide a summary of the validation reports produced after running the regional travel demand model. Establish and explain the difference between the baseline (existing) and updated model. When counterintuitive results are reported, provide an explanation of them.

Validation reports should include but are not limited to the following:

- Average daily traffic summary
- GEH summary
- Root mean square error report
- Screenline report
- Model AADT to observed AADT
- Ridership to on-board survey for transit, if applicable

Contact WisDOT’s Traffic Forecasting Section for more information on validation reports. Validated base year models ensure the model is able to reasonably reflect future year conditions. Validation of a base year model does not, in itself, ensure the reasonability of the future year forecasts. The validation process compares phases and aids in the development of credible forecasts. The process may differ slightly on a project-by-project or transportation mode basis. Document all methods and procedures and verify with WisDOT’s Traffic Forecasting Section procedures to ensure consistency across the state.

10.3.c. Forecast Documentation

When completing a traffic forecast, WisDOT’s Traffic Forecasting Section requires documentation of travel demand model input and output changes, that may have occurred, as well as any other procedures deviating from normal practices or procedures. To understand how to develop a forecast with travel demand model data, please see Section 10, Subject 4. All forecasts created using Wisconsin’s travel demand models must be approved by the traffic forecasting section.
10.4 Demand Model Roadway Forecast Techniques

Travel demand models are a very useful tool in traffic forecasting, particularly in alternatives analysis forecasting and in forecasting growth based on specific socioeconomic factors. Utilized for a wide range of projects, ranging from statewide forecasts to sub-area studies involving micro-simulation models, travel demand models require initial confidence in data assumptions and careful interpretation of model outputs. Several steps are involved in generating a model output. These include and are not limited to:

- Reviewing model assumptions
- Changing attributes and revalidating the model (if applicable)
- Adjusting the assignments for forecast development
- Adjusting roadway link growth rates
- Finalizing the roadway traffic forecast

It is WisDOT policy to document travel demand model and Traffic Analysis Forecasting Information System processes, steps, and assumptions to support logical forecast outputs.

10.4.a. Reviewing Model Assumptions

Roadway traffic forecasts are generally created the same way, regardless of the scale of the model. To be valid across forecast types, model assumptions should be reviewed. At the regional, corridor, site, or the long-range plan levels, several attributes should be reviewed before forecast development. The base year is defined as the year all data has been collected and usually corresponds to decennial U.S. Census data collection year—2000, 2010, 2020, etc. The future year is usually the travel demand model forecast year that corresponds with the MPOs long-range plan horizon year. The following attributes should be reviewed:

- Traffic analysis zones
  - Base and future year employees per zone
Base and future year houses or population per zone
- Centroid connections

- Base and future year transportation network assumptions
  - Functional classification
  - Speed, including travel-time estimations
  - Roadway network capacity
  - Roadway network lanes
  - Operational characteristic review
    - Connectivity with other roadways
    - Surrounding roadway characteristics of influence

- Existing projects, future year STIP and TIP committed projects and planned MPO projects

In addition to the above, at the corridor and site planning levels, travel demand models require a review of the following at a minimum:

- Future year local comprehensive plans or development plans
- Base and future year trip generation assumptions
- Base and future site-specific travel times or origin-destination pairings

During long-range plan development all of the above mentioned items are reviewed in depth, and any changes must be made in accordance with Section 10, Subject 3. WisDOT assists MPOs in updating models as part of the long-range transportation plan update every five years (every four in air quality non-attainment areas). At a minimum, every long-range plan update requires transportation network and socio-economic data (households and employment) review. MPO staffs are able to utilize travel demand models to evaluate urban growth and transportation investments to evaluate future improvements on a regional level.

If after reviewing model assumptions it is determined that no changes to the model are necessary, the analyst should determine the appropriate adjustment to be applied to the model assignment for forecast development. If it is determined that changes are needed to the model to continue forecast development, the analyst should change attributes and revalidate model.
10.4.b. Changing Attributes and Revalidating Model (if applicable)

When modifications are necessary to the travel demand models for roadway traffic forecast development, see Section 10, Subject 3 for procedures. Once approval is granted from the traffic forecasting section, the forecast development can proceed.

10.4.c. Adjusting Assignments for Forecast Development

Because of the difficulty in calibrating and validating travel demand models, the raw traffic assignment, or traffic that is assigned to a roadway link, is often misrepresentative of the actual traffic volumes. This phenomenon is usually evident in the model’s base year and can be tested by comparing the raw base year traffic assignment to the counts on corresponding road segments or travel demand model links.

Usually, a factor in a travel demand model can cause a raw roadway assignment value to be higher than the traffic count in the base year. This can also cause the future roadway traffic assignment to be high (over-assignment). Low traffic count assignment values can also affect model results, creating assignments that are lower than the corresponding counts (under-assignment). To account for the differences between assignments and roadway traffic counts in the base year, a set of methodologies was produced by the Transportation Research Board and published in the National Cooperative Highway Research Program Report #255 Highway Traffic Data for Urbanized Area Project Planning and Design. The methodologies in this report set a standard for adjusting the raw future year roadway traffic assignments (or raw long-range plan horizon year traffic) based on the base year traffic assignment and count values. It is WisDOT policy to follow standard, well-researched, nationwide protocols. Current methodologies are subject to review and/or replacement in light of the development of new standards.

The first method presented in the NCHRP report is called the difference adjustment method, which adjusts the future year assignment based on the absolute difference between the count and the base year assignment. The equation is as follows:

\[
\text{Difference Adjustment:} \\
\text{FORECAST} = (\text{COUNT} - \text{BASE ASSIGNMENT}) + \text{FUTURE ASSIGNMENT}
\]

The difference adjustment method is primarily used for segments with low volumes (less than 10,000 AADT). Ideally, the roadway traffic count and base year traffic assignment should be the same number and the future year traffic assignment can then be used without much adjustment. This is because the travel demand model is accurately assigning roadway traffic in the base year (indicated by the assignment
matching the actual count). Also, it is assumed that the same traffic assignment pattern (over-assignment or under-assignment) will be present in both the base and future years. This assumption is explained more thoroughly in the NCHRP report on page 50.

The second method applicable to roadway traffic forecast production through travel demand models is called the ratio adjustment method, which adjusts the future year traffic assignment based on the ratio of the traffic count and base year traffic assignment. That equation is as follows:

**Ratio Adjustment:**

$$\text{FORECAST} = \left( \frac{\text{COUNT}}{\text{BASE ASSIGNMENT}} \right) \times \text{FUTURE ASSIGNMENT}$$

As with the difference adjustment method, the ratio adjustment uses the future assignment, if the base year assignment is exactly the same as the count. The ratio adjustment method can exaggerate the forecast in either direction when the base traffic assignment and traffic counts are very small [less than 10,000 average annual daily traffic (AADT)]. For example, in the model a base year count of 300 AADT and a base year assignment of 100 AADT exist. The future year traffic assignment is 1,000 AADT producing a forecast value of 3,000 AADT using the ratio adjustment method. Conversely, the difference adjustment method would produce a forecast value of 1,200 AADT because the traffic count, while proportionally much higher than the base assignment, is really very close in absolute terms. Travel demand models tend to be weaker (harder to calibrate and validate) on roadway links with low traffic volumes. When low traffic volumes exist on roadway links, the difference adjustment method is used as the preferred method, if it is still a valid methodology at low volumes. The ratio adjustment method is never used alone (because the difference method is not necessarily weaker on high-volume links), but can be useful in combination with the difference adjustment method. The average of the difference and ratio adjustment combination equation is as follows:

**Average of Difference and Ratio Adjustment:**

$$\text{FORECAST} = \frac{\left( \text{DIFFERENCE FORECAST} + \text{RATIO FORECAST} \right)}{2}$$

10.4.d. Adjusting Roadway Link Growth Rates

Further adjustments to the model output traffic forecast value are required when the base year traffic count is not the most recent count on a roadway segment. The most recent traffic count is the most valuable piece of information in traffic forecasting and is the starting line representing the future year traffic. A new traffic
count that is higher than previous traffic counts will shift a forecast up and a new traffic count that is lower will shift a forecast down. In travel demand model areas, the growth rate on the roadway link is calculated with the following equation:

\[
\text{GROWTH RATE ON MODEL LINK} = \frac{(\text{FORECAST VALUE} - \text{COUNT})}{\text{COUNT}} \div \frac{(\text{FORECAST YEAR} - \text{COUNT YEAR})}{\text{FORECAST YEAR} - \text{COUNT YEAR}}
\]

The slope of the future year traffic forecast line is based on the average annual growth rate present on the specific roadway link within the travel demand model. The average annual growth rate for the roadway link is then applied to the most recent traffic count to create the future year traffic forecast value. The traffic forecast value is then compared with TAFIS to generate a better reasonability to the forecast. See Section 10, Subject 5 for more information about comparing model and TAFIS growth rates.

**10.4.e. Finalizing the Traffic Forecast**

This is the method used to produce the forecast estimate in the outputs produced by the models; however, standard WisDOT policy is to use the best methodology for each individual roadway traffic forecasting situation based on recommendations of analysis of the equations from the NCHRP report. The most important aspect in using a methodology is that it, and its output, makes sense. If the outputs from one methodology do not make sense, using another equation is acceptable. Similar to picking the best adjustment to use, it is WisDOT policy to apply or choose a roadway link growth rate no less than 0.5 percent and/or no greater than 5 percent when generating a travel demand model forecast, unless there have been significant changes to model assumptions. It is also WisDOT policy to use analytical judgment to determine if the applied growth rate makes sense.

WisDOT’s Traffic Forecasting Section uses notes on a roadway traffic forecast to explain any variation to standard protocol in choosing a specific output or growth rate over another. The variation in outputs in question is understood and noted. As indicated earlier, once a method is chosen, it is compared to TAFIS. More information on comparing travel demand model outputs and TAFIS is found in Section 10, Subject 5.
10.5 Travel Demand Models and TAFIS

The Traffic Analysis Forecasting and Information System (TAFIS) is a computer program operating on the principle of projecting future state trunk highway traffic volumes using historic counts to create a best-fit, statistically significant projection. To understand the Traffic Analysis Forecasting Information System methodologies, see Section 30, Subject 2. Forecast adjustment is explained in Section 30, Subject 2, TAFIS Outputs and Growth Rate Adjustments.

WisDOT policy is to compare travel demand model growth rates with Traffic Analysis Forecasting Information System growth rates. This is accomplished using several tools. The traffic forecasting section should be contacted with proper procedures in how to compare travel demand model growth rates with TAFIS. Travel demand model growth rates and TAFIS growth rates are generated with different information at their core. The travel demand model growth rate can account for anticipated changes in population and employment in specific locations. Regression-based TAFIS growth rates are based on formulas that are applied to the past and current counts on that site, with little to no intelligence behind the assumption as to why those changes occur. WisDOT’s Traffic Forecasting Section documents the difference in growth rates before choosing them in traffic forecasts and uses engineering judgment to choose growth rates based on the level of confidence in forecasting tools, including travel demand models and TAFIS. Forecast adjustment is explained in Section 30, Subject 2.

It is WisDOT policy to analyze TAFIS outputs to conduct or review roadway mainline traffic forecasts in all areas of the state. WisDOT analyzes TAFIS and travel demand model outputs to conduct or review roadway mainline traffic forecasts in areas where WisDOT maintains the travel demand model or receives the travel demand model data from a metropolitan planning organization (MPO). WisDOT may use TAFIS, among other tools, to review forecasts based on a travel demand model from an MPO or other entity. An MPO or other entity may consider historic trends to produce a forecast to be used by WisDOT. WisDOT must review the reasonableness of the forecast data and outputs provided by an MPO or other entity. It is
WisDOT policy to review MPO or other entity-provided traffic information for forecasts and document the review in the appropriate location. The review should be kept in an appropriate location for the analysis underway (i.e. project file, data analysis background information, traffic forecasting worksheet, etc…).

TAFIS projects traffic most confidently where several historic traffic counts exist, less confidently in areas influenced by rapidly changing land uses and where there are few historical traffic counts. Travel demand model outputs generally tend to forecast travel with more confidence than TAFIS with relatively high rates of land development. This includes but is not limited to analysis where a new roadway is proposed; congestion is constraining existing capacity; or where surrounding land uses are rapidly developing, generating a high number of trips. Site-specific information, including information on land-use development and changes in nearby roadway designs, may cause WisDOT to adjust incrementally the future projections in the area. Roadway forecast requests (DT1601) should include site-specific information. WisDOT incorporates development-generated traffic or roadway design changes within the local area during forecast development. WisDOT notes changes to land uses, which have not been included in forecast development, to understand the traffic impacts of new roadways or development.

Common model network and TAFIS roadway link identifiers enable both processes to communicate through the shared attribute. Viewing both sets of traffic forecast approaches, simultaneously, allows analysts to have increased quality control in the overall traffic projection process.
Figure 10.5.1 represents different growth rate adjustments calculated on an example roadway link in a travel demand model. The blue line above represents a forecast created in 2001; the red line, a forecast from 2005; and the green line, a forecast from 2012. These are all forecasts completed on the same count site. The 2001 and 2005 forecasts did not utilize a travel demand model, so the slopes of those lines are based on TAFIS. The 2012 forecast used a travel demand model, and the slope of that line is based on standard model formula. The difference in traffic count volumes accounts for the majority of the difference in 2035 forecast values for each forecast. This displays how important count information is in producing forecasts. The slopes of the lines that represent the 2001 and 2005 forecasts are nearly identical; however, a decrease in the count volume from 2001 (10,000 AADT) to 2005 (9,500 AADT) led to a lower 2035 forecast value in the 2005 forecast. The count decreased even more from 2005 (9,500 AADT) to 2011 (7,100 AADT), which further drops the 2012 forecast line and leads to a much lower 2035 forecast value.

If the counts had increased each year, the starting points of the 2005 and 2012 lines would be above that of the 2001 line. The slopes of each line would remain the same, given the same historical count and socioeconomic data (only relevant for the 2012 line that used the travel demand model).

It is WisDOT policy to check traffic counts as a forecast begins. If traffic counts change more than plus or minus 20 percent, or are inconsistent across a corridor, a re-count or an explanation may be requested of the regional office to try and understand possible causes.
Since each segment of highway has its own history and conditions affecting it, WisDOT takes this into account and adjusts forecasts accordingly. Forecast adjustment is explained in Section 30, Subject 2.
10.6 Travel Demand Models and Roadway Simulation Models

Traffic simulation models or microsimulations are real-time models showing the overall predicted flow of roadway traffic on a corridor. Accurate microsimulation models rely on component relationships and interactions between individual vehicles and roadway geometry, traffic congestion and traffic control. While simulation models are not a federally required analysis, they offer a sophisticated level of analysis at the roadway corridor level, for operations and traffic flow.

Sound statistics, reliable socioeconomic macro scale travel demand models, and dependable enterprise data help to create reasonable traffic volume forecasts. However, the effects of capacity upgrades, new access points to a roadway, and traffic diversion cannot be sufficiently modeled in most travel demand models. Similarly, travel demand models do not usually provide detailed information such as turning movement counts, user delay, and vehicle queuing for analysis purposes. Therefore, simulation programs (e.g. Paramics, CORSIM, VISSIM) have been developed to utilize traffic patterns derived from travel demand models. Simulation models can assist planners and engineers in determining measures of effectiveness of a transportation facility, such as levels of service, user delays, travel times, and queue lengths.

Simulation programs typically rely on an extraction of the origin-destination data (O-D) from the travel demand models’ trip tables to determine vehicular travel patterns, often within a subarea. Existing traffic operations data is then input into the simulation model to emulate observed traffic conditions. Simulation models are then run and their outputs are analyzed and calibrated to reflect reasonable traffic conditions.

WisDOT policy is to use travel demand model origin-destination pairings when developing simulations for complex plans or projects. However, due to the increased amount of data input, network building, model calibration and validation, and data extraction, the cost of simulation models may not always be warranted. Also, in travel demand model areas as noted in Section 10, Subject 1, WisDOT policy is to use travel demand models in combination with TAFIS during roadway traffic forecasting procedures where travel
demand models exist. Therefore, the traffic forecasting section must be informed of the use of simulation software before work begins, so procedures can be monitored and done correctly for the project.
10.7 Related Section Policies

A summary of the WisDOT policies that were discussed in this section are:

It’s WisDOT policy to:

- Collaborate and cooperate with Metropolitan Planning Organizations to develop travel demand models following standard forecast development procedures.
- Document travel demand model and Traffic Analysis Forecasting Information System processes, steps, and assumptions to support logical forecast outputs—including the comparison of traffic growth rates and other comparative data analysis as necessary.
- Ensure travel demand modeling practices follow standard, well-researched, nationwide protocols.
- Use the model data request form as a mechanism for those outside WisDOT to request travel demand model files.
- Ensure other parties who have made changes to the travel demand models, report those changes in a formal written email or correspondence.
- Utilize the traffic forecasting section to lead interim reviews, housing, maintenance, and directing model application procedures in all travel demand model areas, except Dubuque, Duluth-Superior and Southeast Wisconsin Regional Planning Commission.
- Use the traffic forecasting section to approve traffic forecasts completed outside the department that use the travel demand models, or their outputs, only if the model sharing procedures have been adhered to, as outlined in Section 10, Section 2.
- Analyze the Traffic Analysis Forecasting Information System (TAFIS) outputs to conduct or review roadway traffic forecasts in all areas of the state.
- Analyze TAFIS and travel demand model outputs to conduct roadway mainline traffic forecasts in areas where WisDOT maintains the travel demand model or receives the travel demand model data from an MPO.
- Review MPO or other entity-provided traffic information and document the review in the appropriate location (i.e. project files). WisDOT may use TAFIS, among other tools, to review travel demand model data or forecasts based on a travel demand model from an MPO or other entity.
- Have the traffic forecasting section approve the base level forecast development process and/or develop the base traffic forecasts for the microsimulation when using a travel demand model for highway microsimulation origin-destination trip pair development.
- Inform the traffic forecasting section of the use of simulation software before work begins so procedures can be monitored and done correctly for the plan or project.
Chapter 9: Traffic Forecasting, Travel Demand Models and Planning Data

Section 20 – Wisconsin Travel Demand Models

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20.1 Multi-County Travel Demand Models

20.1.a. Southeast Regional Travel Demand Model
The Southeastern Wisconsin Regional Planning Commission (SEWRPC) is the official Metropolitan Planning Organization (MPO) and Regional Planning Commission (RPC) for the seven county southeastern Wisconsin area.

- Covers Washington, Ozaukee, Waukesha, Milwaukee, Kenosha, Racine, and Walworth counties
- A Regional Transportation System Plan for Southeastern Wisconsin: 2035 (2006)
- Point of Contact (updated 1/19/2012):
  
  Chris Hiebert  
  W239 N1812 Rockwood Dr  
  Waukesha, WI 53187-1607  
  (262) 547-6722  
  chiebert@sewrpc.org

20.1.b. Northeast Regional Travel Demand Model
The Northeast Regional Model was developed and built upon pre-2010 base year MPO models in the Northeast Region (Green Bay, Fox Cities, Oshkosh, Fond du Lac and Sheboygan). The model will aid in the preparation and analysis of potential land development and transportation scenarios across the Northeast Region.

In 2010, a new model was developed that merged the existing MPO models and added large rural areas that were not previously included in MPO models. The traffic forecasting and long-range planning model spans portions of 14 counties and five MPOs. The model is used by WisDOT, East Central Regional Planning Commission, Bay-Lake Regional Planning Commission, Brown County Planning and local communities. This group is known informally as the Northeast Travel Demand Model Users’ Group. A Memorandum of
Understanding was developed in 2009 that outlines technical and administrative processes to be used among Users’ Group members in developing and maintaining the model, as well as sharing model components and results.

The Northeast Regional Model is a time of day model with four time periods, includes a congestion feedback loop and a mode-choice component. Additional factors that contribute to the Northeast Regional Model’s complexity include a large number of zones and many special generators. Additionally, the model exists in the Cube Application Manager environment. The Northeast Regional Model includes more than 2,600 TAZs, 50 special generators, and transit service for a.m., mid-day, p.m., and night-time periods.

Currently, the US Environmental Protection Agency has designated Sheboygan County as a nonattainment area for ground-level ozone. As such, Sheboygan County must regularly monitor levels of Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NoX). These pollutants are mainly responsible for the chemical processes that create ground-level ozone. The primary sources of these pollutants are tailpipe emissions from motor vehicles.

As the designated MPO for the Sheboygan urbanized area, the Bay-Lake Regional Planning Commission is therefore responsible, together with WisDOT and the Wisconsin Department of Natural Resources (WDNR), for producing periodic air quality analyses required of nonattainment areas. These analyses ascertain whether or not Sheboygan County is in conformity with pre-determined budgets of VOCs and NoX. The Northeast Regional Travel Demand Model produces summaries of forecast vehicle miles of travel by roadway functional classification and speed range. The summaries are then input, along with many other data components, to complex emissions modeling software maintained by the WDNR that determines mobile-source emissions levels within Sheboygan County.

The Northeast Regional Model has the following features:

- Developed using Citilabs’ Cube Application Manager scripting platform
- Incorporates data from the NHTS add-on survey from 2001 and 2009
- Calibrated using additional data gathered from 2010 U.S. Census
- Developed by WisDOT, the MPOs and various consultants
- Contains a base year of 2010 and a future year of 2045.
Utilizes a traditional four-step model process to produce results for each time of day period, aggregated to the daily level.

Includes the following time of day periods: AM (6-9am), Mid-day (9am-3pm), PM (3-6pm) and Night-time (6pm-6am).

Utilizes a mode-choice component for separating transit and auto person trips.

- Northeast Regional Model Notes (2011)
- Fox Valley Regional Travel Demand Model: Model Development, Validation and Users Guide (pre 2010)

Green Bay
Covers Brown County, including: cities of Green Bay and De Pere, villages of Allouez, Ashwaubenon, Bellevue, Hobart, and Howard and part of the village of Suamico, the towns of Lawrence, Ledgeview, Rockland, and Scott.

- Point of Contact (updated 1/19/2012):
  Cole Runge
  305 E. Walnut Street, Room 320
  Green Bay, WI 54305-3600
  (920) 448-6480
  Runge_cm@co.brown.wi.us

Appleton-Fox Cities/Oshkosh/Fond du Lac
The East Central Wisconsin Regional Planning Commission (ECWRPC) manages the workload for three MPO areas that include portions of Calumet, Outagamie, Winnebago and Fond du Lac counties. The following sub-county jurisdictions are also included: Cities of Appleton, Kaukauna, Menasha, Neenah, Oshkosh and Fond du Lac; villages of Combined Locks, Kimberly and North Fond du Lac; towns of Algoma, Black Wolf, Buchanan, Byron, Empire, Fond du Lac, Friendship, Grand Chute, Greenville, Harrison, Kaukauna, Menasha, Neenah, Nekimi, Oshkosh, Taycheedah, Vandenbroek, and Vinland.
• Point of Contact (updated 1/19/2012):
  
  Walt Raith  
  400 Ahnaip St., Suite 100  
  Menasha, WI 54952  
  (920) 751-4770  
  wraith@eastcentralrpc.org  

Sheboygan

Covers Sheboygan County, including: cities of Sheboygan and Sheboygan Falls, villages of Kohler and Howards Grove, towns of Herman, Lima, Mosel, Sheboygan Falls, and Wilson.

• Sheboygan MPO Model Notes (2011)
• Point of Contact (updated 1/19/2012):
  
  Jeff Agee-Aguayo  
  441 S. Jackson St.  
  Green Bay, WI 54301  
  (920) 448-2820  
  jagee@baylakerpc.org
20.2 Countywide Travel Demand Models

20.2.a. Dane County Travel Demand Model

The Dane County Model geographically covers the Madison Area Transportation Planning Board – An MPO planning area as well as the rest of Dane County. Unlike smaller travel demand models across the state, the Dane County Model is more complex, operates as a time of day model with four time periods, includes a congestion feedback loop, and contains a mode choice (transit) component. Other factors contributing to the model’s complexity include an expansive zone system and detailed highway network assumptions.

The Dane County Model was updated from the Tranplan platform to the Cube platform as part of updates made in 2004. In 2011, the model was updated with a base year of 2008 and a future year of 2035. Currently, the 2013 model contains a base year of 2010 and a future year of 2050.

The model is coded with over 1,000 TAZs, 70 special generators, and transit service for peak and off-peak periods. Despite its increased complexity as compared to smaller MPO models, the Dane County Model operates within the familiar Cube TP+ scripting environment, utilizes the same attribute and file nomenclature, and produces traffic estimates on a daily level used for traffic forecasting.

The Dane County Model has the following features:

- Citilabs’ Cube TP+ scripting platform
- Calibrated using additional data gathered from the 2010 U.S. Census
- Applied Bluetooth data to estimate external-external and external-internal trips in an open-system traffic network
- Developed by WisDOT, the MPO and various consultants
- Current base year of 2010 and future year of 2050
- Traditional four-step model process utilized to produce results for each time of day period and aggregated to the daily level
- Time of day periods include: AM (6-9am), Mid-day (9am-3pm), PM (3-6pm) and Night-time (6pm-6am)
- Utilizes a Tranplan mode-choice program for separating transit and auto person trips
- Model area covers Dane County, including: cities of Fitchburg, Madison, Middleton, Monona, Stoughton, Sun Prairie, and Verona; villages of Cottage Grove, Maple Bluff, McFarland, Shorewood Hills, and Waunakee; towns of Blooming Grove, Burke, Madison, Middleton, a portion of Bristol, Cottage Grove, Dunkirk, Dunn, Pleasant Springs, Rutland, Springfield, Sun Prairie, Verona, Westport, and Windsor.
- Point of Contact (updated 1/19/2012):
  
  William Schaefer  
  121 S. Pinckney Street, Suite 400  
  Madison, WI 53703  
  (608) 266-4336  
  wschaefer@cityofmadison.com

20.2.b. Marathon County Travel Demand Model

- Base Year: 2010  Future Year: 2050
- Model area covers Marathon County, including: cities of Wausau, Schofield, and Mosinee, the villages of Kronenwetter and Rothschild; and the towns of Bergen, Maine, Mosinee, Rib Mountain, Stettin, Texas, Wausau, and Weston.
- Wausau MPO Model Notes (2011)
- Technical Memorandum: Marathon County Travel Demand Model Update (2011)
- Point of Contact (updated 1/19/2012):
  
  Dave Mack  
  210 River Drive  
  Wausau, WI 54401  
  (715) 261-6040  
  Dave.mack@co.marathon.wi.us
20.2.c. Rock County Travel Demand Model

Two MPO areas, Janesville and Beloit, are contained within the Rock County Travel Demand Model.

- Base Year: 2010  Future Year: 2050
- Includes: Cities of Janesville, Milton, Beloit and South Beloit; Towns of Harmony, La Prairie, Rock and Turtle; Village of Rockton.
- Beloit/Rock County MPO Model Notes (2011)
- Technical Memorandum: Rock County Travel Demand Model Update (2011)

Janesville

- Point of Contact (updated 1/19/2012):
  Terry Nolan
  18 N. Jackson St.
  Janesville, WI 53547
  (608) 755-3095
  nolant@ci.janesville.wi.us

Beloit

- Point of Contact (updated 1/19/2012):
  Jason DuPuis
  2400 Springbrook Ct.
  Beloit, WI 53511
  (608) 364-6735
  dupuisj@ci.beloit.wi.us
20.2.d. St. Croix County Travel Demand Model

The St. Croix County Travel Demand Model is currently being updated. It exists to more completely understand regional growth issues, to examine cross-state travel characteristics, and to investigate travel characteristics within the Minneapolis – St. Paul area. Previous versions of the St. Croix County Model included portions of Polk and Pierce County, while the current model only covers St. Croix County.

- *St. Croix and Polk County Transportation Models (2007)*
20.3 Regional Travel Demand Models

20.3.a. Eau Claire – Chippewa Falls Regional Travel Demand Model

- Base Year: 2010  Future Year: 2045
- Model area covers Chippewa and Eau Claire counties, including: cities of Altoona, Chippewa Falls and Eau Claire; villages of Lake Hallie, and towns of Anson, Brunswick, Eagle Point, Hallie, Lafayette, Pleasant Valley, Seymour, Tilden, Union, Washington, and Wheaton.
- Point of Contact (updated 1/19/2012):
  
  Ann Schell  
  800 Wisconsin St.  
  Eau Claire, WI 54703  
  (715) 836-2918  
  aschell@wcwrpc.org

20.3.b. La Crosse Regional Travel Demand Model

- Base Year: 2010  Future Year: 2040
- Model area covers La Crosse County, including: cities of La Crosse, Onalaska, and La Crescent (MN), villages of Holmen and West Salem, and towns of Barre, Campbell, Hamilton, Holland, Medary, Onalaska, and Shelby.
- La Crosse MPO Model Notes (2011)
- La Crosse MPO Model Update (2009)
• Point of Contact (updated 1/19/2012):

  Tom Faella  
  400 North Fourth Street  
  La Crosse, WI 54602  
  (608) 785-5977  
  tfaella@lacrossecounty.org
20.4 Sub-Regional Travel Demand Models

20.4.a. Stevens Point Travel Demand Model
The Stevens Point Travel Demand Model covers the city of Stevens Point in central Wisconsin. Though Stevens Point’s population is below the threshold for MPO designation, a travel demand model exists to evaluate roadway investments.

- Base Year: 2010  Future Year: 2050
- *Technical Memorandum: Stevens Point MPO Model (2010)*

20.4.b. Wisconsin Rapids Travel Demand Model
The Wisconsin Rapids Travel Demand Model covers the city of Wisconsin Rapids in central Wisconsin. Like Stevens Point, Wisconsin Rapids’ population is below the threshold for MPO designation, but WisDOT has developed a travel demand model to evaluate roadway investments.

- Base Year: 2010  Future Year: 2050
20.5 Cross-State Regional Travel Demand Models

20.5.a. Duluth – Superior Regional Travel Demand Model

Covers Douglas County, including: the cities of Duluth, Hermantown, and Proctor, Minnesota, city of Superior, Wisconsin; villages of Oliver and Superior, towns of Duluth, Lakewood, Rice Lake, Canosia, Grand Lake, Solway, Midway, Superior, Parkland, and Lakeside.

- Base Year: 2008  Future Year: 2035
- *Duluth-Superior Metropolitan Area Travel Demand Model 2009 (2009)*
- Point of Contact (updated 1/19/2012):
  
  Ron Chicka  
  221 West First Street  
  Duluth, MN 55802  
  (218) 529-7506  
  rchicka@ardc.org

20.5.b. Dubuque Regional Travel Demand Model

The Dubuque (Iowa) Regional Travel Demand Model is maintained by the Dubuque Metropolitan Area Transportation Study (DMATS), the MPO for the region. In addition to the city of Dubuque, the model encompasses the communities of Durango, Sageville, Asbury, Centrailia, Peosta, East Dubuque (IL) and a small portion of Grant County, Wisconsin.

This model is maintained by DMATS. WisDOT does not currently have access to the model, and does not use it in developing forecasts for the small area of Wisconsin which the model covers.

- Base Year: 2010  Future Year: 2040
- *DMATS, Travel Demand Model website*
• *Final DMATS Long Range Plans: Transportation Network Forecast (2010)*
20.6 Statewide Travel Demand Model


A statewide travel demand model describes travel characteristics at a larger scale than a regional, county, or urbanized area model. In the past, statewide model objectives included:

- Developing a planning and modeling process integrating all travel demand models within the statewide model
- Conducting air quality regional emissions and conformity analysis
- Analyzing capacity (level-of-service) and safety impacts on Wisconsin interstates
- Analyzing route diversions
- Developing forecasts for both passenger and freight travel

An update of the Statewide Travel Demand Model is currently underway.
## Chapter 9:
Traffic Forecasting, Travel Demand Models and Planning Data

### Section 30 – Traffic Analysis Forecasting Information System (TAFIS)

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30.1 Introduction and Usage Areas

Developed in 2001, the Traffic Analysis Forecasting Information System, or TAFIS, is an automated procedure and SAS®-based computer program that creates roadway traffic forecasts on Wisconsin’s 11,800 miles of state trunk highway system. TAFIS operates on the principle of projecting future roadway traffic volumes using historic counts to create a best-fit, statistically significant projection. In addition to providing annual average daily traffic forecasts for 40-years into the future, TAFIS calculates estimates for peak hour (or K-factor) traffic and heavy truck percentages. It is WisDOT policy to use a combination of TAFIS, and the travel demand model output, to conduct roadway traffic forecasts in areas where travel demand models exist. See Section 10, Subject 4 for roadway traffic forecasting procedures in locations where travel demand models exist. In areas of the state where no travel demand model exists, it is WisDOT policy to use TAFIS to conduct roadway traffic forecasts.

TAFIS is a systematic forecasting tool that:

- Provides a consistent methodology for developing roadway traffic forecasts
- Creates a systems level comparison, based on different forecasting analysts completing different forecasts
- Allows for continued responsiveness as data updates, such as new annual average daily traffic (AADT) count estimates, become available

30.1.a. The TAFIS Approach

The TAFIS approach to roadway traffic forecasting predicts the roadway traffic volumes will increase at a decreasing rate into the future. As the 1980s and 1990s reflected an atypically high growth rate in roadway vehicle travel, prominent transportation forecasting analysts (i.e. Alan Pisarski, Charles Lave and Steve Polzin) noted specific factors acting on travel in the future that would propel a continued upward trend in travel growth, but at a decreasing rate. Factors included:
- Declines in auto occupancy rates and in real fuel prices
- Increases to the number of women in the labor force
- Increases in the rate vehicle ownership levels would become saturated based on household size and auto occupancy rates

Other factors, including population growth and population cohort change, will inevitably affect future travel trends, as well. **Graph 30.1.1** shows Wisconsin’s projected population, driving age population (age 16 and above) and peak driving age (age 24-64). The graph shows as the baby boom generation passes through its peak driving years, this age group, or cohort’s travel, will influence traffic projections. Fewer new drivers will replace baby boomers as birth rates slow. The aging population, the decreasing rate of population growth and the lower population at peak driving age will grow travel more slowly than in the past, producing trends of increasing travel but at a decreasing rate.
30.1.b. Box-Cox Methodology

In general, WisDOT does not project linearly into the future because linear growth rates would likely overshoot long-term travel trends. TAFIS uses a Box-Cox regression approach that creates projections that are increasing, but at a decreasing rate.

Box-Cox transformations define a general class of mathematical models, which include pure linear and log-linear models. Perhaps the main advantage of the Box-Cox transformation is its flexibility compared to other transformations, such as log transformations. Data transformations are typically used in regression analysis for four reasons, to:

- Satisfy regression analysis functions
- Create likeness between variables
- Improve fit between data and regressed line
- Better understand assumptions forming the line

Box-Cox transformations perform well for traffic forecasting and capture many basic assumptions of the regression analysis. The mathematical formula of the transformation is as follows:

\[ W = \frac{(Y^{\lambda} - 1)}{\lambda} \quad \lambda \neq 0 \]

\[ W = \ln Y \quad \lambda = 0 \]

The variable (Y) depends on lambda (\(\lambda\)). When applied to a variable that increases over time, such as is typical for roadway traffic volumes, values of lambda (\(\lambda\)) are best fit. (W) is then used, post transformation directly in the simple linear regression equation as shown below:

\[ W = B_0 + B_1 X_1 \]

Values of \(\lambda\) greater than or equal to 1.5, and less than or equal to 2.5, usually provide reasonable results for many traffic forecasts—a linear-log function. TAFIS chooses the most statistically significant value of lambda. The chosen value minimizes the sum of the squared errors in the regression, while still producing a positive growth rate.
30.2 Roadway Traffic Forecasting using TAFIS

As previously discussed in Section 30, Subject 1, TAFIS is a computerized tool that compiles historical traffic volumes and other data at a specific state trunk highway traffic count site and then performs a Box-Cox regression in order to predict future traffic at that site. TAFIS produces forecasts for 40 years out into the future. WisDOT has programmed TAFIS as a series of prediction models that produce results based on data conditions at or surrounding each site. Five models exist; which are the:

- Box-Cox Model
- Location-to-Location Model
- Cook’s D Statistic Model
- Average Historic Proportion Model
- Specific Growth Rate Model

Because TAFIS works primarily with traffic counts and traffic count variability, TAFIS functions as a robust statistical tool. However, TAFIS has limits. TAFIS does not take into account classification data or land use development.

30.2.a. TAFIS Models

Traffic count sites are linked to roadway segments in TAFIS analysis. Per WisDOT policy, TAFIS models are used to develop segment level traffic forecasts in areas of Wisconsin where no travel demand model exists. Where travel demand models exist, WisDOT policy is to use a combination of TAFIS and the travel demand model output to conduct roadway traffic forecasts. See Section 10, Subject 4 for procedures on forecasting in travel demand model locations.

Box-Cox Model – TAFIS Model 1.1
In TAFIS Model 1.1, historical traffic counts (AADT values) are regressed for each site to see if each site’s historical counts are a significant predictor of AADT. Processing TAFIS Model 1.1 requires that each site must have at least five historical counts that produce a statistically significant positive slope. The most statistically significant lambda result is chosen as the output forecast. The equation for the forecast is as follows:

FORECAST = ALPHA + (BETA x TRAFFICYEAR); /*ADJUSTED BY LAMBDA */

Table 30.2.1: TAFIS Model 1.1 Graphical Outputs at a Traffic Count Site in Oneida County

The first step in testing count data in TAFIS occurs when the TAFIS program runs the Box-Cox Model – Model 1.1. The Box-Cox Model uses a traffic count site’s history of five or more years, to plot a line. After modeling the historic trend, TAFIS produces a positive, statistically significant trend line; which is increasing at a decreasing rate. A majority of state trunk highway traffic count sites produce a Model 1.1 forecast, making it the primary, most statistically robust, and also most often used TAFIS model.
Location-to-Location Model – TAFIS Model 2.1

TAFIS uses a Location-to-Location Model – Model 2.1 for sites with five or more historical traffic counts which do not produce a significant regression using the Box-Cox Model – Model 1.1. In this process, the two surrounding sites, next to the original site, are checked to see if they produce a significant regression using the Box-Cox Model. If so, the historical average annual daily traffic counts, on the two surrounding sites, are averaged and regressed against the data on the original site to see if there exists significance in their relationship. When the line is statistically significant and positive sloping, the alpha and the beta values are used to develop a forecast. This approach assumes that the traffic at a given location on a highway has a relationship to the traffic at the surrounding traffic count sites on that highway.

TAFIS Model 2.1 produces significant results for a small amount of traffic count sites. Model 2.1 remains worthwhile because it moves the TAFIS procedure away from deterministic time-trend forecasting approaches to more causally based multivariate approaches.

Table 30.2.2: Model 2.1 graphical output at a traffic site in Buffalo County

![Graphical output at a traffic site](image-url)
Cook’s D Statistic – Model 1.2 and 1.3
TAFIS uses Model 1.2 or 1.3 for traffic count sites that do not have a statistically significant relationship after applying the Box-Cox Model or the Location-to-Location Model. Historic traffic count outliers are measured by the Cook’s D statistic, and examined for replacement and normalizing. If an outlier occurs in the last year of historic traffic count observations, the value is increased by five percent. If an outlier occurs in the first year of observed traffic counts, the value is decreased by approximately 10 percent. If an outlier does not occur in either the first or last traffic count year, the TAFIS Model 1.2 uses the average value of the two traffic counts surrounding the outlier year. The traffic forecasting section runs the regression again and checks once more for a statistically significant positive slope, creating TAFIS Model 1.2. TAFIS Model 1.2 is used in a small percent of the total traffic count sites.

TAFIS Model 1.3 is similar to Model 1.2. It includes not only the largest outlier, but also the next largest outlier for replacement. This method is used on a very small percentage of traffic count sites.

Table 30.2.3: Model 1.2 Graphical Output at a Traffic Count Site in Marinette County

![Graphical Output](image)
Average Historic Proportional Relationship – Model 3.1

TAFIS applies Model 3.1 on sites with a non-significant regression, with less than five historical traffic count data points. Sites surrounding the non-significant regression area must have a significant regression. Model 3.1 functions by taking an average of the AADT at the two surrounding sites and then finds a proportional relationship to the AADT estimates at the non-significant site. Therefore, the equation for Model 3.1 is:

\[
\text{FORECAST} = (\frac{(\text{current AADT}/\text{previous AADT}) + (\text{current AADT} / \text{following AADT})}{2}) \text{ averaged over all years} \times (\frac{\text{current AADT} + \text{previous AADT}}{2})
\]

Like Model 2.1 described previously, this method assumes the site’s traffic count has a relationship to the traffic count at surrounding sites. However, in Model 3.1, a regression analysis cannot be performed because not enough data exists on the original site. Proportions are averaged over the historical time period, and then averaged to the forecast at the surrounding sites in order to get the forecast for the non-significant segment. A small percentage of segments are modeled using this approach.

Table 30.2.4: Model 3.1 Graphical Output at a Traffic Site in Oneida County

![Graphical Output of Average Historic Proportion Model](image-url)
Application of Specified Growth Rates – Models 4.1 and 4.2

Some TAFIS sites have only one or two historical counts, show decreasing slopes or have anomalous, scattered data that exhibits no discernible pattern. Unless the growth rate is negative or flat, TAFIS applies a normalized average vehicle miles traveled growth rate to the latest count at the site when using Model 4.1.

\[
\text{FORECAST} = (1 + (0.012 \times \text{TRAFFICYEAR})) \times \text{LAST AADT}
\]

If the original beta is greater than .01, then the formula increases results by 1.2 percent based on the AADT of the last year.

Table 30.2.5: Model 4.1 Graphical Output at a Traffic Site in Douglas County

WisDOT uses a minimum yearly average annual traffic growth rate of 0.5 percent during roadway traffic forecast development. Model 4.2 uses a 0.5 percent per year growth rate when the site shows a negative or flat growth slope.
FORECAST = (1 + (.005 x TRAFFICYEAR)) x LAST AADT

If the original beta is less than .01 then increase the value by 0.5 percent based on the AADT from the last traffic count year.

Table 30.2.6: Model 4.2 Graphical Output at a Traffic Site in Lafayette County

TAFIS provides mathematically sound, research-supported forecast volumes for Wisconsin roadways. Since each segment of highway has its own history and conditions affecting it, the forecasters at the traffic forecasting section take this into account and adjust forecasts accordingly. Forecast adjustment is explained in Section 30, Subject 2, TAFIS Outputs and Growth Rate Adjustments. For updated current statistics on the number of forecasts produced by each TAFIS Model, contact the traffic forecasting section.

30.2.b. TAFIS Logic

The flow chart below briefly summarizes the logic used in the very lengthy and complex SAS® program used for modeling the State Highway System in TAFIS.
SAS Program Decision Rules for Developing a STH Segment Traffic Forecast

**Start:**
Check the number of data points

- ≥ 5 pts? Yes
  - Run Approach 1.1 Box-Cox regressions
  - Any reg. significant? P ≤ 0.05
    - Yes
    - Run Approach 2.1 regression with nearest significant Box-Cox reg.

- No
  - Any neighboring segments?
    - Yes
      - Calculate average historical proportional relationship with previous segment and apply results to get forecast Approach 3.1
        - β > 0? Yes
          - Run Approaches 1.2 & 1.3
            - Any reg. sig. from 1st? P ≤ 0.05
              - Yes
              - Drop largest Cooks D outlier and re-run Box-Cox regression
            - No
              - ≥ 4 pts? Yes
                - Apply 0.5%/yr to last count Approach 4.2
                - β ≤ 0? Yes
                  - Apply avg. growth of 1.2%/yr to last count Approach 4.1
                - No
                  - No
            - No
              - No
        - No
          - No
            - Yes
              - γ > 0?
                - Yes
                  - Output the forecast
                  - β > 0?
                    - Yes
                      - End: Output the forecast
                    - No
                      - No

30.2.c. TAFIS Outputs and Growth Rate Adjustments
Because TAFIS models are chosen with the most statistically significant Box-Cox regression, the line of best fit usually does not pass through the last traffic count point that was collected, calling for an adjustment. WisDOT policy is to adjust traffic forecasts to project future traffic volumes from the last traffic count volume collected, as the last count provides the most up-to-date and accurate indication of current volumes at that site. Count volumes shall be “reasonable” and should not have been altered by exogenous factors such as road construction, equipment malfunction, or other issues. Local knowledge helps to identify if the last counts seems reasonable. After the last count has been analyzed for reasonableness, the forecaster will adjust TAFIS outputs to reflect differences in the last count volumes to the forecasted volumes in that same year that the traffic count was collected. This is called a residual and is applied to the future forecast years. For more information on using growth rates and adjustment between travel demand model outputs and TAFIS outputs, see Section 10, Subject 5.

In the end, the forecaster takes into account the available local knowledge on traffic and land use trends that provide additional information on the specific situation. The best fit TAFIS model may not fully account for all situations where count data has recently changed. The forecaster must know the limits of the TAFIS tool. By consulting WisDOT region planners, local governments, the Institute of Transportation Engineers Trip Generation Manual, Wisconsin travel demand models, or other tools, a robust localized forecast can be developed.

30.2.d. TAFIS Access

There are two user friendly Graphical User Interface (GUI) methods for accessing TAFIS. The first GUI uses SAS® software and a web browser. It accesses the AADT history and forecasts for each year, by link, by site ID, or by location. The second approach accesses forecasting results using a mapping application. The map contains hyperlinks to TAFIS. These applications are available to internal WisDOT users.
30.3 Enterprise Data Updates

The Traffic Analysis Forecasting Information System must be regularly updated to remain functional. It is WisDOT policy to maintain and update future travel volume data, reported on enterprise-based systems, like TAFIS, throughout the year.

The traffic count cycle or schedule dictates when TAFIS updates occur. The Bureau of State Highway Programs’ Data Management Section runs the traffic count program. Traffic counting occurs on a rotating basis, on roughly one-third of the state trunk highway system, every year. After traffic counts have been collected, they are processed through TRADAS© which applies monthly, day-of-week, and axle factors to estimate the site’s annual average daily traffic (AADT), which is stored in the TRADAS© database. TRADAS© is a proprietary traffic data management, validation, summarization, and archive software system used by WisDOT.

After the data management section has processed and stored the counts in TRADAS©, the traffic forecasting section collects the count data, analyzes it for statistical outliers and removes them. The traffic forecasting section completes this step to confirm count “reasonableness.” The traffic forecasting section then compiles an annual SAS® file, which is then merged with the historical files. After the file creation, merges between new traffic counts and historical traffic counts occur and the TAFIS logarithms are calculated. The traffic forecasting section then defines the relationship between count site and roadway segmentation so that TAFIS provides more statistically sound forecasts.

30.3.a. TAFIS Data Reliability

The traffic forecasting section maintains an historic record of traffic count data, going back to 1976. The database includes all annual traffic counts included in the data management section traffic count cycle and average annual daily traffic (AADT) counts collected by Automated Traffic Recorders.
As noted in Section 30, Subject 2, WisDOT requires the TAFIS system to report reliable and statistically significant data. The traffic forecasting section conducts three main data reliability checks, including:

- Confirmation of sites with five or more historic traffic counts
- Compilation of sites that have only one or two counts (usually several hundred)
- Fluctuations in traffic counts on sites that have five or more historic traffic counts

Outliers are expected at a rate of up to 30 percent of the sites. An outlier is considered to be a count that differs by more than 20 percent, upward or downward, compared to the previous count year at the same location. This 20 percent variation serves as a guideline, and all counts are checked for reasonableness. The traffic forecasting section receives input from regional staff that are most familiar with the roadway conditions to find out if the most recent count numbers are reasonable when completing their traffic forecasts (see Section 1, Table 1.4.2). By helping to identify causes for dramatic changes in traffic volume including changes in highway design or new development in the area, as opposed to (for example) equipment errors or construction detours, this approach adds to the credibility of forecasts, where base-year AADT estimates change dramatically from one count cycle to the next.

Even prior to TAFIS analysis; however, the data management section reviews traffic counts and determines their acceptability from year to year. To help prevent such unexplained traffic count deviations, the data management and traffic forecasting sections communicate unreasonable findings and record outlier counts with comments within TRADAS©. The process by which the data management section reviews counts is:

- The preliminary AADTs for all sites are recorded
- The preliminary AADTs are compared with the previous AADT at the site and with current AADTs at adjacent sites
- For those counts that seem unreasonable, the appropriate regional staff is contacted in an attempt to explain large differences and variation in counts
- A recount is requested if there is no known explanation
- The recount volume is reviewed when received to determine acceptability (if it is still unacceptable, another recount is requested)
- Final AADTs are submitted to the regions for comment before they are published

Developed from 48-hour traffic counts, AADT estimates, even under the best of conditions, have considerable sampling error built in them. This occurs even after accounting for seasonal variations, day-
of-week variations, and truck (axle counts) count variations. A report completed in the 1980s\(^2\) explains AADT estimates have an estimation error (not including axle errors) of about plus or minus ten percent for urban counts, 16 percent for rural counts, and 30 percent for recreational area counts. Given that data outliers can considerably affect resulting forecasts (especially when there are few traffic volume data points feeding into the forecast to begin with), and also that it is WisDOT policy to project forecasts from the last traffic volume count taken, it is extremely important that data outlier issues are addressed.

### 30.3.b. Site-Segment Issues

When traffic counts are put into TRADAS\(^2\), they are assigned a site ID. The traffic forecasting section maintains a historic database of average annual daily counts and also a database of state trunk highway traffic segments, related to the counts in order to create the state trunk highway segment traffic forecasts.

\(\begin{align*}
\text{\textsuperscript{2} Bruce Aunet. A Statewide Traffic Counting Program for the Wisconsin Department of Transportation, WisDOT,} \\
\text{January 1987.}
\end{align*}\)
30.4 TAFIS and Meta-Manager

Meta-Manager is a computer enterprise database managed by the Wisconsin Department of Transportation Bureau of State Highway Programs. Meta-Manager consists of a comprehensive set of data management, spatial and tabular analysis tools for developing and managing highway needs, including:

- Pavement and bridge conditions
- *Six Year Highway Improvement Program* information
- Highway geometric and attribute information
- Highway crashes and crash statistics
- Level of service and highway capacity analysis models
- Improvement “reset” models
- Models for evaluating alternatives, costs, priorities and budget constraints

The traffic forecasting section provides data for Meta-Manager analysis, including:

- Average annual daily traffic forecasts
- Average annual daily traffic truck percent
- The amount of traffic occurring in the 30th, 100th and 250th highest travelled hours of the year (K30, K100 and K250), including the percent of AADT expected in these design hours

According to WisDOT guidelines, well-established and consistent protocols are used to gather this information so that enterprise-based systems across WisDOT are not in conflict with one another.

The traffic forecasting section assists Meta-Manager function with level-of-service projection inputs and safety inputs. Level-of-service (LOS) is calculated using traffic forecasts and roadway geometry data. If the level-of-service exceeds the threshold for a state trunk highway segment during the planning period, for example, the segment may have deficient capacity. TAFIS information is also used within the safety data...
model, which is comprised of crash tabulations, proportions, rates and flags. TAFIS provides five years of historical average annual daily traffic volumes to generate Meta-Manager crash rates.

TAFIS assumptions and outputs that are used in Meta-Manager usually warrant further investigation at the region level to confirm results.
30.5 Local Road Traffic Forecasting

Local roads consist of county trunk highways and other local city, village, or town roads, not “on” the state trunk highway system. Traffic forecasts on local and county trunk roadways are completed with tools other than TAFIS.

Forecasting traffic on local roads is essentially the same as on state trunk highways. Using methods similar to those within the Traffic Analysis Forecasting Information System (see Section 30, Subject 2), historic traffic count site and segment IDs are collected and input to an Excel© spreadsheet that replicates the TAFIS Model 1.1 approach (see Section 30, Subject 2-Model 1.1). This approach uses a Box-Cox transformation with various values of lambda to project future traffic volumes to be increasing at a decreasing rate. As previously discussed in Section 30, Subject 1, trends such as population growth and an increasingly older population, justifies the use of the Box-Cox regression conceptually.

Various lambda values allow traffic forecasting judgment in using an otherwise deterministic time-trend extrapolation forecasting approach. As discussed in Section 30, Subject 2, factors, including adjusting for residuals, taking into account proposed land use changes, changes in roadway geometry, and others affect results. Generally, the traffic forecasting section will use a lambda value of 1.50 or 1.75. This correlates to predictions of reduced future traffic growth on a statewide level. Each site is unique, however, and the forecaster doing the traffic forecast must gather all necessary information with respect to land use development, changes in roadway geometry, and other factors to arrive at the most credible forecast prediction.

If a regression is performed and the resulting lambda values show negative or near zero growth, like the Specified Growth Rate – Model 4.2, the traffic forecasting section forecaster uses a minimum yearly average growth rate of 0.5 percent.
30.6 Related Section Policies: Traffic Analysis Forecasting Information System (TAFIS)

A summary of the WisDOT policies that were discussed in this section are:

It’s WisDOT policy to:

- Produce forecasting models for all state highway segments in TAFIS.
- Program TAFIS to use Box-Cox Model – TAFIS Model 1.1 where possible. First, using a linear regression to forecast traffic volumes increasing at a decreasing rate, over time. Also consider:
  - Adjacency rules
  - The Cook’s D statistic
  - Proportions and ratios
  - Normalized vehicle-miles travelled rates
  - The yearly average annual traffic growth rate of 0.5 percent
- Maintain and update future travel volume data, reported on enterprise-based systems like TAFIS and Meta-Manager throughout the year.
- Adjust traffic forecasts to project future traffic volumes from the last traffic count volume collected, as the last count provides the most up-to-date and accurate indication of current volumes at that site.
- Always use the latest and best data available in order to complete a new forecast; forecasts more than five years old should have newer data available.
- Maintain a record of all roadway traffic forecasts.
## Section 40 – Data Elements of Roadway Traffic Forecasting

<table>
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<tr>
<th>Subject No.</th>
<th>Subject Title</th>
<th>Effective Date</th>
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<tr>
<td>40.1</td>
<td><strong>Introduction</strong></td>
<td>December 2012</td>
</tr>
<tr>
<td>40.2</td>
<td><strong>Estimating Vehicle Miles of Travel</strong></td>
<td>December 2012</td>
</tr>
<tr>
<td>40.3</td>
<td><strong>Geometric Design Factors</strong></td>
<td>December 2012</td>
</tr>
<tr>
<td>40.4</td>
<td><strong>Continuous Count Data and Adjustment Factors</strong></td>
<td>December 2012</td>
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<tr>
<td>40.5</td>
<td><strong>Truck Analysis for Traffic Forecasting</strong></td>
<td>December 2012</td>
</tr>
<tr>
<td>40.6</td>
<td><strong>Related Policies</strong></td>
<td>December 2012</td>
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</table>
40.1 Introduction

As noted in Section 1, Subject 4, roadway traffic forecasts require investigation, sufficient knowledge of best practices, and applied expertise. Once the appropriate roadway traffic forecast volumes have been prepared, the next phase of forecast report preparation involves calculating other component data elements of the traffic forecast. Design parameters, which include peak-hour information, together with truck percentages, are output from these calculations. Design parameters are normally requested by each region via the forecast request form (DT1601). Commonly-requested design parameters include:

- K250—the percent of average annual daily traffic (AADT) occurring in the 250th highest traveled hour of the year
- K100—the percent of AADT occurring in the 100th highest traveled hour of the year
- K30—the percent of AADT occurring in the 30th highest traveled hour of the year, the most commonly used K factor and the one most commonly used in FHWA analyses
- P(PHV)—the percent of AADT occurring in the highest traveled hour of the year
- T(DHV)—the percent of trucks during the 100th highest hour of the year
- T(PHV)—the percent of trucks during the highest travel hour of the year
- Truck Class Percent—the percent of heavy trucks by AADT
40.2 Estimating Vehicle Miles of Travel (VMT):

Vehicle miles of travel (VMT) indicate travel intensity on the roadway system. It is WisDOT policy to provide VMT annually, as it is used for federal and state budgeting purposes, crash analysis, and for general travel behavior analysis from year to year. As reported to FHWA, VMT is calculated by the summed product of segment AADT multiplied by roadway segment length for each roadway segment where a traffic count is taken.

40.2.a. Methodology

WisDOT’s Traffic Forecasting Section analyzes traffic volume information and fuel usage data to produce the official Wisconsin estimates each year by highway jurisdiction, by functional classification, and by county. Three sources of information are used to estimate VMT:

- Automatic Traffic Recorder (ATR) continuous traffic counts
- Highway Performance Monitoring System (HPMS) data
- Wisconsin Department of Revenue (DOR) fuel consumption figures

To produce annual VMT, this information is reviewed for error and logically compiled. Annual VMT increases or decreases as a result of the data comparison from the previous year to the current year.

ATRs

Traffic forecasting derives the weighted average percent change in traffic from year to year at automated traffic recorder (ATR) count sites. ATRs continue to be the best source of traffic count data. See Section 40, Subject 4, for more information about ATRs.
HPMS Data

The Highway Performance Monitoring System (HPMS) provides a complete picture of statewide travel, both for the state trunk highway network and for local roads. Every year, as noted in Section 30, Subject 3, traffic counting occurs on a rotating basis, on roughly one-third of the state trunk highway system. While many traffic counts are collected, most are short term or 48-hour counts; some are on ATRs. After traffic counts have been collected, the data management section adjusts traffic volumes to account for seasonal, daily, axle and monthly factors and enters the data into TRADAS©. Time-of-day, day-of-week, weather conditions, and a variety of other factors influence error likelihood, although factoring errors are rare. WisDOT makes every attempt possible to scan for quality and consistency in data collection.

Fuel Consumption Figures

The Wisconsin Department of Revenue collects fuel consumption data based on motor vehicle fuel taxes. The traffic forecasting section then applies fuel efficiency assumptions to fuel consumption figures to estimate this component of statewide VMT. In addition, diesel fuel consumption and efficiency also helps WisDOT estimate commercial vehicle travel.

40.2.b. Results

Wisconsin’s annual HPMS federal submittal contains VMT. WisDOT recognizes HPMS VMT as one component to its statewide VMT value. A weighted average of continuous traffic counts, 48-hour counts, and fuel consumption against fuel efficiencies generates Wisconsin’s final estimated annual VMT every year. Each factor is given a weight based on logical data confidence levels. The result provides the estimated percent change in annual VMT. The percent change is then applied to the previous year’s VMT estimate and tested for accuracy against real traffic counts.

After compilation and verification, the final estimate is posted on WisDOT’s web site. Final statewide VMT figures for previous years are located at: http://wisconsindot.gov/Pages/projects/data-plan/veh-miles/default.aspx.
40.3 Geometric Design Factors

The traffic forecasting section maintains geometric design hour factor data and design hour traffic volume percentages, or K-factor data, as part of the overall forecasting duties. Highway geometric design hour volumes (DHWs) are the percentages of annual average daily traffic (AADT) expected to occur during a specific hour of the year. In general, the "design hours" are the 30th highest hour or $K_{30}$, the 100th highest hour, or $K_{100}$, and the 250th highest hour, or $K_{250}$. Peak hour or “P,” represents the ratio of the highest hourly volume in the year to AADT, expressed as a percentage. “K” represents the percent of AADT in the "design hour" and whether that hour represents the 30th, 100th, or 250th highest hour of the year.

To calculate the method to derive K values, WisDOT generally uses statistical analysis. The Bureau of Planning and Economic Development’s Traffic Forecasting Section updates K-factors and associated policies pertaining to their analysis as necessary. Updates have occurred in 2012, 2007, 1991, and 1981.

40.3.a. Background

Highway seasonal adjustment factor groups correspond to the seasonal (monthly) variation of traffic volumes, as identified by the automatic traffic recorder (ATR) stations across Wisconsin. Highway seasonal adjustment factors are assigned by the Bureau of State Highway Programs’ Data Management Section. Factor groups 1 and 2 apply to urban highways. In urban areas, there exists little seasonal variation in traffic volumes. Groups 3 and 4 apply to rural highways. In rural areas, there is moderate seasonal variation in traffic, with some peaking; meaning that traffic volumes go up about 20 percent over AADT in the summer months and down by the same amount in the winter months. Groups 5 and 6 apply to highways in and leading to tourist and recreational areas. On highways in and leading to recreational areas, considerable seasonal variation in traffic is found, with high peaking; where traffic increases 30-45 percent or more over AADT in the summer months.

Analysis also showed that the capacity of a roadway helps determine the peak hour volumes. As capacity increases, the volume of the peak hour also increases. This is due to an increase in overall volumes as well as an increase in the rate at which the peak hours change. This was determined after a multivariate analysis.
of the K-factors in relation to overall AADT on the roadways. The result of this analysis is a grouping of roadways by seasonal factor group and number of lanes.

The odd numbered seasonal groups (1, 3 and 5) refer to interstate highways and even numbered groups (2, 4, 6 and 8) refer to non-interstate highways. The six seasonal adjustment factor groups include:

- Factor Group 1 - Urban Interstate
- Factor Group 2 - Urban Other
- Factor Group 3 - Rural Interstate
- Factor Group 4 - Rural Other
- Factor Group 5 - Tourist/Recreational Interstate
- Factor Group 6 - Tourist/Recreational Other

Group 8 is not shown above. It applies to county trunk highways; mostly rural, lower volume roads. Group 8 displays different peaking characteristics than state trunk highway rural roads. To account for capacity changes the arterials and collectors were grouped as two lane and multi lane, where multi-lane were considered any roadway with more than two lanes.

40.3.b. K-factor Table Use

Where ATR data exists, WisDOT uses an ATR-driven K-factor derivation method to similarly slope a K-factor growth relative to other like sites during forecast analysis. The following steps are completed by the forecaster:

1. Verify automatic traffic recorder (ATR) locations; a location next to or on the site
2. Forecast traffic volumes
3. Apply a constant; which is the difference between the base year K-factor and the average K-factor for the highway seasonal factor group where the ATR resides
4. Determine the design year K-factor with the resulting linear equation applied to the design year volume

Since the K-factors decrease as traffic volume increases, the design volume K-factors percents should be lower than the base year K-factors percents. Therefore, when estimating design peak hour volumes, the design volumes should be used as the volume input.
Where no automated traffic recorders exist, WisDOT policy is to use Tables 40.3.1 - 40.3.2 for estimating P, K30, K100, and K250. The appropriate table is determined by the segment’s seasonal factor group as well as number of lanes. To find the appropriate data, read down the AADT column to find the AADT level that corresponds to the forecast design volume. Read across the row to find the P and K factors.

Linear interpolation may be used to estimate values between given AADT values. Values that are on the ends of Tables 40.3.1 - 40.3.2 may extend beyond the range of values used in the analysis, and, as a result, have low statistical validity. Extreme caution is used when extrapolating factors beyond the values given as the roadway likely does not fit into the factor group in terms of DHV patterns.

The linear relationships used to create Tables 40.3.1 - 40.3.2 were derived from continuous count data from years 2010 and 2011. Scatter plots were developed, using the SAS® plot procedure. The plots of the K-factors and hourly volumes were grouped by AADT within the plot procedure. Factor group assignment changes were made for any outliers in the data and a second iteration of the procedure was run with adjusted groupings. The final regression results have related goodness-of-fit statistics associated with them that were used to generate Tables 40.3.1 - 40.3.2. When using the equations directly, i.e. in place of the tables, caution is used in extrapolating beyond the AADT minimum and maximum for each factor group. The resulting hourly volume is divided by the total design hour AADT to arrive at the appropriate K-factor.

Table 40.3.1: Design Hour Volume Factors for Wisconsin Roadways

<table>
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<tr>
<th>Factor Group: 1</th>
<th>Multi Lanes</th>
<th>AADT Min: 34,000</th>
<th>AADT Max: 160,000</th>
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<tr>
<td>DHV</td>
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<td>Coef</td>
<td>R-SQ</td>
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<td>P</td>
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<td>K30</td>
<td>1,463.44624</td>
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<tr>
<td>K100</td>
<td>1,254.81358</td>
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<tr>
<td>K250</td>
<td>1,068.46379</td>
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<td>DHV</td>
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<td>Coef</td>
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<td>DHV</td>
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<td>DHV Const</td>
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Group 1 with Four+ Lanes

URBAN INTERSTATE

Group 2 with Four+ Lanes

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40.4 Continuous Count Data and Adjustment Factors

WisDOT maintains more than 200 permanent, continuous data collection stations or automated traffic
recorders (ATRs) on Wisconsin’s roadways. WisDOT collects ATR data and produces several reports,
including but not limited to:

- Daily, weekly and yearly counts
- Factor groups (day-of-week, seasonal)
- Functional classification
- Historical counts and trends
- Peak through 500th highest hour statistics
- Percent annual average hourly traffic volume

Generally speaking, the number of and reporting capabilities of individual ATRs affect results. Because
ATRs are expensive, WisDOT attempts to gather statistically valid samples to provide increased data
confidence and integrity.

Coverage counts are traffic counts collected cyclically (every three years for most sites) at nearly 30,000
locations throughout the state. They are not continuous; rather they are usually 48-hour counts with a
pneumatic tube counter placed across a roadway. State trunk highways have varying coverage count
schedules. Coverage counts are on WisDOT’s web site and are found at:


40.4.a. Factors for average annual daily traffic

WisDOT analyzes the continuous count and vehicle classification data collected during the same year as
the coverage count data (January 1 to December 31) to develop factors used to compute annual average
daily traffic (AADT). Estimated AADT is developed by multiplying raw counts by seasonal, day-of-week, and axle adjustment factors.

WisDOT then produces:

- Monthly seasonal adjustment factors
- Day-of-week factors for each seasonal group
- Monthly axle adjustment factors by functional classification group, including interstates
- Axle adjustment factors determined by functional classification exceptions
- Annual growth factor groups

### 40.4.b. Traffic forecasting and automated traffic recorders

Traffic count accuracy depends on equipment limitations, malfunctions and trained expertise in data collection. Automatic traffic recorders (ATR) provide more accurate traffic count data over coverage count tube stations because of both equipment sophistication and longer count duration. It is WisDOT policy to convert, factor and adjust ATR data using statistically valid procedures. In roadway traffic forecasting, ATRs are used for primarily three purposes:

1. To derive estimates of AADT
2. To provide generalized peak and design hour factors for highway geometric design
3. To monitor annual changes in traffic volumes

The formula for estimating AADT using ATR data is as follows:

$$
AADT = CC \times SAF \times DOW \times AAF
$$

Where:

- CC = Coverage Count
- SAF = Seasonal Adjustment Factor
- AAF = Axle Adjustment Factor
- DOW = Day of Week Factor
40.4.c. SAF or seasonal adjustment factors
WisDOT uses the month of year as the unit of measure for the seasonal factoring procedure. Monthly traffic volume data is used to group ATRs into seasonal factors based on similar seasonal patterns of monthly traffic volumes. Monthly volumes are also used to determine adjustments to coverage counts to arrive at the AADT. Monthly adjustment factors and day-of-week factors, for each seasonal group, are then produced. The week can also be used to factor seasonal variation, where necessary to factor, or seasonally adjust, coverage counts when estimating AADT.

SAF factors are found by contacting the Bureau of State Highway Programs’ Data Management Section.

40.4.d. DOW or day-of-week factors
In addition to seasonal adjustments, WisDOT uses day-of-week (DOW) adjustment factors to account for daily traffic volume variation. Day-of-week adjustments exist for all days of the week and vary depending on the ATR location. In the Madison area, on I-39/90 for example, the largest adjustments are given to Friday through Sunday because peak travel generally occurs during Friday and Sunday afternoons.

DOW factors are found by contacting the Bureau of State Highway Programs’ Data Management Section.

40.4.e. AAF or axle adjustment factor
In addition to variations due to seasonality and DOW sampling, short period traffic counts collected with road tubes are subject to axle inflation or vehicle over-count error. Road tubes count axles, not vehicles, and most portable traffic counters record one vehicle for every two impulses. For example, without adjustment, if a five axle semi crosses a tube it would be counted as 2.5 vehicles. Typical AAF error is in the range of 10-15 percent; however, errors have been found as high as 50 percent. WisDOT made no adjustment for axle error prior to 1990, as is done currently.

AAFs are found by contacting the Bureau of State Highway Programs’ Data Management Section.
40.5 Truck Analysis for Traffic Forecasting

Vehicle classification includes axle-based data and length-based data (known as Wavetronics). WisDOT’s heavy truck and vehicle classification continues to evolve and follows federally recognized data collection procedures.

Truck class percent is the percent of heavy trucks and heavy vehicles of average annual daily traffic volumes. Heavy truck/vehicle classification is reported using the following groupings:

- 2D—single unit, dual rear tires, two axles only
- 3AX—single unit, three or more axles
- 2S1+2S2—three or four axle tractor-semitrailers
- 3S2—five or more axle tractor-semitrailers
- DBL-BTM—Includes multiple semitrailers and/or trailers

WisDOT analyzes axle and length-based data together to estimate heavy trucks and vehicles. The integration of the axle-based and length-based systems is not seamless, as there is not a one-to-one relationship between vehicle length and the number of vehicle axles. The length-based groupings WisDOT uses are:

- 0-9 feet
- 9-24 feet
- 24-40 feet
- 40-75 feet
- Greater than 75 feet
Heavy vehicles are 24 feet or longer. Heavy trucks are single- or multi-trailer trucks that are 40 feet or greater in length. Double-bottom trucks are represented by vehicles greater than 75 feet in length.

The percent of heavy trucks and vehicles out of all vehicles on a roadway is reported on official WisDOT forecast reports because heavy truck/vehicle volume data are useful for planners and engineers in designing roadways, particularly pavement.

40.5.a. Average daily truck percentage estimates for Wisconsin roadways

Two methods to calculate heavy truck/vehicle percent on a roadway exist; the ATR method and the equation method.

The ATR method uses ATR locations on or near desired forecasted segments and bases its calculation on the ATR’s available vehicle length data. Upon finding site-specific vehicle length data, the forecaster uses it for the forecast location. When completing a corridor forecast, the forecaster analyzes the corridor for ATR sites at the forecast location to adjust vehicle classification data on an average-day basis. The forecaster then uses a full week of ATR data (if possible) to adjust for counters that only collect weekday traffic.

The equation method calculates heavy truck/vehicle percent based on system-wide averages. The traffic forecasting section uses system-wide averages as a function of AADT for many routine project forecasts, where no site-specific vehicle length data exists. Information includes average daily heavy trucks and vehicles:

- As a percent of AADT
- By length and existing AADT
- By highway functional classification

Average daily heavy truck/vehicle percentage can be obtained by contacting the traffic forecasting section. The equation method utilizes current functional classification and either existing AADT or the latest adjusted traffic count as a means to calculate the heavy truck/vehicle percent. Traffic forecasting does not use peak hour traffic volumes; rather heavy truck/vehicle percent is based on overall traffic volume. Future heavy truck/vehicle percentages could be overestimated or underestimated, if peak volumes are used.

40.5.b. Professional Judgment
When using either method, the forecaster must use professional judgment and location-specific data (if at all possible). Common sense suggests that highways near a gravel pit, a factory, or distribution center for example, would have above-average heavy truck traffic. If no heavy truck/vehicle data exists in the exact location, a site should be chosen in the same general location. Heavy truck/vehicle percents of neighboring sites can be used as long as a major truck route, municipality or other factor that would affect the count does not lie between the neighboring site and the forecast location. If a forecaster is unsure or has concerns about the derived percent heavy truck/vehicle volumes, a special week-long vehicle classification count should be conducted.

Several conditions influence heavy truck/vehicle percents and they can vary from site to site. Truck percents can vary in the future, based on the overall rate of growth of heavy trucks/vehicles versus all vehicles. Generally, the percent of heavy trucks/vehicles compared to overall traffic volume decreases with increased total volumes. However, depending on economic conditions and other factors, heavy truck/vehicle volume can increase faster than total vehicle traffic volume. Traffic can vary depending on the measure of time analyzed as well. For example, weekday vehicle classification differs from daily vehicle classification data. Currently, WisDOT data outputs show that more trucks travel on weekdays than weekends. As much as 20-40 percent more trucks are traveling on the average weekday (Monday through Friday) than are traveling on the average day during the typical week (Saturdays and Sundays included).

Data limitations can also sometimes confound results, including functional classification. For example, an urbanized stretch of I-90 that runs through Janesville is classified as “urban;” however, the traffic existing on the site is of a “rural” interregional nature. Traffic in this urban section behaves like rural interstate traffic. Traffic forecasting never takes at face value data that doesn’t “look right” given the context of the forecast. Suspect data is always investigated.
40.6 Related Policies: Data Elements of Forecasting

A summary of the WisDOT policies that were discussed in this section are:

It is WisDOT policy to:

- Estimate vehicle miles of travel yearly.
- Analyze axle and length-based data together as well as ATR data to estimate trucks.
- Maintain, estimate, and identify appropriate geometric design hour factor data and design hour traffic volume percentages for roadways using mathematically valid procedures.
- Use professional judgment and location-specific data (if at all possible).
- Analyze a large number of sites to derive averages across the state roadway network.
Chapter 9: 

Traffic Forecasting, Travel Demand Models and Planning Data

Section 50 – Traffic Impact Analysis (TIA)

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50.1 TIA Forecasts

WisDOT’s *Facilities Development Manual (FDM), Chapter 7: “Access Control”*, defines a Traffic Impact Analysis (TIA) as:

An engineering study that compares before and after traffic conditions on a road network due to a proposed land use change. For WisDOT purposes, it is produced to identify... the optimum number and location of highway access points and any roadway changes needed to accommodate the traffic generated by the development.

WisDOT’s Bureau of Planning and Economic Development Traffic Forecasting Section develops and approves base traffic forecasts that are conducted to support creation of TIAs. The traffic forecasting section also provides review of and comment on TIAs, and coordinates with WisDOT region staff to resolve remaining issues with a TIA before final approval is granted by region staff. (See Section 50, Subject 2).

50.1.a. Conducting TIA Base Forecasts

A TIA base forecast is essentially like any other base forecast. It is a roadway forecast that follows standard forecast procedures and estimates the future volume of traffic on the roadway. When required, a TIA base forecast is produced as part of the initial TIA analysis. A TIA forecast is generally required when the proposed development generates more than 500 driveway trips during the peak hour, although region staff may determine that a forecast is required when the development generates more than 100 peak hour driveway trips. Typically, a 30-year projection is required, though this is at the discretion of the TIA project manager. To request a forecast, the developer or consultant can contact WisDOT Region Planning with an authorized form DT1601. The forecast requester needs to clarify the assumptions to the forecaster as part of the request process prior to the development of the forecast. The forecast will serve as an underlying base condition for the TIA alternative development.
As noted in Section 1, Subject 4, it is WisDOT policy to use the Traffic Analysis Forecasting Information System (TAFIS) to conduct roadway traffic forecasts in all areas of the state where no travel demand model exists, and to use a combination of TAFIS and travel demand model output to conduct traffic forecasts in areas where travel demand models do exist (See Section 10, Subject 4 and Section 30, Subject 1).

Travel demand models include “committed” roadway improvements (improvements that have funding committed to them) in the Metropolitan Planning Areas (MPOs) Long-range Transportation Plan, as well as future land use conditions described in the comprehensive plans of the jurisdictions within the MPO. Before a TIA base forecast is produced, the traffic forecasting section verifies that committed roadway improvements, as well as future land use conditions are represented accurately in the travel demand model. Committed projects included in a travel demand model (including lane additions, roadway bypasses, etc.) affect the model’s growth rate of predicted future traffic. Land use changes also directly affect model output.

Forecasts developed for areas of the state where no travel demand model exists do not directly take into consideration future land use changes, or committed projects included in the six year State Transportation Improvement Program, unless this information is known to the forecaster. Therefore, TIA base forecasts where no travel demand model exists are considered to be “unconstrained,” and do not consider relationships with other traffic generators or trip attractions, unless identified by the forecaster. For this reason, information sharing and communication about forecast inputs are critical.

In all forecasts, traffic forecasters document whether any additional traffic generators are included in traffic forecasts within the “Notes” section of the TIA base forecast. Once the TIA base forecast and other gathered supporting information is completed, prepare a TIA following WisDOT’s Bureau of Traffic Operations procedures.

50.1.b. Conducting TIA Development Forecasts

In addition to developing the base forecasts to support the creation of TIAs, the traffic forecasting section also conducts development forecasts, or forecasts which includes the traffic generated by the development added onto the base forecasts. Development forecasts are beneficial to the overall evaluation of corridor studies. Prior to generating a development forecast, the base forecast is reviewed to determine if the proposed development was included as part of the background growth. An assessment of the following items is made to establish if the base forecast included the proposed development:
• For TAFIS based forecasts (i.e. the development is located outside of a travel demand model area) the historical development of land within the area is examined to ascertain if the proposed development is consistent with past development and thus included in the background growth rate.

• For Travel Demand Model forecasts (i.e. the development is located within a travel demand model area) the land uses included in the travel demand model for the development site is reviewed to determine if the proposed development was included in the base traffic forecast projections.

• For either the TAFIS based or Travel Demand Model forecasts, aerials, site visits, and/or discussions with the WisDOT region staff will be reviewed and/or conducted to verify whether the subject development has already been constructed and thus included as part of the existing traffic counts.

The traffic forecasting section follows the flow chart illustrated in Figure 50.1.1 to assess if a development project is already incorporated into the base traffic forecast or if it needs to be added prior to generating the final traffic forecast.
Figure 50.1.1: Development Traffic Forecast Flow Chart
As part of the steps outlined in Figure 50.1.1, the forecasting section considers the following elements in the creation of all TIA development forecasts: (1) trip generation potential; (2) pass-by and/or linked trips; (3) trip distribution/traffic assignment; (4) development phasing schedule; and (5) resulting growth rate. Details on how each of these elements is considered in the development of traffic forecasts are provided below.

**Trip Generation Potential:**

In most cases, the trip generation potential associated with a development project is obtained from the approved TIA. In absence of a TIA, the trip generation potential for the project is calculated by utilizing the WisDOT’s Bureau of Traffic Operations accepted methodologies. The most commonly accepted source for trip generation data for land use development is the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, an ITE informational report. The ITE *Trip Generation Manual* provides data in terms of trip rates (average, minimum, and maximum), regression equations (i.e. fitted curve equations), and data plots. A guideline of when to use each source of data in estimating the trip generation potential of a land use is provided in the ITE *Trip Generation Handbook*. As outlined in the WisDOT’s Bureau of Traffic Operations procedures for preparing TIAs, the following are the recommended guidelines for when the average rates, equations, or local data should be utilized for calculating the trip generation of a proposed development:

1) **Use regression equation when:**
   
   a) Regression equation is provided;

   b) Independent variable is within the range of data;

   c) Data plot has at least 20 points;

   d) \( R^2 \geq 0.75; \)

   e) Equation falls within data cluster in plot at size of development; and

   f) Standard deviation $> 110\%$ of weighted average weight.

2) **Use weighted average rate when:**

   a) At least 3 data points are available;
b) Independent variable is with the range of data;

c) Standard deviation ≤ 110% of weighted average weight;

d) $R^2 < 0.75$ or no equation is provided; and

e) Weighted average rate falls within data cluster in plot at size of development.

3) Collect local data when:

a) Study site is not compatible with ITE land use code definition;

b) Only 1 or 2 data points are provided;

c) Independent variable does not fall within range of data; and

d) Neither the weighted average rate line nor fitted curve fall within data cluster at size of development.

In most cases, the weighted average is utilized to estimate the trip generation of the development. When ITE data is unavailable (or when the ITE data is limited), appropriate trip generation rates will be chosen from one of the following sources:

- Local data for comparable developments
- Other published references such as the ITE Journal
- Trip generation studies conducted at sites similar to the proposed development

In all cases, the traffic forecasting section works closely with WisDOT region staff and applicable metropolitan planning organizations to determine the most appropriate trip generation calculations for the development.

**New, Pass-by and/or Linked Trips:**

The standard trip generation rates provide an estimate of the total driveway trips that will be generated by the proposed development. However, some of the driveway trips generated by a development may already be on the existing roadway network (i.e. pass-by trips) and/or may stop at more than one location within
the development and/or along the corridor (linked trips) thus reducing the total number of net new trips added to the roadway network. New, pass-by, and linked trips have a significant impact on the number of trips assigned to the highway facility and are therefore critical in the preparation of accurate traffic forecasts. A detailed definition of new, pass-by and linked trips is provided below:

- **New trips** are trips made for the specific purpose of visiting the trip generator. Therefore, these trips are new traffic on the area roadway network. Trip generation rates are derived from actual traffic counts conducted at the driveways of various developments. When dealing with non-commercial land uses such as residential projects, office buildings, hotels, and industrial parks, these driveway volumes usually represent the amount of new traffic being added to the area roadway network by those particular uses.

- **Pass-by trips** are trips that are currently on the roadway system and pass directly by a generator on the way to their primary destination. Pass-by trips are convenience-oriented; for example, stopping to refuel a vehicle during a commute from work. Pass-by trips are applied only to retail-oriented land uses that would have utilized the roadway adjacent to the retail land use even if the development was not present. The amount of pass-by traffic does not affect the number of trips that may enter and exit a proposed development (i.e. driveway volumes). However, it does reduce the amount of traffic that may be added to the adjacent street system by the new development (i.e. new trips). Depending on the type of development and adjacent street traffic volumes, predicted pass-by trips can vary significantly, so these adjustments must be applied carefully. The number of pass-by trips is calculated after accounting for internal trips.

\[
\text{External Trips} = \text{Total Site Trip Generation} - \text{Internally-Linked Trips}
\]

(Note: Apply pass-by reduction to external trips)

Generally, pass-by traffic should not exceed 5 to 10 percent of the traffic volumes on the adjacent roadways. Pass-by traffic should have equal ingress and egress volumes. WisDOT has developed a set of acceptable ranges for pass-by rates based on data from the ITE *Trip Generation Handbook, 2nd Edition*. The traffic forecasting section works closely with WisDOT region staff to select the appropriate pass-by trip rates for a development.
• **Linked Trips** can consist of internally linked trips, multi-linked trips, and externally linked trips. Internally-linked trips are trips made without utilizing the major roadway system. An internal trip may stop at a drugstore, fast-food restaurant, and a service station within the same mixed-use development (MXD) without using the state highway facility to travel from one land use to another. Internally-linked trips reduce the estimates of the number of trips entering and exiting the proposed MXD because one entrance and exit to the study area may serve two or more trips. Internally-linked trips also reduce the amount of traffic that may be added to the adjacent street system by the new development. Internal capture rates vary by the mix of land uses, size, the amount of potential interaction between complementary land uses and the availability of convenient internal on or off street facilities and connections. Typically, internally linked trips may be applied to mixed use developments that justify a significant amount of interactions to capture trips internally. The traffic forecasting section follows the WisDOT’s Bureau of Traffic Operations procedures for preparing TIAs guidance in selecting a proposed internal capture rate. The traffic forecasting section works closely with WisDOT region staff to select the appropriate internal capture rate for a development.

Multi-linked trips are similar to internally-linked trips. Multi-linked trips may stop at multiple land uses and will use the state highway facility to travel from one land use to another land use. Multi-linked trips affect the estimates of the number of trips entering and exiting the proposed development. One entrance/exit to the study area may serve two or more trips. Multi-linked trips will increase the estimate of the number of trips at specific driveway locations for the new development. The traffic forecasting section works closely with WisDOT region staff to select the appropriate trip generation reduction to account for multi-linked trips.

Externally-linked trips occur when an existing trip stops at a land use within the development and stops at an existing land use within the study area boundaries of the development. Externally-linked trips should be considered only for developments occurring in heavily developed areas such as Central Business Districts. Externally-linked trips shall be limited to the lesser of 10% of the existing commercial and institutional trips or 10% of the new development trips.

The ITE *Trip Generation Handbook, 2nd Edition* and the *NCHRP Report 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments* are two sources utilized by the traffic forecasting section for estimating the number of linked trips.
It should be noted that although the approved TIA for the development may have incorporated pass-by and/or linked trips; the pass-by/linked trips presented in the TIA are generally conservative numbers and may not be the best data source for utilization in traffic forecast for an entire corridor. Thus the traffic forecasting section works with WisDOT region staff and applicable metropolitan planning organizations to identify the appropriate new trips, pass-by trips, and/or linked trips to incorporate into the final traffic forecast.

**Trip Distribution/Traffic Assignment:**

The approved TIA is the primary source utilized to determine how to distribute and then assign the net new trips associated with a development to the adjacent roadway network. In absence of a TIA, or in situations where the study area provided within the TIA does not cover the entire study area for the corridor study, the forecasting sections utilizes the following methodologies to estimate the distribution of the traffic generated by a development:

- **Analogy Method** is a method which derives the trip distribution of a proposed development based on existing data/existing travel patterns from sites that are similar to the subject development. Typically, daily traffic count and turning movement data are utilized with the analogy method.

- **Travel Demand Model Method** is utilized when the development is located within one of the established model areas to either: 1) generate a select zone assignment for the development to determine the trip distribution for the development which is then utilized to assign the development traffic to the adjacent roadway network manually; or 2) modify the land uses within the travel demand model to generate a new forecast which includes the proposed development.

- **Market Area Analysis Method** utilizes a market study, if available, or delineated influence area to determine the boundaries of the study area for trip distribution.

- **Origin-Destination Method** is a method which estimates how trips will be distributed from the proposed land use (origin) to another land use (destination) based on the land use type. For example a residential development typically will have destinations at land uses which contain commercial development (retail trips), office/industrial development (work trips), and institutional developments (school trips). Likewise, an institutional development (school) will primarily be
attracted to nearby residential areas. Aerials, regional transportation plans, and local plans are good sources for determining the existing and proposed land uses in the area.

All methodologies described above also take into consideration the philosophy that drivers normally choose the fastest, not necessarily the most direct, route to travel to/from a development. The traffic forecasting section works closely with WisDOT region staff and applicable metropolitan planning organizations when developing the trip distribution percentages for a proposed development.

Development Phasing Schedule:

Larger developments are generally built over a period of five years or more and thus are included in the traffic forecasts based on the proposed phasing schedule of the development. To determine the most likely project phasing, the traffic forecasting section refers to the phasing schedule and timing outlined in the approved TIA for the development. In absence of a TIA, WisDOT region staff and applicable metropolitan planning organizations are consulted to determine the appropriate phasing to utilize in the traffic forecast. Note, appropriately phasing development is important to evaluate the appropriate traffic and assess the timing of any potential improvements needed along a corridor.

Overall Growth Rate:

Upon completion of the initial development forecasts, the traffic forecasting section reviews the overall resulting growth rate (growth between existing traffic volumes and traffic volumes with base/background traffic plus development traffic forecast) for reasonableness. As discussed in Section 10, Subject 4 it is WisDOT policy to apply or choose an appropriate roadway link growth rate relative to typical forecasting procedures and if there has been significant changes in socioeconomic data, land use, and/or roadway network data. It is also WisDOT policy to use analytical judgment to determine if the applied growth rate makes sense. If it is determined that the growth rate of the initial development forecast is too high, the forecasting section will reevaluate the base traffic forecasts to determine if the background growth includes part or all of the proposed development. Additionally, if the initial development forecast is deemed too high, the development traffic itself will be reviewed to verify that the appropriate trip generation rates, new trips, pass-by trips, and/or linked trips were utilized for the development.

As a first resource, the traffic forecasting section will reference a completed/approved TIA to determine the trip generation potential, new trips, pass-by/linked trips, trip distribution/traffic assignment, and phasing
schedule for the proposed development. When a TIA does not exist and it’s appropriate to conduct one, the WisDOT’s Bureau of Traffic Operations procedures for preparing TIAs will be followed.
50.2 TIA Review

As noted in Section 50, Subject 1, the traffic forecasting section develops and approves base traffic forecasts that are conducted to support creation of TIAs. As noted in Section 1, Subject 3, if an outside consultant, WisDOT Region, or MPO has completed a traffic analysis, WisDOT’s Central Office Traffic Forecasting Section conducts overall review and final determination of approval of all forecasts. All forecasts should be submitted to the traffic forecasting section for review and approval prior to them being utilized for TIA development.

Once a TIA is in draft form, WisDOT region staff reviews the TIA with assistance from others in the department. The traffic forecasting section provides comments as part of this process, and assists in resolving issues identified during review before region approval of a TIA. A TIA review by the traffic forecasting section involves an understanding of the future vision of the roadway being studied and a comparison of the results of the TIA traffic generation figures with an initial TIA base forecast.

50.2.a. Future Vision Analysis

The decision as to whether the department should allow highway access to the State Trunk Highway System is guided by the long-range vision for access management described in the Connections 2030 Long-Range Multimodal Transportation Plan. The State Access Management Plan on page 37, defines the vision for appropriate access on the system, and includes a statewide map of proposed access tiers. As part of the TIA process, the traffic forecasting section consults the State Access Management Plan and provides an overall assessment regarding the degree to which the proposed development impacts the state trunk highway system, thus helping to achieve the department’s long-range vision for highway access.
50.2.b. Results of the TIA Compared to Initial Base Forecast Development

If a TIA base forecast has not been developed, the traffic forecasting section will request that the TIA project manager complete one (see Section 50, Subject 1). Typically, a 30-year projection is required, though this is at the discretion of the TIA project manager. Forecast requests are coordinated through WisDOT regions and require the completion of form DT1601 (Please see Chapter 1, Section 4 for more information).

To conduct a TIA review, the traffic forecasting section requires a copy of the TIA base forecast to be submitted so the base forecast can be compared to TIA traffic generation forecasts provided in the final draft TIA. Upon having the analysis in hand, many aspects of the TIA are commented on. The traffic forecasting section will provide the region with responses to the following questions (at a minimum):

- Are the base traffic volumes consistent with WisDOT coverage counts in the area?
- Are individual trips generated consistent with the most current version of the ITE Trip Generation Manual or other documented sources?
- Will internal circulation allow multiple stops without entry onto the immediate highway network?
- Have multiple-stop trips been considered within the development that would reduce trip generation?
- Is the trip generation from the proposed development included in the base forecast or is it part of a new land use plan?
- Are generated or pass-by trips incorporated into the analysis?
- Is the trip distribution based on traffic direction consistent with a market area analysis?
- Is the directional distribution for the various land uses reasonable?
- Does the TIA consider pending development in the area?
- Does the TIA consider future roadway improvements?

Once the review of the TIA is complete, comments are sent to the appropriate region contact.

The traffic forecasting section maintains a database that tracks TIAs around the state to help planners understand how proposed development might affect traffic on the state trunk highway system. This database continues to be valuable because it ultimately improves the quality of forecasts.
50.3 Wisconsin TIA Guidelines

The purpose of WisDOT’s TIA guidelines is to provide a set of uniform guidelines for the preparation of traffic impact analyses and for efficient department review. For specific and detailed TIA guidelines, contact WisDOT’s Bureau of Traffic Operations. TIA preparation is required of developers who propose new developments, or expansions of existing developments, and request new (direct or indirect) access, or modification of, existing access to the state trunk highway system. The guidelines provide a detailed description of how the TIA should be organized—including the list of required TIA exhibits; what types of analysis should be provided in each chapter of the document; and what data should be provided in the appendices.

50.3.a. WisDOT Roles and Responsibilities

When the department becomes aware of a proposed development, WisDOT staff begins to gather information to determine what impact, if any, the development would have on the existing highway system. Generally, all proposed developments impacting the state highway system are required to go through an access request procedure. The access request procedure includes an initial review process that occurs prior to submittal of a TIA (if required). The initial review process informs the region staff of the proposed development area. The developer/consultant/project manager should submit the following general information to the region for an initial review prior to setting up a meeting with region staff:

- A brief overview of the proposed development including its size (square footage) and type (retail, industrial, residential)
- A location map
- An initial site plan
- Details describing existing transportation facilities potentially serving the proposed development
- The approximate background AADT and anticipated site-generated peak hour volume of the proposed development
• A discussion regarding the need for a TIA (please refer to Facilities Development Manual (FDM) Chapter 7, Section 7-35: "Corridor Access Management" – a TIA shall not be submitted until a written response is received indicating the region requests a TIA)

• If it is anticipated that a TIA is needed, the recommended study area and rationale for selection of study area boundaries
  - The study area should include at least the major intersections in all directions, signal systems, and any other roadways that would experience a volume increase of 20 percent or greater due to the development

Region staff will reply to the initial review with a written response. The response will include information regarding access regulations, possible highway changes, determination of whether a TIA is needed, and approval of the study area.

If a TIA is required for the development, region staff will review the TIA once completed to ensure it meets the requirements of the TIA guidelines and to verify what impacts, if any, the proposed development has on the highway. If the development has impacts, mitigation measures for the project’s impacts will be developed in coordination with the developer submitting the proposal. After region staff completes a full review of the TIA, it is forwarded to the traffic forecasting section for review and comment.

50.3.b. TIA Development and WisDOT Support

Additional resources available to assist both the preparers and reviewers of TIAs include the WisDOT’s TIA Users Group and the WisDOT Facilities Development Manual (FDM) (specifically Chapter 7).

TIA Users Group

The purpose of the TIA Users Group is to identify and address concerns related to the preparation and review of TIA studies, and to promote and recommend to region management statewide standards relating to the TIA submittal and review process.

The TIA Users Group consists of representatives from various departments within WisDOT including a representative from the Bureau of Traffic Operations, the Bureau of Planning and Economic Development, the Bureau of Technical Services and a representative from the North Central Region, the Northeast Region, the Northwest Region, the Southeast Region, the Southwest Region (Madison) and the Southwest Region (La Crosse). The TIA Users Group meets approximately three times a year to discuss various issues and
concerns regarding the preparation and review of TIAs. The TIA Users Group is responsible for the development and maintenance of TIA Guidelines.

The TIA Users Group also conducts training (hosted by the Southeast Region) for those who prepare TIAs. The training is a one-day course to familiarize current and future TIA specialists on WisDOT requirements for TIA submittals.

**Facilities Development Manual (FDM)**

The *Facilities Development Manual* defines a TIA, identifies the conditions for when a TIA is required, defines the required methodology and analysis procedures, and provides guidance regarding which analytical software should be used to complete the analysis.

Specific references to TIAs are provided in the *Facilities Development Manual (FDM)* within Chapter 7: “Access Control” and Chapter 11: "Design" at the following locations:

- Chapter 7, Section 7-10: Methods of Control;
- Chapter 7, Section 7-35: Corridor Access Management - Additional Tools for Managing Access;
- Chapter 7, Section 7-50: Land Division Review - Abutting Land Division;
- Chapter 11, Section 11-5: General Design Considerations - Highway Capacity;
- Chapter 11, Section 11-5: General Design Considerations - Access Control.

A key element of the *FDM*, as it pertains to TIAs, is the thresholds that trigger the need for a developer to require a TIA as defined in FDM Chapter 7, Section 7-35: Corridor Access Management - Additional Tools for Managing Access:

A TIA should be considered whenever traffic, generated by the proposed development, is expected to exceed 100 vehicles in the peak hour. Greater consideration should be given to requiring a TIA on an already congested or unsafe highway than on one with lower traffic volumes and incident rates. Whenever WisDOT determines a TIA is necessary, the developer is required to provide it.
50.3.c. Institute of Transportation Engineers (ITE) *Trip Generation Manual*

If a TIA is required, the number of trips generated by the proposed development must be estimated. The most frequently used reference of trip generation for proposed developments is the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. The ITE *Trip Generation Manual* provides daily and peak-hour trip generation rates for several types of land uses. Per the TIA guidelines, the ITE *Trip Generation Manual* should be used to estimate site traffic unless individual special studies have been conducted specific to the proposed development, or individual company data exists. If the ITE *Trip Generation Manual* does not have a published trip generation rate for the proposed development, appropriate trip generation rates may be available from one or more of the following sources:

- Local data from comparable developments
- Other published references such as the ITE Journal
- Trip Generation studies conducted at a site similar to the proposed development

50.3.d. Project-Level Cost-Share

If after a TIA has been approved and it is determined transportation system alterations will occur, further review is needed. To accommodate the additional trips generated by the proposed development, a Memorandum of Understanding (MOU) is usually developed with WisDOT and local approving authorities. The following issues are discussed:

- Required roadway and intersection improvements
- Phasing of required improvements
- Responsible municipalities (local approving authority)
- Legal issues
- WisDOT standards
- Cost responsibilities (State vs. Developer)

WisDOT will work out a project-level cost-sharing agreement with the developer and/or local government for roadway and intersection improvements along the state trunk highway needed to accommodate the expected traffic from the proposed development.
Per WisDOT policy that is outlined in program management procedures, if it is determined that 40 percent of the trips begin and/or end within one-half (1/2) mile of the project limits, the local government may be required to provide 25 percent of the funding for the project. Typically an origin-destination study is conducted to help justify how much participation from others is necessary for the transportation project. Contact the WisDOT region office for more information about cost-share agreements. More details on origin-destination studies are provided in Section 60, Subject 1.
50.4 Related Section Policies: Traffic Impact Analysis

A summary of the WisDOT policies that were discussed in this section are:

It’s WisDOT policy to:

- Require a traffic forecast for traffic impact analysis whenever traffic is expected to exceed 500 driveway trips in the peak hour or when directed by region staff when the development generates more than 100 peak hour driveway trips
- Use a travel demand model in the base traffic impact analysis forecast development whenever possible
- Reference a completed/approved TIA to determine the trip generation potential, new trips, pass-by/linked trips, trip distribution/traffic assignment, and phasing schedule for the development traffic to be added onto the base forecast
- Recognize that traffic impact analysis results are often integral to WisDOT access management efforts
- Recognize and follow WisDOT long-range vision in long-range transportation plan for all modes of travel
- Follow cost share policy, as applicable, if 40 percent of the trips are generated within ½ mile of the project
Chapter 9: Traffic Forecasting, Travel Demand Models and Planning Data

Section 60 – Travel Surveys

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60.1 Data Collection Reasons

Travel surveys obtain information about trip patterns, behavior and other traveling characteristics. The data collected during surveys are utilized by WisDOT for three primary reasons: (1) data and policy development; (2) data verification; and (3) determination of project-level cost sharing. These are explained in more detail below.

60.1.a. Data and Policy Development

WisDOT utilizes travel surveys to help provide necessary background data to make decisions. Corridor studies, transportation projects, and program development all have used survey data to improve estimation procedures, planning information, and implementation measures. Data collected during a survey is utilized to identify regional travel patterns, providing a geographic context to evaluate the benefits and costs of large, long-term transportation investment alternatives.

When planners are evaluating the need for a bypass around a community, travel surveys are used to help estimate the volume of vehicular traffic that would potentially utilize the new facility. The magnitude of local trips versus through-trips is evaluated. WisDOT’s Traffic Forecasting Section completes traffic forecasts using travel survey data and provides the preliminary volume estimates to start planning the proposed bypass facility. If enough through-trips are made, the bypass may be justified from the perspective of potential demand. Survey data is examined with several other factors to determine all of the component pieces that might justify a bypass. Survey data also helps WisDOT determine locations for operational improvements or highway capacity changes along a highway corridor.

The traffic forecasting section utilizes information obtained from surveys in regional travel demand models. When survey data documents trip purpose, the results can be applied together with results from state or national surveys, to validate modeled travel patterns between employment and residential areas within a community. They can also be used to determine vehicle occupancy rates and travelers mode choice (i.e.
bicycle, auto or transit). Results from surveys are used to help predict future traffic volumes and vehicle mix. Less detailed surveys are used by the traffic forecasting section to help calibrate travel speeds and/or external-to-external through-trips within a specific area of a regional travel demand model.

60.1.b. Data Verification

The National Household Travel Survey (NHTS) data and data from any origin-destination surveys can be compared for better data verification. These surveys also serve as inputs into the travel demand models as part of the roadway forecasting process.

National Household Travel Survey

The National Household Travel Survey (NHTS) is a household-based survey that provides information to transportation planners and policymakers who need comprehensive data on travel patterns in the United States. The current 2009 NHTS provides data collected for daily trips made over a 24-hour period, and includes information about the following:

- Purpose of the trip (work, shopping, etc.)
- Means of transportation used (car, bus, subway, walk, etc.)
- How long the trip took (i.e., travel time)
- Time of day when the trip took place
- Day of week when the trip took place
- If a private vehicle trip:
  - Vehicle occupancy
  - Driver characteristics (age, sex, worker status, education level, etc.)
  - Vehicle attributes (make, model, model year, amount of miles driven in a year)

The NHTS data is used primarily for gaining a better understanding of travel behavior. The data enables WisDOT officials to assess program initiatives, review programs and policies, study current mobility issues, and plan for the future. NHTS data is used by planners to:

- Quantify travel behavior
- Analyze changes in travel characteristics over time
- Relate travel behavior to the demographics of the traveler
- Study the relationship of demographics and travel over time
As an example as to how traffic forecasting uses the data, the NHTS may have determined that there were between 7.8 and 12.2 average trips per household (depending on the number of automobiles per household) in a given region. The NHTS survey can then be used by the traffic forecasting section to project future regional traffic demand based on the number of households in the region. A localized area or regional survey would then assist traffic forecasting in predicting how those trips are assigned to the roadway network.

**Origin-destination (O-D) surveys**

Origin-destination (O-D) surveys are specific travel surveys which obtain information on trip patterns and purposes exhibited by residents in or around a community or specific area of interest. The type of information collected in an O-D can include and is not limited to one or more of the following:

- The degree of local trip making behavior versus through trip making behavior, or how many trips are traveling to or from the community as opposed to passing through it
- Purpose of the trip being made, such as work, recreation, shopping, or other personal business reasons
- Type of vehicle used for the trip, including automobile, heavy duty truck (such as a delivery vehicle or tractor-trailer combination), bicycle, or public transportation
- The number of people in each vehicle

**60.1.c. Project-Level Cost-Share**

Historically, the most common application of survey data, specifically O-D surveys has been for cost share evaluation and determination. Cost sharing studies are utilized by WisDOT to determine if a local government will be required to provide matching funds for a transportation project. Historic precedent has set a typical process where, if 40 percent of the trips begin and/or end within one-half (1/2) mile of the project limits, the local government may be required to provide 25 percent of the funding for the project. The reasoning behind this is that if a large portion of the trips using the facility will be of local benefit, then the local government should cover a portion of the cost of the project (see Section 50, Subject 3). Contact WisDOT’s Regional Offices for more information about cost-share agreements.
60.2 Types of Surveys

The information collected during a travel survey depends on the type of survey. Household surveys can assist analysts in developing travel characteristics and trip making behavior patterns. Roadside intercept surveys can identify the amount of through-trips versus trips that begin or end in an area. On-board transit surveys or passenger rail surveys collect other types of data like passenger trips, commute patterns and traveler information. Surveys can also assist in determining percent of trips taking a route or mode and using that split to estimate future flows or to estimate share of the coasts of transportation projects. The following provides a summary of WisDOT survey types, including but not limited to:

- Roadside intercept surveys
- License plate surveys
- Travel diary surveys
- Global positioning system surveys
- Bluetooth® media access control surveys
- Aerial surveys
- On-board surveys

It should be noted that regardless of the type of survey conducted, all information obtained from the travel survey will be utilized for statistical purposes only. No personal information about the individual completing the survey will be retained or reported on the survey summaries.

60.2.a. Roadside intercept survey

A roadside intercept survey involves stopping traffic to conduct a roadside driver interview, or to distribute a return-mail handout survey. Historically, WisDOT has relied on the roadside intercept methodology for conducting O-D surveys, where vehicles traveling on less-traveled roadways (less than 10,000 vehicles per day) are interviewed at the survey station, while vehicles traveling on higher-volume roadways (over 10,000
vehicles per day) are handed a return-mail survey. More recently, WisDOT has begun to employ other survey methodologies.

Please contact the Bureau of Planning and Economic Development Traffic Forecasting Section for the most recent forms available for O-D surveys. For example, Form DT1673 is the inspection check list utilized by WisDOT staff and/or the consultant during the initial field review of the survey sites. Completion of Form DT1673 provides written documentation of the existing roadway and traffic conditions at each survey site.
Form DT1790 is a sample of the survey form that WisDOT staff and/or the consultant fills out during a roadside intercept survey to keep track of the total number of vehicles and the types of vehicle that pass through each survey site. Form DT1790 also provides a tracking system for the number of surveys that were completed and/or handed out at each survey station. As illustrated, no personal information about the individuals participating in the survey is collected. The surveys are anonymous.

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<th>Outside Count</th>
<th>Inside Count</th>
<th>Outside Count</th>
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Form DT1674 is a sample of the label that staff will complete and attach to the envelope that contains all of the surveys conducted at the survey station. The envelope label identifies the name of the transportation study being conducted, provides a brief description of the survey station (i.e. station name, number), identifies the time the survey was conducted, and summarizes the total number of vehicles.
Form DT1600 and Form DT1726 are samples of the survey forms that are provided to the drivers who pass through the survey site. The surveys are either provided to the drivers via hand through the roadside intercept survey or via mail during the license plate survey. Form DT1600 is used when a map of the study area is needed, while form DT1796 is used when an accompanying map is not necessary. Staff may modify some of the questions listed in the sample forms DT1600 and/or DT1726. As with the surveys conducted at the survey station, all hand-out/mail back surveys are anonymous.
60.2.b. License plate survey

A license plate survey involves collecting license plate numbers at a location and either mailing a survey to the address to which license plates are registered, or matching them with plate numbers recorded at other locations. Form DT1600 or something similar can be used during license plate surveys.
60.2.c. Travel diary survey
A travel diary survey involves having a respondent fill out a form that lists all trips made over a specified time period, generally utilized for commercial trucks. The travel diary surveys are anonymous, as only information relating to the vehicle trip is collected.

60.2.d. Global positioning system (GPS) survey
A GPS survey involves the utilization of a GPS device to track vehicle, pedestrian, and/or bicycle movements over a specified time period. This survey can utilize existing GPS units provided on commercial vehicles, a GPS device could be handed out to an individual person selected to participate in the survey, and/or a smart phone application can be created which will utilize GPS or a combination of other technologies such as Wi-Fi, cell tower triangulation, or Bluetooth® to track the travel route of those individuals who agree to participate in the survey and download the application. For example, a smart phone data application known as CycleTracks, developed by the San Francisco County Transportation Authority, tracks the travel routes of bicyclers. This data is then gathered by the county for analysis. No personal information about the individual participating in the survey is collected.

60.2.e. Bluetooth® media access control (MAC) survey
A Bluetooth® MAC survey involves the mapping of MAC addresses from Bluetooth® devices. The MAC address can be utilized to track a vehicle from one point to another and also to calculate the time spent traveling along a specific route. No information about the individual or specific vehicle that is associated with the MAC address can be retrieved.

The Bluetooth® MAC travel survey is currently being utilized by WisDOT on several travel surveys, and is quickly becoming the standard when a large study area needs to be surveyed.

60.2.f. Aerial survey
An aerial survey involves creating an aerial video of the study corridor to be able to visually track the vehicles and/or bicycles as they travel. Since the aerials are taken from a distance of approximately one mile above ground, no identifying information about the individuals in the vehicle or on the bicycle is retrieved.

60.2.g. On-board survey
On-board surveys involve surveying passengers utilizing the transit system (i.e. bus, rail, light rail, airport shuttle). Surveys can either be conducted on-board via personal interviews, self-complete surveys handed
out and back during the transit trip, or through mail-back surveys that are handed out as the passenger boards or disembarks the transit vehicle. Surveys are utilized to obtain information on the trip purpose, passenger reasons for choosing transit, origin-destination of the final trip, and how the person traveled to/from the transit station (i.e. auto/bike/walk). Follow up surveys can be conducted via the Internet to obtain more details about the passenger (age, gender, etc.) of the trip if necessary. The surveys are anonymous, so no personal identifying information about the individual participating in the survey is collected.

60.2.h. Summary of travel survey types

The following table provides a summary of the current types of surveys being utilized by WisDOT, along with some of the advantages and disadvantages of each type of survey.

<table>
<thead>
<tr>
<th>Type of Survey</th>
<th>Data Collected</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Roadside intercept survey | -origin-destination  
-vehicle  
-occupancy/type  
-trip purpose | -accuracy  
-detailed | -intrusive  
-labor intensive  
-interferes with traffic |
| License plate survey | -origin-destination  
-home address*  
-trip purpose  
-travel time data | -does not interfere with traffic  
-rich data source | -some resistance to home address matching  
-slow process |
| Travel diary survey | -origin-destination  
-specific travel routes | -does not interfere with traffic  
-rich data source | -low participation |
| GPS survey          | -origin-destination  
-specific travel routes  
-travel time data | -does not interfere with traffic  
-useful for several modes of travel (pedestrians, bicycles, passenger cars, commercial trucks)  
-rich data source | -higher cost than other survey methods |
| Bluetooth® MAC survey | -origin-destination  
-travel time data | -non-intrusive  
-24/7 coverage captures variability and evolution of travel data  
-equipment is self-reporting, simplifying data collection & maintenance | -field infrastructure must be maintained during study period  
-relatively low capture rate |
<table>
<thead>
<tr>
<th>Type of Survey</th>
<th>Data Collected</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| **Aerial survey** | -volume  
-vehicle classification  
-travel patterns | -data can be verified with video | -only can monitor a limited time period  
-usually higher cost than other survey methods |
| **On board surveys** | -origin-destination  
-trip purpose  
-reason for choosing transit | -does not interfere with traffic  
-rich data source | -sample size is vastly dependent on number of staff that can be utilized to conduct surveys |

*Not all bordering states will provide address data for the license plates so it may not be possible to get an address match in order to mail them a survey

The needs of the study, the size of the study area, and the advantages/disadvantages of each survey are weighed to help determine the most appropriate travel survey methodology for a specific project. Questions and/or other concerns regarding the types of travel surveys can be directed to:

Vu Dang  
Traffic Forecasting Section  
Wisconsin Department of Transportation  
Phone: (608) 266-2571  
Fax: (608) 267-0294  
Email: Vu.Dang@dot.wi.gov
60.3 WisDOT Roles and Responsibilities

60.3.a. WisDOT Regions
WisDOT Regions often work with traffic forecasting to determine whether there is a need to conduct a travel survey to address the issues discussed in Section 60, Subject 1. Sometimes, traffic forecasting or a metropolitan planning organization may request a survey to conduct long-range transportation plan or model data updates. Once it has been determined that a travel survey is needed, the region or traffic forecasting section takes the lead in organizing efforts to determine the appropriate study methodology and survey locations required (see Section 60, Subject 4 for more details). Data collection responsibilities should be discussed and agreed to before a survey commences between the region and the interested WisDOT Central Office bureaus.

60.3.b. WisDOT’s Bureau of Planning and Economic Development
The traffic forecasting section determines when a survey may be necessary with their metropolitan planning organization (in urbanized areas) and WisDOT Region partners. Sometimes a survey is used to develop a long-range transportation plan or to update a regional travel demand model. As discussed later in Section 60, Subject 4, the traffic forecasting section also provides guidance as to:

- The type of survey
- The data collection procedures and needs
- Travel survey policies
- Travel behavior results tests and assumptions analysis

60.3.c. WisDOT’s Bureau of Traffic Operations
The Bureau of Traffic Operations is responsible for reviewing and approving traffic control plans required to be prepared for certain types of travel surveys, including roadway intercept surveys. They may also
provide input into data collection procedures and needs, as part of transportation project design. Traffic control plans are prepared in accordance with the guidelines established in Chapter 11.50 of the FDM.

Traffic control plans at survey sites includes necessary traffic control equipment to ensure a safe survey site. Plans often include identified locations of barrels, cones, and signage. The traffic control plan is reviewed and approved by WisDOT prior to implementation.
60.4 Tasks to Conduct Travel Surveys

As stated in Chapter 60, Section 3, the Bureau of Planning and Economic Development Traffic Forecasting Section determines when a survey may be necessary with their metropolitan planning organization (in urbanized areas) and WisDOT Region partners. The following basic tasks should be completed during travel surveys. Identification of:

- Entity conducting survey
- Survey method
- Survey locations
- Field site review
- Traffic control planning (if needed)

60.4.a. Entity conducting survey

Prior to starting the survey, WisDOT decides who is leading the project. This decision may be made after determining the survey method.

60.4.b. Survey Method

Initially WisDOT traffic forecasting and region should prepare or review data requirements for the proposed project, along with the project scope to determine the most appropriate survey methodology. Section 60, Subject 2 outlines the details on different travel survey types. Statistical significance, statewide best practices and cost-effectiveness checks are considerations in determining the survey need.

60.4.c. Survey Locations

Once the survey methodology has been selected, the project managers prepare a map which defines the boundary of the study area, as well as proposed external station locations. WisDOT’s team of project managers, traffic forecasting section, region staff and metropolitan planning organization (where located in Wisconsin Department of Transportation Transportation Planning Manual

Chapter 9, Section 60 Travel Surveys

Subject 4 Tasks to Conduct Travel Surveys
an urbanized area) review the draft map and make site specific recommendations. This task will help identify the appropriate origin-destination pairs to ensure that all potential travel paths within the study area will be captured by the survey.

Data collection techniques will vary depending on the type of data required for the study. For example, if the survey is only concerned with collecting information on the number of through trips on a particular roadway corridor, then survey locations would only need to be set up on each end of the facility. However, if the purpose of the survey is to document where internal trips are traveling, then several survey stations will likely need to be set up along the corridor. The type of data to be collected at each site will be noted, and a map will be prepared to document the survey locations.

60.4.d. Field Site Review

After the survey sites have been selected, an initial field review will need to be conducted to ensure that the survey can actually take place without creating traffic hazards. For example, if a roadside intercept survey is being proposed, the survey site needs to have adequate sight distance to ensure the safety of the survey crew and the drivers. If a Bluetooth® device is proposed, then the survey site needs to provide a mechanism to mount the signal receiver. Additionally, a field review of the site prior to the survey can identify if there is any previously-unknown nearby construction sites, or other activities that may impact smooth operation of the survey process. If the field review determines that a proposed survey site is unacceptable for any reason, a new survey site should be selected.

60.4.e. Traffic control planning (if needed)

If road intercept surveys are conducted, traffic control plans will need to be developed for each survey location. Traffic control at survey sites is deployed to provide a safe operation area from which to work. Temporary traffic control plans may also be required for the installation of other survey devices (i.e. the Bluetooth® signal receiver). As previously discussed in Section 60, Subject 3, the traffic control plans are prepared in accordance with the guidelines established in Chapter 11-50 of the FDM.
60.5 Travel Survey Frequently Asked Questions

The following questions are typically asked during surveys.

Why do we collect this data and what is it used for?
The answer partially depends on the type of study:

- For a **system analysis or long-range transportation plan**, the data is used in developing a long-range transportation plan that will be used in the evaluation of transportation investment alternatives for ten or more years.
- For a **bypass or corridor study**, the data could be used to determine where to locate the bypass, or when to make improvements to the highway.
- For a **cost-sharing study**, the data is used to forecast future traffic volume and mix, which is a major factor in the cost-effective design of transportation facilities.

When WisDOT collects this data, it guides the efficient and effective expenditure of taxpayer dollars. All data collected is anonymous and utilized for statistical purposes only.

How does WisDOT analyze the data or the reports? What data analysis is suggested?
The answer partially depends on the type of survey data collected and the purpose of the survey.

- The travel surveys can be compiled by WisDOT’s Traffic Forecasting Section to create origin-destination tables to update/validate the regional travel demand model.
- Travel time information obtained from the surveys can be utilized by WisDOT’s Traffic Forecasting Section to assist in validation of a regional travel demand model. Additionally, travel time information can be utilized by WisDOT for corridor studies and/or traffic control management plans.
Data obtained from pedestrian and bicycle surveys can assist WisDOT staff in planning activities for existing and future pedestrian/bicycle routes and paths.

On-board travel surveys are useful in assessing the existing and future transit needs and to quantify the value/impact of the transit system in the area.

Travel surveys also assist WisDOT in preparing corridor plans, evaluating truck routes, and estimating the number of person trips by travel mode.

How do we conduct a study? What can a driver expect when coming upon a site?
The answer to this depends on the type of survey being conducted. The road-side intercept survey will be the most observable to the driver. As the driver approaches the station for a road-side intercept survey, there will be a series of signs posted: (travel) survey ahead, reduce speed, be prepared to stop, obey flagger. The crew will be set up along the center-line of the highway in an area marked off by traffic cones. A flagger at the end of the coned off area will stop traffic so that the drivers can be interviewed. When the interviews are completed, those vehicles are allowed to leave and the next group enters the station.

If Bluetooth® or GPS technology is utilized to collect vehicle travel surveys, with the exception of the short duration when the devices are being installed, the driver will not experience any changes in the normal travel conditions along the roadway.

Other travel surveys such as the aerial surveys will not impact the traffic patterns of the driver at all, and in most cases will not even be noticed by the average driver.

What questions does WisDOT ask as part of a travel survey?
Questions vary. Where did the trip begin? Where will the trip end? What is the purpose of the trip? What is the type of vehicle? How many occupants are travelling today?

Are we concerned about inconveniencing drivers?
Yes. Typically, at a road-side intercept survey, a driver is delayed by no more than a couple minutes. If traffic backs up too much some of the vehicles will be waved through the site until the backup is eliminated. In the event backups cannot be eliminated or the survey site becomes unsafe, the station will be shut down. On-board transit surveys are conducted in a manner that will not delay the transit vehicle and/or passenger riding transit.

Will survey locations and dates be advertised ahead of time to the public?
WisDOT does not give out specifics of the schedule to the public because that could result in drivers changing their travel behavior, thus biasing the sample and invalidating the results. The schedule is shared between the transportation region office, the State Patrol, WisDOT’s Office of Public Affairs, WisDOT’s Secretary’s Office, and requests from local law enforcement.

How long does a survey take to do?
For roadside intercept surveys, WisDOT staff is typically at each site for one day (eight hours). Bad weather may cause delays. The length of other surveys depends on various factors such as the volume of traffic, the amount of data needed, and the capture rate of the survey method being utilized.

What legal basis do we have for conducting these studies?
Wisconsin State Statutes:

- **84.01(2) – Powers and duties: general provision.** The department shall have charge of all matters pertaining to the expenditure of state and federal aid for the improvement of highways, and shall do all things necessary and expedient in the exercise of such supervision.
- **84.01(6) – Surveys and plans.** The department shall make provision for and direct the surveys, plans, construction, inspection and maintenance of all highways, whenever the construction or maintenance is under its jurisdiction.
- **84.06(1m) – Plans.** The department may prepare plans, estimates and specifications and undertake and perform all surveys, investigations and engineering work for any highway improvement within its jurisdiction.
- **85.02 – Planning, promotion and protection.** The department may direct, undertake and expend state and federal aid for planning, promotion and protection activities in the areas of highways, motor vehicles, traffic law enforcement, aeronautics, railroads, waterways, specialized transportation services, mass transit systems and for any other transportation mode.

Why does WisDOT need this data in addition to volume counts?
Volumes are site specific; the travel survey collects data on travel patterns, which is what is required in order to predict the effect of various transportation investment alternatives.

Must drivers answer every question at a roadside intercept survey site?
The interviews are voluntary and anonymous. If a driver does not want to answer the questions they do not have to, but they will have to wait for the vehicles ahead of them before leaving the station.

What kind of response do we get from the public on roadside intercept surveys?
WisDOT has experienced excellent cooperation from the public over the years. There are only a very few who refuse to answer the questions in person, and a survey handout response rate in the range of 35 percent to 45 percent is typical.

Why should the public take part in a survey?
The data WisDOT staff collects is an important component to determining prudent transportation investments.
60.6 Related Policies: Travel Surveys

A summary of the WisDOT policies that were discussed in this section are:

It’s WisDOT policy to:

- Utilize travel surveys to help provide necessary background data to make decisions
- Assess travel behavior for long-range transportation plans, project investigations, roadway traffic forecasts, travel demand model assumptions and cost-share determinations
- Define the survey collection method and data collection responsibilities prior to the onset of a travel survey
- Have concern for the inconvenience of the travelling public and the privacy of information about travel
- Maintain the privacy of the survey participants
- Use the traffic forecasting section as the statewide “go-to expertise” in travel survey efforts
Chapter 9:  
Traffic Forecasting, Travel Demand Models and Planning Data  

Section 80 – Appendix

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject Title</th>
<th>Effective Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Section 80 (All Subjects)</td>
<td></td>
</tr>
<tr>
<td>80.1</td>
<td>Model Nomenclature</td>
<td>December 2012</td>
</tr>
</tbody>
</table>
80.1 Model Nomenclature

The purpose of this subject is to formalize and standardize the nomenclature used for the Wisconsin MPO models. Standardization of nomenclature throughout all MPO models reduces confusion and increases consistency. Consistent nomenclature enables users to be proficient and familiar with all Wisconsin MPO models. Standards are defined for both the land use inputs files and the highway network files.

TAZ Attributes

TAZ attributes for the MPO models should be consistent throughout all models, in a manner that will allow users to accurately estimate land use activity within each zone. The zonal attributes in Table 80.1.1 below are currently in use for the MPO models and should continue as the standard zonal attributes to maintain consistency throughout the Wisconsin MPO models.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZONE</td>
<td>TAZ Number</td>
</tr>
<tr>
<td>HOUSEHOLDS</td>
<td>Occupied Households</td>
</tr>
<tr>
<td>RETAIL</td>
<td>Retail Sector Jobs</td>
</tr>
<tr>
<td>SERVICE</td>
<td>Service Sector Jobs</td>
</tr>
<tr>
<td>MANUF</td>
<td>Manufacturing Jobs</td>
</tr>
<tr>
<td>NON_MANUF</td>
<td>Total Non-Manufacturing Jobs</td>
</tr>
<tr>
<td>TOTEMP</td>
<td>Total Employment</td>
</tr>
<tr>
<td>SCHENR</td>
<td>School Enrollment</td>
</tr>
</tbody>
</table>

Listed below are thorough definitions for each zonal attribute used in the Wisconsin MPO models:

Zone: Transportation Analysis Zone number
Households: Total occupied primary dwelling units, not including group quarters (US Census 2000)
Retail Employment: Total persons employed in the retail sector, NAICS 44-45 (US Census 2000, Wisconsin Department of Workforce Development, InfoUSA, aerial imagery, local plans/officials)
Service Employment  Total persons employed in the service sector, NAICS 51, 54, 56, 61, 62, 71, 72, 81 (US Census 2000, Wisconsin Department of Workforce Development, InfoUSA, aerial imagery, local plans/officials)

Manufacturing Emp.  Total persons employed in the manufacturing sector, NAICS 31-33 (US Census 2000, Wisconsin Department of Workforce Development, InfoUSA, aerial imagery, local plans/officials)

Total Employment  Total employment regardless of sector (US Census 2000, Wisconsin Department of Workforce Development, InfoUSA, aerial imagery, local plans/officials)

School Enrollment  Total K-12 school enrollment (Wisconsin Department of Public Instruction)

**Highway Network Attributes**

Highway network attributes for the MPO models should be consistent throughout all models, in a manner that will allow users to apply a consistent set of assumptions to the transportation system. The highway network attributes in the tables below are currently being used in the MPO models and should continue as the standard input and output network attributes to maintain consistency throughout the Wisconsin MPO models.

Listed in Table 80.1.2 are thorough definitions for each input highway network attribute used in the Wisconsin MPO models:

**Table 80.1.2**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A-Node #</td>
<td>CHG_LANE</td>
<td>Change Lane</td>
</tr>
<tr>
<td>B</td>
<td>B-Node #</td>
<td>CHG_FC</td>
<td>Change Functional Class</td>
</tr>
<tr>
<td>NAME</td>
<td>Roadway Name</td>
<td>CHG_SIGNAL</td>
<td>Change Signal Type</td>
</tr>
<tr>
<td>LANES</td>
<td>Number of Lanes</td>
<td>CHG_CROSS</td>
<td>Change Cross Type</td>
</tr>
<tr>
<td>DISTANCE</td>
<td>Link Distance (Miles)</td>
<td>SUB_SYSTEM</td>
<td>WisDOT Backbone Class</td>
</tr>
<tr>
<td>LINKCLASS</td>
<td>Functional Classification</td>
<td>CHG_SUBSYST</td>
<td>Change WisDOT Backbone Class</td>
</tr>
<tr>
<td>COUNT</td>
<td>Traffic Count</td>
<td>CHG_AREA</td>
<td>Change Area Type</td>
</tr>
<tr>
<td>YEAR</td>
<td>Traffic Count Year</td>
<td>CHG_P_SPEED</td>
<td>Change Posted Speed</td>
</tr>
<tr>
<td>CROSS</td>
<td>Cross Type</td>
<td>PLAN_FC</td>
<td>Planned Functional Classification</td>
</tr>
<tr>
<td>SIGNAL</td>
<td>Signal Density Classification</td>
<td>PLAN_LANE</td>
<td>Planned Lanes</td>
</tr>
<tr>
<td>AREA</td>
<td>Area Type</td>
<td>PLAN_AREA</td>
<td>Planned Area Type</td>
</tr>
<tr>
<td>SCREENLINE</td>
<td>Model Screenline ID Number</td>
<td>PLAN_CROSS</td>
<td>Planned Cross Type</td>
</tr>
<tr>
<td>TAFIS</td>
<td>TAFIS ID Number (4-digit)</td>
<td>PLAN_SIGNAL</td>
<td>Planned Signal Type</td>
</tr>
<tr>
<td>USERSPEED</td>
<td>Manual Free-Flow Speed Override</td>
<td>PLAN_SUBSYS</td>
<td>Planned WisDOT Backbone Class</td>
</tr>
<tr>
<td>NEWLINK</td>
<td>New Network Link</td>
<td>PLAN_P_SPEE</td>
<td>Planned Posted Speed</td>
</tr>
</tbody>
</table>

Not used in the modeling process.
Listed in Table 80.1.3 are thorough definitions for each output highway network attribute used in the Wisconsin MPO models:

Table 80.1.3

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNT</td>
<td>Traffic Count</td>
</tr>
<tr>
<td>B_LINKCLASS</td>
<td>Base Year Linkclass</td>
</tr>
<tr>
<td>B_LANES</td>
<td>Base Year Lanes</td>
</tr>
<tr>
<td>B_AREA</td>
<td>Base Year Area Type</td>
</tr>
<tr>
<td>B_CAPACITY</td>
<td>Base Year Daily Capacity</td>
</tr>
<tr>
<td>B_SPEED</td>
<td>Base Year Free Flow Speed</td>
</tr>
<tr>
<td>B_SUBSYS</td>
<td>Base Year WisDOT Backbone Class</td>
</tr>
<tr>
<td>B_CTIME</td>
<td>Base Year Congested Travel Time</td>
</tr>
<tr>
<td>B_CSPD</td>
<td>Base Year Congested Travel Speed</td>
</tr>
<tr>
<td>B_AUTO</td>
<td>Base Year Auto Volume</td>
</tr>
<tr>
<td>B_TRUCK</td>
<td>Base Year Truck Volume</td>
</tr>
<tr>
<td>B_TOTAL</td>
<td>Base Year Total Volume</td>
</tr>
<tr>
<td>B_GEH</td>
<td>Base Year GEH Statistic</td>
</tr>
<tr>
<td>B_LOS_P</td>
<td>Base Year Base Year Level of Service Primary</td>
</tr>
<tr>
<td>B_LOS_S</td>
<td>Base Year Base Year Level of Service Secondary</td>
</tr>
<tr>
<td>B_DEF_P</td>
<td>Base Year Base Year Deficiency Primary</td>
</tr>
<tr>
<td>B_DEF_S</td>
<td>Base Year Base Year Deficiency Secondary</td>
</tr>
<tr>
<td>F_LNKCLSS</td>
<td>Future Year Linkclass</td>
</tr>
<tr>
<td>F_LANES</td>
<td>Future Year Lanes</td>
</tr>
<tr>
<td>F_AREA</td>
<td>Future Year Area Type</td>
</tr>
<tr>
<td>F_CAPACITY</td>
<td>Future Year Daily Capacity</td>
</tr>
<tr>
<td>F_SPEED</td>
<td>Future Year Free Flow Speed</td>
</tr>
<tr>
<td>F_SUBSYS</td>
<td>Future Year WisDOT Backbone Class</td>
</tr>
<tr>
<td>F_CTIME</td>
<td>Future Year Congested Travel Time</td>
</tr>
<tr>
<td>F_CSPD</td>
<td>Future Year Congested Travel Speed</td>
</tr>
<tr>
<td>F_AUTO</td>
<td>Future Year Auto Volume</td>
</tr>
<tr>
<td>F_TRUCK</td>
<td>Future Year Truck Volume</td>
</tr>
<tr>
<td>F_TOTAL</td>
<td>Future Year Total Volume</td>
</tr>
<tr>
<td>AUTODIFF</td>
<td>Base - Future Auto Difference</td>
</tr>
<tr>
<td>TRUCKDIFF</td>
<td>Base - Future Truck Difference</td>
</tr>
<tr>
<td>TOTALDIFF</td>
<td>Base - Future Total Difference</td>
</tr>
<tr>
<td>EST2035</td>
<td>Total Volume Estimate 2035</td>
</tr>
<tr>
<td>EST2035AUTO</td>
<td>Auto Volume Estimate 2035</td>
</tr>
<tr>
<td>EST2035TRUC</td>
<td>Truck Volume Estimate 2035</td>
</tr>
</tbody>
</table>

3 Output Network Attributes will differ for the Northeast Regional Model.