Decennial Model Update

Executive Summary

final report

prepared for

Contra Costa Transportation Authority

prepared by

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Executive Summary

1.0 Introduction

The Decennial Model Update was a process to update current models being used for transportation planning applications in Contra Costa County. This process involved implementing the recommendations in the *Modeling Evaluation Study*, which addressed the planning and modeling needs of the Contra Costa Transportation Authority (CCTA) over the next 10 years.

The CCTA Travel Model was developed using a systems-up approach. This is a process for which model development develops and tests all model components before validation of the full model is complete. This approach used initially available or estimated input data for model development and Beta testing in Phase I. Final versions of input data were used for model calibration and validation and are referred to as Phase II. All results presented in this report are the product of Phase II.

This report is one of five reports written to document the work completed during the Decennial Model Update study:

1. Executive Summary,
2. CCTA Travel Model Documentation,
3. CCTA Travel Model User's Guide,
4. CCTA Travel Model Technical Appendices, and
5. MTC Consistency Report.

The purpose of this report is to provide a brief overview of the study and summaries of validation and forecasting results. The purpose of the model documentation is to document the process of preparing the CCTA Travel Model and to provide results of the validation and forecasting model runs. The purpose of the user's guide is to provide technical guidance on the use of the models, including documenting new software procedures developed as part of this study. The purpose of the technical appendices is to provide technical details required in the model documentation and user's guide that are too voluminous to be placed within these reports. The purpose of the MTC consistency report is to compare the CCTA travel model results with the MTC model results for each of the model components required by the MTC.

Modeling Needs

In the early 1990s, the CCTA developed and has since been maintaining four subarea models and one Congestion Management Program (CMP) model. These models have been used extensively by the Authority, local jurisdictions, and private developers to generate the 20-year traffic forecasts that are needed to address the transportation planning requirements of Measure C and the CMP. While the models are fully functional, it has become increasingly difficult and expensive to maintain all the models at an equal state of readiness. To address these needs, the Authority has updated their modeling capabilities to develop a single fine-grained countywide model with 1,500 zones in Contra Costa and the Tri-Valley region and retaining the 1,099-zone structure of the Metropolitan Transportation Commission's (MTC) model for the remainder of the Bay Area. The updated model was developed using TransCAD® software.

Model Update Objectives

To achieve the overall goals for the model update, a more specific set of objectives was developed as part of this model update:

- To develop a model that meets both the Growth Management Programs (GMP) and CMP needs and allows the Authority to provide these results without having to maintain, store, and document five individual models for these purposes.
- To provide consistency for all planning applications in the County and eliminate questions concerning inconsistent forecasts at the subarea borders.
- To review the assumptions for the input data and update them. For instance, the new MTC models have additional requirements for input land use data, such as school and college enrollment, which have not been standardized inputs to the subarea models.
- To include special generators to account for unique trip generation rates for hospitals, parks, or shopping centers.
- To update pricing and auto ownership assumptions to match the MTC BAYCAST Model.
- To review network attributes for reasonableness and update them.

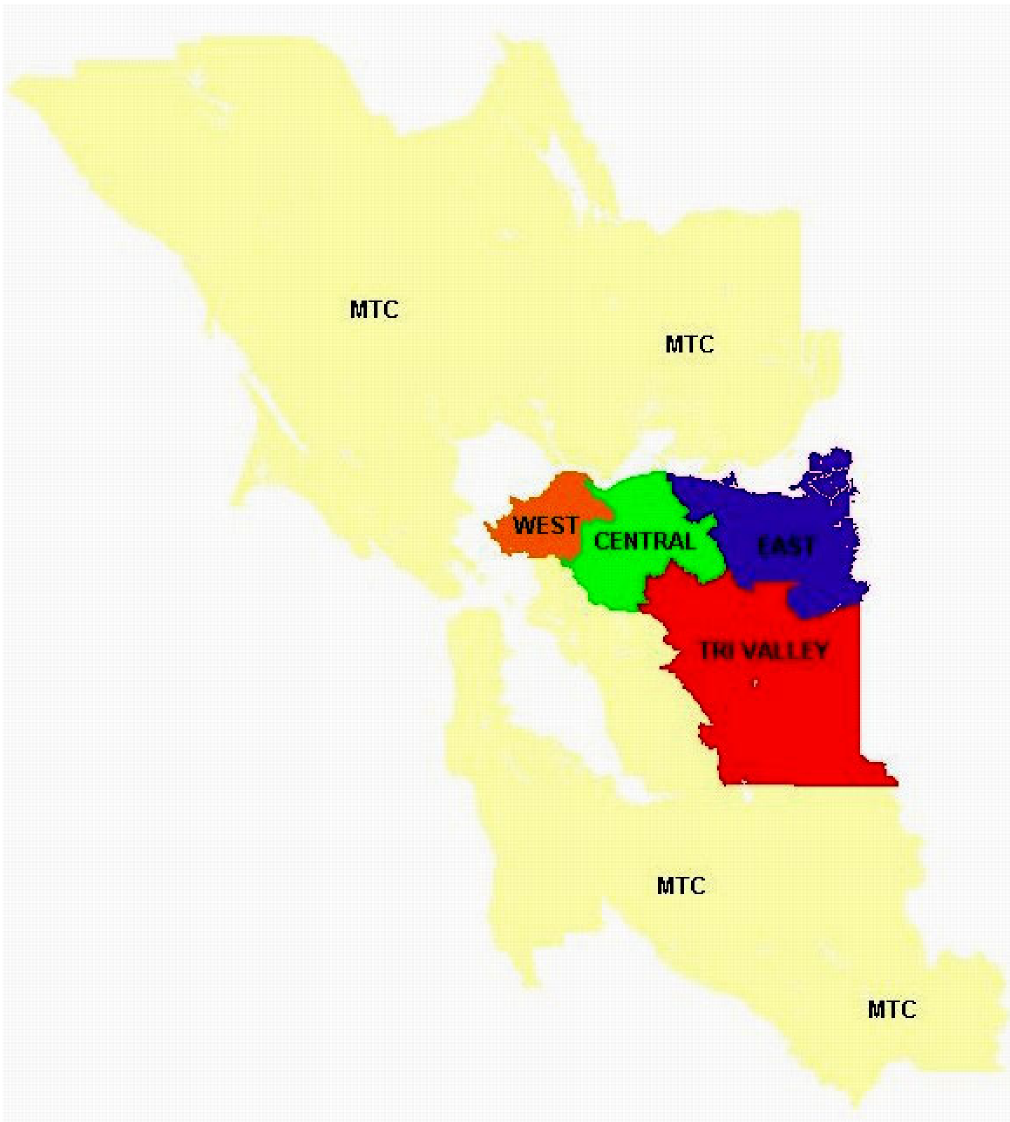
All of the objectives have been achieved during the model update and the documentation of the specific modeling features addressing these objectives is contained herein.

Model Framework

The CCTA Travel Model was developed to include the nine-county region currently modeled by MTC (Marin, Napa, Sonoma, Solano, Contra Costa, Alameda, Santa Clara, San

Mateo, and San Francisco). The geographic coverage is consistent with the MTC model in the areas outside the Contra Costa County study area and considerably more detailed for the area within the study area. The geographic coverage is presented in Figure 1.

Figure 1. Geographic Coverage in the CCTA Travel Model



There are five primary trip purposes in the CCTA Travel Model. These are the same trip purposes defined by the MTC model for intraregional personal travel:

1. Home-based work (HBW),
2. Home-based shop and other (HBSH),
3. Home-based social and recreation (HBSR),

4. Home-based school (HBSK), and
5. Non-Home-Based (NHB).

Home-based school trips are further broken down into:

- Home-based school: Grade school (HBGS),
- Home-based school: High school (HBHS), and
- Home-based school: College (HBCol).

In addition to the intraregional person travel, there are additional sets of trip making included in the model for trucks and external trips (including internal-external and external-internal trips).

There are seven modes represented in the seven individual mode choice models (one for each of the seven personal trip purposes), but not all modes are represented in each model. These modes are defined by the MTC regional model. The home-based work model contains all seven modes:

1. Drive Alone,
2. Shared ride 2 persons,
3. Shared ride 3+ persons,
4. Walk access to transit,
5. Drive access to transit,
6. Bike, and
7. Walk.

The home-based shop/other and home-based social/recreation trip purposes contain six modes, including all of the above, with walk and drive access to transit combined as a single transit mode. The non-home-based, home-based high school, and home-based college trip purposes have five modes, as follows: vehicle driver, vehicle passenger, transit, bike, and walk. The home-based grade school mode choice model has only four modes, as follows: vehicle passenger, transit, bike, and walk.

There are three time periods in the CCTA Travel Model; these are a departure from the time periods currently being used in the MTC regional model. The three time periods are defined as follows:

1. The a.m. peak period (6:00 a.m. to 10:00 a.m.);
2. The p.m. peak period (3:00 p.m. to 7:00 p.m.); and
3. The off-peak period (12:00 a.m. to 6:00 a.m., 10:00 a.m. to 3:00 p.m., and 7:00 p.m. to 12:00 a.m.)

The a.m. and p.m. peak periods were developed by evaluating the traffic counts in the CCTA study area over a 24-hour period. In addition to the a.m. and p.m. peak periods, the CCTA Travel Model contains a.m. and p.m. peak hour models that represent the highest hour volume at any location in the system. The peak hour can be any hour, based on 15-minute time increments, during the four-hour peak period.

■ 2.0 Data Development

Validation Data

The Validation Database was developed for storing model validation information in a readily accessible form that is also linked to the CCTA TransCAD travel demand model. The Validation Database consists of daily transit boarding data, daily and peak-period freeway ramp counts, peak-period intersection turn counts, 24-hour screenline counts, and peak-period freeway speed data. The validation data is linked to the CCTA TransCAD® highway and transit networks according to intersection ID number, link ID number, and transit operator.

Highway Networks

The objective of the highway network task for the CCTA Model Update was to develop a comprehensive TransCAD® highway and high-occupancy vehicle (HOV) geographic database file that has reasonable geographic shape (i.e., curvilinear streets, true interchange forms, etc.) and appropriate network attributes (lanes, functional classification, etc.) from which the following six network scenarios could be extracted:

1. **Scenario #1 –** Year 2000, Existing Conditions;

2. **Scenario #2 –** Regional Transportation Improvement Program (2000 RTIP) for Year 2010;

3. **Scenario #3 –** 2000 RTIP, plus Seven-Year CMP Capital Improvement Program (CIP) (CCTA 2001 CMP Update) also for the Year 2010;

4. **Scenario #4 –** Regional Transportation Plan (RTP) Track 1 (2001 RTP Update) for Year 2020;

5. **Scenario #5 –** RTP Track #1 (same as Scenario #4), but for Year 2025; and

6. **Scenario #6 –** RTP Blueprint, plus selected projects from CCTA's Comprehensive Transportation Project List (CTPL) for Year 2025.

The 2000 Model Update highway network within the CCTA area (defined as those links and nodes within Contra Costa County and the Tri-Valley area) includes all of the roadways in the detailed networks of the subarea models from the 1990 CCTA model set. All links within this area have been geographically shaped to overlay the CCTA Land Use Information System (LUIS) map, which, in turn, is based upon the Contra Costa County road centerline file.

Network links and attributes outside of the CCTA area are consistent with currently available MTC networks. These networks were transformed to a coordinate system consistent with the LUIS; however, no additional geographic shaping was performed for links outside of the CCTA study area.

Transit Networks

In the CCTA model implementation of TransCAD®, the transit network consists of two layers overlaid over the master highway network node and line layers: 1) route layer and 2) stop layer. The transit access links (walk and drive) are stored in the master highway network. There are a total of 1,704 routes in the master route layer. The stop layer contains 6,047 stops and 154 park-and-ride lots for both 2000 and 2025. A summary of the transit routes by location is presented in Table 1.

Table 1. Number of Transit Routes by Location

	Inside CCTA	Through CCTA	Outside CCTA	Total
2000	138	60	896	**1,094**
2020/2025	138	68	907	**1,113**

Zonal Data

The CCTA master zonal database includes all the base economic conditions for the region. This file includes the following:

- Population,
- Number of households,
- Employment categories,
- Income classifications,
- School/college enrollment,

- Age categories, and
- Auto zonal level of service variables.

In order to implement Phase 1, testing of the new CCTA countywide model, the missing data was generated using the existing MTC zonal data. Because all CCTA zones nest within the MTC zones, it was possible to derive the values for each CCTA zone using the MTC data as a reference. For Phase 2, many of the data items were collected from local sources. If the data was from local sources, the derived values by analysis year serve as default values.

3.0 Model Development

Regional Models

The core modeling components of the CCTA Travel Model have been derived to match the procedures and parameters in the MTC regional travel model. The procedures and parameters of these models are provided in detail in the *CCTA Travel Model Documentation* report. During model calibration, minor adjustments were made to the calibration files within Contra Costa County. A direct comparison of the model outputs for each model component is provided in a separate report *MTC Model Consistency*. A series of flow charts to identify inputs, programs, and outputs throughout the modeling process is provided in the *User's Guide* report.

Countywide Model Refinements

The CCTA travel model has been converted from the MTC BAYCAST model and implemented in TransCAD® software. There were five model refinements that were considered and adopted by the Technical Model Working Group (TMWG) for use in the CCTA travel model:

1. Modifying the estimation of school trip attractions in the trip generation model based on the enrollment of schools within the study area;
2. Adding special generator trips within the study area to the trip generation model;
3. Identifying transit trips that drive to park-and-ride lots and assigning these trips to the highway network;
4. Developing time-of-day models for a.m. peak, off-peak and p.m. peak periods, assigning these time-period specific trip tables separately, then summing the volumes to produce average daily volumes; and
5. Developing peak hour assignment processes for a.m. and p.m. peak hours.

The approaches and rationale for these model refinements are discussed in the *CCTA Travel Model Documentation* report.

Model Validation

The primary purpose of model validation is to test the reasonableness of the travel demand forecasting model for the planning applications it will be used to evaluate. The goal is to validate different components of the modeling system separately and to validate different model outputs that will be used in planning evaluations. Validation targets were developed for each of several categories to provide a reasonable level of accuracy at the countywide and subarea planning level expectations. It is not expected that the validated county model would meet the expectations of project- or local-level planning applications without localized refinements to the input data. All of the validation results have been reviewed and accepted by the Technical Model Working Group (TMWG).

A summary of the results of the validation tests is provided in Table 2. The majority of all validation tests have met the validation targets set for the project; and the majority of targets not met by the CCTA travel model are lower-level facilities, such as minor arterials, collectors, and intersections. These types of facilities would be the focus of smaller area studies and will improve in accuracy as the model is used for various small area studies.

Both highway and transit validation results are presented in Table 2. The systemwide highway and transit validation targets are all within set targets. The highway assignments are slightly over-estimating freeways and slightly under-estimating arterials and collectors for all time periods, but most of these facilities are still within targets. After extensive validation testing, we concluded that this trend is a localized issue and should be resolved by calibrating arterials and collectors in local areas. The highway validations by area type standards have all been met.

Transit validation targets were set for average daily assignments only. The transit validation met these targets by mode and by route group. Individual BART station boardings were also validated to within +/-10 percent validation target.

Link-based validation targets were set to identify the accuracy and reliability of the model at an individual link level. These are very stringent validation targets set only for the peak hour models. The freeway link-based targets were met; the arterial and freeway ramp based targets were not met (although some are close). The primary reason for this is that the peak hour assignments in the model are a fixed peak hour and the traffic counts represent a floating peak hour (i.e., not the same hour of the day in all locations), so the model is unable to adequately replicate these traffic counts. Adjustments to this process were tested and rejected, so the validation tests were accepted as is, with the expectation that these results will improve when local area studies are conducted.

Table 2. Summary of Validation Tests

Validation Test	Variables	Sub Groups	Targets	Model Results AM Peak Period	AM Peak Hour	PM Peak Period	PM Peak Hour
Systemwide	Vehicle Miles Traveled		+/-10%	-3%	3%	2%	6%
	Vehicle Hours Traveled		+/-10%	-4%	4%	-1%	5%
	Vehicle Hours of Delay		+/-10%	-1%	8%	-4%	5%
Highway Assignments	Facility Type	Freeway	+/-7%	5%	4%	9%	2%
		Major Arterial	+/-10%	-9%	-9%	-7%	-7%
		Minor Arterial	+/-15%	-33%	-9%	-37%	-30%
		Collector	+/-25%	-36%	-31%	-31%	-25%
	Area Type	Regional Core	+/-10%	-4%	11%	-6%	-11%
		Central Business District	+/-10%	1%	-5%	-3%	-5%
		Urban Business	+/-10%	1%	0%	-6%	-7%
		Urban	+/-10%	-7%	-6%	1%	-1%
	Gateways	Cordon Line	+/-10%	+2%	+4%	+4%	+5%

Validation Test	Variables	Sub Groups	Targets	Daily Model Results
Transit Assignments	Boardings by Mode	BART	+/-10%	9%
		Bus	+/-10%	10%
	Boardings by Route Group	BART Stations	+/-20%	9%
		Local Bus	+/-20%	9%
		Express Bus	+/-20%	18%

Validation Test	Variables	Sub Groups	Model Results AM Peak Period	PM Peak Period	Minimum Goal
Link-based	Facility Type	Freeways within 20%	76%	81%	75%
		Freeways within 10%	61%	66%	50%
		Arterials >10,000 VPD within 30%	50%	68%	75%
		Arterials> 10,000 VPD within 15%	26%	53%	50%
		Freeways within diversion curve	69%	66%	80%
		Ramps within diversion curve	63%	66%	80%
Intersections	Volume Group	Intersections >1,000 VPH within 20%	41%	46%	50%
		Intersections 500-1,000 VPH within 20%	26%	28%	30%
		All Intersections within 30% of Counts	44%	50%	75%
		All Intersections within 15% of Counts	20%	28%	50%

The screenline validation results are presented in Figures 2 and 3 for a.m. and p.m. peak hours, respectively. The cordon and regional screenline standards have all been met. The internal screenlines have been reviewed by direction and the majority of the internal screenlines that do not meet the overall validation target do meet this target in the peak direction of travel, so these internal screenlines have been accepted by the TMWG.

Figure 2. A.M. Peak Hour Model Validation

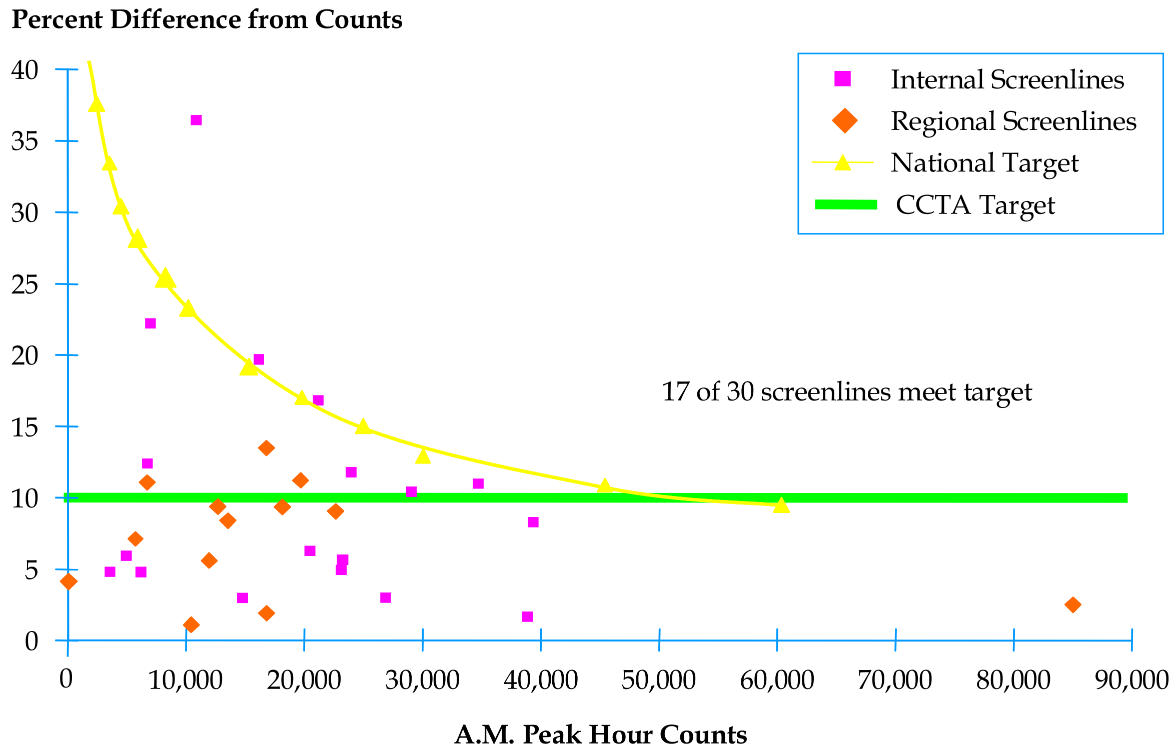
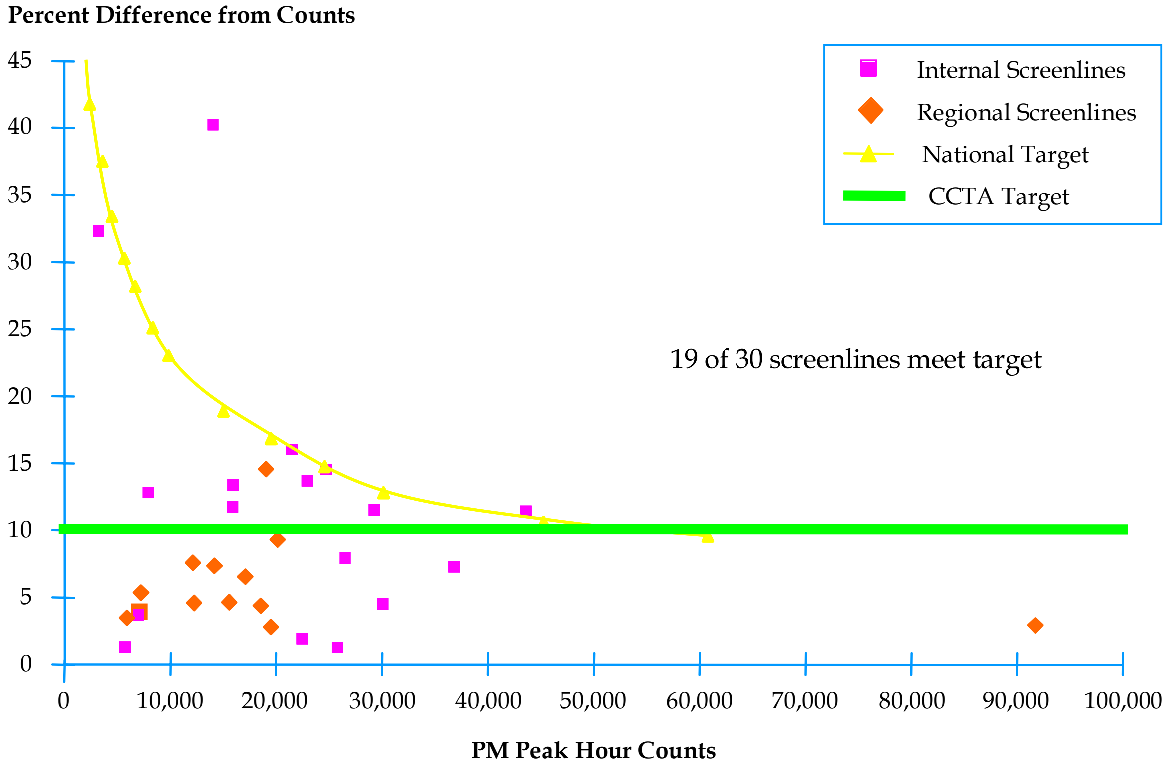


Figure 3. P.M. Peak Hour Model Validation



4.0 Forecasts

Overview

A key function of the travel demand forecasting model is to generate long-range traffic forecasts that can be used in a variety of applications. The decennial model update uses ABAG *Projections 2000* and *2002* land use information to generate new traffic forecasts for near-term (10-year) and long-range (25-year) planning horizons. The model is capable of forecasting still further into the future, provided that an appropriate land use data set is available.[1]

The future year socioeconomic data was generated based upon forecasts developed by the Association of Bay Area Governments (ABAG). Almost all of the forecast socioeconomic input values for the model forecasts were contained in the LUIS for the CCTA model area.

[1] ABAG *Projections 2003* is expected to provide a 2030 horizon year.

For the MTC region, the forecasted inputs were obtained from the MTC web site. The CCTA requires additional information beyond that contained in the LUIS in order to perform forecasts. Most of this supplementary data was obtained from MTC files.

The year 2000 highway network was created as part of the model calibration and validation process. The future year network builds upon the 2000 network using a "master network" approach. New links, link deletions, and link edits are specified for each future scenario using one large database that includes all link data for all scenarios. The future year transit network modifications to the master transit network were created in much the same manner as for the future highway networks.

Summary Statistics

The forecasted county-to-county vehicle trip tables for each scenario are shown in Table 3. The forecasted a.m. peak hour, p.m. peak hour, a.m. peak period, p.m. peak period, and daily traffic volumes (drive alone plus shared ride) are also shown in Table 3. Scenario #3, which is the 2000 RTIP, plus Seven-Year CMP Capital Improvement Program (CIP) for the Year 2010, was not run due to timing in obtaining the network improvements. This scenario will be run during upcoming model forecasting activities.

Level of Service (LOS)

Caliper developed an interface that replaces the existing CCTA VCCC LOS program with a new program that can work independently on a Windows OS, or can be invoked within the CCTA TransCAD® countywide model. The program is capable of managing base and future year turning movement and approach volume datasets; calculating the adjusted model output for the approach and departure volumes for each link at an intersection; applying Furness adjustment to estimate future turning movements; and computing the LOS for signalized intersection using the CCTALOS method.

The model is capable of generating future year intersection LOS based upon a data set of future-year intersection geometry. This information is subject to further analysis and review at the subarea and local level. Consequently, intersection LOS reports were not generated as part of this initial effort.

Table 3. Percent Growth over Year 2000

	2010 STIP	2020 Track 1	2025 Track 1	2025 MTC BluePrint
County to County Vehicle Trips				
AM Peak Hour	13%	28%	32%	27%
AM Peak Period	13%	28%	32%	27%
PM Peak Hour	13%	26%	30%	26%
PM Peak Period	13%	26%	30%	26%
Off-Peak Period	12%	24%	28%	25%
Cordon Line Traffic Volumes				
AM Peak Hour	23%	39%	50%	53%
AM Peak Period	22%	38%	49%	47%
PM Peak Hour	16%	31%	47%	57%
PM Peak Period	19%	31%	49%	48%
Daily	22%	34%	50%	46%
Regional Screenlines Traffic Volumes				
AM Peak Hour	29%	43%	51%	48%
AM Peak Period	26%	41%	49%	46%
PM Peak Hour	23%	37%	48%	52%
PM Peak Period	23%	35%	47%	45%
Daily	27%	39%	50%	47%
Internal Screenlines Traffic Volumes				
AM Peak Hour	32%	45%	53%	49%
AM Peak Period	27%	41%	50%	47%
PM Peak Hour	27%	38%	48%	51%
PM Peak Period	26%	39%	48%	44%
Daily	27%	40%	48%	44%