APPENDIX E
DOCUMENTATION OF CDTC STEP MODEL AND PLANNING ASSUMPTIONS

Capital District Transportation Committee

SYSTEMATIC TRANSPORTATION EVALUATION AND PLANNING MODEL: THE CDTC STEP MODEL

Validation of the CDTC STEP Model

Capital District
Transportation Committee

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1. Introduction

The Capital District Transportation Committee (CDTC) is the designated Metropolitan Planning Organization for the Albany and Saratoga Springs urbanized areas, and the balance of Albany County, Rensselaer County, Schenectady County and the majority of the balance of Saratoga County.

CDTC has developed a travel demand model, called the STEP Model, which is used for numerous transportation planning applications. These applications include the following:

- Demand forecasting for the New Visions Regional Transportation Plan
- Evaluation of critical congestion corridors for the CDTC Congestion Management Process
- Development of performance measures
- Travel forecasts for project design
- Linkage land use and transportation corridor studies
- Evaluation of TIP project applications
- Air quality conformity analysis
- Calculation of mitigation fees for the Airport Area
- Assessment of energy impacts of the New Visions Plan
- Assessment of greenhouse gas impacts of the New Visions Plan

This report documents the development of the STEP Model and the validation of the model.

2. Model Description and Calibration

2.1 General Overview of Demand Modeling

The simulation of travel is based on the premise that the magnitude and pattern of travel is a stable function of the characteristics of the land use pattern and of the transportation system. In travel simulation modeling, those aspects of land use development and of the regional transportation system demand are identified, quantified, and correlated with travel through the analysis of origin-and-destination, land use, and transportation system data. It has been demonstrated that the relationships between land use and the transportation system and attendant travel remain reasonably stable over time, thus enabling the forecast of future travel patterns based upon a future land use development pattern. By considering the future distribution and intensity of land use activity in a corridor and in the surrounding communities as the major factor influencing future traffic patterns, a transportation plan could be developed which would not only serve the existing traffic patterns in the area, but which would also serve the new pattern that will evolve with changing development.

Transportation models are generally structured to analyze the flow of vehicles over highways throughout a specified geographic area. The geographic area is divided into smaller subareas, termed traffic analysis zones (TAZ). The street networks are identified by points of intersection, termed "nodes" and segments between nodes, termed "links". Given the necessary transportation system characteristics and knowledge of population and employment location, the sequence of travel simulation typically occurs in three steps:

1. **Trip Generation:** In which the total number of vehicle trips generated in each zone of a study area is determined using existing relationships between land use and travel. The output from this step is the total number of vehicle trip ends --- that is, trips entering and leaving each zone of the study area. The total number of trips is dependent upon the trip generation rate used.

2. **Trip Distribution:** Given a street system and knowledge of the location of population and employment, a model will distribute trips, that is, calculate how many trips are produced in one location and attracted to another. The methodology is based on a probability model called the gravity model. Like Newton's Law of Gravity, from which the technique is derived, the number of trips between each origin and destination pair is inversely proportional to the travel time between each origin and destination and proportional to the attractiveness of one destination relative to all other destinations.

   This process results in an estimated trip table for all the zones in the region. For a given zone, the trip table estimates where each trip will come from or go to.

3. **Trip Assignment:** In which the interzonal trips are assigned to existing and proposed highway facilities. The output of this step is the number of vehicles utilizing each link of the existing or proposed arterial street and highway system. The decision which route a vehicle takes is based on a process that seeks to minimize delay or travel time, including considerations of link capacity and congestion effects.

2.2 CDTC STEP Model Network Specifics

The CDTC STEP Model utilizes VISUM software developed by PTV America. The model includes 1000 traffic analysis zones that cover the entire four counties of Albany, Rensselaer, Saratoga and Schenectady. The network includes all federal aid highways in the four counties, as well as selected streets not on the federal aid system. The network consists of 10,686 directional links and 4,168 nodes.

Links include the following information:

- Number of through travel lanes
- Speed limit
- Length
- Directionality (one-way or two-way)
- Capacity- based on level of service C capacity
- Class:
    - Rural Local
    - Rural Minor Collector
    - Rural Major Collector
    - Rural Minor Arterial
    - Rural Principal Arterial
    - Rural Expressway
    - Urban Local
    - Urban Collector
    - Urban Minor Arterial
    - Urban Principal Arterial
    - Urban Expressway
    - Ramp

Link capacity is calculated based on level of service C, as shown in Table 1. The model calculates operating capacities at the link level based on the following Bureau of Public Roads (BPR) equations:

$t_{cur} = t_0 \cdot (1 + a(V/C)^b)$

where:

t_{cur} = travel time at the link operating speed
t_0 = travel time at the initial link speed (speed limit)
V/C= volume to capacity ratio for level of service C capacity
a = 0.15, b = 4.0 for arterials, collectors and local roads
a = 0.15, b = 10.0 for expressways.

Operating speeds are calculated by dividing link length by t_{cur}.

Table 1
Level of Service C Link Capacities for the Model;
And Level of Service D and E Link Capacities
from the CDTC Congestion Management Process

Roadway Type	**LOS C Model Capacity**	**Approximate LOS D Threshold**	**Approximate LOS E Capacity**
Arterial and Collector (each direction)			
Single Lane	800 vph	1,000 vph	1,300 vph
Single Lane (with managed left turns)	1,000 vph	1,250 vph	1,625 vph
Two Lane Undivided	2,000 vph	2,500 vph	3,120 vph
Two Lane Divided with Flush Median	2,400 vph	2,800 vph	3,500 vph
Expressway (per lane)			
Limited Access (Divided), volume per lane	1,500 vph	1,875 vph	2,250 vph
Expressway Ramps, per lane	1,200 vph	1,600 vph	1,840 vph
Note: vph is vehicles per hour			

The network contains 4,168 nodes. A total of 1,203 intersections are coded with traffic signals, stop signs, yield signs or roundabouts. Intersection turn movement delays are calculated using the same BPR formula, where t_{cur} is the turn movement delay, with a = 8.0 and b = 2.0, and t_0 is defined as follows:

t_0 = 5 seconds for through movements;
t_0 = 8 seconds for right turn movements;
t_0 = 12 seconds for left turn movements.

Turn movement capacities were developed based on traffic studies at individual intersections where available and generalized from traffic studies for other intersections.

Traffic analysis zones (TAZ's) were defined based on the year 2000 Census. The Census defines 925 traffic analysis zones. An additional 31 zones were added to the STEP Model for external zones, and 44 zones were added for special trip generators. Zones are shown in Table 2 by municipality. Future external to external trips were increased by 1% per year.

Table 2 Traffic Analysis Zones by Municipality						
	Zone Ranges					
Municipalities	from	to	from	to	from	to
Albany Downtown	1	25			501	518
Albany Midtown	26	53			519	545
Albany Uptown	54	64			546	551
Bethlehem	65	95			552	560
New Scotland/Voorheesville	96	104			561	562
Guilderland/Altamont	105	105	107	123	563	585
Colonie T,V/Menands	124	129	132	179	586	643
Watervliet	180	184			644	649
Green Island T,V	185	185			650	651
Cohoes	186	191			652	658
Knox/Berne/Westerlo/Rensselaerville	193	198			660	663
Coeymans/Ravena	199	202			664	667
City of Troy	210	216	218	238	668	686
North Greenbush	239	247			687	694
City of Rennselaer	248	251			695	700
East Greenbush	252	263			701	710
Schodack/Castleton/Nassau	264	272			711	718
Berlin/Stephentown	273	276			719	719
Poestenkill/Sand Lake	277	280			720	724
Brunswick	281	286			725	729
Grafton/Petersburg/Pittstown/Hoosick/Valley Falls	287	296			730	732
Schaghticoke	297	301			733	735
City of Schenectady	310	348			736	767
Niskayuna	349	361			768	783
Rotterdam	362	383			784	811
Scotia/Glenville	384	407			812	830
Princetown/Duanesburg	408	414			831	834
Waterford	192	192	420	423	659	659
					835	838
City of Mechanicville	424	425			839	839
Halfmoon	426	432			840	847
Clifton Park	433	449			848	868
Ballston/ and B. Spa	450	453			869	878
Charlton/Galway/Edinburg/Day	454	463			879	882
Milton	464	465			883	888
Greenfield/Corinth/Hadley	466	470			889	897
Malta/Round Lake	471	473			898	909
City of Saratoga Springs	474	479	485	485	910	926
Stillwater/Town of Saratoga/Schuylerville	480	484			927	933
Wilton	486	488			934	944
Northumberland/Moreau	489	492			945	951
South Glens Falls	493	493			952	954
External	130	131	203	209	217	217
	302	309	415	419		
Special Generators	954	1000				

2.3 Trip Generation

Trip generation estimates were developed for calibration for year 2000 and year 2007. For year 2000, 2000 Census results and traffic counts, and results from the 2001 National Household Travel Survey (NHTS) were used. Year 2005 Census results were not used, because the models used to prepare the 2005 Census estimates are based on data bases that may not be accurate at the municipal level. Also, the Census estimates data are not disaggregated below the municipal level to the traffic analysis zone level. The Capital District Regional Planning Commission analysis and projections for 2010 are considered to be more appropriate for disaggregate analysis. 2007 trip generation estimates were based on CDRPC household and employment numbers.

The CDTC STEP Model was developed and calibrated in the early 1990s and was based on the 1983 CDTC Household Travel Survey. The STEP Model was updated and validated based on the year 2000 Census results and traffic counts. This update incorporates the new 950 zone structure of the year 2000 Census and the results of the 2001 National Household Travel Survey. The methodology for trip generation builds upon the previous trip generation model, updated using the 2001 NHTS and the 2000 Census.

The following two tables compare the results of the 1983 Household Travel and the 2001 NHTS for the Capital District for vehicle trips per household. The trip making patterns by household type are remarkably similar, although the data indicates that trip making rates increased from 1983 to 2001.

Table 3
Weekday Daily Vehicle Trips per Household Categorized
By CDTC Trip Purpose and Vehicle Availability:
CDTC 1983 Household Travel Survey

Vehicle Availability	Home to Work	Work to Home	Home to Other	Other to Home	Other to Other	All Purposes
0	0.07	0.04	0.06	0.10	0.15	0.43
1	0.44	0.35	0.98	1.07	1.11	3.95
2	0.98	0.83	1.55	1.70	1.73	6.79
3+	1.51	1.33	2.10	2.18	2.09	9.21
All	0.70	0.58	1.18	1.29	1.31	5.06

Table 4
Weekday Daily Vehicle Trips per Household Categorized by CDTC Trip Purpose and Vehicle Availability: 2001 Capital District National Household Travel Survey (NHTS)

Vehicle Availability	Home to Work	Work to Home	Home to Other	Other to Home	Other to Other	Other to Work	Work to Other	Total O-O	All Purposes
0	0.014	0.014	0.057	0.045	0.129	0.004	0.004	0.137	0.284
1	0.265	0.253	0.903	0.953	0.716	0.134	0.151	1.001	3.464
2	0.915	0.780	1.689	1.899	1.220	0.388	0.504	2.112	7.704
3	1.156	0.925	1.599	1.897	1.621	0.491	0.654	2.766	8.896
4	1.506	1.242	2.034	2.385	1.539	0.530	0.842	2.911	10.896
All	0.689	0.586	1.293	1.451	1.027	0.292	0.384	1.703	5.997

NHTS numbers were used to develop equations for PM peak hour home based trip ends as shown in Table 5. Because of the consistency in trip making behavior between 1983 and 2001, the trip generation equations developed from the household travel survey were used for estimating year 2000 trip generation for non-home based trips (Tables 6 and 7). Coefficients were increased by 4% to reflect modest increases in PM peak hour trip making. Year 2000 household and employment data were used as inputs. Non-home based trips were adjusted so that total trips agreed with total home based trips and also with the regional amount of trips per household from the 2001 NHTS data.

After trip tables were developed by trip rates and equations, trip generation was updated for selected regional shopping centers. These trip generation estimates were based on square footage of the shopping center and ITE (Institute of Traffic Engineers) trip generation rates.

External trips are trips that start or end outside of the four county area. External to internal trips start outside of the four county area and end within the four county area; internal to external trips begin within the four county area and end outside of the four county area; and external to external trips pass through the four county area. External zones were defined at 31 locations on the border of the four county region at roadways that enter the region. Total external trips were developed for each external zone based on PM peak hour traffic counts entering and exiting the region. An external to external trip table was developed based on data Thruway origin destination data and judgment. The external to external trips were subtracted from the total external trips and allocated by trip type as shown in Table 8.

Table 5 Home Based PM Peak Hour Production and Attraction Equations				
Urban Core Area:				
H-W Productions	=	0.007	*	Households
W-H Attractions	=	0.085	*	Households
H-O Productions	=	0.062	*	Households
O-H Attractions	=	0.092	*	Households
Non-Urban Core Area:				
H-W Productions	=	0.015	*	Households
W-H Attractions	=	0.170	*	Households
H-O Productions	=	0.126	*	Households
O-H Attractions	=	0.184	*	Households

Table 6 Work End Production and Attraction Equations (Daily)				
Urban Core Area:				
H-W Attractions	=	0.755	*	EMPLOYMENT
W-H Productions	=	0.638	*	EMPLOYMENT
Urban Non-Core Area:				
H-W Attractions	=	0.571	*	EMPLOYMENT
W-H Productions	=	0.469	*	EMPLOYMENT
Non-Urban Area:				
H-W Attractions	=	0.836	*	EMPLOYMENT
W-H Productions	=	0.714	*	EMPLOYMENT
Cities in Non-Urban Areas:				
H-W Attractions	=	0.469	*	EMPLOYMENT
W-H Productions	=	0.404	*	EMPLOYMENT
Major Employment Sites				
H-W Attractions	=	0.581	*	EMPLOYMENT
W-H Productions	=	0.487	*	EMPLOYMENT
Major Shopping Areas				
H-W Attractions	=	0.487	*	EMPLOYMENT
W-H Productions	=	0.434	*	EMPLOYMENT

Table 7 **Other End Production and Attraction Equations (Daily)**
Urban Core Area:
O-H Productions = RE * 1.458 + SE * 0.561 + FIR * 2.390 + HHS * 0.624
H-O Attractions = RE * 1.377 + SE * 0.529 + FIR * 2.258 + HHS * 0.590
O-O Productions = RE * 1.755 + SE * 0.674 + FIR * 2.877 + HHS * 0.612 + OTHEMP * 0.350
O-O Attractions = RE * 1.747 + SE * 0.671 + FIR * 2.863 + HHS * 0.642 + OTHEMP * 0.268
Urban Non-Core Area:
O-H Productions = RE * 2.562 + SE * 0.393 + FIR * 3.008 + HHS * 0.489
H-O Attractions = RE * 2.306 + SE * 0.353 + FIR * 2.707 + HHS * 0.440
O-O Productions = RE * 2.542 + SE * 0.39 + FIR * 2.984 + HHS * 0.358 + OTHEMP * 0.268
O-O Attractions = RE * 2.678 + SE * 0.411 + FIR * 3.143 + HHS * 0.422 + OTHEMP * 0.187
Non-Urban Area:
O-H Productions = RE * 4.596 + SE * 0.573 + FIR * 2.251 + HHS * 0.560
H-O Attractions = RE * 4.465 + SE * 0.579 + FIR * 2.276 + HHS * 0.566
O-O Productions = RE * 3.478 + SE * 0.433 + FIR * 1.704 + HHS * 0.301 + OTHEMP * 0.376
O-O Attractions = RE * 3.237 + SE * 0.403 + FIR * 1.585 + HHS * 0.305 + OTHEMP * 0.274
Cities in Non-Urban Areas:
O-H Productions = RE * 3.016 + SE * 0.463 + FIR * 3.540 + HHS * 0.677
H-O Attractions = RE * 2.712 + SE * 0.416 + FIR * 3.183 + HHS * 0.609
O-O Productions = RE * 2.107 + SE * 0.323 + FIR * 2.474 + HHS * 0.467 + OTHEMP * 0.133
O-O Attractions = RE * 2.234 + SE * 0.343 + FIR * 2.624 + HHS * 0.497 + OTHEMP * 0.113
Major Employment Sites
O-H Productions = RE * 1.125 + SE * 0.210 + FIR * 2.680 + HHS * 0.823
H-O Attractions = RE * 1.166 + SE * 0.218 + FIR * 2.770 + HHS * 0.849
O-O Productions = RE * 2.180 + SE * 0.544 + FIR * 2.126 + HHS * 1.069 + OTHEMP * 0.315
O-O Attractions = RE * 1.938 + SE * 0.485 + FIR * 1.893 + HHS * 0.956 + OTHEMP * 0.238
Major Shopping Areas
O-H Productions = RE * 2.884 + SE * 0.549 + FIR * 2.446 + HHS * 0.723
H-O Attractions = RE * 2.759 + SE * 0.526 + FIR * 2.194 + HHS * 0.711
O-O Productions = RE * 2.192 + SE * 0.418 + FIR * 1.859 + HHS * 0.426 + OTHEMP * 0.151
O-O Attractions = RE * 2.263 + SE * 0.431 + FIR * 1.920 + HHS * 0.517 + OTHEMP * 0.098

Notes: RE= retail employment; SE = service employment;
FIR = finance, insurance and real estate employment;
OTHEMP = other employment; HHS= households

Table 8 PM Peak Hour External to Internal Trips (Origins) and Internal to External Trips (Destinations)			
Location	**Zone**	**Origins**	**Destinations**
I-88, Schoharie County	106	264	460
Route 7, Schoharie County	130	60	58
Route 9W, Greene County	131	228	293
Route 20, Schoharie County	203	170	186
Route 5, Montgomery County	204	341	802
Thruway, I-90, Montgomery County	205	609	899
Route 5S, Montgomery County	206	138	224
Route 9N, Warren County	207	203	221
Northway, I-87, Warren County	208	765	876
Route 9, Warren County	209	920	743
Route 29, Washington County	217	328	356
Route 40, Washington County	302	160	173
Route 103, Washington County	303	78	81
Route 67, Vermont, Bennington Co.	304	131	95
Route 7, Vermont, Bennington Co.	305	196	173
Rt. 2, Massachusetts, Berkshire Co	306	46	50
Rt. 43, Massachusetts, Berkshire Co.	307	112	122
Route 22, Columbia County	308	161	175
Route 20, Columbia County	309	262	285
Route 29, Montgomery County	415	272	370
Thruway, I-90, Berkshire Spur	416	394	391
Route 144, Greene County	417	185	172
Thruway, I-87, Greene County	418	1277	1272
Route 32 Greene County	419	244	265
Route 197, Ft Edward	494	305	356
Route 30, Schoharie County	495	82	88
Route 145, Schoharie County	496	141	56
Route 145, Greene County	497	190	197
Route 81, Greene County	498	35	20
Route 9J, Columbia County	499	45	49
Route 9, Columbia County	500	659	806

2.4 Trip Distribution

Trip distribution was developed for each of five trip types:

- Home to Work
- Work to Home
- Home to Other
- Other to Home
- Other to Other

The VISUM software uses a distribution formula based on the TMODEL gravity model.

$$Trips_{ij} = \frac{\dfrac{P_i A_j}{(d_{ij})^\beta}}{\sum \dfrac{A_j}{(d_{ij})^\beta}}$$

Where
$Trips_{ij}$ = trips between zones i and j;
P_i = Trip productions (origins) at zone I;
A_j = Trip attractions (destinations) at zone j;
d_{ij} = distance between zones i and j ; and
β = an exponent.

The VISUM doubly constrained balancing option was used. The exponents were selected by running the assignment process for the year 2000 (described in section 2.5) and comparing the average trip time for each trip type with average trip times from the 2001 NHTS by trip type. After a number of iterations, the exponents shown in Table 9 were obtained.

Travel times are calculated based on the STEP Model network. Travel times are recalculated for each model iteration, as explained in the next section. A travel time of 6 minutes is assumed for intrazonal trips (trips within the same zone). A terminal time for each zone is assumed to be 1.25 minutes. The terminal time represents the time needed to get onto the network from the trip starting point; including walking, parking, driving to the network entry point.

Table 9 Gravity Model Exponents and Average Travel Times			
Trip Types	**Gravity Model β Exponent**	**Average STEP Model Travel Time Year 2000 (minutes)**	**Average NHTS Travel Times Year 2001 (minutes)**
Home to Work	2.65	18.7	18.7
Work to Home	2.40	24.3	24.3
Home to Other	3.20	15.0	15.0
Other to Home	3.20	15.6	16.0
Other to Other	2.60	15.4	15.8
Total	NA	18.1	18.2

PM peak hour work to home trips were compared with Journey to Work data from the year 2000 Census. Tables 10 shows the trip distribution for the STEP Model Work to Home trips; 11 show the trip distribution for the Journey to Work data, both at the county level. The two distributions show remarkable agreement between a probability model based distribution and a survey data set.

Table 10 Percent of Year 2000 PM Peak Hour Work to Home Trips (within the four counties) Predicted by the STEP Model Gravity Model					
	Working in:				
Living in:	**Albany**	**Rensselaer**	**Schenectady**	**Saratoga**	**Total**
Albany County	32%	3%	1%	1%	37%
Rensselaer County	11%	7%	0%	1%	19%
Schenectady County	7%	1%	9%	1%	18%
Saratoga County	9%	2%	2%	13%	26%
Total Four Counties	59%	12%	13%	15%	100%

Table 11 Percent of Year 2000 Journey to Work Trips (all work trips beginning and ending in the four counties) from the Year 2000 Census					
	Working in:				
Living in:	**Albany**	**Rensselaer**	**Schenectady**	**Saratoga**	**Total**
Albany County	33%	2%	2%	1%	38%
Rensselaer County	9%	9%	0%	1%	19%
Schenectady County	6%	1%	10%	1%	18%
Saratoga County	7%	1%	3%	14%	25%
Total Four Counties	55%	13%	15%	16%	100%

2.5 Trip Assignment

The trip assignment methodology was developed by PTV America using VISUM software. The methodology uses an iterative feedback procedure with an equilibrium assignment.

The equilibrium assignment is described in the VISUM user's manual as follows:

> The Equilibrium assignment distributes demand according to Wardrop's first principle: "Every individual road-user chooses his route in such a way that his journey takes the same time on all alternative routes and that switching routes would only increase personal journey time." The state of equilibrium is reached by multi-successive iteration based on an incremental assignment as a starting solution. In the inner iteration step, two routes of a relation are brought into a state of equilibrium by shifting vehicles. The outer iteration step checks if new routes with lower impedance can be found as a result of the current network state...
> The Relative Gap determines the difference between the current volume in the network and the equilibrium. It measures the excess cost of vehicles that do not take the optimum routes yet in proportion to the total impedance in the network.

The maximum relative gap selected was .001.

The equilibrium assignment is just one step in an iterative feedback procedure used by the STEP Model to assign traffic. During the first iteration, trip distribution is calculated based on starting travel time impedances. Then, traffic is assigned based on the equilibrium assignment process. Travel times are then calculated based on the assigned traffic volumes; these travel times are used to calculate a new trip distribution. The resulting trip distribution is averaged with the previous trip distribution, using a Method of Successive Averages (MSA), in which the weight on the new matrix decreases with each feedback loop. The procedure is repeated until convergence is achieved between successive distributions. This methodology is described in "New Computational Results on Solving the Sequential Procedure with Feedback" by David Boyce, Christopher O'Neill and Wolfgang Scherr, Presented at the 11th Transportation Planning Applications Conference, May 6-10, 2007, Daytona Beach, FL.

One of the benefits of the iterative feedback procedure is that the STEP Model traffic assignment models the impact of congestion on travel decisions in a meaningful way. It allows the assigned trips to change routes based on congestion and also allows the model to modify trips based on congestion. For example, in the real world, a discretionary trip might choose to go to a closer shopping location to avoid congestion, or to travel at a different time. The gravity model suggests that work trips, while less dependent on travel time than other trips, will still be influenced by travel time and therefore by congestion. The iterative feedback procedure should result in a more realistic modeling of the influences of congestion on travel behavior.

2.6 Model Calibration

Simulated link volumes from the model for year 2000 were compared with traffic counts. 3,097 directional link counts were compiled from the years 1999, 2000, and 2001. The comparisons are summarized in Table 12. A model is considered calibrated when the simulated link volumes reasonably represent observed traffic count volumes. Guidelines for calibration standards developed by the Federal Highway Administration (FHWA) are shown in Table 11, along with the results of the VISUM Model. (See Ismart, Dane. Calibration and Adjustment of Planning Models. U.S. Department of Transportation, Federal Highway Administration Publication FHWA-ED-90-015. Washington, DC, December 1990.)

All of the model's measures of performance exceed the FHWA guidelines. The model also shows strong agreement with average trip length by trip type found in the National Household Travel Survey (see Table 8).

Table 12
Year 2000
PM Peak Hour Calibration of the Model

	FHWA Guideline	CDTC STEP Model 2000 PM Peak Hour
Correlation Coefficient	0.88	0.95
Percent Error for the Entire Model	5.0%	-1.69%
Sum of Differences by Roadway Class		
Freeways	7.0 %	1.1%
Principal Arterials	10.0%	-3.5%
Minor Arterials	15.0%	-1.7%
Collectors	25.0%	-10.9%

Table 13 illustrates the model's performance by major facilities and by geographic areas. The results show a strong agreement between simulated volumes and traffic counts.

Table 13
Year 2000 PM Peak Hour Calibration of the Model for Selected Facilities and Geographic Areas

Selected Facilities and Geographic Areas	Sum of Simulated STEP Model Volumes	Sum of Count Volumes	difference	percent
Thruway--I-87	35,772	41,076	(5,304)	-13%
Thruway--I-90	67,680	72,557	(4,877)	-7%
I-90 free Albany County	120,563	131,402	(10,839)	-8%
I-90 free Rensselaer County	53,836	48,661	5,175	11%
I-87 free Albany County	125,204	127,714	(2,510)	-2%
I-87 free Saratoga County	119,583	105,727	13,856	13%
I-88	11,034	10,230	804	8%
I-787	93,280	88,004	5,276	6%
I-890	57,527	53,656	3,871	7%
City of Albany	525,503	560,093	(34,590)	-6%
Cohoes, Watervliet, Menands	102,869	100,718	2,151	2%
Colonie, Guilderland, Bethlehem	499,263	538,877	(39,614)	-7%
City of Troy	124,364	120,544	3,820	3%
City of Rensselaer	27,147	25,880	1,267	5%
E+N Greenbush, Brunswick	109,557	108,215	1,342	1%
City of Schenectady	116,600	127,423	(10,823)	-8%
Niskayuna, Glenville, Rotterdam	198,375	207,557	(9,182)	-4%
Clifton Park, Halfmoon, Waterford	134,559	136,884	(2,325)	-2%
Ballston, Malta, Round Lk, B Spa	100,701	80,966	19,735	24%
Saratoga Springs	79,779	71,036	8,743	12%
Mechanicville	10,822	9,201	1,621	18%
All Links With Count Volumes	2,320,672	2,360,482	(39,810)	-1.69%

2.7 Development of Year 2007 Model and Calibration

Year 2010 trips were developed based on CDRPC forecasts of households and employment by type, using the same trip generation process described above. Year 2007 trips were estimated by interpolating between year 2000 trips and year 2010 trips. Trip distribution and assignment were estimated for year 2007 using the STEP Model framework developed for year 2000. The results were compared with 416 directional link year 2007 traffic counts. The results of this comparison are shown in Table 14. All of the model's year 2007 measures of performance exceed the FHWA guidelines.

Table 14
Year 2007
PM Peak Hour Calibration of the Model

	FHWA Guideline	CDTC STEP Model 2007 PM Peak Hour
Correlation Coefficient	0.88	0.99
Percent Error for the Entire Model	5.0%	2.64%
Sum of Differences by Roadway Class		
Freeways	7.0%	3.2%
Principal Arterials	10.0%	-2.6%
Minor Arterials	15.0%	4.3%
Collectors	25.0%	2.3%

Table 15 illustrates the model's performance by major facilities and by geographic areas. The results show a strong agreement between simulated volumes and traffic counts.

Table 15
Year 2007 PM Peak Hour Calibration of the Model for Selected Facilities and Geographic Areas

Selected Facilities and Geographic Areas	Sum of Simulated STEP Model Volumes	Sum of Count Volumes	difference	percent
Thruway--I-87	9,320	11,177	(1,857)	-17%
Thruway--I-90	28,420	27,741	679	2%
I-90 free Albany County	12,474	12,147	327	3%
I-90 free Rensselaer County	26,396	21,964	4,432	20%
I-87 free Albany County	90,352	90,052	300	0%
I-87 free Saratoga County	45,907	39,998	5,909	15%
I-88	-	*No counts*	-	-
I-787	25,347	23,730	1,617	7%
I-890	-	*No counts*	-	-
City of Albany	58,854	59,584	(730)	-1%
Cohoes, Watervliet, Menands	28,721	27,267	1,454	5%
Colonie, Guilderland, Bethlehem	154,040	159,952	(5,912)	-4%
City of Troy	3,552	2,705	847	31%
City of Rensselaer	10,823	8,623	2,200	26%
E+N Greenbush, Brunswick	18,111	18,421	(310)	-2%
City of Schenectady	3,824	5,105	(1,281)	-25%
Niskayuna, Glenville, Rotterdam	32,153	29,508	2,645	9%
Clifton Park, Halfmoon, Waterford	37,331	38,210	(879)	-2%
Ballston, Malta, Round Lk, B Spa	31,594	26,469	5,125	19%
Saratoga Springs	4,402	4,415	(13)	0%
Mechanicville	2,576	2,664	(88)	-3%
All Links With Count Volumes	559,904	545,163	14,741	2.70%

3. Future Year Models

3.1 Demographic and Employment Forecasts

Population and Household Forecasts- In May of 2004, CDRPC completed revising its population and household projections for each of the Region's municipalities in ten-year increments to the year 2040. The Population Projection Model implemented involved two distinct stages: a quantitative first stage using a log-linear regression projection model on historic Census data and U.S. Census Bureau estimates, and a qualitative second stage using non-quantitative judgments of the likelihood and extent of future population change within particular jurisdictions.

The Log-Linear model - so-called because of its straight-line form when plotted on graph paper that has a logarithmic scale for X-axis measurements - uses historic population to forecast or project future population based on a logarithmic curve, which is the best general model for natural populations.

Log-Linear models when used for forecasts will project the historic rate of change of the actual data into the future at a steadily declining rate (i.e., historic growth or decline will continue, but at a lesser rate). Log-linear models are an excellent basis for population forecasts because they project average historic rates of change into the future in a manner consistent with the average changes in natural populations. While short-term population data will often exhibit some variety of a saw-tooth pattern when charted, long-term population data usually follow a log-linear trend.

Historic data by minor civil division (MCD) for the Region were fitted to individual log-linear models, and the results proportionally reduced or increased to force the sum of a county's MCDs to equal the county total.

The projections derived from the Log-Linear Model provided a basis from which to further analyze the forces that affect population change in each minor civil division. There are many historic trends other than simple population which may give an indication of the direction and extent of future population change, including, but not limited to, average persons per household, persons in group quarters, building permit issuances, new home and apartment unit construction, immigration and emigration patterns, journey-to-work data, and labor force data. In addition, there may be new development opportunities or constraints for particular jurisdictions embodied in zoning and subdivision regulations, environmental regulations, economic development programs, and capital budgets for transportation facilities and water and sewer service extensions, to name a few. This information was taken into account in consultation with county and municipal planners and the projections derived from the Log-Linear Model were adjusted accordingly.

CDRPC projects a net gain of 90,538 persons and 59,898 households by 2040. The map, "Projected Change in Population: 2000-2040," shows this projected net population growth by minor civil division. This would bring the total population of the region by 2040 to 884,831 persons and the total households to 378,153.

CDRPC then developed a set of population projections for the Region's 925 Traffic Analysis Zones. The initial TAZ projections were based on a distribution of projected MCD populations to Traffic Analysis Zones based on 1990 and 2000 historic distributions of TAZ populations within each municipality.

Modifications were made to individual TAZ's based on the best available TAZ data, including, historic and existing growth pressure, environmental constraints, available land, available or likely available public infrastructure, existing zoning, existing planning policies, average persons per household and persons in group quarters.

After the adoption of the New Visions 2021 plan in October 2000, CDTC received results from the 2000 Census. The basic 2000 Census population and household values have proved to be remarkably consistent with forecasts prepared by the Capital District Regional Planning Commission (CDRPC) and used by CDTC in the 2021 plan. CDTC commissioned CDRPC to produce new growth forecasts consistent with the 2000 Census. The new forecasts, going out to 2040, re-affirm previous forecasts with the continued forecast for a slow population growth and a slowing of the rate in outer years. The rate of population growth forecast to 2030 and beyond remains essentially the same as the rate used in the 2021 plan. Similarly, analysis of journey-to-work data from the 2000 Census is consistent with prior work.

Employment- Under contract with the Capital District Transportation Committee, the Capital District Regional Planning Commission has completed employment projections by Traffic Analysis Zone (TAZ) and major industry sector for the period 2010 through 2040 in five-year increments. The Employment Projection Model was implemented in three stages. The first stage was devoted to obtaining the best available estimates of employment by TAZ in 2000 and 2005. The second stage involved the construction of a log-linear model to project existing employment into the future, and the third stage involved adjusting the output of the second stage using qualitative factors.

1. Current Estimates Stage- The best available estimates of current employment by TAZ in the Region are contained in a special 2000 Census tabulation entitled the Census Transportation Planning Package (CTPP). Using the CTPP employment numbers as a basis, the most significant of the Region's 925 TAZs were checked for reliability and adjusted as necessary, and appropriate estimates were made for employment in the 24 TAZs which were unaccountably excluded from the CTPP. The

industry sectors, defined using the North American Industrial Classification System (NAICS), were reduced to four major industry groups suitable for transportation planning: Retail; Services; Finance, Insurance, and Real Estate (FIRE); and Other (see tables below for 3-digit NAICS inclusions in each major industry group).

Most economists would agree that the very best available estimates of current employment are contained in the U.S. Bureau of Labor Statistics BLS 790 data. Unfortunately, these data are only available at the Metropolitan Statistical Area level, so the Albany-Schenectady-Troy MSA BLS 790 data for 2000 and 2005 (the latest year available) were modified using distributions from the N.Y.S. Department of Labor ES-202 data, which provide estimates of 3-digit NAICS employment by place of work and county based on actual unemployment insurance filings. Applying the sector and TAZ distributions from the CTPP to the modified BLS 790 county-level data yielded current employment estimates by TAZ for 2000 and 2005.

2. Quantitative Stage- The Log-Linear model — so-called because of its straight-line form when plotted on graph paper which has a logarithmic scale for X-axis measurements — uses historic employment to forecast or project future employment based on a logarithmic curve, which is the best general model for natural populations and employment.

Log-Linear models when used for forecasts will project the historic rate of change of the actual data into the future at a steadily declining rate (i.e., historic growth or decline will continue, but at a lesser rate). Log-linear models are an excellent basis for employment forecasts because they project average historic rates of change into the future in a manner consistent with the average changes in natural populations and employment. While short-term population and employment data will often exhibit some variety of sawtooth pattern when charted, long-term population and employment data usually follow a log-linear trend.

The 2000 and 2005 employment data by TAZ and major industry group for the Region were fitted to individual log-linear models (one for each of the four major industry groups within each TAZ), and the results proportionally reduced or increased to force the sum of a county's TAZs to equal the pre-determined county major industry group totals, which had been previously determined from log-linear projections at the county level.

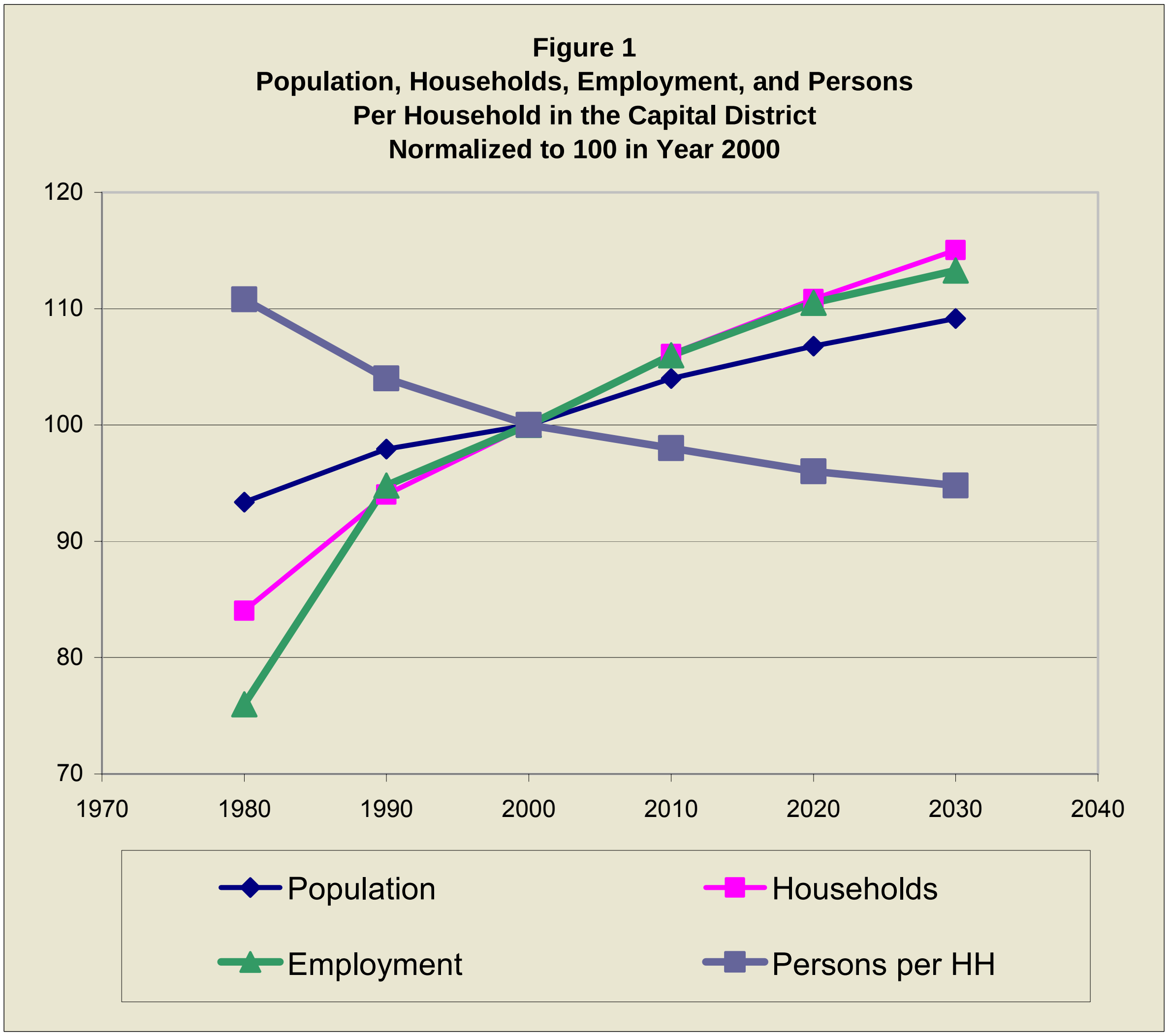
3. Qualitative Stage- The projections derived from the log-linear models provided a basis from which to further analyze the forces which affect employment change in each TAZ. There are many historic trends other than simple employment which may give an indication of the direction and extent of future employment change, such as immigration and emigration

patterns, journey-to-work data, labor force data, and transit and public transit development plans. In addition, there may be new development opportunities or constraints for particular jurisdictions embodied in Zoning and Sub-Division regulations, environmental regulations, economic development programs, and existing capital budgets for transportation facilities and water and sewer service extensions, to mention just a few of the possible sources. As much of this information as possible was considered in reviewing the individual TAZ projections derived from the log-linear models, and changes made as appropriate by a joint CDTC/CDRPC group using the latest satellite imagery and development data.

Table 16 presents the CDRPC forecasts of population, housing, employment and persons per household. Note that households have been growing faster than population because average household size has been declining (see Figure 1). Note also that growth in employment during the 1980s was more rapid that households or population. This can be attributed to the trend for greater participation of women in the work force.

Table 16
CDRPC Forecasts of Population, Households, Employment and Persons Per Household

	1980	1990	2000	2010	2020	2030
Population	741,580	777,783	794,293	826,094	848,107	867,000
Households	267,427	299,244	318,255	337,701	352,694	366,081
Employment	325,851	406,529	428,799	454,548	473,854	485,794
Persons/HH	2.77	2.60	2.50	2.45	2.40	2.37



3.2 Transit Operating Policies and Ridership Trends

Year 2000 Census results showed the transit share of regional journey to work trips is at 3.4%. This percentage is consistent with CDTC's regional travel demand model, the CDTC STEP Model. Although CDTC has used its Mode Choice Model to evaluate different transit investment scenarios, the STEP Model is based on vehicle trips and implicitly estimates transit ridership in its trip generation forecasts. For future forecasts, the STEP Model assumes that transit fares will stay at current values after adjusting for inflation. It is assumed that under the implementation of the New Visions Plan, transportation and land use actions called for in the Plan will result in stable transit ridership. Under trend conditions, without the New Visions Plan, it is assumed that ridership will decrease by roughly ten percent.

The most current transit fares and network operating conditions were input to the modeling structure used in generating transit ridership (modal shares). The transit operator for the Capital District is the Capital District Transportation Authority (CDTA). The base fare is currently $1.00, increasing to $1.50 in 2009 and $2.00 in 2010.

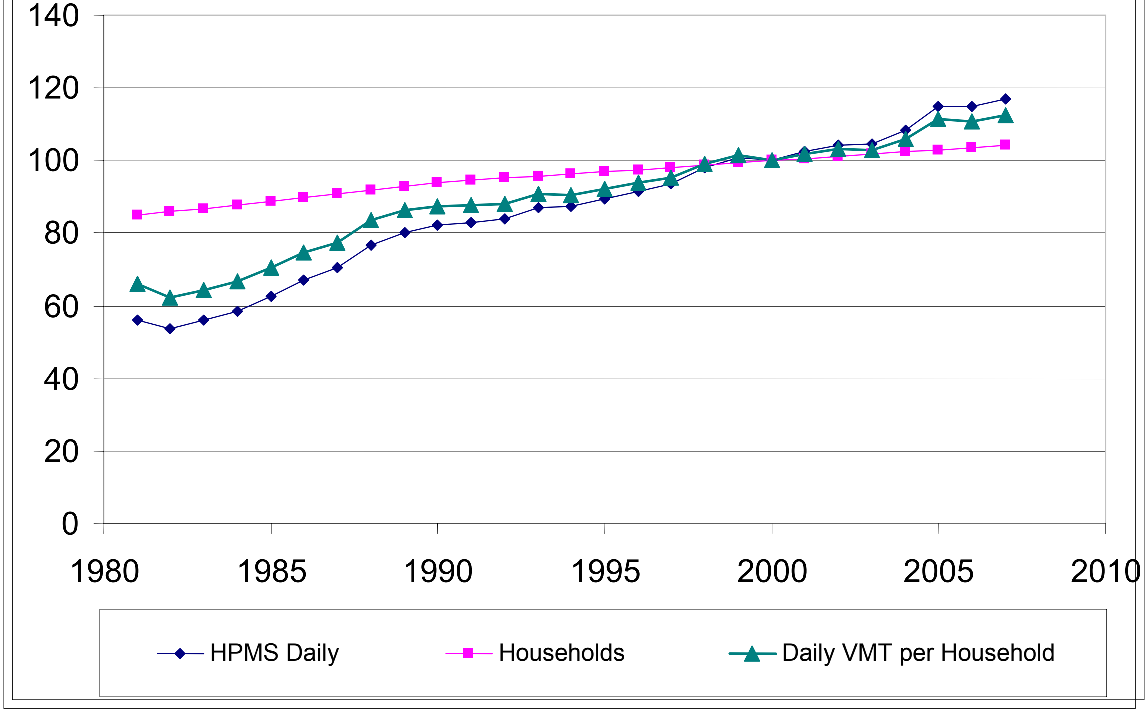
3.3 Future Travel Forecasts

Future travel will be a function of households, population and employment, propensity to travel, and time of day trip making. Historically, daily vehicle miles of travel (VMT) have been growing faster than households, population and employment in the Capital District, based on the HPMS database (HPMS stands for Highway Performance Monitoring System). Nevertheless, VMT growth has been slowing over time. Table 17 shows growth in daily VMT for the Capital District. Growth in VMT has been slower since 1989. From 1981 to 1989, average annual growth in daily VMT generally ranged from 4% to 9%. Since 1990, average annual growth in daily VMT generally ranged from 2% to 3% (when looking at the 5 year moving average). While daily VMT was steadily increasing, the rate of growth was steadily declining.

Table 17 Capital District HPMS VMT 1981 to 2007			
Year	**HPMS Daily VMT (Thousands)**	**Annual Percent Increase**	**Annual Moving Average (5 Year Period) Percent Increase**
1981	7,821		
1982	7,472	-4%	
1983	7,809	5%	
1984	8,166	5%	
1985	8,745	7%	
1986	9,370	7%	4%
1987	9,831	5%	6%
1988	10,717	9%	7%
1989	11,196	4%	7%
1990	11,463	2%	6%
1991	11,563	1%	5%
1992	11,710	1%	4%
1993	12,124	4%	3%
1994	12,173	0%	2%
1995	12,467	2%	2%
1996	12,760	2%	2%
1997	13,042	2%	2%
1998	13,672	5%	3%
1999	14,070	3%	3%
2000	13,955	-1%	2%
2001	14,313	3%	2%
2002	14,568	2%	2%
2003	14,610	0%	1%
2004	15,134	4%	2%
2005	16,013	6%	3%
2006	16,020	0%	2%
2007	16,339	2%	2%

Figure 2 compares daily VMT growth with growth in households in the Capital District from 1981 to 2005. Daily VMT grew faster than households during that period. Daily VMT per household grew at a slower rate that daily VMT. In the early 1990s, CDTC developed trend forecasts that predicted that VMT per household would continue to increase into the future. While households were forecast to grow at 0.6% per year from 1990 to 2015, PM peak hour VMT was forecast to grow more than three times as fast as households, at 1.9% per year. From 2000 to 2030, peak hour VMT was forecast to grow twice as fast as households, at 1.2% per year.

Figure 2
Capital District HPMS Daily VMT, CDRPC Households, Daily VMT per Household, 1981 to 2007
Normalized to 100 in Year 2000



Over 20 years, from 1970 to 1990, the cost of fuel per mile dropped 40%; single occupant commuting increased 86%; carpooling declined 32%. The number of vehicles in the Capital District more than doubled between 1970 and 1990. Gasoline cost per mile traveled has been decreasing (discounting inflation) until recently because the cost of fuel has grown more slowly than inflation and the fleet has become more fuel efficient. The rapid growth in these variables contributed to the rapid growth in VMT.

Another factor that contributed to rapid VMT growth over the last thirty years is the dominance of the baby boom generation. As explained by Steven Polzin ("The Case for Moderate Growth in Vehicle Miles of Travel: A Critical Juncture in U.S. Travel Behavior Trends", Steven E. Polzin, PhD, sponsored by the U.S. Department of Transportation, April 2006):

> While VMT rates may change over time, it is apparent that the age cohorts that are currently at their peak travel rates are the largest age cohorts in the population. The aging baby boomers are passing through their peak travel years. If it were assumed that VMT per capita for a given age cohort were stable over time, the age profile affect alone explains a few percent of the growth in VMT since 1970.

Gasoline prices rising in 2007 and especially in 2008 have caused VMT growth to slow nationally; and while data is not yet available to confirm this trend in the Capital District, indications are that the rate of VMT growth is slowing locally as well. The recent increases in fuel prices, public awareness about energy issues, the saturation of vehicle ownership, and the bottoming out of carpooling can be expected to lead to moderation of VMT growth in the future.

As the baby boom generation retires and ages, its members can be expected to drive less, especially during the commuter peak hour. This is one more factor that can be expected to contribute to moderation in VMT growth.

CDTC Forecasts a Moderation of VMT Growth with the New Visions Plan.
The CDTC New Visions Plan was developed with the expectation that increases in daily vehicle travel would be dampened from the trend forecast of 49% (1990-2015). This can be expected through a combination of actions, including the substitution of communication for travel, increased carpooling, increased non-auto travel (transit, walking and cycling), shorter trip lengths (due to proximity of activities), spreading of peak hour trips to off-peak hour, increased telecommuting and slowing of the projected growth in the number of cars. The New Visions Plan is much broader than highway capital projects. It includes travel demand strategies, operational strategies, land use policies (such as urban reinvestment and encouragement of mixed use development) and investments in transit, walking, and bicycle facilities.

CDTC's New Visions policy forecast results from planned transportation investment, demand management and the shifts of vehicular traffic to other modes and other times of day produced by improved regional land use patterns, community structure, site design and the better accommodation of bicyclist, pedestrian and transit modes. The policy forecast remains CDTC's target traffic condition used in project design and reflects plausible success in implementing the plan through the horizon year of 2030. CDTC forecasts for the New Visions Plan assume that PM peak hour trip growth rate will dampen so that it corresponds to the growth rate in households.

If CDTC was to assume that the New Visions Plan will not succeed in moderating the growth of auto VMT, this would become a self-fulfilling prophecy. This is because design of highway projects is based on PM peak hour traffic forecasts for twenty years, and for bridge projects, for thirty years. Assuming linear trend forecasts of travel ignores the socioeconomic trends, trends in gas prices, and land use planning, and ironically leads to larger foot prints for highway projects, and diversion of resources into highway capacity and urban disinvestment. Linear trend forecasts for VMT would under cut the New Visions Plan and the CDTC Congestion Management System, and would encourage and contribute to increased fuel consumption and air quality emissions.

CDTC assumes that the desired outcome will be achieved by the set of land use and transportation actions in the plan. CDTC thus embraces its tempered, policy-based traffic forecasts for all planning and design work – not the trend forecasts. As a result, TIP projects are implemented in the Capital District at scopes and with design details that reflect the desired outcome. If CDTC were to assume in its forecasts that the CDTC Plan will not be successful, then we would defeat the intended outcome. Put more simply, if we plan to fail, then we will fail.

Rationale for VMT Moderation with the New Visions Plan. Nationally, the increase in gas prices in 2008 led to a 5.6% reduction of VMT (based on comparing August 2008 to August 2007) and a five percent increase in transit ridership (based on comparing the second quarter of 2008 to the second quarter of 2007)[1]. These changes in travel behavior suggest that changes in VMT growth trends are possible. While the New Visions Plan does not address the issue of gasoline pricing, it does call for investments in transit, pedestrian and bicycle facilities, planning for smart growth, demand management, and other investments that will encourage a reduction in VMT growth per capita.

The New York State Energy Plan recommends reducing VMT by 10% below projected levels by 2020. The New Visions Plan by itself will not achieve this level of VMT reduction. However, the New Visions Plan recommendations for VMT reduction are strongly consistent with the New York State Energy Plan goals for VMT reduction. The New Visions Plan represents an important component of implementing the New York State Energy Plan VMT reduction goals.

The New Visions Plan is expected to reduce VMT by 5% below projected trend levels by 2030. Working with the best secondary sources available, an attempt to quantify future VMT reductions was made. These estimates are not scientifically provable, yet they are as likely to be conservative as they are to be optimistic. The effects of the New Visions Plan will be cumulative over time, and the different components of the plan will reinforce each other. The various New Visions initiatives work together to create viable places to live, work, shop and play that provide shorter trip options and non-auto options for travel.

VMT reductions are expected to result from New Visions Plan investments as follows:

- Investments in **smart growth, mixed use development and transit oriented development**—a 1.5% reduction in future VMT.
- Investments in **transit**—a 1.5% reduction in future VMT
- Investments in **bicycle and pedestrian facilities**—a 1.5% reduction in future VMT
- Investment in **demand management**—a 0.5% reduction in future VMT

[1] New York State Energy Plan, December 2009.

Each of these investments is explained in more detail in the following paragraphs.

- **Investments in Smart Growth, mixed use development and transit oriented development-** The New Visions Plan calls for urban reinvestment and smart growth. The New Visions Plan encourages community planning for mixed use development and transit oriented development. National studies have demonstrated that concentrated development patterns result in less VMT per person. CDTC investment in the Transportation and Land Use Linkage Program will support this development, which has been proven to generate less VMT.

  The New Visions Plan supports smart growth in a number of ways.

  Smart growth is encouraged by CDTC's Linkage Program. CDTC's Community and Transportation Linkage Planning Program (the Linkage Program) provides consultant or CDTC staff technical assistance for joint regional-local planning initiatives that link transportation and land use. It is a key implementation activity of New Visions 2030, the regional long range transportation plan. The Linkage Program is also the cornerstone of CDTC's local planning assistance and public outreach efforts. CDTC's transportation and land use policy is that good site and community design are essential to achieving regional transportation system goals. The Linkage Program is one of the most significant cooperative regional efforts in the nation to reflect, in practice, what representatives of the region's counties, cities, towns and villages as well as state and local transportation providers have adopted as policy.

  CDTC has funded a total of 61 collaborative, jointly-funded studies over the past nine years. Study sponsors have included 37 separate urban, suburban and rural municipalities and counties as well as not-for-profits and other public entities. Roughly $4.0 million in federal, state and local funds have been committed to the Linkage Program since its inception in 2000. Ongoing funding for the Linkage Program is supported in the New Visions Plan.

  Smart growth is encouraged by investing in urban areas. An important component of the CDTC New Visions Plan is the principle of urban reinvestment. The New Visions Plan encourages equitable investments of federal-aid transportation projects in urban areas. According to the Plan, transportation investments will encourage residential and commercial development to locate within an Urban Service Area defined for the Capital Region. The Plan calls for transportation investments supportive of growth and redevelopment in city centers and urban corridors that promote the efficient use of land and existing infrastructure.

Smart Growth is supported by congestion management. The CDTC New Visions Plan takes a conservative approach to capacity increases. The congestion management principles of the New Visions Plan limit the amount of capacity expansion projects and emphasize incident management, multi-modal ITS and operational solutions.

Numerous studies have documented the relationship between density, diversity (mix of uses), land use design and VMT[2]. According to Winkelman[3], "The empirical evidence shows that a typical resident of a traditional, walkable neighborhood emits significantly less transportation GHG emissions than typical auto-oriented development – 30 percent lower on average." This finding can be applied to the Capital District as follows. A 10.3 percent increase in households is forecast for the Capital District between 2007 and 2030. Assuming that 50 percent of new households in the Capital District will be in a mixed use, walkable neighborhood with 30 percent less VMT per household because of the New Visions Plan results in a 1.5 percent reduction in future VMT for the region.

- **Investment in transit-** The New Visions Plan incorporates CDTA's Transit Development Plan, which will improve and grow a variety of transit services for the Capital District, increasing mobility for the Capital District. The New Visions Plan calls for $387 million of investment in transit infrastructure between 2007 and 2030, and $1,449 million of investment in transit service. The New Visions budget will provide for urban, STAR, commuter and Saratoga Springs vehicles, garages and maintenance facilities and continuous deployment of BRT systems, including the NY5 Bus Rapid Transit Service. The transit infrastructure budget is 38% higher than the previous budget. The New Visions plan continues to call for modest expansion of transit services. New funding values are approximately 50% higher than the previous budget. The transit ridership increases and VMT reductions of 2008 demonstrate that improvements in transit service are correlated with VMT reduction.

  CDTC VMT forecasts assume that without the New Visions Plan, transit disinvestment will lead to declines in ridership comparable to the declining trends of the 1990s, when ridership was as low as 30% less than recent ridership. The New Visions "No Build" scenario would result in increased VMT as transit ridership declines. With the New Visions Plan, ridership will continue to grow beyond current levels because of increased funding for

[2] See TCRP Report 95, *Traveler Response to Transportation System Changes, Chapter 15, Land Use and Site Design,* Transportation Research Board, 2003

[3] Testimony of Steve Winkelman, Center for Clean Air Policy Senate Committee on Environment and Public Works, "Transportation's Role in Climate Change and Reducing Greenhouse Gases", July 14, 2009. See also Ewing, R., Keith Bartholomew, S. Winkelman, J. Walters, and D. Chen. 2007. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute, Washington, D.C.

transit infrastructure, modest expansion of services and significant investment in the Route 5 BRT service. The cumulative impacts of the New Visions continued transit investment will be a 1.5% decrease in VMT with respect to the New Visions “No Build” scenario.

- **Investment in bicycle and pedestrian facilities**- The New Visions Plan encourages development that incorporates bicycle and pedestrian accommodations into highway construction as well as city, village and town plans and provides for recreational opportunities through creation of bike/hike trails. The New Visions Plan calls for $84 million of investment in Supplemental Bike & Pedestrian Accommodations between 2007 and 2030. The Plan calls for significant investment in highway rehab, reconstruction and redesign with attention to pedestrian and bicycle facilities and pedestrian crossing improvements. Walkable complete streets are supported in the New Visions Plan.

  According to *Emissions Benefits of Land Use Planning Strategies*[4], the elasticity of VMT with respect to the presence of sidewalks is -0.14; and the elasticity of VMT with respect to a “Pedestrian Environment Factor” is -0.19. That is, a ten percent increase in “Pedestrian Environment Factor” reduces VMT by 1.9%. Based on the New Visions commitment to bicycle and pedestrian improvements, it is reasonable to expect an increase in walking and cycling that will correspond to a 1.5% decrease in future VMT.

- **Investments in Demand Management**- The New Visions Plan investments in demand management will fund parking cash-out, transportation allowance, broad transit pass programs and greater awareness of carpool and transit Guaranteed Ride Home programs, using CMAQ funds. The TDM initiatives are spearheaded by CDTC, which is actively involved in implementation and evaluation efforts. Our expansion target is a state worker “Commuter Cash” program. Existing transit pass, GRH and marketing programs will also be under this item. Eligible program activities include:

  - Transit Pass Subsidies/Try Transit Programs/LINK Program with private operators
  - Guaranteed Ride Home Programs for transit users and carpoolers
  - Occasional Use Parking Programs
  - Carpool/Vanpool Programs—Ridematching, Park and Ride
  - Telecommuting Support

  The New Visions Plan calls for continuing this investment level by spending $46 million of investment in Demand Management programs between 2007 and 2030. The New Visions Plan TDM initiatives are

[4] *Emissions Benefits of Land Use Planning Strategies*, FHWA TOPR 29, December 20, 2004.

expected to result in 0.5 % reduction in 2030 VMT compared to the New Visions “No Build” scenario.

Table 18 compares population, household and employment forecasts with CDTC forecasts of PM peak hour trips and PM peak hour VMT, based on the STEP Model. These forecasts are based on the implementation of the New Visions Plan, and they assume that PM peak hour auto travel will grow as a function of household growth. The same trip generation equations are used in the future years as were used in 2000 and 2007.

Table 18 also shows PM peak hour growth in trips under the “No Build” scenario. This scenario is based on the assumption that the New Visions Plan was not implemented, and that trend growth continues in travel. Trend growth has been modeled by CDTC to occur at about twice the rate of household growth from 2000 to 2030.

Table 18
CDRPC Forecasts of Population, Households and
CDTC Forecasts of PM Peak Hour Trip Generation

	1980	1990	2000	2007	2020	2030
Population	741,580	777,783	794,293	*816,554*	848,107	867,000
Households	267,427	299,244	318,255	*331,867*	352,694	366,081
Employment	325,851	406,529	428,799	*446,823*	473,854	485,794
Persons/HH	2.77	2.60	2.50	*2.47*	2.40	2.37
Plan PM Peak Hour Trips	NA	189,961	214,318	225,606	239,670	249,288
Plan PM Peak Hour VMT	NA	1,559,507	1,815,079	1,910,784	2,015,145	2,093,621
No Build PM Peak Hour Trips	NA	189,961	214,318	225,606	265,339	283,665
No Build PM Peak Hour VMT	NA	1,559,507	1,815,079	1,910,784	2,206,887	2,352,923

Note: 2007 numbers (in italics) for population, households and employment were interpolated.

3.4 Methodology to Estimate Daily VMT

A new methodology was developed for estimating daily VMT. The methodology develops trip generation and traffic assignments for three additional times of day: AM peak hour (8:00 AM), mid day (12:00 PM) and night time (9:00 PM), in addition to the PM peak hour (5:00 PM). For the year 2000, these four time of day traffic assignments were run, and the hourly distribution shown in Table 19 was used to expand the VMT estimates to a daily estimate of VMT.

Table 19
Capital District Percent VMT by Hour of the Day and Period of the Day.
Source: Analysis of 2001 National Household Transportation Survey
Analysis by NYSDOT**.**

AM Period		Midday Period		PM Period		Nighttime Period	
Hour	**VMT%**	**Hour**	**VMT%**	**Hour**	**VMT%**	**Hour**	**VMT%**
6:00 AM	1.68	**10:00 AM**	6.50	**4:00 PM**	9.33	**8:00 PM**	3.67
7:00 AM	5.52	**11:00 AM**	6.01	**5:00 PM**	10.05	**9:00 PM**	2.49
8:00 AM	7.58	**12:00 PM**	5.48	**6:00 PM**	7.04	**10:00 PM**	2.08
9:00 AM	6.46	**1:00 PM**	5.67	**7:00 PM**	5.07	**11:00 PM**	0.95
Total	**21.24**	**2:00 PM**	5.78	**Total**	**31.49**	**12:00 AM**	0.70
		3:00 PM	6.41			**1:00 AM**	0.44
		Total	**35.85**			**2:00 AM**	0.10
						3:00 AM	0.05
						4:00 AM	0.39
						5:00 AM	0.56
						Total	**11.43**

Under the No Build forecast, hourly distributions of traffic are assumed to remain the same into the future. Under the New Visions Plan forecasts, it is assumed that the plan will be successful in spreading some traffic away from the PM and AM peak hours, as shown in Table 20.

The New Visions Plan expects VMT growth to be moderated through a combination of actions, including the substitution of communication for travel, increased carpooling, increased non-auto travel (transit, walking and cycling), shorter trip lengths (due to proximity of activities), spreading of peak hour trips to off-peak hour, increased telecommuting and slowing of the projected growth in the number of cars. Some of these factors will reduce auto trips throughout the whole day, while some actions will either shift travel away from the peak hour or reduce travel in the peak hour without reducing travel during the off peak hours. Previous CDTC analysis has assumed that under the New Visions Plan, peak hour auto trip growth would be moderated to grow at the same pace as household growth, and then extrapolated that pace of growth to daily VMT.

Past travel data has indicated that daily VMT growth is growing faster than peak hour growth. In addition, further analysis has indicated that some of the New Visions actions would primarily affect peak hour growth. Based on this analysis, a future year distribution of hourly traffic volumes was developed that corresponds to the implementation of the New Visions Plan, as shown in Table 20. Under the New Visions Plan, peak hour trips (AM peak and PM peak) are expected to grow at the same rate as households; and off peak trips are expected to grow 50% faster than households. Under the No Build scenario, without the New Visions Plan, the trend growth rate is expected to be twice the household rate of growth.

Table 20
Capital District Percent VMT by Hour of the Day and Period of the Day.
With Future Peak Hour Spreading

AM Period		Midday Period		PM Period		Nighttime Period	
Hour	**VMT%**	**Hour**	**VMT%**	**Hour**	**VMT%**	**Hour**	**VMT%**
6:00 AM	1.71	**10:00 AM**	6.59	**4:00 PM**	9.46	**8:00 PM**	3.72
7:00 AM	5.60	**11:00 AM**	6.09	**5:00 PM**	9.31	**9:00 PM**	2.52
8:00 AM	7.20	**12:00 PM**	5.56	**6:00 PM**	7.13	**10:00 PM**	2.11
9:00 AM	6.55	**1:00 PM**	5.74	**7:00 PM**	5.14	**11:00 PM**	0.97
	21.05	**2:00 PM**	5.85		**31.04**	**12:00 AM**	0.71
		3:00 PM	6.50			**1:00 AM**	0.44
			36.33			**2:00 AM**	0.10
						3:00 AM	0.05
						4:00 AM	0.39
						5:00 AM	0.56
							11.58

Future year traffic assignments were prepared under these assumptions for 2020 and 2030 for the "Plan Build" and "No Build" scenarios. Traffic assignments were run for four times of day: PM peak hour, AM peak hour, Mid Day, and Night Time; the results were then factored to 24 hours using the factors shown in Tables 19 and 20. Table 19 was used for the No Build scenarios and Table 20 was used for the Plan Build scenarios. The results are shown in Table 21 and Figure 3.

Table 21
CDRPC Forecasts of Population, Households and
CDTC Forecasts of PM Peak Hour Trip Generation

	2000	**2007**	**2020**	**2030**
Population	794,293	*816,554*	848,107	867,000
Households	318,255	*331,867*	352,694	366,081
Plan PM Peak Hour VMT	1,815,079	1,910,784	2,015,145	2,093,621
Plan Daily VMT	18,098,536	20,156,432	21,579,455	22,798,140
No Build Daily VMT	18,098,536	20,156,432	22,394,158	23,985,998

Note: 2007 numbers (in italics) for households and employment were interpolated.

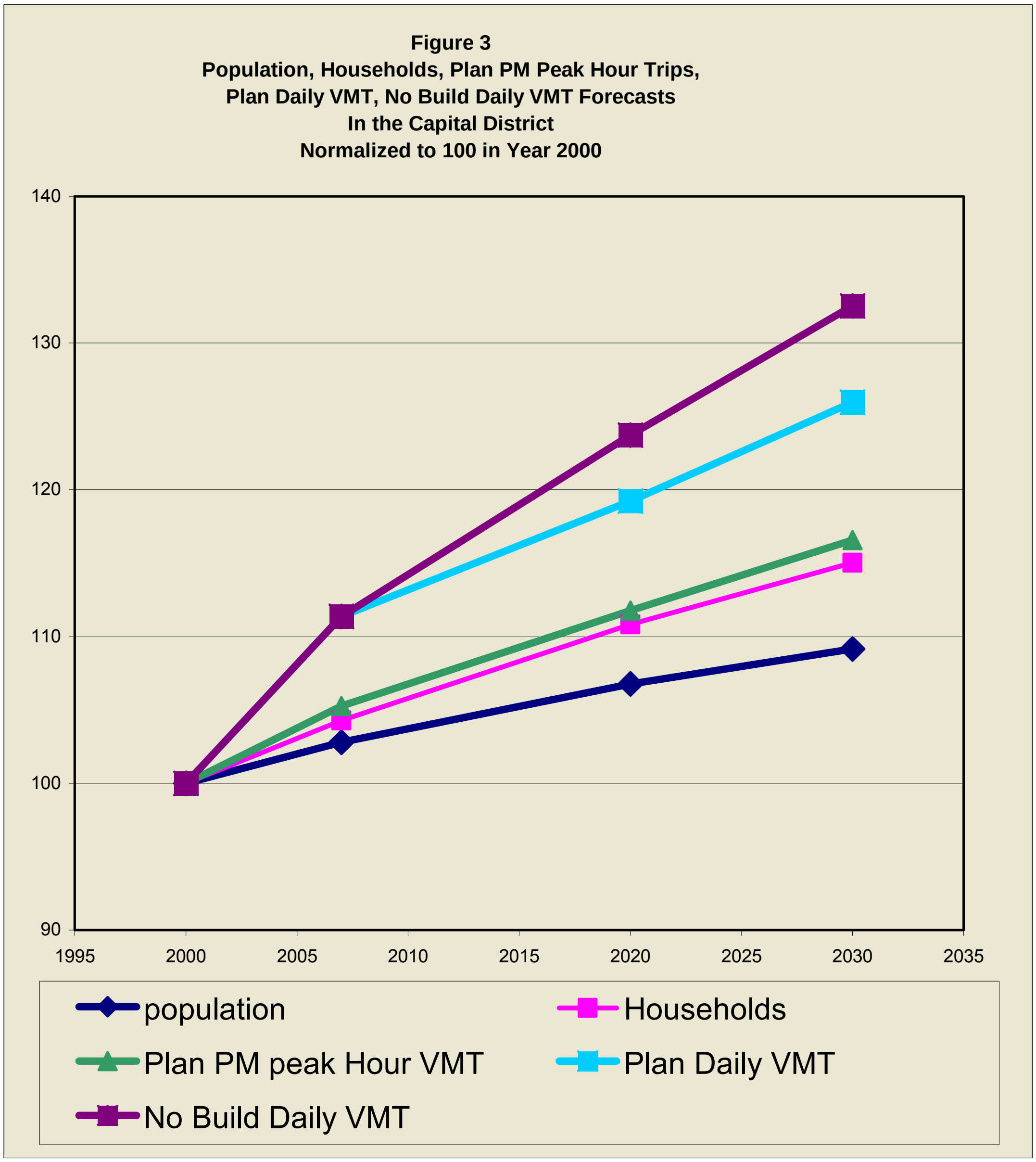


Figure 3
Population, Households, Plan PM Peak Hour Trips,
Plan Daily VMT, No Build Daily VMT Forecasts
In the Capital District
Normalized to 100 in Year 2000
140
130
120
110
100
90
1995
2000
2005
2010
2015
2020
2025
2030
2035
population
Households
Plan PM peak Hour VMT
Plan Daily VMT
No Build Daily VMT