1.0 TRAVEL DEMAND MODEL INTRODUCTION

1.1 What is a Travel Demand Model?

Transportation modeling is an essential component of planning for regional infrastructure improvements. Regional travel demand models (TDMs) provide the scale needed to analyze the benefits of transportation investments. The critical questions surrounding any transportation investment include not only "Where is a facility needed?" but also "When and why is a facility needed?" These questions can be answered through the regional perspective provided by large-scale TDMs. The process of travel demand forecasting uses what we know about the existing world to predict what conditions will be like in the future. It is a projection based on empirical data and foreseeable circumstances.

Most TDMs utilize a traditional four-step approach to estimate travel demand and patterns, how many trips will be generated, where they are going, what modes they are using, and which routes they will use. In the broadest sense, the Metropolitan Planning Organization (MPO) TDM consists of three elements: 1) model inputs, 2) a series of models conducting mathematical procedures, and 3) model outputs. Further detail on each is provided below.

A. Model Inputs

Model inputs are based upon the roadway system, land use and demographic or socioeconomic (SE) data. SE data, such as population, household and employment by type, represents land use. Future year projections of SE data were based on existing land uses including land development, as well as region wide forecasts of population, household and employment. Future year forecasts also considered planned major transportation improvements. It is in this area of TDM development that land use and community planning are connected to the transportation planning process. The SE data and the highway network serve as the basic inputs to the TDM.

B. A Series of Mathematical Procedures

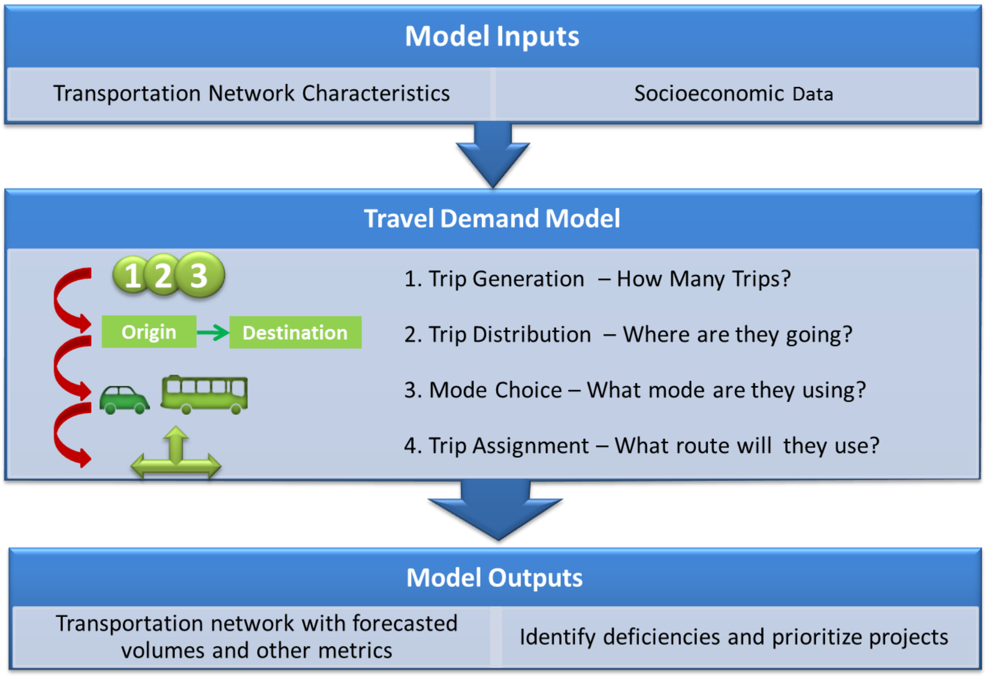
TDMs ultimately forecast travel demand using four steps: 1) trip generation, 2) trip distribution, 3) mode choice, and 4) trip assignment. The first step, trip generation, calculates the trips that can be generated within the study area using the SE data noted above. The second step, trip distribution, determines where the generated trips go (i.e. their origin and destination). The third step, mode choice, determines what modes will be utilized (i.e. passenger vehicles, transit, etc.). The fourth step, trip assignment, determines what routes will be taken to get from point A to point B.

C. Model Outputs

The TDM outputs include forecasted traffic volumes and other traffic metrics (i.e., travel speeds, travel time, congestion levels, etc.) on the transportation network. These metrics can be used to helps identify transportation system deficiencies. TDMs are often used to assist in prioritizing transportation projects as well.

Figure 1-1 illustrates the structure of a TDM and its purpose.

Figure 1-1: TDM Structure



1.2 What the MPO's Regional TDM Can and Cannot Provide

TDMs across the country range in their abilities. Large metropolitan areas may include time-of-day, transit, and/or freight components. Very few even include non-motorized trip (bicycle/pedestrian) components. However, given the smaller nature of the MPO areas in Georgia outside Atlanta, the TDMs are simpler. A regional TDM in Georgia outside Atlanta generally can provide users with forecasted highway volumes for roadways with a functional class of collectors and above. The highway volumes are usually average daily volumes for long-range forecasts; 20 to 30 years out. The TDM can help MPOs to identify roadway deficiencies where daily volumes exceed the roadway capacities, evaluate impacts of major highway improvements, and evaluate transportation system performance for the purpose of LRTP development. For MPOs within the air quality nonattainment areas, the TDM is also used as the basis for air pollution emission estimates and for congestion management system statistics.

Because of its aggregate nature and regional scope, these TDMs are not designated to forecast the following metrics:

- Peak hour or peak period travel demand
- Freight demand
- Bicycle and walking trips
- Logical termini determination

2.0 2010 BASE YEAR MODEL

2.1 2010 Base Year Model Update

For updating the base year model to 2010 in support of the Warner Robins Area Transportation Study (WRATS) 2040 LRTP update, the following changes were made to the WRATS 2006 TDM:

- Updated study area
  - » Expanded the MPO TDM study area to include the entirety of Peach County for transportation continuity. The expanded model area also assists with validation, as most of the collected transportation data are based on county boundaries.
- Updated socioeconomic data
  - » The WRATS provided the updated study area traffic analysis zones (TAZs) and the associated socioeconomic data to reflect year 2010.
- Updated base year highway network
  - » Updated Highway Performance Monitoring System (HPMS) functional classification. The functional classification has been changed from the previous 13 groups to seven groups based on the 2010 Federal Highway Administration (FHWA) designation;
  - » Verified and corrected number of lanes;
  - » Updated traffic count locations and traffic counts from 2006 to 2010;
  - » Reflected projects that have been completed (open to traffic) during 2006 to 2010; and
  - » Updated other road characteristics including road names, intersection geometries (such as interchange ramps), etc.
- Updated base year validation components:
  - » Updated screenlines and cutlines;
  - » Updated trip generation model;
  - » Updated trip distribution model;
  - » Updated trip assignment procedure; and
  - » Updated external stations and trip data sets.
- Removed the delta matrix post-processing procedure that was included in the previous model to assist with the validation.

2.2 2010 Socioeconomic data

The MPO provided 2010 base year socioeconomic data for the model. For each of the TAZs in the two-county study area, the following socioeconomic variables were developed by the MPO for use in the trip generation model:

- **Population:** The total number of individuals that are residing in a given TAZ;
- **Households:** Total number of occupied housing units in a given TAZ;
- **Retail Employment:** Number of employees working for retail-based businesses in a given TAZ where the business is located;

- **Service Employment:** Number of employees working for service-based businesses in a given TAZ where the business is located;
- **Manufacturing Employment:** Number of employees working for manufacturing-based businesses in a given traffic analysis zone where the business is located;
- **Wholesale Employment:** Number of employees working for wholesale based-businesses in a given traffic analysis zone where the business is located;
- **Total Employment:** The total number of employed persons in a given TAZ;
- **Median Income:** Median household income in a given TAZ in 2010 dollars (per 2010 Census);
- **School Enrollment:** The total number of enrolled students in a given TAZ at educational facilities.

The socioeconomic variables are the key inputs in the first step of the travel demand process, trip generation, which estimates the number of trips that will begin and end in each individual TAZ. These are referred to as "trip ends." Trip ends generated by households are referred to as productions. Trip ends calculated from population, employment or school enrollment figures are referred to as attractions. In the trip production step, a household stratification model is used that stratifies the number of households based on the household size and zonal income. The trip rates by different purposes are applied to this stratified data to estimate trip productions by purpose. The trip attractions are estimated for different purposes by applying appropriate trip rates to population, employment and school enrollments.

2.3 2010 Base Year Model Validation

GDOT requires refinements to various model parameters until the 2010 base year model sufficiently replicates observed 2010 travel patterns and conditions. The following documents serves as the primary sources for checking the reasonableness of model parameters and results:

- *Model Validation and Reasonableness Checking Manual*, Travel Model Improvement Program (TMIP), FHWA, 2010;
- *NCHRP Report 716 Travel Demand Forecasting: Parameters and Techniques,* Transportation Research Board, 2012*; and*
- *Calibration and Adjustment of System Planning Models*, USDOT, FHWA, 1990.

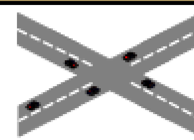
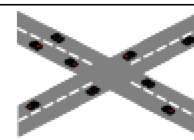
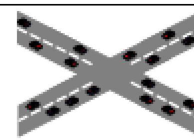
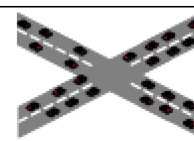
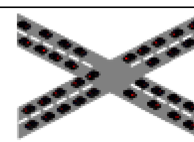
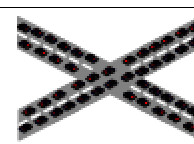
The 2010 base year model was checked for accuracy under each of the major steps in the TDM process starting from trip generation to trip assignment. Both inputs and outputs were checked for accuracy and reasonableness and include review of the transportation network and attributes, trip generation and distribution parameters, average trip lengths by purpose, vehicle-miles traveled (VMT) statistics and root mean squared error (RMSE). Modeled volumes are validated against traffic counts at several levels – regional, corridor (including screenlines) and link-by-link. Results of these validation steps were presented to the Technical Coordinating Committee and Policy Committee meeting and will be documented in detail in the *Travel Demand Model Documentation*.

2.4 2010 Base Year Model Results

The purpose of TDM development is to assist in the evaluation of future travel conditions and deficiency analysis in the study area. Besides the traffic volumes, another key output from the TDM is the daily volume to capacity ratio for each roadway segment. Each volume to capacity ratio corresponds to a Level of Service (LOS) based on accepted methodologies. LOS is a qualitative measure of traffic flow describing operating conditions. Six LOS are defined by the FHWA in the *Highway Capacity Manual* for use in evaluating roadway operating conditions. They are given letter designations from A to F, with LOS A representing the best operating conditions and F the worst. A facility may operate at a range of levels of service depending upon time of day, day of week or period of the year. A qualitative description and depiction of the different levels of service is provided in

Figure 2-**.**

Figure 2-1: Level of Service Description and Depiction

Description	Depiction
LOS A – Drivers perceive little or no delay and easily progress along a corridor.	
LOS B – Drivers experience some delay but generally driving conditions are favorable.	
LOS C – Travel speeds are slightly lower than the posted speed with noticeable delay in intersection areas.	
LOS D – Travel speeds are well below the posted speed with few opportunities to pass and considerable intersection delay.	
LOS E – The facility is operating at capacity and there are virtually no useable gaps in the traffic.	
LOS F – More traffic desires to use a particular facility than it is designed to handle resulting in extreme delays.	

3.0 2040 TRAVEL DEMAND MODELS

3.1 2040 Model Inputs

As the base year TDM was calibrated and validated, the model was used to assist in evaluating the traffic conditions for the future year 2040 reflecting 2040 socioeconomic data and transportation network.

The 2040 LRTP networks include the following network scenarios based on the inputs from the WRATS and their LRTP planning analyses and resulting project list:

- **The 2nd Network - Do-Nothing Network**: 2010 base year network plus any projects that either opened to traffic since 2010 or currently under construction;
- **The 3rd Network - Existing + Committed (E+C) Projects Network**: 2nd network plus projects with construction phase funded in the STIP year 2014 to 2017;
- **The 4th Network - Remainder of STIP Projects Network**: 3rd network plus projects with preliminary engineering phase and right-of-way (ROW) phase funded in the STIP year 2014-2017;
- **The 5th Network - Remainder of Programmed LRTP Projects**: 4th network plus projects with preliminary engineering, construction and construction funded in 2018-2020;
- **The 6th Network - Remainder of LRTP Projects:** 5th network plus projects identified in the current LRTP including Long Range (LR) 1: 2021-2030 and LR 2: 2031-2040; and
- **The 7th Network - Financially Constrained Projects.**

The 2040 socioeconomic data was developed by the WRATS and used as input into the TDM to forecast the number of future year trips.

Figure 2- shows a comparison of the 2010 and the 2040 Socioeconomic data for the entire modeling area. The Socioeconomic data growth for each county in the modeling area is shown in **Table 3-1**.

The observations for the WRATS data include the following:

- The total growth in population and households between 2010 and 2040 is approximately 60% for the entire modeling area.
- The total growth in employment between 2010 and 2040 is approximately 70% for the entire modeling area.
- The total growth in student enrollment between 2010 and 2040 is approximately 70% for the entire modeling area.

Figure 3-1: Comparison between 2010 and 2040 Socioeconomic Data for TDM Area

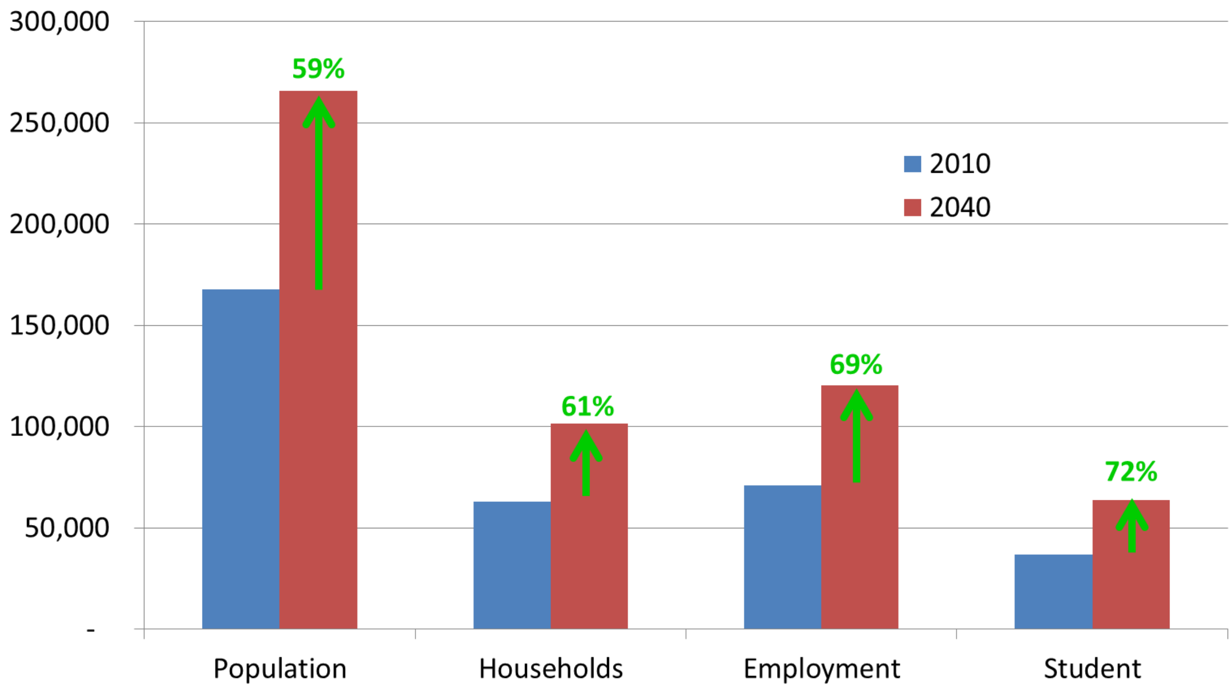


Table 3-1: Socioeconomic Variables by County for 2010 and 2040

Area	SE Variable	2010	2040	Absolute Growth	Growth Rate (2010 - 2040)	Average Annual Growth Rate (2010 - 2040)
Houston County	Population	139,824	221,242	81,418	58%	1.5%
	Households	53,028	84,444	31,416	59%	1.6%
	Employment	63,484	106,131	42,647	67%	1.7%
	Manufacturing	4,078	7,658	3,580	88%	2.1%
	Service	46,395	73,771	27,376	59%	1.6%
	Retail	12,307	23,471	11,164	91%	2.2%
	Wholesale	704	1,231	527	75%	1.9%
	Students	26,724	45,842	19,118	72%	1.8%
Peach County	Population	27,802	44,473	16,671	60%	1.6%
	Households	9,995	16,952	6,957	70%	1.8%
	Employment	7,690	14,180	6,490	84%	2.1%
	Manufacturing	1,280	1,914	634	50%	1.4%
	Service	3,842	7,068	3,226	84%	2.1%
	Retail	1,580	3,578	1,998	126%	2.8%
	Wholesale	988	1,620	632	64%	1.7%
	Students	4,004	7,154	3,150	79%	2.0%
TDM Area	Population	167,626	265,715	98,089	59%	1.5%
	Households	63,023	101,396	38,373	61%	1.6%
	Employment	71,174	120,311	49,137	69%	1.8%
	Manufacturing	5,358	9,572	4,214	79%	2.0%
	Service	50,237	80,839	30,602	61%	1.6%
	Retail	13,887	27,049	13,162	95%	2.2%
	Wholesale	1,692	2,851	1,159	68%	1.8%
	Students	30,728	52,996	22,268	72%	1.8%