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Middle Rio Grande Regional Travel Model Recalibration and Validation Report

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TABLES OF COTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

In order to support pending analysis for the Metropolitan Transportation Plan (MTP), Mid-Region Council of Governments (MRCOG) requested that the existing "standard" regional model be recalibrated and validated to current conditions. The "standard" regional model is known informally as "Hicks" model, and it was recently converted to CUBE from emme2 under a previous contract. The objective of this limited recalibration was to ensure that the standard model provided a reasonable forecasting process for MRCOG's near term needs prior to obtaining new survey data and the anticipated model update tentatively scheduled for 2011. This current project was performed under two separate scopes of services which are briefly discussed below.

1.1 Initial Scope of Services

An analysis was initially performed to evaluate whether the current model could adequately replicate observed travel patterns from the 2007-2008 baseline condition. The effort utilized existing traffic counts and highway performance data as well as transit ridership data and recent patterns from the transit on-board survey conducted in 2004. The model networks were verified, modified, and refined to existing conditions observed from aerials and the baseline transit service available in 2008 as needed.

An evaluation was conducted and the analysis results were presented to MRCOG staff on September 22, 2009. Based on the evaluation results several significant deficiencies were identified and a decision was made to recalibrate the model and to further refine the model networks to reflect current conditions. This supplemental effort is described in detail in the following section of this report.

1.2 Additional Scope of Services

The additional scope of services included all of the necessary modifications and refinements identified during the model evaluation task, with particular emphasis on resolving several deficiencies in the transit estimation procedures and improving the estimation of highway demand and performance characteristics, such as speed. The recalibration effort was primarily on trip distribution and highway assignment. Mode choice was recalibrated in an aggregate setting, focusing on regional mode shares and ridership by mode. The following additional tasks were performed.

- The highway network coding was reviewed to ensure symmetry.
- The network procedures for walk and auto access were modified.
- The transit path-building parameters were adjusted to ensure consistency across the model structure.
- The off-peak transit assignment process was altered to be equivalent to the peak period transit assignment.

- All cost terms in the model (auto operating costs, parking costs, transit fares, and incomes) were converted to the baseline year in the original model estimation using the available documentation and professional judgment.
- The volume delay functions were updated to ensure consistency and reflect the latest “state-of-the practice” standards.
- Period specific capacity scaling factors were reviewed and adjusted.
- The trip generation procedure from the Enhanced Transit Regional Model was implemented within the standard model.

It should be noted that the model recalibration was limited to adjustments and refinements that could be implemented without modifying the basic structure of the standard model. While there were several situations that modifications to the structure were required due to inconsistencies, many elements and coding conventions of the model remained the same. These limitations ultimately influenced the ability of the recalibrated model to achieve the proposed calibration criteria in each model component.

1.3 Report Overview

This report is divided into four major sections. **Section 2** describes the validation approach, which includes the validation data set and the validation criteria. **Section 3** briefly describes the Standard Regional Model and the sensitivity analysis. The discussion provides the background for the model recalibration and refinements, which are discussed in the section that follows. Details of the recalibration and refinements are found in **Section 4**. The validation results are presented in **Section 5**, the last section of the report.

2 MODEL VALIDATION

2.1 Introduction

Model validation involves testing the model’s predictive capabilities. To ensure that a travel demand model can provide adequate future-year estimates of demand, the model must be able to replicate observed conditions within reasonable ranges. This section discusses the data set collected for validation purposes, followed by the description of the validation criteria used to evaluate.

2.2 Validation Data Set

Systra Mobility, in conjunction with Planning Technologies (PT) staff collected observed travel data and performance data, such as speed/travel time runs, for use in the model calibration. The traffic count data was reviewed for the purposes of modeling and posted to the network links. For facilities where speed or travel time data were available, unique group codes were assigned to the network links for calculating estimated speeds and travel times from the model with an automated extraction process. Time of day traffic counts were posted to key screen-lines for use in adjusting the time of day modeling. Observed transit ridership data and runtime data for the existing bus service were collected. Run time information was obtained from existing transit schedules provided by MRCOG staff. The transit on-board survey data was reviewed and assessed for potential use in the project. The validation data is briefly described in the remainder of this section.

2.2.1 Census Data

2000 Census journey to work flow data was obtained through Planning Technologies in a GIS boundary shape file. The region was subdivided into twelve (12) districts. The information was provided in a GIS shape file, in which the relationship between the TAZ and the district was obtained. For comparison purposes, the journey to work flow data and the estimated model trips were aggregated into twelve districts. **Table 1** shows the equivalency table between TAZ and the districts.

Table 1 TAZ/District Equivalency Table

District Number	District Name	Taz Numbers
1	RR/Corrales	14-112
2	Bernalillo/SW SandCo	113-131
3	East Mountains	133-165
4	Valencia Co.	166-242
5	S Valley/SW Mesa	302-387
6	West Mesa	454-549, 578
7	NE Heights	132, 579-756
8	SE Heights/ KAFB/MDS	757-849
9	Edgewood/S Santa Fe Co.	850-865
10	N. Valley	388-453, 550-577
11	S Valley E of River	257-258, 289-301
12	CBD	243-256, 259-288

2.2.2 Traffic Count Data

The following traffic count data was provided.

- 2008 average weekday traffic volumes
- Three-hour AM (6:30 – 9:30 AM) and PM (3:00 – 6:00 PM) traffic volumes
- AM and PM peak hour traffic volumes

Originally the 2008 daily traffic count and the AM and PM peak hour traffic count data were provided. Due to the fact that the model estimates peak period volumes, three-hour traffic count data was subsequently requested and provided by MRCOG staff. The intent was to use the three-hour AM and PM traffic count data together with the daily traffic count data for the recalibration; however, various issues were identified with the three-hour traffic count data that limited its usefulness in the calibration effort. The ratio of peak period to daily traffic volumes shown in **Table 2** illustrates the major issues. An analysis was conducted to evaluate the reasonableness of the traffic count data. The evaluation computed the ratio of the peak period volume to the daily traffic volume. The ratio should be within a typical range. Based on professional experience and reviewing literature, the typical range for the AM period should be between 0.20 and 0.30, and 0.25 to 0.35 for the PM period. Based on these ratios, about 66% of the links with AM period count data and about 57% for the links with PM period count data were outside the typical range.

Table 2 Ratio of Peak Period to Daily Traffic Volumes

Ratio Range	AM Period		PM Period	
	# Links	**Percent**	**# Links**	**Percent**
0.00-0.05	37	0.54%	20	0.29%
0.05-0.10	457	6.72%	61	0.90%
0.10-0.15	1,427	20.98%	281	4.13%
0.15-0.20	1,857	27.30%	898	13.20%
0.20-0.25	*1,437*	*21.12%*	1,898	27.90%
0.25-0.30	*874*	*12.85%*	*1,899*	*27.91%*
0.30-0.35	354	5.20%	*1,054*	*15.49%*
0.35-0.40	176	2.59%	393	5.78%
0.40-0.45	83	1.22%	114	1.68%
0.45-0.50	34	0.50%	58	0.85%
0.50-0.55	27	0.40%	48	0.71%
0.55-0.60	18	0.26%	21	0.31%
>0.60	22	0.32%	58	0.85%
Total	**6,803**		**6,803**	

As a result, only the daily traffic volume and the speed data were used as the major data set to calibrate and validate the highway elements of the model. **Table 3** shows the extent of the coverage. The highway network had a total of 8,640 links, in which 60% of these links had the daily traffic count data and covered 51% of the link miles.

Table 3 Daily Traffic Count Data Coverage

Category	Category Name	Total Number of Links	% Coverage by Link	Total Distance (miles)	% Coverage by Mile
7	Urban freeway	331	29%	165	28%
8	Urban entrance ramps	145	61%	22	70%
9	Urban exit ramps	163	56%	24	67%
1	High speed ramps	42	12%	6	14%
6	Urban freeway frontage roads	128	76%	20	74%
10	Limited access principal arterials	650	67%	206	69%
2	Urban principal arterials	1,780	77%	406	72%
3	Urban minor arterials	1,764	71%	397	67%
4	Urban collectors	2545	56%	645	53%
5	Urban locals	136	32%	31	21%
	Urban Subtotal	**7684**	**64%**	**1,923**	**59%**
17	Rural freeway	128	32%	146	41%
18	Rural entrance ramps	35	40%	8	36%
19	Rural exit ramps	41	29%	9	29%
16	Rural freeway frontage roads	24	0%	19	0%
12	Rural principal arterials	1	0%	0	0%
14	Rural major collectors	396	30%	329	25%
11	Rural minor collectors	138	51%	141	40%
15	Rural locals	193	14%	113	11%
	Rural Subtotal	**956**	**30%**	**764**	**28%**
	Grand Total	**8,640**	**60%**	**2,686**	**51%**

Twenty-eight (28) screen-lines were identified by MRCOG staff; however, not every link on the screen-lines had observed traffic count data. **Table 4** depicts the total links and the percent coverage for each of the screen-lines. It should also be noted that several of these screen-lines were relatively limited in that they intercepted only a few roadways and relatively low volumes. As such these screen-lines were more typical of cutlines focusing on specific corridors rather than regional flow patterns.

Table 4 Traffic Count Data Coverage at Screenlines

ScreenLine	Name	Total Links	Percent Coverage
1	Rio Grande - Val. Co.	8	100.0%
2	Rio Grande - Bern. Co.	16	100.0%
3	Rio Grande - Sand. Co.	2	100.0%
4	N. of I-40 - Abq. W. of B	21	100.0%
5	N. of I-40 - Abq. E. of B	25	100.0%
6	N. of I-40 - E. Mnts.	16	100.0%
7	S. of I-40 - Abq. W. of B	19	100.0%
8	S. of I-40 - Abq. E. of B	27	100.0%
9	S. of I-40 - E. Mnts.	16	87.5%
10	E. of I-25 - Val. Co.	10	100.0%
11	E. of I-25 - S. of Big-I	21	100.0%
12	E. of I-25 - N. of Big-I	24	95.8%
13	E. of I-25 - Sand. Co.	4	100.0%
14	W. of I-25 - Val. Co.	4	100.0%
15	W. of I-25 - S. of Big-I	19	100.0%
16	W. of I-25 - N. of Big-I	22	95.5%
17	W. of I-25 - Sand. Co.	4	100.0%
18	Sandoval Co. - W. of River	10	100.0%
19	Sandoval Co. - E. of River	4	100.0%
20	Valencia Co. - W. of River	4	100.0%
21	Valencia Co. - E. of River	2	100.0%
22	Tijeras Canyon	4	100.0%
23	CBD	30	100.0%
24	Big-I I-25 S. of Interchange.	2	100.0%
25	Big-I I-25 N. of Interchange	2	100.0%
26	Big-I I-40 W of Interchange	2	100.0%
27	Big-I I-40 E. of Interchange	2	100.0%
28	NA	8	100.0%

NA name not provided by MRCOG staff

2.2.3 Speed data

The AM and PM peak hour speed data was provided on most of the links with traffic count data. The speed data was used to compute the observed travel time. A total of 30 corridors were identified and they are listed in **Table 5** with the information of the total distance for the corridor and the percent coverage for the AM and PM peak hour. Corridors 1 to 9 were first identified by Systra Mobility for Interstate freeway links and major arterials, the rest of the corridors were added by MRCOG staff subsequently. Not every link in the corridors had speed data, as indicated in **Table 5**. Note that the speed data was collected at different times (or years) for various studies. The number of runs conducted also varied.

Table 5 Travel Time Corridors

Corridor ID	Corridor Name	Direction	Total Distance (Miles)	Percent Coverage	
				AM	PM
1	I-25	NB	41.0	99%	69%
		SB	41.4	65%	100%
2	I-40	WB	13.4	77%	100%
		EB	13.5	46%	71%
3	N Valley –CBD	NB	9.9	93%	82%
		SB	9.8	90%	69%
4	Central Ave, E of River	EB	8.4	75%	92%
		WB	8.4	92%	56%
5	Montano Rd - Montgomery Blvd	EB	12.6	75%	85%
		WB	12.6	50%	68%
6	Central Ave, W of River	WB	3.6	100%	100%
		EB	3.6	100%	100%
7	Coal Ave/Lead Ave	EB	7.9	42%	100%
		WB	7.9	83%	83%
8	Eubank Ave	SB	6.3	84%	100%
		NB	6.3	69%	76%
9	Bridge Blvd	WB	10.5	95%	75%
		EB	10.5	95%	80%
10	NM 47	NB	19.2	88%	7%
		SB	19.2	31%	99%
11	NM 6	EB	3.3	93%	100%
		WB	3.3	100%	11%
12	Rio Bravo	EB	4.3	71%	100%
		WB	4.3	71%	71%
13	Isleta	NB	3.2	100%	100%
		SB	3.2	100%	100%
14	Gibson	EB	0.8	100%	100%
		WB	0.8	100%	100%
15	Unser	NB	5.0	32%	100%
		SB	5.0	100%	32%
16	Coors	NB	7.6	94%	100%
		SB	7.6	100%	72%
17	Golf Course	NB	6.6	100%	93%
		SB	6.6	100%	100%

Table 5 Travel Time Corridors (cont')

Corridor ID	Corridor Name	Direction	Total Distance (Miles)	Percent Coverage	
				AM	PM
18	4th St	NB	7.2	72%	96%
		SB	7.2	100%	63%
19	2nd St	NB	7.0	89%	100%
		SB	6.0	100%	76%
20	Menaul	EB	8.4	18%	82%
		WB	8.4	100%	24%
21	Osuna	EB	2.5	10%	20%
		WB	2.5	100%	90%
22	San Mateo	NB	6.4	63%	94%
		SB	6.4	100%	93%
23	Wyoming	NB	7.0	68%	86%
		SB	7.0	100%	100%
24	Tramway	NB	7.5	100%	50%
		SB	7.5	100%	8%
25	Paseo del Norte	EB	9.5	100%	100%
		WB	9.5	100%	100%
26	Eubank	NB	7.2	73%	79%
		SB	7.2	86%	100%
27	Alameda	EB	5.1	80%	100%
		WB	5.1	81%	81%
28	NM 528	NB	10.3	100%	100%
		SB	10.3	100%	100%
29	US 550	EB	2.3	100%	100%
		WB	2.3	100%	100%
30	Southern Blvd	EB	2.3	100%	76%
		WB	2.3	68%	100%

2.2.4 Transit Data

The following transit related data were provided.

- Observed transit schedule time by route
- Daily transit ridership in October 2008 by route
- Observed station activity by direction for the Rail Runner Service on April 14, 2009
- 2004 on-board survey data summary

Supplemental information regarding the actual routing and schedule times were also downloaded for some of the routes from the ABQ Ride web site (http://www.cabq.gov/transit/) to verify data. In addition, transit fare information was also downloaded from the same web site to estimate the average transit fare.

2.2.5 Other Documentation

The technical report of *Travel Demand Model Modifications for the Albuquerque Region New Mexico*, prepared by Parsons Brinckerhoff and dated August 2001 was reviewed. Available emme2 macro scripts and C++ program source code were also checked whenever questions arose. In addition, various reports were reviewed regarding information of other regional model statistics and guidance for validation criteria.

2.3 Validation Criteria

Proposed validation criteria were established from relevant industry guidance issued by FHWA and other sources[1],[2],[3]. The criteria were focused primarily on those standards recognized for trip distribution and highway assignment procedures. Trip distribution was validated against average trip lengths by purpose and coincidence ratios as well as other criteria such as district-district flows. The highway assignment criteria consisted of standard measures such as VMT by facility type and area type, root mean square error analysis by volume group and volumes at screen-lines. The criteria were proposed to MRCOG staff in a meeting on September 22, 2009. Note while the overall model was recalibrated to acceptable levels of replication, the model could not achieve all of the criteria for every model component due to various issues encountered while recalibrating the model. Details of the validation criteria can be found in **Appendix A**.

3 STANDARD REGIONAL MODEL

3.1 Introduction

The standard Albuquerque Region Travel Demand Model was last updated by Parsons Brinckerhoff in 2001 as part of the Middle Rio Grande Connections Study. Changes made to the then existing model were documented in the *Travel Demand Model Modifications, Technical Report*, dated August 2001. The original model was developed in emme2 following the traditional four-step modeling process. Citilabs converted the model to CUBE VOYAGER in 2008. Systra Mobility reviewed the 2001 report and the CUBE VOYAGER scripts. The available emme2 script was consulted as necessary. This section of the report briefly discusses the elements of the model that had been reviewed or where changes were made for this project. Prior documentation should be referred to for more details about the previous emme2 model. This section concludes with the sensitivity analysis conducted for the standard regional model as part of the initial scope of services.

[1]TCRP Report 73. Characteristics of Urban Transit Demand. TRB. 2002
[2] Travel Demand Model Modifications Technical Report for the Albuquerque Region New Mexico, prepared by Parsons Brinckerhoff. August 2001
[3] Model Validation and Reasonableness Checking Manual. FHWA. February 1997

3.2 Cost Components

After carefully reviewing the scripts and the previous documentation, it was determined that the cost components were in 1992 dollars. This was consistent with the data used in the original model estimation project. Note that all cost terms in the model needed to be converted back to equivalent 1992 values and procedures employed for this conversion are discussed in detail provided later in **Section 4.3.5**. The following sections below describe the cost components used in the model.

3.2.1 Income

Zonal households were stratified into five (5) income groups based on the distributions shown in **Table 6**. The income group was identified by the index number which was provided in columns 121-122 of the socio-economic data file.

Table 6 Income Distributions

Index	Low	Low-Median	Median	Median-High	High
1	0.3285	0.1680	0.2262	0.2195	0.0578
2	0.1929	0.1332	0.2539	0.3108	0.1092
3	0.1261	0.1031	0.2263	0.3915	0.1530
4	0.0880	0.0687	0.1747	0.4237	0.2449
5	0.0481	0.0401	0.1051	0.3565	0.4502
source: WORKERAUTO program source code (worker and auto ownership sub-models)					

3.2.2 Value of Time

A value of time of $6.467/hour, derived from the 1991 annual income data, was assumed for the peak period. The off-peak value of time was $3.233/hour, half of the peak value of time was assumed.

3.2.3 Auto Operation Cost

The auto operation cost of 8 cents per mile was assumed. It was computed with an average gasoline cost of $1.20 per gallon and an average vehicle consumption rate of 15 miles per gallon.

3.2.4 Parking cost

Parking cost was added to the terminal impedance. The model assumed the average parking duration of 8 hours for work trips, and 2 hours for non-work trips. Parking cost was coded in an emme2 file named "**PARK$.311**", which is shown below.

```
c EMME/2 Module: 3.14(v7.01)   Date: 95-06-25 15:54   User: E199/AUA.......bci
c Project:      ALBUQUERQUE MODEL DEVELOPMENT
t matrices
d md23
a matrix=md23 pcost     0 2000 daily (8 hours) parking cost
   all  50010:  307  50020:  307  50030:  307  50040:  307  50050:  286
   all  50060:  286  50070:  286  50080:  286  50090:  286  50110:  200
   all  50120:  200  52610:  286  52720:  200  80110:   57  80120:   46
   all  51030:   71  51210:   71  51720:   36  51730:   36  52310:   36
   all  52410:   36  52620:  143  52710:   71  52730:   71  76840:   36
   all  76850:   36  76810:   36  76820:   36  76830:   36  76910:   36
   all  76930:   36  76940:   36  76950:   36  76960:   36
```

3.2.5 Transit Fare

The model accepted an input of an average transit fare for the entire transit service. An average transit fare of 34.7 cents was assumed for year 1992. Note that the local transit system included only local buses and transfers were free.

3.3 Zone System

3.3.1 Introduction

Traffic analysis zones (TAZs) are the basic geographic unit for inventorying demographic and land use data within a study area. This section describes the TAZ system observed from the CUBE VOYAGER highway network converted from the emme2 model and the mode choice model control files.

3.3.2 Traffic Analysis Zones

There are a total of 877 TAZs. Zones 1 to 13 are external stations. Zones 14 to 865 are internal zones. The remaining zones are "dummy" zones attached to nodes for park ride lots. These dummy zones were required for skimming drive access paths and loading drive access transit trips using park-ride lots in the emme2 transit assignment process. (These zones were not required by PT in CUBE VOYAGER). The mode choice model, which was developed for the emme2 model, was designed to handle up to 900 TAZs, however it was unclear whether the TAZs beyond 865 were reserved for transit dummy zones.

3.4 Highway Network

3.4.1 Introduction

This section describes the CUBE VOYAGER highway network, which was converted from the highway network in emme2 format using the Data Conversions Application developed by Citilabs. MRCOG Staff maintained the highway network in GIS format. The GIS shape file was then converted and the network data was stored in an emme2 databank. Highway link and node data were exported from the emme2 databank to text file format. The Data Conversions Application transformed this link and node data to the CUBE VOYAGER highway network.

3.4.2 Link Attributes

The CUBE VOYAGER highway network has 23 link attributes and they are listed in **Table 7**.

Table 7 Highway Link Attributes, Standard Model

Field Name	Field Type	Description
A	Numeric	A node
B	Numeric	B node
SCREENLINE	Numeric	Screenline ID from 1 to 13.
DISTANCE	Numeric	Link distance
MODESTR	character	emme2 link attribute fields. It is a combination of a, b, e, p, k, w, o, i, x, q, and l. Each character has a special meaning in emme2.
NLANES	Numeric	Number of lanes
FUNCTION	Numeric	Functional class, maintained by MRCOG staff
UL1	Numeric	Posted speed
UL2	Numeric	COD ID
UL3	Numeric	Subarea code, defined by MRCOG staff
CATEGORY	Numeric	Facility type. The attribute codes are 2 - Urban principal arterials 3 - Urban minor arterials 4 - Urban collectors 5 - Urban locals 6 - Urban freeway frontage roads 7 - Urban freeway 8 - Urban entrance ramps 9 - Urban exit ramps 10 - Limited access principal arterials 11 - Rural minor collectors 12 - Rural principal arterials 13 - Rural minor arterials 14 - Rural major collectors 15 - Rural locals 16 - Rural freeway frontage roads 17 - Rural freeway 18 - Rural entrance ramps 19 - Rural exit ramps 20-22 - dummy links 50 - transit drive access links 99 - centroid connector links

Table 7 Highway Link Attributes, Standard Model (cont')

Field Name	Field Type	Description
ISAUTO	Numeric	A binary field to identify auto is allowed on the link. IsAUTO = 1 if "a" is found in MODESTR
ISBUS	Numeric	A binary field to identify bus is allowed on the link. IsBUS = 1 if "b" is found in MODESTR
ISEXBUS	Numeric	A binary field to identify ex-urban bus is allowed on the link. IsEXBUS = 1 if "e" is found in MODESTR
ISPAR	Numeric	A binary field to identify the transit drive access link. IsPaR = 1 if "p" is found in MODESTR. CATEGORY=50
ISKAR	Numeric	A binary field to identify the transit drive access link. IsKaR = 1 if "p" is found in MODESTR. CATEGORY=50
ISWALK	Numeric	A binary field to identify a side-walk link. IsWALK = 1 if "w" is found in MODESTR. CATEGROY=2-19
ISWALKOUT	Numeric	A binary field to identify a transit walk access link in the direction from centroid to a network node. IsWALKOUT = 1 if "o" is found in MODESTR..CATEGORY=99 and ISWALKIN=0
ISWALKIN	Numeric	A binary field to identify a transit walk access link in the direction to a centroid from network node. IsWALKIN = 1 if" I" is found in MODESTR. CATEGORY=99 and ISWALKOUT=0
ISPNRTOBUS	Numeric	A binary field to identify a transit –only link connecting the node for a park ride lot or a dummy transit zone to a network node. IsPnRtoBUS = 1 if "x" is found in MODESTR. If the link to connected to a park ride lot node, CATEGORY=50 and the link is one-way. If the link is connected a transit dummy zone, CATEGORY=99, the link is two-way.
ISINFOPAR	Numeric	A binary field to identify a transit drive access link for a centroid connector link. IsInfoPaR = 1 if "q" is found in MODESTR. The link is used as part of the drive to park ride lot path.
ISINFOKAR	Numeric	A binary field to identify a transit drive access link for a centroid connector link. IsInfoKaR = 1 if "l" is found in MODESTR. The link is used as part of the drive to park ride lot path.
ONEWAY	Numeric	One-way flag, maintained by MRCOG staff

Note that attribute fields A, B, ONEWAY and the binary attribute fields were created by the CUBE VOYAGER conversion application. The values of the binary attribute fields were calculated by the CUBE VOYAGER conversion application based on the attribute values of MODESTR. It should be noted that once the network was converted, additional editing of these networks would require MRCOG staff to update the binary attribute fields manually.

3.4.3 Node Attributes

The node attribute fields are shown in **Table 8**. NORIG corresponded to the node ID field in the GIS shape file before the conversion. This field was used to create the linkage to the GIS polyline file for displaying the highway network in true shape.

Table 8 Highway Node Attributes, Standard Model

Field Name	Field Type	Description
N	Numeric	Node number
NORIG	Numeric	ID number corresponds to the node in the GIS shape file
X	Numeric	X-coordinate
Y	Numeric	Y-coordinate

3.4.4 Speed and Capacity

Link free-flow speed is a function of posted speed, which was manually maintained by MRCOG staff. Link free-flow speeds were automatically computed by the CUBE VOYAGER scripts at different stages in the model stream. Minimum free-flow speeds were imposed when calculating the free-flow travel time. **Table 9** shows the equations for computing the free-flow speeds.

Table 9 Link Free-Flow Speed, Standard Model

Category	Free-Flow Speed, mph	Minimum Free-Flow Speed, mph
7,17	$posted\ speed\ + 0.2\ \times\ (75 - posted\ speed)$	65.0
10-14	$posted\ speed\ + 0.2\ \times\ (75 - posted\ speed)$	16.5
2-6,8-9,15-16,18-19,20-22	$posted\ speed\ + 0.1\ \times\ (75 - posted\ speed)$	16.5

Link capacity was assigned according to the link based on category using a link capacity lookup table shown in **Table 10**.

Table 10 Link Capacity, Standard Model

Category #	Category Name	Per Hour Per Link Capacity
7	Urban Freeway	1,900
8	Urban Entrance Ramps	700
9	Urban Exit Ramps	700
6	Urban Freeway Frontage Roads	850
10	Limited Access Principal Arterials	1,100
2	Urban Principal Arterials	800
3	Urban Minor arterials	750
4	Urban Collectors	675
5	Urban Locals	600
17	Rural Freeway	1,900
18	Rural Entrance Ramps	900
19	Rural Exit Ramps	900
16	Rural Freeway Frontage Roads	850
12	Rural Principal Arterials	950
13	Rural Minor Arterials	950
14	Rural Major Collectors	850
11	Rural Minor Collectors	750
15	Rural Locals	750
20-22	Dummy Links	1,000
50	Transit-Only Links	600
99	Connector Links	600

3.5 Transit Network Elements

3.5.1 Introduction

Under CUBE VOYAGER, transit networks are developed by the Public Transport (PT) Routine. The PT routine abstracts transit networks using a series of files that represent transit lines, modes, operators, fares, speeds, and access connectors. Each of these elements describe different aspects of the transit network. This section discusses all the transit elements in detail.

The transit line file was a conversion of the emme2 transit network. Similar to the highway network, the transit network in the emme2 model was stored in the emme2 databank. Transit data was exported to a text file (with file extension 211) and reformatted to two VOYAGER PT line files, AM and OP (off-peak), using Citilabs' Data Conversions Application. The PT line file that was reviewed and described in this section was originally created from the transit network data stored in the 2004 emme2 databank. The transit data was converted to the format required by VOYAGER PT when Citilabs converted the regional model from emme2 to CUBE VOYAGER. In addition, Citilabs created other support file scripts for the modes, fares, and speeds, as well as scripts to automatically generate the access connectors to mimic the emme2 model. In a subsequent effort, MRCOG staff modified the 2004 PT line files to create the 2008 PT line files. The highway network was also edited by MRCOG staff to add the fixed guide-way links for the recently opened commuter rail service (Rail Runner).

3.5.2 PT Line Files

The transit routes were provided in two PT line files, one for the AM peak period and the other for the off-peak period. The transit lines defined the orientation and service frequency of each route that operates in a given time period. The attributes in the PT line files are summarized in **Table 11**. Note that only the first six (6) attributes are required by PT, the rest are optional.

Table 11 PT Line File, Standard Model

Attributes	Description
Name	Route name
Mode	Transit mode
Oneway	Flag to indicated one-way or two-way routes
Freq[1]	Peak period headway in minutes
Freq[2]	Off period headway in minutes
N	List of node sequence identifying the transit route
Vehicletype	An integer indicating the vehicle type operating for the transit route. The vehicle types are defined in SYSTEMFILE.PTS.
XYSpeed	Speed for link that do not exist in the underlying highway network
Timefac	Factor applied to the link travel time
Longname	Unique string identifier for the transit route

The parameters of VEHICLETYPE were defined in **SYSTEMFILE.PTS,** the PT system file**.** The values of TIMEFAC varied by transit modes but the local mode bus routes (mode 2) actually had two different codes. **Table 12** lists the TIMEFAC coding observed in the transit line files.

Table 12 TIMEFAC CODING, Standard Model

TIMEFAC	Transit Mode*
1.790	1
1.100	2
1.359	2
*1 – premium mode 2 – local mode	

3.5.3 Transit Modes

The standard model used six (6) transit modes, which were defined in the PT system file named **SYSTEMFILE.PTS**. The modes are described in **Table 13**.

Table 13 Transit Modes, Standard Model

Mode Number	Mode Description
1	Premium mode
2	Local mode
30	Input walk (access), one-way
31	Output walk (egress), one-way
32	Interchange walk (sidewalk links), two-way
33	Park-and-ride access, one-way
34	Park-and-ride egress, one-way

Modes 30 to 33 are non-transit modes. The premium mode included some express bus routes, the Rapid Ride bus service, and the Rail Runner commuter rail service. It should be noted that the existing documentation did not provide firm definitions for services to be categorized as premium services. Note also that neither the Rapid Ride service nor the Rail Runner was in service prior to December 2004. Thus, there was no clear guideline for coding the transit mode to the routes. **Table 14** lists the transit mode coding by route as provided by MRCOG staff.

Table 14 Transit Mode Coding by Routes, Standard Model

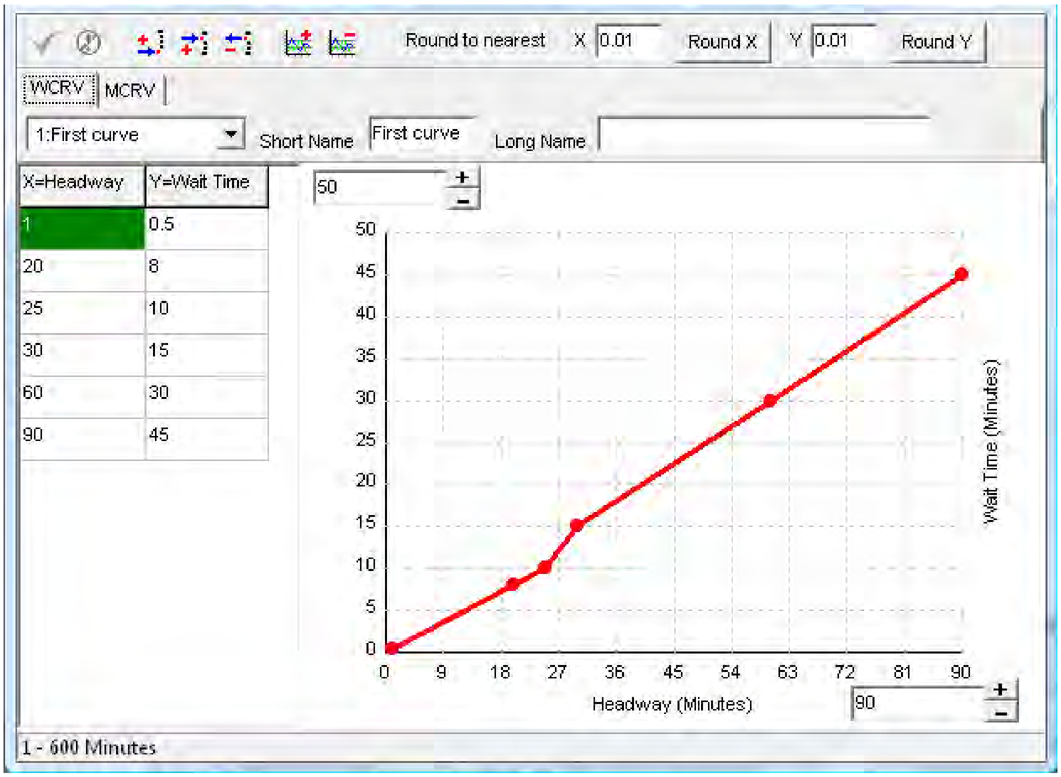
Route #	Route Name	Transit Mode	Route Service
92	Taylor Ranch Express	Premium	Peak hours commuter service
93	Academy	Premium	Peak hours commuter service
94	Unser Express	Premium	Peak hours commuter service
96	Crosstown Commuter	Premium	Peak hours commuter service
151	Rio Rancho/RR Conn.	Premium	Local all day service
222	Rio Bravo/Sunport/Kirtland	Premium	Local all day service
317	Downtown/KAFB Limited	Premium	Peak hours commuter service
766	Rapid Ride - Red Line	Premium	Peak hours commuter service
790	Rapid Ride - Blue Line	Premium	Peak hours commuter service
Rail Runner	Rail Runner	Premium	Peak hours commuter service
1	Juan Tabo	Local	Local all day service
2	Eubank	Local	Local all day service
3	Uptown/Cottonwood	Local	Local all day service
5	Montgomery/Carlisle	Local	Local all day service
6	Indian School	Local	Peak hours commuter service
7	Candelaria	Local	Peak hours commuter service
8	Menaul	Local	Local all day service
10	N. 4th St.	Local	Local all day service
11	Lomas	Local	Local all day service
12	Constitution	Local	Peak hours commuter service
13	Comanche	Local	Peak hours commuter service
31	Wyoming	Local	Local all day service
34	San Pedro	Local	Peak hours commuter service
36	Rio Grande/12th St.	Local	Local all day service
50	Airport/Downtown	Local	Local all day service
51	Atrisco/Rio Bravo	Local	Local all day service
53	Isleta	Local	Local all day service
54	Bridge/Westgate	Local	Local all day service
66	Central	Local	Local all day service
97	Zuni	Local	Local all day service
98	Wyoming	Local	Peak hours commuter service
140	San Mateo Line	Local	Local all day service
141	San Mateo Line	Local	Local all day service
155	Coors Blvd. Line	Local	Local all day service
157	Montano Uptown	Local	Local all day service
162	Ventana Ranch/Montano Plaza	Local	Peak hours commuter service
1618	The BUG	Local	Local all day service
Route1	Route 1	Local	Local all day service

Note: All routes were operated by ABQ Ride except Route 1, Route 350 Airport/Downtown Non-Stop Express was not coded

3.5.4 Wait Curve

The wait curves were used to relate the frequency of the transit service to the time the transit user had to wait at the transit station. **Figure 1** presents the wait curve used by the standard model. This curve says if the transit service had headway of 10 minutes, the rider would spend four minutes waiting at the transit stop or station; however, the wait time would become half of the headway if headway was thirty (30) minutes or longer.

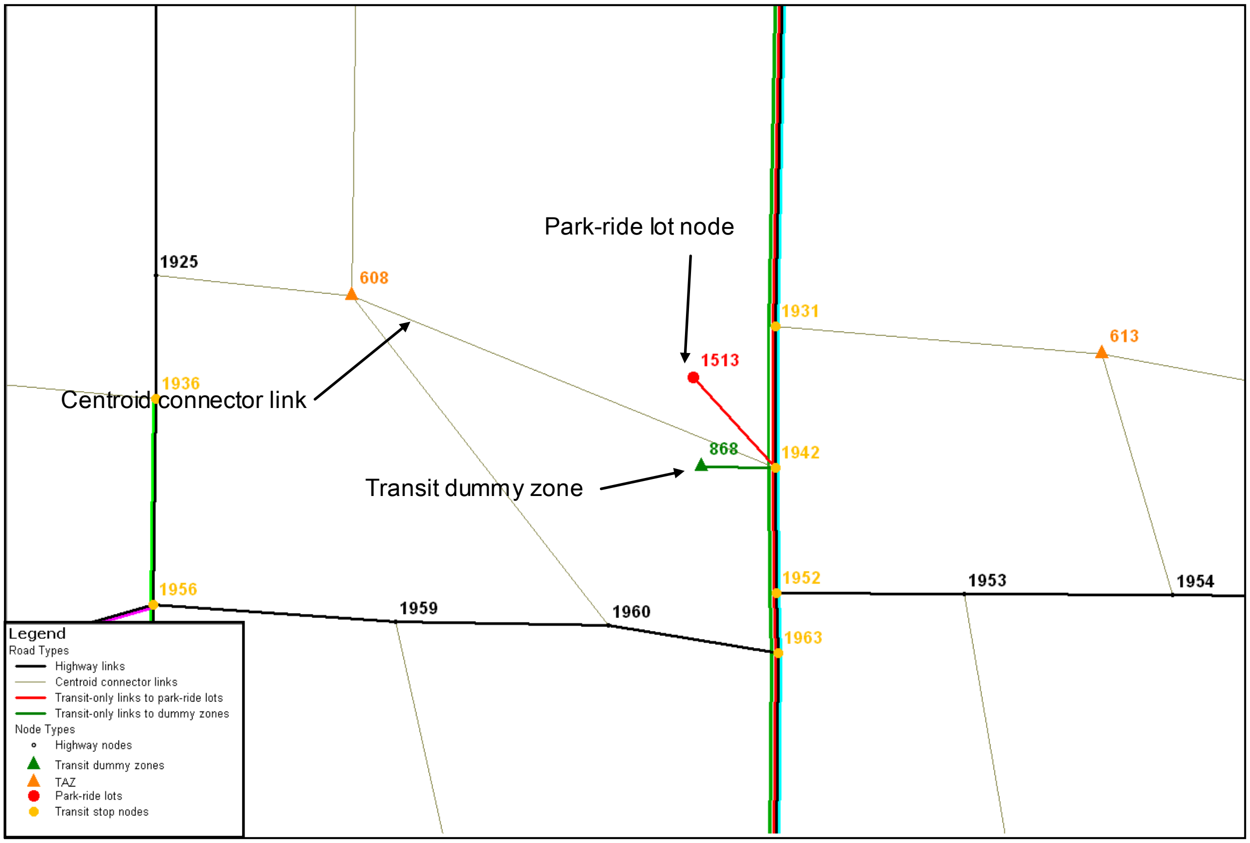
Figure 1 Wait Curve, Standard Model



3.5.5 Park-Ride Lots

Park-ride lots were coded to highway network as highway nodes. Each park-ride lot was accompanied by a transit dummy zone. In the 2004 transit network, there were fifteen (15) park-ride lots (nodes=1501-1515) and fifteen (15) transit dummy zones (TAZs from 863 to 877). The special coding rules for those links that were connected to the park-ride lot nodes and the transit dummy zones are discussed in **Section 3.5.7**. An example of the original coding for park-ride lots and associated transit dummy zones are shown in **Figure 2**.

Figure 2 Park-Ride Lots Coding, Standard Model



3.5.6 Transit Bus Stops

Transit bus stops were coded at nodes along the routes and the nodes were connected to centroid connector links. Note that both the Rapid Ride and Rail Runner services were not in service prior to 2004. **Figure 2** also shows an example of typical bus routes with stop nodes highlighted in yellow.

3.5.7 Transit-Only Links

Transit-only links were added to the highway network to support transit modeling. These links were maintained in the highway network, which could be more properly described as "transportation" since it included all of the physical infrastructure links that supports transportation. The following four types of transit-only links were coded:

- Transit-only links connecting park-ride lots to highway nodes
- Transit-only links connecting transit dummy zones to highway nodes
- Transit-only links connecting TAZ to park-ride lots
- Transit-only links for the walk network

The first three types of transit-only links were used to generate drive access links. More detailed discussion can be found in **Section 3.5.8**. The transit-only links for the walk network served as connector links for transfer between buses.

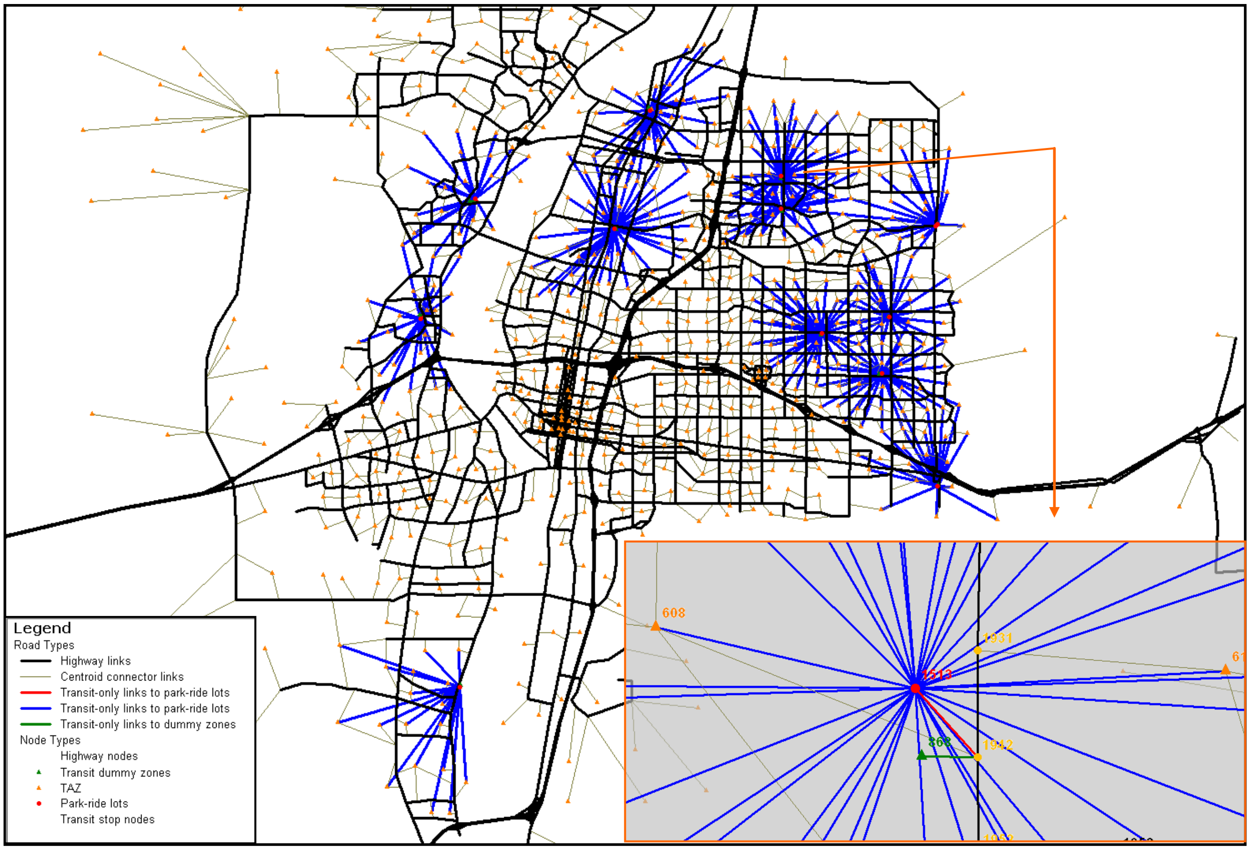
Table 15 Transit-Only Links Coding Rules, Standard Model

Link Attributes	Park-Ride Lot Nodes to Highway Nodes	Transit Dummy Zones to Highway Nodes	TAZ to Park-Ride Lot Nodes
CATEGORY	50	99	50
ISAUTO	0	1	0
ISBUS	0	0	0
ISEXBUS	0	0	0
ISPAR	0	0	1
ISKAR	0	0	1
ISWALK	0	0	0
ISWALKOUT	0	0	0
ISWALKIN	0	0	0
ISPNRTOBUS	1	1	0
ISINFOPAR	0	0	0
ISINFOKAR	0	0	0
Directionality	One-way only from park-ride lot to highway node	Two-way	One-way only from TAZ to park-ride lot

Examples of the transit-only links from park-ride lot node to highway nodes and from transit dummy zones to highway nodes are shown previously in **Figure 2.** **Figure 3** depicts the transit-only links that connected the TAZ to park-ride lots. The insert figure in **Figure 3** zooms into the same area shown previously in **Figure 2**. Note that the TAZ to park-ride lot transit-only links were inherited from the emme2 transit network. Note that this type of link is usually generated based on "actual" congested travel time in the highway network. It was believed that links were created by an undocumented "pre-processor" routine in emme2 which is no longer available.

The last type of the transit-only links in the bullet list represents links in a walk network. These are links available to only transit users walk from one highway node to another for either connecting to a walk access or egress links or as sidewalk link used for transferring between transit vehicles. These sidewalk links were found in the downtown area and some areas along Tramway Blvd.

Figure 3 TAZ to Park-Ride Lots Transit-Only Links, Standard Model



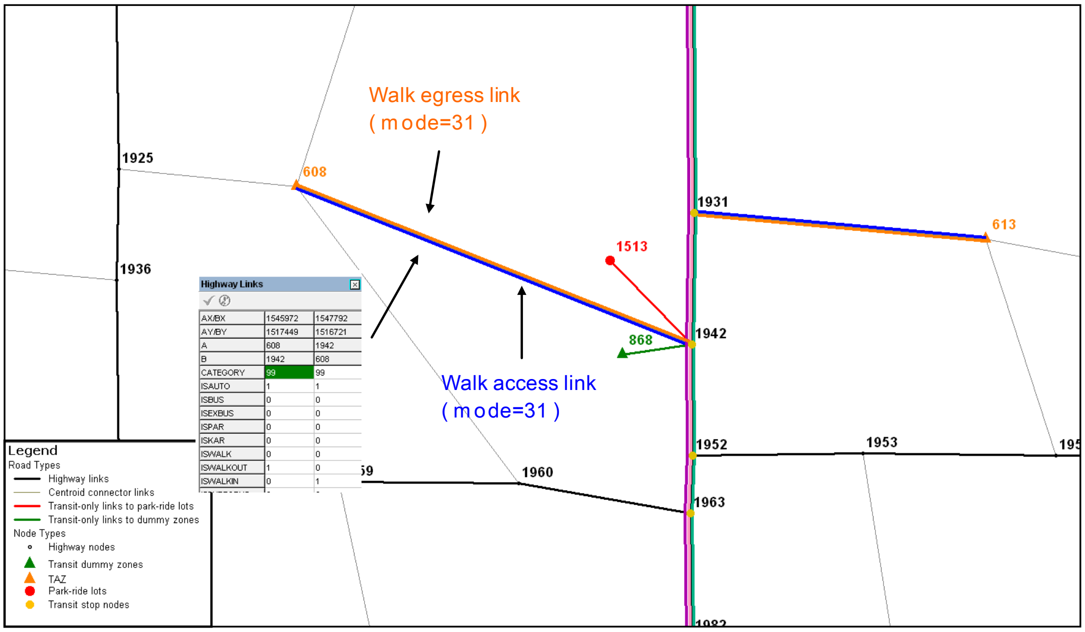
3.5.8 Transit Access/Egress Links

In a PT transit network, a TAZ is connected to the transit routes via access and egress links either by walk mode or drive mode. These types of access/egress links correspond to the mode specification in the mode choice model (see **Section 3.11**). The transit walk access modes include separate walk-to-local bus mode and walk-to-premium service modes, and the transit drive access modes including separate park-and-ride and kiss-ride modes. While neither the Rapid Ride nor the Rail Runner was in service prior to 2004, the same methodology was employed to generate the access/egress links for the various access modes to these services.

Walk Mode

One-way walk access and egress links were generated to connect the TAZ to transit stop nodes along the connector links. The coded values of the highway attribute fields ISWALKIN and ISWALKOUT were indicators of the directionality of the generated links. If ISWALKOUT=1, an access link would be generated from the TAZ to the transit stop node and a mode number of 30 would be assigned to the link. Likewise, if ISWALKIN=1, an egress link would be generated in the direction from the transit stop node to the TAZ and the assigned mode number would be 31. A walk speed of 3 miles per hour was assumed to compute the walk time. The coding convention is illustrated in **Figure 4**. Note that the values of ISWALKOUT and ISWALKIN on one direction of a centroid connector link cannot be set to 1 at the same time.

Figure 4 Transit Walk Access/Egress Links, Standard Model



Drive Mode

Similar methodologies were used to generate drive access links from TAZs to transit stop nodes for kiss-ride mode and to park ride lot nodes for park-ride mode. Mode number 33 was assigned to the access links. For the kiss-ride mode, a drive access link was generated at the same time when a walk access link was generated. For the park-ride mode, the drive access links were generated from the TAZ to the transit stop nodes using the TAZ to park-ride lot nodes and park-ride lot nodes to highway nodes transit-only links that were coded with CATEGORY=50. A car speed of 60 mph was assumed to compute the link travel time on the drive access links.

Note that drive access links in typical "state of the practice" models are usually generated along "actual" highway links based on congested travel time. As discussed in **Section 3.5.7**, the transit-only links with CATEGORY=50 were inherited from the emme2 highway network that was provided to Citilabs. It was believed that these access connector links already existing in emme2 highway network could have been created from an undocumented "pre-processor" routine which was no longer available. The routine most likely created the connections directly into the highway network based on the location of park ride lot nodes. As a result the source emme2 network used for the conversion to CUBE VOYAGER already had these links and they were automatically retained. Note however, that these access links could not be dynamically modeled for any new park-ride facilities would need to have access links created manually or through another automated process that would need to be developed.

3.6 Highway Skims

3.6.1 Introduction

The highway path-building procedure accumulates impedances for the auto modes defined in the mode choice model. The highway impedances include auto travel time, terminal time, as well as cost of parking. These impedances were used to calculate the generalized cost for travel between the production zone and attraction zone. The accumulated impedance values and the generalized cost are stored in a series of matrices referred to "skims" which became input files to the mode choice model.

3.6.2 Generalized Cost

The generalized cost accounts for the costs due to travel time, distance, and parking. Highway travel time and distance between zones (including intra-zonal pairs) were converted to equivalent costs by applying the value of time and the average auto operating cost. (See **Sections 3.2.2 and 3.2.3** for the discussion of the values of time and average auto operating cost). A factor of 0.500 was applied to the parking cost for computing the peak period generalized cost, while a factor of 0.125 was applied to the off peak period.

3.7 Transit Skims

3.7.1 Introduction

The transit path-building procedure is used to accumulate impedances for the transit modes defined in the mode choice model. The transit impedances include transit in-vehicle time and out-of-vehicle time such as walk time and wait time. The accumulated impedance values are stored in a series of matrices referred to as "skims". The skim files are input to the mode choice model. A set of four transit skim files, which is a combination of access mode and line-haul mode, were prepared for both the AM and off-peak time period. The combination of the access mode and line-haul mode is defined as follow:

- Walk access to local transit mode
- Walk access to premium transit mode
- Drive access to park-ride mode
- Drive access to kiss-ride mode

3.7.2 Mode Hierarchy

In the transit path-building procedure, it is necessary to define a mode hierarchy because a path could involve both the premium and local modes. For the Albuquerque regional model, the premium mode was the "primary" mode, while the local mode was the "secondary" mode.

Generating paths for the "walk to local bus" mode was accomplished by removing the premium mode service from the available services in the transit network. For the "walk to premium" mode path-building procedure, both the local and premium transit routes were available since the mode hierarchy permits local buses to service as an access & egress connection for those travelers that used a premium mode. Therefore if the minimum path between a given origin-destination zonal pair involved transferring between a local route and a premium route, the path would be treated as a walk to premium path.

3.7.3 Transit Time

Transit time is the time that the transit vehicle traverses on the link. It is usually a function of the link travel time on the highway side and it should be longer than the highway time to account for the transit dwell time, and acceleration and deceleration time. A global factor of 1.6 was applied to the link travel time. Note that the factor was multiplied to the link travel time before applying TIMEFAC coded at the PT line level.

3.7.4 Path-Building Parameters

In the path-building procedure, impedances along the path from the production zone to attraction zone were accumulated. The impedance included the in-vehicle travel time as well as out-of-vehicle travel time, such as wait time and transfer time. It is common that weight factors are applied to the various time components to reflect how a transit user perceives the time spent on that component. For example, the time spent on waiting is usually perceived to be more burdensome than the time spent on riding with the transit vehicle. The weight factors were specified in four factor files, which were used by different path-building procedures. The file names are shown in **Table 16** and the parameter specifications are depicted in **Table 17**. These factor files were used in the converted model.

Table 16 Transit Factor Files, Standard Model

Time	Sub-Mode	Factor File Names			
		FACTOR.FAC	FACTOR_PREM.FAC	FACTOR_PR.FAC	FACTOR_OP.FAC
Peak	WL	X			
	WP		X		
	PNR			x	
	KNR			x	
OffPeak	WL	X			
	WP		X		
	PNR				x
	KNR				x

WL Walk to local
WP Walk to premium
PNR Drive to park-ride
KNR Drive to kiss-ride

Table 17 Transit Factor Parameters, Standard Model

Parameters	Factor File Name			
	FACTOR.FAC	FACTOR_PREM.FAC	FACTOR_PR.FAC	FACTOR_OP.FAC
IWAITCURVE	1	1	1	1
XWAITCURVE	2	2	2	2
VALUEOFTIME	2*6.467	2*6.467	2*6.467	2*6.467
BRDPEN	10.4,10.4	10.4,10.4	0.625,0.625	10.4,10.4
MAXFERS	4	4	3	4
ALPHA	1.0	1.0	1.0	1.0
LAMBDAW	0.2	0.2	0.2	0.2
LAMBDAA	0.2	0.2	0.2	0.2
LOOKBACK	2.0	2.0	2.0	2.0
CHOICECUT	0.2	0.2	0.2	0.2
RUNFACTOR[1]	1.0	0.1	1.0	1.0
RUNFACTOR[2]	1.0	1.0	1.0	1.0
RUNFACTOR[30]	1.0	1.0	1.0	1.0
RUNFACTOR[31]	1.0	1.0	1.0	1.0
RUNFACTOR[32]	2.0	2.0	2.5	2.0
RUNFACTOR[33]	NA	NA	1.0	NA
WAITFACTOR	2.0	2.0	2.5	2.0
BESTPATHONLY	T	T	T	T
DELACCESSMODE	NA	NA	34	34
DELEGRESSMODE	34	34	34	34

3.7.5 Path-Building Procedures

The scripts for building paths for the walk to local and walk to premium were essentially the same with the exception of the factor files. Note the run-time factor of 0.1 for premium services in factor_prem.fac favored paths using premium modes. Likewise, the scripts for building drive to kiss-ride and drive to park-ride were the same.

3.8 Non-Motorized Skims

3.8.1 Introduction

Travel time and distance between the production and attraction zones for the non-motorized mode were accumulated using two path-building procedures, one for time and one for distance. The time skim value was compared to the walk to local and walk to premium transit skims. If the time skim value was a non-zero number and was less than the transit skim time, the transit model would be eliminated for travel between the production and attraction zones.

3.8.2 Path-Building

The path-building procedure for the walk time skim excluded the highway links that were coded with `ISWALKOUT=0, ISWALKIN=0, and ISWALK=0,` but allowed the path to pass through centroids. The accumulated impedance was free-flow travel time. In the path-building procedure for the distance skim, the highway link exclusive restriction was relaxed and the path was NOT allowed to pass through the centroid.

3.9 Trip Generation

3.9.1 Introduction

Trip generation estimates the number of person trip ends to and from a traffic analysis zone. Trip ends were stratified into eleven (11) trip purposes. Home-Based Work trip ends were further stratified by auto ownership. The trip purposes are shown in **Table 18**.

Table 18 Trip Purposes, Standard Model

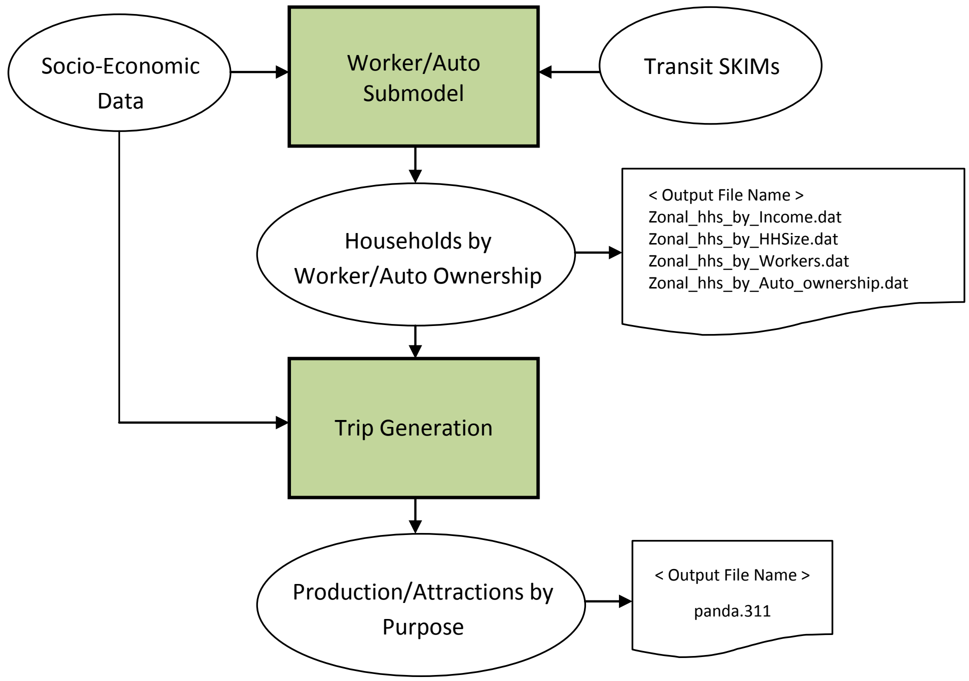
Trip Purposes	Auto Ownership
Home-Based Work (HBW), AM	0 auto ownership
	1 auto ownership
	2 auto ownership
	3+ auto ownership
Home-Based Work (HBW), PM	0 auto ownership
	1 auto ownership
	2 auto ownership
	3+ auto ownership
Home-Based Work (HBW), OP	All
Home-Based Elementary (HBES)	All
Home-Based High School (HBHS)	All
Home-Based University of New Mexico (HBUNM)	All
Home-Based Technical Vocational Institute (HBTVI)	All
Home-Based Shopping (HBSHOP)	All
Home-Based Other (HBO)	All
Non-Home-Based Work (NHBW)	All
Non-Home-Based Other (NHBO)	All
Truck	All
External-Internal	All

3.9.2 Methodology

The trip generation procedure is best described by the flow chart shown in **Figure 5**. The procedure began with two sub-models, the workers sub-model and the auto-ownership sub-model to estimate the number of households by number of workers and the number of households by auto ownership, as well as other input data for trip generation. The sub-models were executed through a C++ application (**AUTOWORKER.EXE**).

The production model used the method of cross-classification to estimate the production trip ends, and the attraction trip ends were predicted by the aggregate cross-classification attraction model. The execution of the trip generation model was through a C++ application (**PANDANEW.EXE**). Note that the execution of PANDANEW.EXE was interactive. A more detailed discussion about the production model and the attraction model could be found in the *Travel Demand Model Modifications Technical Report.*

Figure 5 Trip Generation, Standard Model



The daily home-based work person trips were further stratified to trip ends by time of day. The time of day factors are shown in **Table 19**.

Table 19 Home-Based Work Person Trips Time of Day Factors, Standard Model

Auto Ownership	AM	PM	Off-Peak
0-Auto Ownership	0.3821	0.3371	0.2808
1-Auto Ownership	0.4308	0.2884	
2-Auto Ownership	0.4213	0.2979	
3+Auto Ownership	0.4190	0.3002	

Note that only the AM and PM home-based work person trips were stratified by auto ownership. Home-based work off-peak person trips and the other trip purposes were not stratified by auto ownership. In addition, these purposes were modeled on a daily basis.

3.9.3 Production Model

Production trip rates for each of the trip purposes are presented in **Table 20** to **Table 27**. Note that the purpose and rates were the original values developed for the standard model.

Table 20 Home-Based Work Production Trip Rates, Standard Model

AutoOwnership	Number of Workers			
	0	1	2	3+
0	0.0000	1.1538	2.1111	3.4865
1	0.0000	1.3026	2.1111	3.4865
2	0.0000	1.3026	2.5597	3.4865
3+	0.0000	1.3026	2.5597	3.9626

Table 21 Non-Home Based Work Production Trip Rates, Standard Model

AutoOwnership	Number of Workers			
	0	1	2	3+
0	0.0000	0.3028	0.5905	0.8858
1	0.0000	0.7410	0.9842	1.2795
2	0.0000	0.7410	1.3724	1.6732
3+	0.0000	0.7410	1.5108	2.0052

Table 22 Home-Based Elementary School Production Trip Rates, Standard Model

Income Class	Household Size				
	1	2	3	4	5+
1	0.0000	0.0714	0.6111	1.4878	3.1152
2	0.0000	0.0714	0.6111	1.4878	3.1152
3	0.0000	0.0525	0.4889	1.4767	2.6381
4	0.0000	0.0525	0.4889	1.4767	2.6381
5	0.0000	0.0525	0.2881	1.1233	2.5893

Table 23 Home-Based High School Production Trip Rates, Standard Model

Income Class	Household Size				
	1	2	3	4	5+
1	0.0133	0.1225	0.1852	0.4146	0.4237
2	0.0000	0.1225	0.1852	0.4146	0.4237
3	0.0000	0.0426	0.3187	0.5188	0.4237
4	0.0000	0.0426	0.3187	0.5188	0.9722
5	0.0000	0.0426	0.3187	0.5188	1.2143

Table 24 Home-Based Shop Production Trip Rates, Standard Model

Income Class	Household Size				
	1	2	3	4	5+
1	0.5503	1.0657	1.1364	1.1727	1.4331
2	0.5503	1.0657	1.1364	1.1727	1.4331
3	0.5503	1.0657	1.1364	1.1727	1.4331
4	0.5503	1.0657	1.1364	1.1727	1.4331
5	0.5503	1.0657	1.1364	1.1727	1.4331

Table 25 Home-Based Other Production Trip Rates, Standard Model

Income Class	Household Size				
	1	2	3	4	5+
1	1.5000	2.2959	2.9815	3.1951	4.8077
2	1.5000	2.2959	2.9815	3.1951	4.8077
3	1.2043	2.3529	3.2278	4.2889	5.4242
4	1.1048	2.4800	3.2278	4.3243	5.7083
5	1.1000	2.8869	3.4746	4.9589	7.0179

Table 26 Non-Home-Based Other Production Trip Rates, Standard Model

Income Class	Household Size				
	1	2	3	4	5+
1	0.7867	1.0408	1.3148	1.9104	1.9104
2	0.9051	1.0408	1.3148	1.9104	1.9104
3	0.9051	1.3580	1.6522	2.2444	2.9379
4	0.9051	1.3580	1.8358	2.6697	2.9379
5	1.2000	2.0298	2.6525	2.6697	2.9379

Table 27 Home-Based University of New Mexico Production Trip Rates, Standard Model

Income Class	UNM	
	Single Family	Multi-Family
1	0.2074	0.5870
2	0.0845	0.1667
3	0.0845	0.1667
4	0.1089	0.1081
5	0.1089	0.1081

A production trip rate of 0.0318 for a single family was used for the home-based TVI trip purpose. (TVI, Technical Vocational Institute is currently known as Central New Mexico Community College, CNM)

The truck trip rates for the standard model are summarized in **Table 28**.

Table 28 Truck Production Trip Rates, Standard Model

Trip End	Truck Axle	Employment		
		Basic	Retail	Service
Production	Truck 2 Axles	0.0554	0.0464	0.0610
	Truck 3 Axles	0.0059	0.0040	0.0058
	Truck 4+ Axles	0.0123	0.0073	0.0129

Source : Input file ('Tgdataba.h') compiled with 'Panda2.C'

3.9.4 Attraction Trip Rates

The attraction trip rates are depicted in **Table 29**.

Table 29 Attraction Trip Rates, Standard Model

Trip Purpose	Number of Households	Employment			School Enrollment
		Basic	Retail	Service	
Home-Based Work	0.0450	1.6970	0.8320	0.6620	
Home-Based Other	0.6470	0.4100	7.3190	2.9640	
Home-Based Elementary					1.6680
Home-Based High School					1.9910
Home-Based UNM					1.4230
Home-Based TVI					1.3070
Non-Home-Based Work	0.1000	0.1570	1.8460	0.6500	
Non-Home-Based Other	0.2520	0.1610	3.2410	1.2640	
Truck 2 Axles		0.0588	0.0588	0.0588	
Truck 3 Axles		0.0057	0.0057	0.0057	
Truck 4+ Axles		0.0209	0.0209	0.0209	
Internal-External Trips	0.0522	0.0138	0.0356	0.0277	

Sources : Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
Input file ('Tgdataba.h') compiled with 'Panda2.C'

3.10 Trip Distribution

3.10.1 Introduction

The trip distribution model links the production trip ends in the model region with the attraction trip ends to create matrices of travel flows, disregarding mode of travel. Both the production and attraction trip ends were estimated by the trip generation model.

3.10.2 Methodologies

As noted in PB's documentation, trip distribution models were developed for each trip purpose. The trip purposes of HBTVI and HBUNM were distributed using the Fratar technique, while gravity model-based trip distribution models were developed for the other trip purposes. The trip purposes of AM and PM HBW with 0-, 1-, and 2+auto-ownership households were referenced in the PB report, but the HBW trips were stratified into 0-, 1-, 2- and 3+auto-ownership households in the model.

The trip distribution models in the converted model by Citilabs were gravity model-based. The gravity model, as referred to by social scientists as the modified law of gravity, states that the number of trip exchanges between two TAZs are directly proportional to the number of trip productions and attractions, but inversely proportional to the spatial separation between them. The formula for a gravity model is

$$Tripij = \frac{Pi * Aj * fij * kij}{\sum_{j=1}^{zones} (Aj * fij * kij)}$$

Where

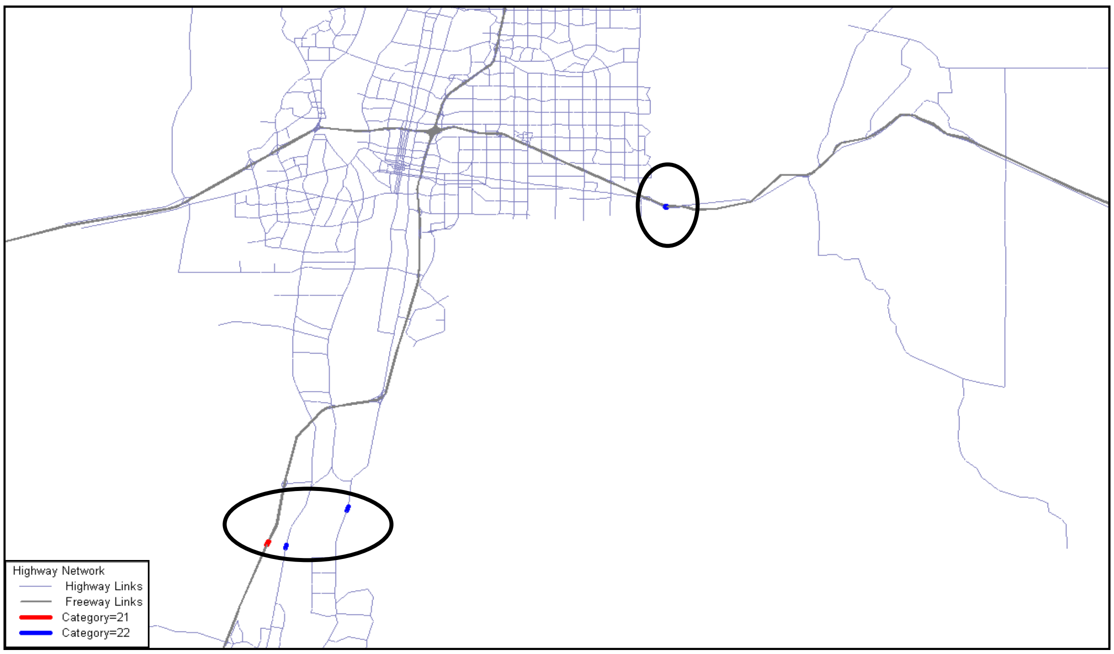
Pi	the number of trip productions from zone i
Aj	the number of trip attractions to zone j
fij	the friction faction from zones i to j, a function of travel impedance, commonly known as f-factors
kij	the specific zone-to-zone adjustment factor, commonly known as the k-factors

The travel impedance is measured by the logsum term, which is computed by the mode choice model. The use of logsum incorporates the travel times and costs of all modes between i-j zonal pairs appropriately weighted for the various modal shares. The friction factors are discussed in more detail in a later section. The k-factors were set to 1.0 and attempts to constrain distribution were accomplished with link-based time penalties imposed on specified links in the highway network. These links could be identified by the coded value of CATEGORY, a highway link attribute field. The imposed highway travel times are depicted in **Table 30** and their locations are shown in **Figure 6**.

Table 30 Imposed Highway Travel Time

Category	Highway Travel Time, min
20	4
21	15
22	10

Figure 6 Locations of Highway Links with Imposed Highway Travel Time



Note that Category 20 was referred to in the model highway assignment scripts but was not coded on any links in the highway network.

3.10.3 Friction Factors

As discussed above, the friction factors (or the f-factors) are functions of travel impedances. The travel impedance is measured by the logsum term, which is computed by the mode choice model. The friction factors described in this section corresponds to those used by the trip distribution models in the feedback loop. (Note that an initialization step was executed prior to the model feedback loop to create the initial set of travel skims and utility logsum. The travel impedance used by the trip distribution model in the initialization step was generalized cost that included the cost of travel time, travel distance, and parking; therefore, the friction factors are not the same). The f-factors were estimated by a formula named **gamma-function**, which has the formula of

$$f\ factor\ =\ \alpha * IMP^{\beta} * e^{IMP*\gamma}$$

α, β, and γ are calibrated parameters.

Table 31 lists the gamma function parameters that were specified in the converted model by Citilabs.

Table 31 Gamma Function Parameters by Trip Purpose, Standard Model

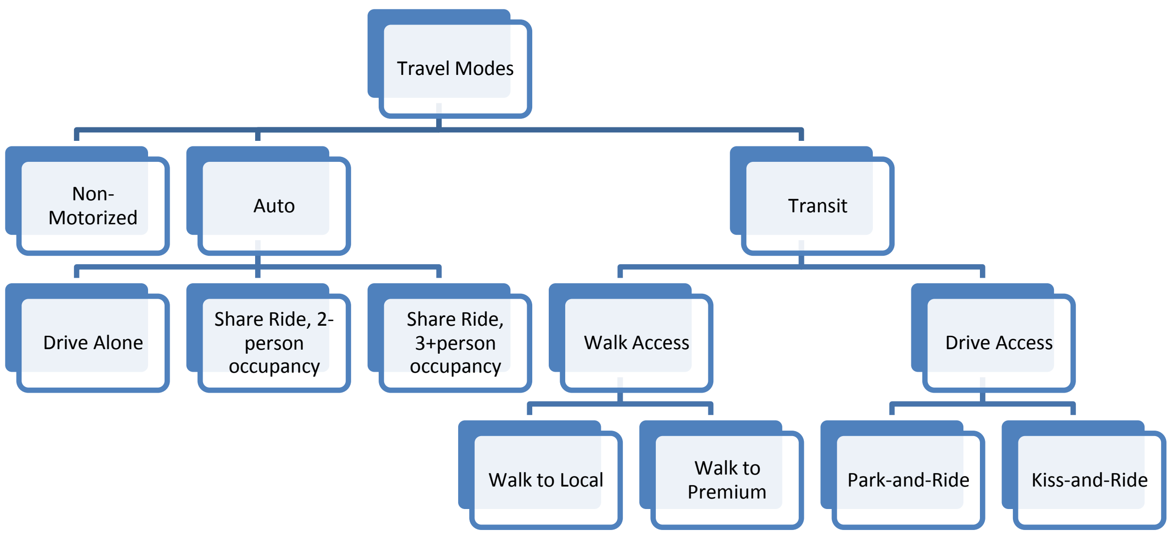
Trip Purposes	Stratum	ALPA	BETA	GAMMA
HBW AM	0-auto ownership	1.0000	-0.1000	-0.0900
	1-auto ownership	1.0000	-0.1000	-0.0900
	2-auto ownership	1.0000	-0.1000	-0.0900
	3+auto ownership	1.0000	-0.1000	-0.0900
HBW PM	0-auto ownership	1.0000	-0.1000	-0.0770
	1-auto ownership	1.0000	-0.1000	-0.0770
	2-auto ownership	1.0000	-0.1000	-0.0770
	3+auto ownership	1.0000	-0.1000	-0.0770
HBW OP		1.0000	-0.8000	-0.0770
HBSHOP		1.0000	-0.6000	-0.1500
HB Others	EE	1.0000	-0.8000	-0.2500
	EW	1.0000	-5.0000	-0.2000
	WE	1.0000	-5.0000	-0.2000
	WW	1.0000	-0.0500	-0.0600
NHBW		1.0000	-0.3000	-0.0500
NHBO		1.0000	-0.4000	-0.0600

3.11 Mode Choice

3.11.1 Introduction

The mode choice model of the Albuquerque model is a nested logit model. The model structure is shown in **Figure 7.**

Figure 7 Mode Choice Structure



3.11.2 Mode Choice Parameters

The mode choice models were developed in C++. As separate compiled modules, the mode choice models were executed in a batch file within the CUBE environment. Input parameters were specified in the control files (with file extension ini). The mode specific constants and the level of service (LOS) variable coefficients are shown in **Table 32** and **Table 33** respectively.

Table 32 Mode Specific Constants, Standard Model

Trip Purposes	Auto Ownership	Non-Motorized	Drive Alone	Share Ride-2	Share Ride 3+	Walk to Local	Walk to Premium	Park-Ride	Kiss-Ride
HBWAM	0-Auto Ownership	-0.52711	-20.00000	-10.85474	-11.67134	-5.99334	-20.00000	-20.00000	-20.00000
	1-Auto Ownership	-0.64265	-0.28823	-3.71858	-5.22313	-0.52711	-20.00000	-8.47684	-7.68246
	2-Auto Ownership	-1.72195	-0.24385	-3.76643	-4.10742	-3.34605	-20.00000	-8.13869	-9.28146
	3+Auto Ownership	-1.43866	-0.23432	-4.06872	-5.14567	-3.60987	-20.00000	-8.80131	-9.66952
HBWPM	0-Auto Ownership	-0.54826	-20.00000	-7.46879	-8.28084	-0.82519	-20.00000	-20.00000	-20.00000
	1-Auto Ownership	0.00000	-2.46410	-6.64097	-7.33235	-5.68285	-20.00000	-12.67273	-12.23986
	2-Auto Ownership	-0.87887	-1.53340	-5.45996	-6.39453	-6.55229	-20.00000	-10.66477	-12.29911
	3+Auto Ownership	-0.86525	-1.52562	-5.92256	-6.86181	-7.10445	-20.00000	-11.61140	-12.80385
HBWOP	All	-1.49105	-0.91189	-4.84748	-5.67919	-4.73620	-8.12489	-10.89955	-11.38265
HBESs	All	0.00000	-20.00000	-1.51591	-2.72177	-3.64691	-20.00000	-20.00000	-13.84026
HBHSs	All	-0.38208	-0.49565	-0.51456	-1.72338	-1.17462	-20.00000	-6.84301	-7.46614
HBTVIi	All	-20.00000	-0.27955	-4.42078	-5.00689	-20.00000	-20.00000	-20.00000	-20.00000
HBUNM	All	0.00000	-5.52376	-12.18814	-13.81822	-13.48715	-20.00000	-18.71823	-19.36179
HBO	All	-3.80146	-4.60661	-7.59594	-8.23079	-12.13999	-15.55921	-18.51637	-19.05727
HBSHOP	All	-4.63739	-4.67009	-7.78728	-8.74847	-13.69678	-17.12835	-19.82498	-20.46813
NHBO	All	-3.95397	-4.93849	-8.04236	-8.84849	-12.54931	-15.98311	-17.88206	-18.79542
NHBW	All	-3.30163	-3.69981	-8.12080	-9.38891	-11.26040	-14.68918	-16.59940	-17.54157

Table 33 Mode Choice LOS Variable Coefficients, Standard Model

Parameters	HBWAM	HBWPM	HBWOP	HBES	HBHS	HBTVI	HBUNM	HBO	HBSHOP	NHBO	NHBW
In-Vehicle Time	-0.029100	-0.029100	-0.029100	-0.009603	-0.009603	-0.029100	-0.029100	-0.009603	-0.009603	-0.023280	-0.023280
Operating Cost(cents)	-0.004589	-0.004589	-0.004589	-0.009178	-0.009178	-0.004589	-0.004589	-0.009178	-0.009178	-0.007342	-0.007342
Parking Cost(cents)	-0.005004	-0.005004	-0.005004	-0.010008	-0.010008	-0.005004	-0.005004	-0.010008	-0.010008	-0.008006	-0.008006
Walk Time	-0.067270	-0.067270	-0.067270	-0.024008	-0.024008	-0.067270	-0.067270	-0.024008	-0.024008	-0.058200	-0.058200
First Wait Time	-0.075770	-0.075770	-0.075770	-0.024008	-0.024008	-0.075770	-0.075770	-0.024008	-0.024008	-0.058200	-0.058200
Transfer Wait Time	-0.041700	-0.041700	-0.041700	-0.024008	-0.024008	-0.041700	-0.041700	-0.024008	-0.024008	-0.058200	-0.058200
Drive Access Time	-0.058200	-0.058200	-0.058200	-0.024008	-0.024008	-0.058200	-0.058200	-0.024008	-0.024008	-0.058200	-0.058200
Access Mode Coeff	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000	0.650000
Sub-mode Nest Coeff	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000	0.750000
DA Transfer Factor	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460	1.020460

3.12 Time of Day Trips

3.12.1 Introduction

This section discusses the process that converted the person trips in production-attraction format (after running the mode choice model) to trip tables by time of day. On the highway side, time of day factors were applied to distribute daily trips to AM, PM, and off-peak periods. In addition, factors were applied to account for the vehicle occupancy when converting from person trips to vehicle trips. The resulting trip tables were vehicle trip tables by time of day in origin-destination format. On the transit side, the person trips were aggregated to peak and off-peak travel based upon trip purpose.

3.12.2 Highway Trip Tables

Vehicle Occupancy Rates

Vehicle occupancy rates were applied to the highway daily person trips after mode choice. The three auto sub-modes are drive alone, shared ride with 2-person occupancy, and shared ride with 3+person occupancy. The vehicle occupancy rates for the 3+person auto are listed in **Table 34**.

Table 34 Vehicle Occupancy Rates by Purpose, Standard Model

Trip Purpose	3+ Person Vehicle Occupancy Rates
HBWAM	3.5592
HBWPM	3.5428
HBWOP	3.6540
HBES	3.5000
HBHS	3.9205
HBUNM	3.0000
HBTVI	3.0000
HBSHOP	3.3932
HBOTH	3.4574
NHBW	3.3585
NHBO	3.5512

In order to account for vehicle trips that occurred in the region that were not captured by the household survey, the NHBW and NHBO vehicle trips were multiplied by a factor of 1.90. Note that the basis for the derivation of the 1.90 factor is not included in the previous documentation. It should also be noted that prior to the conversion to origin-destination format, the HBW trip purpose vehicle trips of the HBWAM, HBWPM, and HBWOP market segments were summed to daily vehicle trips.

Time of Day Factors

Time of day factors were applied to the daily vehicle trips which were still in production-attraction format to create the vehicle trip tables by time period in origin-destination format. The time of day factors are shown in **Table 35**.

Table 35 Highway Trips Time of Day Factors, Standard Model

Trip Purpose	Production			Attraction		
	AM	PM	OP	AM	PM	OP
HBW	0.3800	0.0190	0.1010	0.0185	0.3116	0.1700
HBEM	0.4578		0.0422		0.3037	0.1963
HBHS	0.4468	0.0081	0.0452		0.1273	0.3726
HBUNM	0.2823	0.0177	0.2000		0.1760	0.3240
HBTVI	0.2773	0.0727	0.1500		0.1370	0.3630
HBSHOP	0.0379	0.1160	0.3460	0.0070	0.1568	0.3363
HBO	0.1012	0.1200	0.2788	0.0294	0.1400	0.3306
NHBW	0.0740	0.1200	0.3060	0.0740	0.1200	0.3060
NHBO	0.0768	0.1100	0.3132	0.0768	0.1100	0.3132

3.12.3 Transit Trip Tables

Transit person trips were aggregated to peak and off-peak transit trip tables based upon the trip purposes and travel sub-modes. The aggregation scheme is stated in **Table 36.** (See **Section 3.14.2** for the discussion of transit assignment). The aggregated trip tables were assigned to the respective transit networks based on the travel sub-modes. .

Table 36 Transit Trip Table Components, Standard Model

Trip Purpose	Sub-Mode	Transit Network
HBWAM	Walk to Local	AM
HBWPM		
HBWOP		
HBWAM	Walk to Premium	
HBWPM		
HBWOP		
HBWAM	Park-Ride	
HBWPM		
HBWOP		
HBWAM	Kiss-Ride	
HBWPM		
HBWOP		
HBEM	All sub-modes	Off-Peak
HBHS		
HBUNM		
HBTVI		
HBSHOP		
HBO		
NHBW		
NHBO		

3.13 Highway Assignment

3.13.1 Introduction

Trips in the vehicle trip tables were loaded to the highway network based on network performance. This section discussed the volume-delay functions (VDF) and the peak hour capacity scaling factors.

3.13.2 Volume Delay Functions

Link travel time is computed using a set of Bureau of Public Road (BPR) speed-flow curves to define the volume-delay functions (VDF). The general formation of the BPR curve used by the Albuquerque model is

$$Tc \ = To * [1 + a * \ \langle V/0.782C\rangle^{b} \ ]$$

Where
To free-flow travel time
V/C volume / capacity ratio
a, b parameters

a and b for the urban and rural link categories are depicted in **Table 37** and **Table 38** respectively. The curves are displayed in **Figure 8** and **Figure 9**. Note that the application of 0.782 to the denominator of the V/C ratio was undocumented.

Table 37 Volume-Delay Function Parameters of Urban Categories, Standard Model

Category	Category Name	*a*	*b*
7	Urban Freeways	0.15	9.8
8	Urban Freeway Entrance Ramps	0.15	5.5
9	Urban Freeway Exit Ramps	0.15	3.5
6	Urban Freeway Frontage Roads	0.75	2.1
10	Limited Access Principal Arterials	0.15	3.2
2	Urban Principal Arterials	0.75	3.2
3	Urban Minor Arterials	0.25	5.8
4	Urban Collectors	0.25	5.6
5	Urban Locals	0.75	3.8

Figure 8 Volume-Delay Curves of Urban Categories, Standard Model

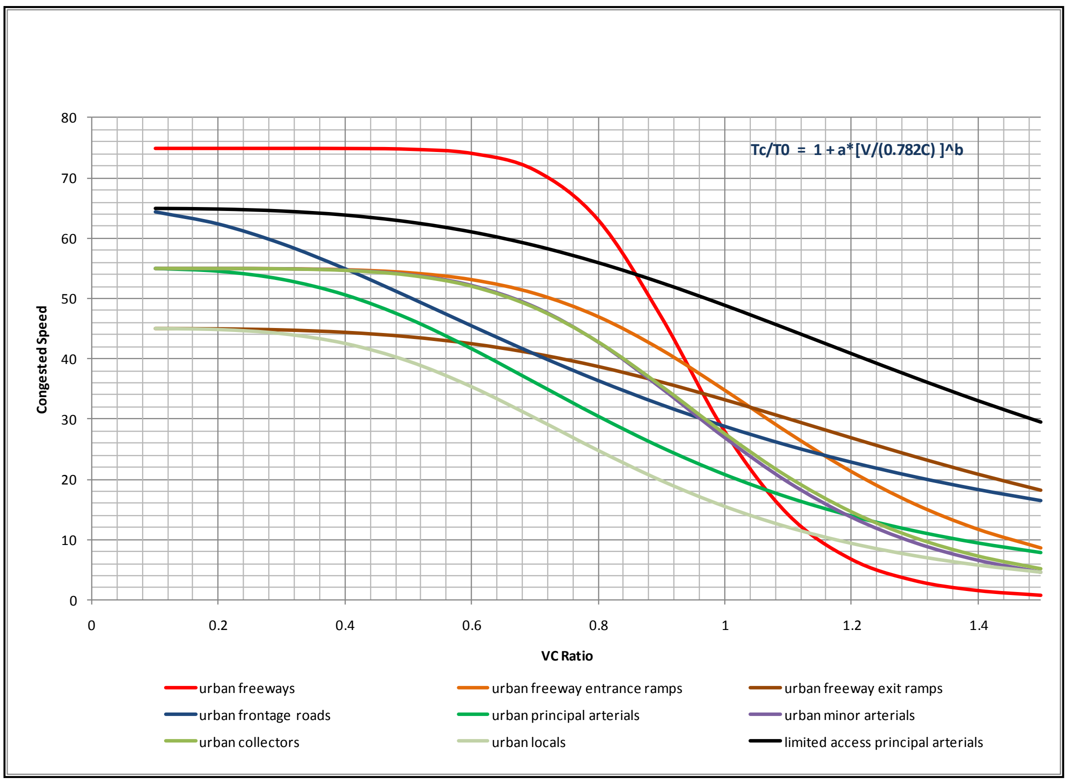
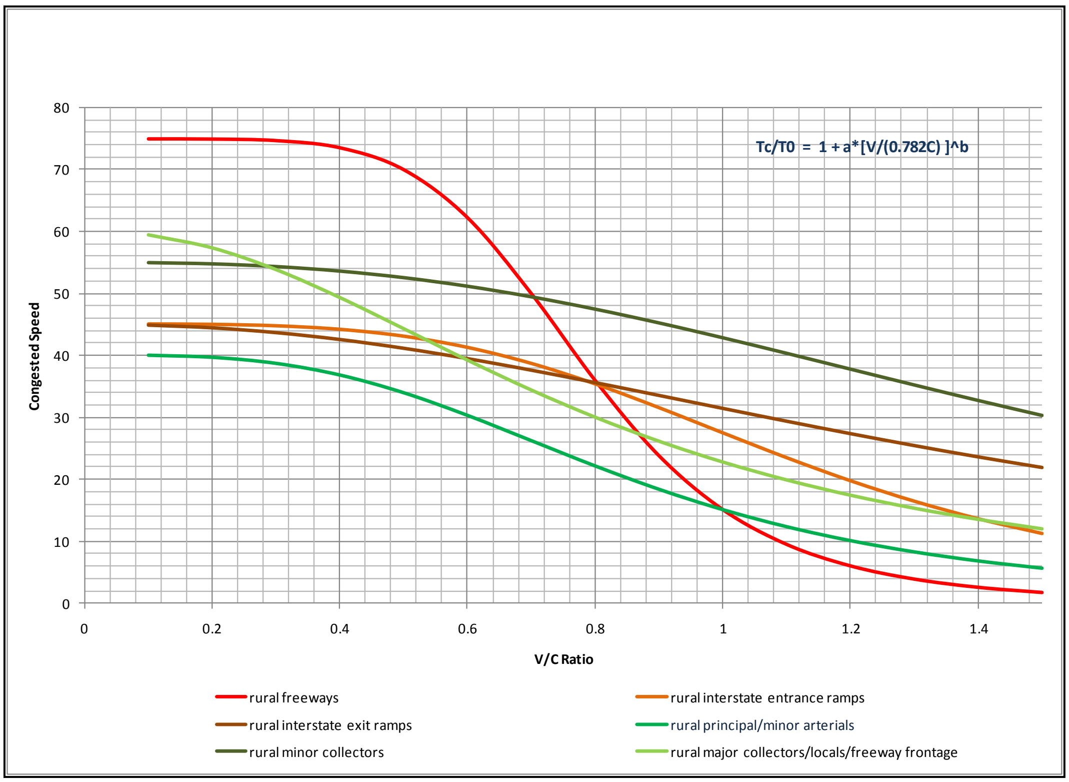


Table 38 Volume-Delay Function Parameters of Rural Categories, Standard Model

Category	Category Name	*a*	*b*
17	Rural Freeways	0.95	5.8
18	Rural Interstate Entrance Ramps	0.25	3.8
19	Rural Interstate Exit Ramps	0.25	2.2
16	Rural Freeway Frontage Roads	0.95	2.2
12	Rural Principal Arterials	0.75	3.2
13	Rural Minor Arterials	0.75	3.2
11	Rural Minor Collectors	0.15	2.6
14	Rural Major Collectors	0.95	2.2
15	Rural Locals	0.95	2.2

Figure 9 Volume-Delay Curves of Rural Categories, Standard Model



3.13.2 Peak hour capacity scaling factors

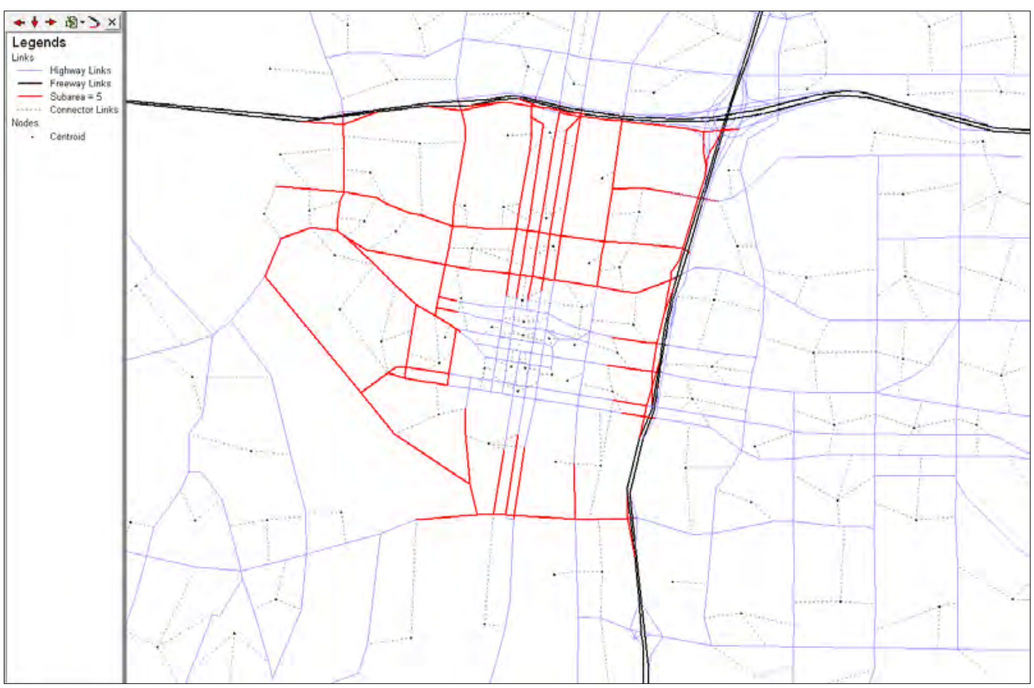
Highway vehicle trips were stored in trip matrices by time periods and assigned to the highway network. The link hourly capacities (see **Section 3.4.4**) were scaled to reflect the capacity for the time period. The capacity scaling factors are depicted in **Table 39**.

Table 39 Capacity Scaling Factors, Standard Model

Time Period	Capacity Scaling Factor
AM Peak Period (6:30 to 9:30 AM)	0.384
PM Peak Period (3:00 to 6:00 PM)	0.358
Off-Peak Period (6:00PM – 6:30 AM, 9:30AM – 3:00 PM)	0.113

An additional factor of 0.9 was applied to the link capacity for those links with the attribute field "Subarea" coded 5. The reason for the factor was not documented. These links are primarily immediately adjacent to the CBD core area as shown in **Figure 10**.

Figure 10 Links with Subarea=5, Standard Model



3.14 Public Transport Assignment

3.14.1 Introduction

Transit trips were assigned to the respective transit networks shown in **Table 36**. This section describes the transit assignment process in the converted CUBE VOYAGER model.

3.14.2 Transit Path-Building Procedure

Transit travel between the production and attraction zones could only take place when transit paths exist. For the AM period, the paths for the walk to local, walk to premium, drive to park-ride, drive to kiss-ride were built. For the off-peak time, only one set of path were generated disregarding the mode of access and the line-haul mode. **Table 40** summarizes the PT factor files used in the PT assignment step.

Table 40 Transit Factor Files of PT Assignment, Standard Model

Time	Mode	Factor File Names		
		FACTOR_PREM.FAC	FACTOR_PR.FAC	FACTOR_OP.FAC
Peak	WL		x	
	WP	x		
	PNR		x	
	KNR		x	
OffPeak	Transit			x

HBW transit trips were assigned to the AM transit network by the respective travel modes used to estimate these trips in mode choice. In contrast, all the non-work trip purposes were aggregated to one trip table and assigned the off-peak transit network using only one mode/access path designation.

It should be noted that assigning the non-work trips to a single mode/access path rather than the individual mode access paths that were used to estimate these trips in mode choice caused some transit trips to be unassigned since the paths used to predict these trips were not available. Systra Mobility resolved this inconsistency as part of the overall model recalibration effort

3.15 Sensitivity Analysis

As part of the initial scope of work, two sensitivity tests were conducted using the standard model to assess its response to likely changes in transit policy variables. This section describes the tests and summarizes the results of the sensitivity analysis.

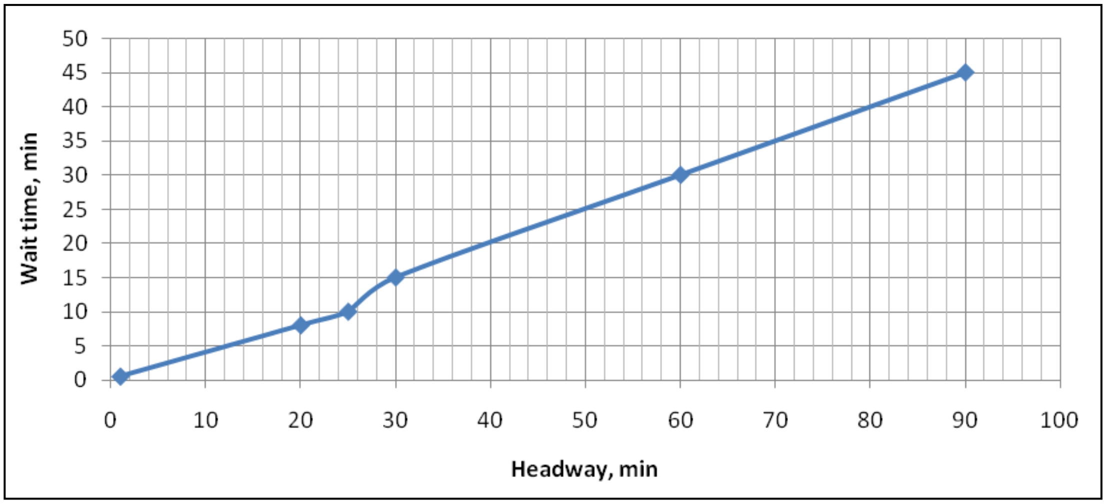
3.15.1 Sensitivity Tests

The following two sensitivity tests were performed.

- Increased transit frequency by 50%
- Increased transit fare by 30%

Transit frequency was increased by multiplying 0.5 to the headway coded in the transit line files. Note that increasing transit frequency by 50% did not reduce wait time by 50%. **Figure 11** shows the wait curve that was assumed by the model. The wait time was half of the headway when headway was 1 minute, and at or above 30 minutes.

Figure 11 Transit Wait Curve



The second test increased transit fare by 30%. The standard model was limited to a flat fare policy disregarding the transit mode (premium versus local) and transit operator (ABQ bus versus Rail Runner). The standard model set the average fare in the ABQ Ride transit system is 34.7 cents. The fare was increased to 45.1 cents in the test.

3.15.2 Sensitivity Analysis

The base case (2008) mode choice results are summarized in **Table 41**.

Table 41 Mode Choice Results, 2008 Base

Trip Purpose	Non-Motorized	Highway: Drive-Alone	Highway: Shared Ride	Transit: Walk to Local	Transit: Walk to Premium	Transit: Drive	Total
HBW	13,587	419,470	83,478	8,353	44	616	525,548
HBES	38,590	0	66,751	1,053	0	10	106,404
HBHS	3,574	19,409	32,165	1,172	0	135	56,455
HBUNM	6,659	24,912	4,552	189	0	22	36,335
HBTVI	0	27,119	4,312	0	0	0	31,432
HBSHOP	13,709	156,456	164,213	849	27	63	335,319
HBOTH	84,654	381,009	503,186	4,848	159	389	974,245
NHBW	8,774	202,068	67,767	1,340	43	82	280,074
NHBO	15,697	232,725	295,920	2,320	75	141	546,878
Total	**185,244**	**1,463,168**	**1,222,346**	**20,124**	**348**	**1,458**	**2,892,689**

A full model run was executed for each of the scenarios. **Table 42** and **Table 43** summarize the comparisons of the mode choice results between the base and the other two runs.

Table 42 Comparison of Mode Choice Results, Base versus Increased Frequency

Trip Purpose	Non-Motorized	Highway: Drive-Alone	Highway: Shared Ride	Transit: Walk to Local	Transit: Walk to Premium	Transit: Drive	Total
HBW	-547	-2,608	-1,039	4,215	18	409	449
HBES	-94	0	-147	238	0	3	0
HBHS	-17	-107	-167	256	0	34	0
HBUNM	-6	-82	-26	101	0	11	0
HBTVI	0	8	-8	0	0	0	0
HBSHOP	-92	-108	-105	279	9	17	0
HBOTH	-825	-322	-726	1,687	55	132	2
NHBW	-220	-453	-148	736	24	45	-15
NHBO	-314	-460	-613	1,271	41	76	0
Total	**-2,116**	**-4,131**	**-2,978**	**8,784**	**147**	**729**	**436**

Table 43 **Comparison of Mode Choice Results, Base versus Increased Fare**

Trip Purpose	Non-Motorized	Highway		Transit			Total
		Drive-Alone	Shared Ride	Walk to Local	Walk to Premium	Drive	
HBW	32	136	13	-182	-1	-18	-20
HBES	10	0	47	-57	0	-1	0
HBHS	9	21	34	-57	0	-8	0
HBUNM	1	-2	6	-5	0	-1	0
HBTVI	0	0	0	0	0	0	0
HBSHOP	15	21	20	-51	-2	-4	0
HBOTH	117	86	121	-290	-9	-25	0
NHBW	25	31	12	-62	-2	-4	0
NHBO	36	32	50	-108	-3	-7	0
Total	**247**	**325**	**304**	**-811**	**-18**	**-66**	**-20**

Note that the total number of person trips for both of the tested scenarios were slightly different compared to the base because transit skim affected the results of trip generation. Because of the improved transit times as a result of increased transit frequency, the total trips increased by 436 as a result of increased mobility. The transit travel times in the increased fare scenario was equal to base times and, as accessibility was not a function of transit fare, the total person trips should be the same. The minimal difference of 20 trips could be a result of a minor inconsistency in the generation algorithms in the standard model.

Similar to sensitivity analysis documented in *Travel Demand Model Modifications. Technical Report*, dated August 2001 and prepared by Parsons Brinckerhoff, the sensitivity analysis was also based on calculating the ridership elasticity relative to the change of transit frequency and transit fare. The sensitivity is measured by elasticity, which measures the relationship as the ratio of percentage changes between the changes in demand (ridership) and the changes in service attributes (service frequency and fare). The elasticity can be computed by either the end-point change calculation or the mid-point change calculation. The equation for the **end-point change calculation** is

$$\frac{(A2 - A1)}{A1} \div \frac{(R2 - R1)}{R1}$$

The **mid-point change calculation equation** is

$$\frac{(A2 - A1)}{(A2 + A1)/2} \div \frac{(R2 - R1)}{(R2 + R1)/2}$$

A1 and A2 are the old and new attribute values, R1 and R2 are ridership before and after the changes.

Table 44 summarizes the sensitivity analysis using the end-point change calculation.

Table 44 Summary of Sensitivity Analysis

Change	% Change	Base Ridership	After Ridership	Ridership Change	Elasticity
End-Point Change Calculation					
Increased frequency	50%	35,297	51,635	0.46	0.92
Increased fare	30%	35,297	32,875	-0.06	-0.20
Mid-Point Change Calculation					
Increased frequency	67%	35,297	51,635	0.38	0.75
Increased fare	46%	35,297	32,875	-0.07	-0.24

The elasticity indicated that the model was more sensitive to the change in service frequency, compared to the transit fare. The service frequency was directly related to the transit wait time, sas shown in **Figure 11**, which is 2.5 times of the in-vehicle travel time.

Comparisons of daily ridership are shown in **Table 45** and **Table 46**.

Table 45 Comparison of Daily Transit Ridership Before and After Changes Scenario: Increased Frequency

Line #	Line Name	Estimated Ridership		Diff	% Error
		Before Change	After Change		
1	Juan Tabo	865	1,224	358	41.4%
2	Eubank	839	1,534	695	82.8%
3	Uptown/Cottonwood	698	889	192	27.5%
5	Montgomery/Carlisle	3,631	4,728	1,097	30.2%
6	Indian School	224	357	133	59.3%
7	Candelaria	396	1,040	644	162.6%
8	Menaul	3,331	4,204	873	26.2%
10	N. 4th St.	1,155	1,755	600	51.9%
11	Lomas	3,278	4,545	1,267	38.7%
12	Constitution	249	545	296	118.8%
13	Comanche	143	267	124	86.5%
31	Wyoming	973	1,746	772	79.4%
34	San Pedro	136	334	199	146.2%
36	Rio Grande/12th St.	1,164	1,890	726	62.4%

Table 45 Comparison of Daily Transit Ridership Before and After Changes Scenario: Increased Frequency (cont')

Line #	Line Name	Estimated Ridership		Diff	% Error
		Before Change	After Change		
40	D-Ride Downtown Shuttle(3)	1,991	2,261	270	13.6%
50	Airport/Downtown	630	1,008	378	60.0%
51	Atrisco/Rio Bravo	114	204	90	78.6%
53	Isleta	681	1,154	473	69.4%
54	Bridge/Westgate	1,198	2,061	863	72.0%
66	Central	5,927	7,195	1,268	21.4%
92	Taylor Ranch Express	245	330	85	34.8%
93	Academy	38	78	40	105.2%
94	Unser Express	65	86	22	33.3%
96	Crosstown Commuter	58	70	11	19.6%
97	Zuni	383	647	264	68.7%
98	Wyoming	374	558	184	49.0%
140	San Mateo Line	2,482	3,882	1,400	56.4%
141	San Mateo Line	548	697	149	27.2%
151	Rio Rancho/RR Conn.	444	998	554	124.8%
155	Coors Blvd. Line	178	464	285	160.0%
157	Montano Uptown	1,358	2,396	1,038	76.4%
162	Ventana Ranch/Montano Plaza	81	201	119	147.2%
222	Rio Bravo/Sunport/Kirtland	60	91	31	50.5%
317	Downtown/KAFB Limited	87	138	50	57.7%
766	Rapid Ride - Red Line	280	151	-129	-46.1%
790	Rapid Ride - Blue Line	275	180	-95	-34.4%
1618	The BUG	445	777	332	74.6%
Rail Runner	Rail Runner	245	879	634	258.4%
Route1	Route 1	27	73	46	171.0%
Total		**35,297**	**51,635**	**16,338**	**46.3%**

Table 46 Comparison of Daily Transit Ridership Before and After Changes Scenario: Increased Fare

Line #	Line Name	Estimated Ridership		Diff	% Error
		Before Change	After Change		
1	Juan Tabo	865	800	-65	-7.5%
2	Eubank	839	793	-45	-5.4%
3	Uptown/Cottonwood	698	657	-40	-5.8%
5	Montgomery/Carlisle	3,631	3,388	-243	-6.7%

Table 46 Comparison of Daily Transit Ridership Before and After Changes Scenario: Increased Fare (cont')

Line #	Line Name	Estimated Ridership		Diff	% Error
		Before Change	After Change		
6	Indian School	224	205	-19	-8.4%
7	Candelaria	396	367	-29	-7.4%
8	Menaul	3,331	3,136	-194	-5.8%
10	N. 4th St.	1,155	1,067	-88	-7.6%
11	Lomas	3,278	3,060	-217	-6.6%
12	Constitution	249	232	-17	-6.8%
13	Comanche	143	130	-13	-9.2%
31	Wyoming	973	915	-59	-6.0%
34	San Pedro	136	129	-7	-4.9%
36	Rio Grande/12th St.	1,164	1,089	-75	-6.5%
40	D-Ride Downtown Shuttle(3)	1,991	1,843	-148	-7.4%
50	Airport/Downtown	630	588	-42	-6.7%
51	Atrisco/Rio Bravo	114	108	-6	-5.3%
53	Isleta	681	627	-54	-7.9%
54	Bridge/Westgate	1,198	1,127	-70	-5.9%
66	Central	5,927	5,474	-452	-7.6%
92	Taylor Ranch Express	245	207	-38	-15.4%
93	Academy	38	36	-2	-5.7%
94	Unser Express	65	53	-12	-17.9%
96	Crosstown Commuter	58	57	-1	-2.5%
97	Zuni	383	363	-20	-5.3%
98	Wyoming	374	340	-34	-9.1%
140	San Mateo Line	2,482	2,332	-149	-6.0%
141	San Mateo Line	548	506	-42	-7.7%
151	Rio Rancho/RR Conn.	444	405	-39	-8.8%
155	Coors Blvd. Line	178	166	-12	-7.0%
157	Montano Uptown	1,358	1,279	-80	-5.9%
162	Ventana Ranch/Montano Plaza	81	76	-6	-7.0%
222	Rio Bravo/Sunport/Kirtland	60	56	-4	-7.3%
317	Downtown/KAFB Limited	87	82	-6	-6.3%
766	Rapid Ride - Red Line	280	253	-26	-9.5%
790	Rapid Ride - Blue Line	275	264	-11	-4.1%
1618	The BUG	445	419	-26	-5.8%
Rail Runner	Rail Runner	245	220	-26	-10.5%
Route1	Route 1	27	25	-1	-5.4%
Total		**35,297**	**32,875**	**-2,422**	**-6.9%**

As expected, increasing the transit frequency increased ridership by 46.3%. Note that the two Rapid Ride lines loss ridership despite the increase of service frequency. There could be two contributing factors. The first was that there were many competing local bus routes and their service frequency had also been increased by 50%. The Rapid Ride Lines were coded with a time factor (TIMEFAC) of 1.79, which was higher than the local bus time factor. These two factors together could make the local routes more attractive than the two Rapid Ride lines.

The mid-point elasticity for service frequency at approximately 0.74 was somewhat higher than the general rates in the available literature, but it must be noted that the observed studies indicate a fairly wide range with more recent elasticity values above 0.70. Increasing transit fare reduced transit ridership by about 6.9% and the calculated elasticity is approximately similar to the expected elasticity of -0.30.

4 MODEL RECALIBRATION

4.1 Introduction

The standard model was recalibrated to existing conditions. As part of the recalibration process, the model was carefully reviewed and other refinements were implemented as needed. Adjustments to the network procedures for walk and auto access as well as a final review of the highway network coding to ensure symmetry was performed. The transit path-building procedures and parameters were also adjusted to ensure consistency across the model structure and the off-peak transit assignment process was altered to be equivalent to the peak period transit assignment. All cost terms in the model (auto operating costs, parking costs, transit fares, and incomes) were converted to the baseline year in the original model estimation. Additional features that enable cost-related policy analysis were added to the recalibrated model. The volume delay functions were updated to ensure consistency and reflect the latest "state-of-the practice" standards. Period specific capacity scaling factors were reviewed and adjusted. The mode bias constants of the mode choice models were recalibrated to estimated targets. The friction factor curves of the trip distribution were updated using the new logsum values from the recalibrated mode choice model. Lastly, the trip generation procedure from the enhanced transit regional model was implemented.

Unlike most regional model calibration efforts where recent travel survey data was available to estimate observed or "target" values for the mode choice model and trip generation model, recent survey data was not available to use in the recalibration task. Due to the limitations resulting from the lack of recent observed data, a unique approach was taken to recalibrate the model. Observed mode share values were synthesized from several data sources including the mode choice targets were estimated based on a combination of the 1992 household survey data available from PB's 2001 report, the 2004 transit on-board survey data, and the 2008 daily transit ridership.

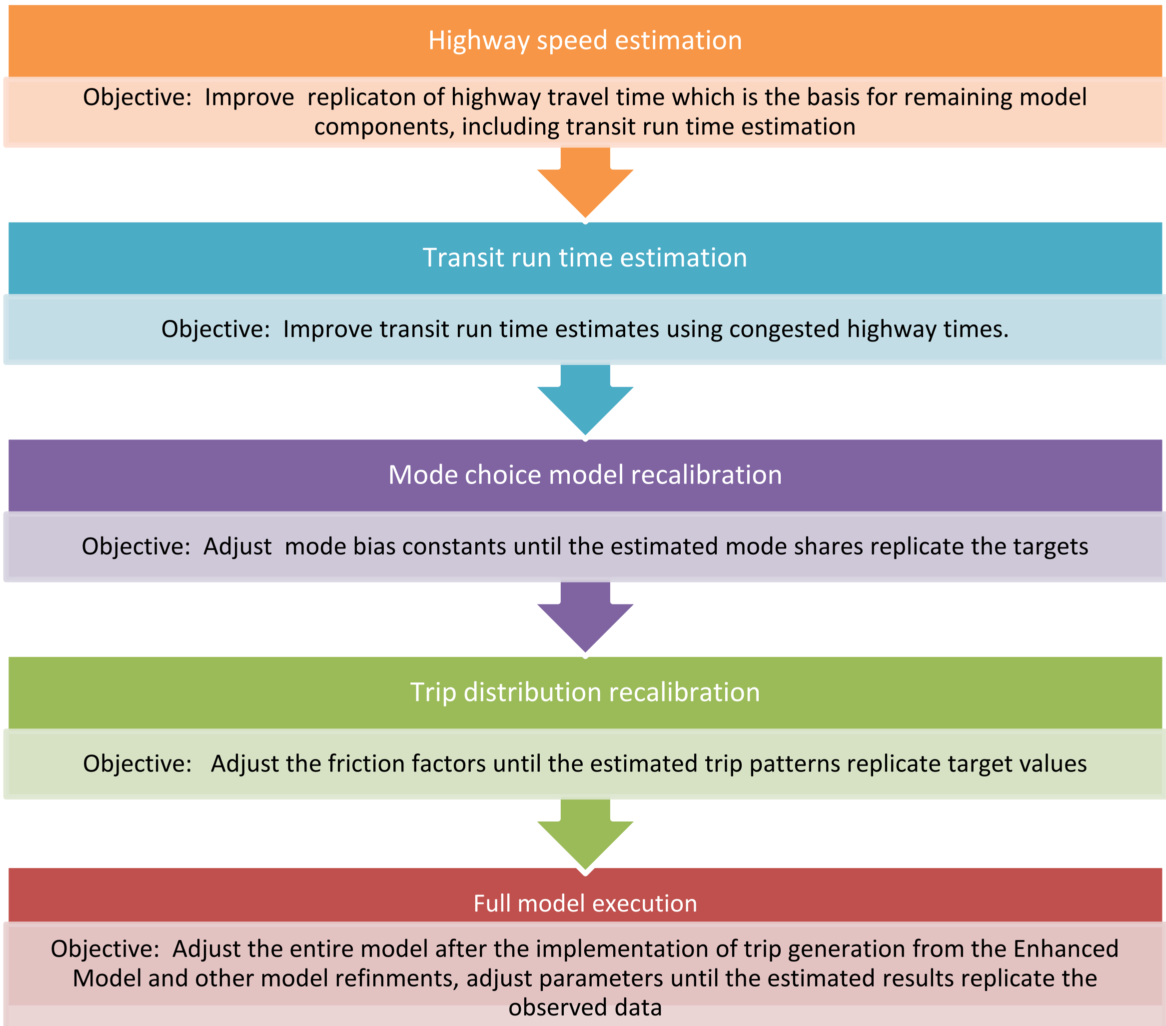
It must be noted that both the Rapid Ride and Rail Runner were not yet in service when the 2004 on-board survey was conducted.

For trip distribution the observed trip patterns by trip purpose used as target patterns for recalibrating the friction factor curves was assumed to be the "current" trip tables that resulted from running the standard model with the updated 2008 highway network and transit routes. This decision reflected MRCOG staff's belief that the current regional model trip tables provided an adequate overall representation of regional travel. The recalibration approach is briefly described in the next section; followed by discussions from **Sections 4.3** to **Section 4.9** regarding the refinements and modifications made to the various model components, as well as the new features. Detailed discussions of the tasks involved in the recalibration process are presented from **Section 4.10** to **Section 4.17**.

4.2 Recalibration Approach

The recalibration approach initially focused on preparing estimates of congested highway speeds for the peak and off peak periods. These congested speeds, though preliminary, implicitly represented the effects of the trip distribution, mode choice and highway assignment procedures employed in the model. Using the existing standard model vehicle trip tables and the updated volume-delay functions, the network capacity and free flow speeds were adjusted until the volumes and congested speeds resulting from the assignment replicated observed volumes and speed data. The "preliminary" congested speeds then served as the foundation for estimating transit run times by period and recalibrating all of the remaining model components. As the final step of the recalibration, the entire model chain was executed to ensure the overall consistency. The recalibration approach is best summarized by the work flow chart shown in **Figure 12**.

Figure 12 Recalibration Approach



Prior to recalibrating the model, the standard model was executed with the updated highway and transit networks to seed the recalibration process. In addition, the path-building procedure for creating the drive access links were rebuilt to dynamically estimate auto access links that were sensitive to traffic conditions. This new procedure replaced the original hard-coded connecting links between the TAZs and the park-ride lot nodes that had been generated with an undocumented process. (See **Section 3.5.8** for a discussion of generating transit access links).

The recalibration process began with improving the estimated highway speed. This task involved replacing the existing (and somewhat counter-intuitive) BPR volume delay functions (VDF) used in highway assignment with new VDFs based on the Akcelik formula. Link free-flow speed and capacity were adjusted until the estimated speeds were close to the observed values and logical by facility type with decreasing speed for lower capacity roadways.

The second task was to improve transit run time by time period, which is a function of the congested highway times in the peak and off peak periods. The global transit factor of 1.6 and the TIMEFAC values that were coded individually for each transit line were replaced with a set of transit factors. The factors were calibrated so that the estimated transit run times replicated the observed transit schedule times as provided by ABQ RIDE.

The mode specific constants from the mode choice model were recalibrated using the improved highway skims and transit skims resulted from the first two tasks. The observed "target" share values were estimated using the limited available data that included the 2004 transit on-board survey data which was conducted prior to the services of Rail Runner and Rapid Ride were initiated, observed shares from the 1992 household survey data listed in the prior documentation, and the 2008 transit boarding data. Since this data reflected conditions from different years, professional judgment was used to create logical target values for the various mode shares.

The above three tasks were completed using the existing person trip tables generated by the current standard model. Note that the recalibrated mode choice yielded new composite impedances (logsum terms) that were used as input to the trip distribution model. The logsum values were used in the distribution as measures of spatial separation and represent a blended (and appropriately weighted) value of the times and costs for all available modes between each origin–destination zonal pair. Tabulating the trips from the existing standard model with the revised logsum terms provided "target" distributions by impedance interval by trip purpose for the recalibration effort. The friction factors used in the trip distribution model were then recalibrated using the new distribution patterns from the recalibrated logsum values.

Parallel to the above four tasks, additional refinements and enhancements were added to the standard model. The standard model trip generation was replaced with the trip generation of the Enhanced Transit Model. In addition, the model cost components were reviewed and updated as necessary and a new feature that automated future year cost adjustment procedures was implemented. A new feature to incorporate the calculation of the zero volume delay network were added to the model and various model components such as the procedures to generate transit access links and path-building procedures were updated and refined. Note that the automated walk access coverage process developed for the Enhanced Transit Model was also incorporated into the new standard model.

The "new" recalibrated model was executed with the adjusted VDFs, new transit time factors, and the recalibrated mode choice model and trip distribution model components. Results were compared to the observed data and adjustments were made to the different components of the model until reasonable model estimates were achieved for all model components.

4.3 Cost Components

4.3.1 Introduction

All cost terms in the model were reviewed to the extent feasible to ensure that the values were converted to the dollar term of year 1992. It was believed that the income distributions and the values of time were already in 1992 dollars. Parking cost and auto operating cost were updated to 1992 dollars. A Consumer Price Index (CPI)-based cost adjustment approach was adopted for adjusting cost back to 1992 dollars from either present year (2008) dollars or future year dollars. Using this approach, additional features that enable cost related policy analysis were added to the recalibrated model. The following sections discuss the updated auto operating cost and parking cost, as well as the CPI-based cost adjustment approach. As part of the refined model, the default process assumes that all cost-related terms are provided in 2008 dollar terms and the model converts these terms back to 1992 dollar values.

4.3.2 Auto Operation Cost

Research was conducted for the auto operating cost for 2008. According to the U.S. Department of Energy[4], the average gasoline price in 2008 in the region was 338.3 cents per gallon. The average fuel consumptions for passenger car and light truck were 21.5 and 17.2 miles per gallon respectively[5]. Assuming the share of passenger car and light truck was 80/20, the average auto consumption rate was computed as 20.6 miles per gallon. The 2008 auto operating cost was computed to 16.4 cents per mile, which was equivalent to 10.6 cents per mile in 1992 dollars.

4.3.3 Parking cost

The parking assumptions of an average parking duration of 8 hours for work trips, and 2 hours for non-work trips remain with the calibration. After discussing with MRCOG staff, the cost figures coded in "**PARK$.311**" were adjusted to reflect 2008 dollars based on CPI due to the lack of actual data, as shown below.

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[4] Source: http://tonto.eia.doe.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=mg_tt_5b&f=a

[5] Source: http://www.epa.gov/otaq/consumer/f00013.htm

```
c EMME/2 Module: 3.14(v7.01)   Date: 10-14-09       User: E199/AUA.......bci
c Project:      ALBUQUERQUE MODEL DEVELOPMENT
t matrices
d md23
a matrix=md23 pcost     0 2000 daily (8 hours) parking cost
   all  50010:  475  50020:  475  50030:  475  50040:  475  50050:  442
   all  50060:  442  50070:  442  50080:  442  50090:  442  50110:  309
   all  50120:  309  52610:  442  52720:  309  80110:   88  80120:   71
   all  51030:  110  51210:  110  51720:   56  51730:   56  52310:   56
   all  52410:   56  52620:  221  52710:  110  52730:  110  76840:   56
   all  76850:   56  76810:   56  76820:   56  76830:   56  76910:   56
   all  76930:   56  76940:   56  76950:   56  76960:   56
```

4.3.4 Transit Fare

The original standard model used a single transit fare for the entire region, which reflected the transit fare policies in place in 2001. As a result, the mode choice model accepted only one value, rather than a separate transit fare for each zonal pair. It should be noted that the fare policy of the Rail Runner is different than the local bus and that there are now costs for transfers. Despite this limitation of the mode choice model, Systra Mobility did add procedures to dynamically estimate transit fare based on actual transit paths and 2008 fare policy now implemented in the revised model. However it was necessary to create an average value for the entire transit system and pass this value to the mode choice model.

Note that this approach is a compromise that was introduced since the existing mode choice model only accepts a regional transit fare for all zonal pairs rather than separate values for each zonal pair based on modes used in creating the individual paths. It was not possible to obtain or to confirm the version of the C++ source code for the original mode choice model and additional resources were not available to resolve this limitation through the use of standard CUBE functions, such as XCHOICE which could replace the existing compiled executable mode choice program. However, this compromise approach does provide an approximate sensitivity to transit fare policies since the average value is now dynamically determined as part of the model execution, which permits the user a mechanism to incorporate changes to the fare policy. Lastly, since the revised process does provide individual fare values by origin-destination zonal pair, if the current mode choice model is replaced, the transit fare estimation procedures are already in place and ready to be used.

Bus Transit Fare

A discounted bus boarding fare was computed based on the current fare structure and prices downloaded from the ABQ Ride web site (http://www.cabq.gov/transit) in October 2009 and the 2004 transit on-board survey data for the fare type. Prior to 2009, transfers between buses were free. The survey results are summarized in

Table 47 under the columns of "Count Frequency" and "Percent Share". Based on the price information downloaded from the ABQ Ride web site, one-way fares were computed for each of the fare types. For those fare types that involved "pass", the one month pass was used to compute the average one-way fare. The price of the monthly pass was spread out over the number of days in a year, in which the rider was likely to ride transit. For example if the number of workdays in a year was assumed to be 260 (52 weeks x 5 days per week). The average number of days per month was calculated to be 21.7 (260 days/12 months). By assuming two trips a day, the average one-way fare for those who used an adult gold pass was $0.67 ($28.00/43.4 trips per month). The one-way fare was weighted by the count frequency and the average bus boarding fare was computed to be $0.65 in 2008 dollars.

Table 47 Assumed Bus Boarding Fares

Fare Type	Count Frequency	Percent Share, %	Assumed One-way fare
Student cash	2,084	13.4	$0.35
Student pass	894	5.7	$0.20
Citizen cash	765	4.9	$0.35
Adult cash	5,895	37.8	$1.00
College pass	741	4.8	$0.20
Citizen pass	659	4.2	$0.20
Adult gold pass	3,577	22.9	$0.64
Other pass	568	3.6	$0.46
Total	**15,601**	**100.0**	
Average boarding fare			**$0.65**
Source: 2004 Transit On-Board Survey			

Rail Runner Transit Fare

Unlike the bus fare structure, the fare structure of the Rail Runner was zone-based. The coded fares for the Rail Runner were computed based on information downloaded from http://www.nmrailrunner.com/tickets.asp. Similar to the calculation of the bus boarding fare, the price for the reduced monthly pass was assumed in the calculation. It was also assumed that the majority of the Rail Runner riders were commuters to work. An average of 20 work days was assumed for a month. The total fare was the number of zones through which the rider would travel. There are a total of six fare zones. The assumed fares by the number of zones traveled are summarized in **Table 48**. Note the Rail Runner in the modeled region covered only three zones.

Table 48 Assumed Rail Runner Fares

Number of Zones Traveled	Assumed Fare
1	$0.875
2	$1.250
3	$1.625
4	$2.375
5	$2.500
6	$2.750

4.3.5 Cost Adjustment

The model uses cost in 1992 dollars. In addition, the original mode choice model was estimated using 1992 dollar terms, it is necessary to provide all cost-related impedance terms in equivalent 1992 values. MRCOG staff should update the income index in the socio-economic data file to reflect the zonal income characteristics for the model year. The user's inputs of parking cost, auto operating cost, and transit fare were adjusted to 1992 dollars based on Consumer Price Index (CPI). Annual average CPI was downloaded from the Bureau of Labor Statistics (BLS). CPI specific to Albuquerque and New Mexico was not available; therefore, the CPI of the west region was downloaded together with the nation-wide CPI for comparison purposes. **Table 49** shows the CPI from 1990 to 2008. The CPI data for the cities with population between 500,000 to 1,500,000 in the west region was available for years from 1996 to 2008.

The following sections describe the basic methodology for adjusting the 2008 (validation year) dollars to 1992, as well as two options for estimating cost values for future year scenarios. These options are provided to permit the user to address specific "cost-based" scenarios using the regional modeling process.

Adjusting 2008 Costs to Model Estimation Year

The validation year is 2008 and all cost values for the validation year have been provided in 2008 dollar values. Using the West Region CPI values in Table 2, an adjustment factor to deflate the 2008 dollars back to equivalent 1992 values is established by dividing the 2008 CPI factor by the 1992 factor (219.65/142.0). For example, $1,000.00 in 2008 is equivalent to $646.29 in 1992. Note that the final model automatically factors these costs from 2008 to 1992, so the user is only concerned with changes to cost values beyond 2008.

Table 49 Average Consumer Price Index (CPI)

Year	U.S. Cities Average		U.S. Cities in West Region(2)	
	CPI(1)	Compound Growth %, from 1992	CPI(1)	Compound Growth %, from 1992
1990	130.70		131.50	
1991	136.20		137.30	
1992	140.30		142.00	
1993	144.50	2.99%	146.20	2.96%
1994	148.20	2.78%	149.60	2.64%
1995	152.40	2.80%	153.50	2.63%
1996	156.90	2.84%	157.60	2.64%
1997	160.50	2.73%	161.40	2.59%
1998	163.00	2.53%	164.40	2.47%
1999	166.60	2.48%	168.90	2.51%
2000	172.20	2.59%	174.80	2.63%
2001	177.10	2.62%	181.20	2.75%
2002	179.90	2.52%	184.70	2.66%
2003	184.00	2.50%	188.60	2.61%
2004	188.90	2.51%	193.00	2.59%
2005	195.30	2.58%	198.90	2.63%
2006	201.60	2.62%	205.70	2.68%
2007	207.34	2.64%	212.23	2.72%
2008	215.30	2.71%	219.65	2.76%

(1) Annual average CPI for all urban consumers (CPI-U) for all items, based period 19982-84=100

(2) West region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming

Source: http://www.bls.gov/cpi/#data

Adjusting Future Year Costs

Preparing future year cost data for scenarios is typically a difficult task for analysts in that assumptions to changes in cost data (transit fares and tolls) are difficult to predict in terms of specific amounts and years of implementation, as well as being potentially a controversial policy issue that many agencies are reluctant to disclose directly in analysis and documentation. For this reason, it is common for MPO regional models to assume that the relevant cost terms, (fuel prices, parking costs, transit fares, and tolls) will increase overtime in direct proportion to travelers' incomes. Under such assumptions, the increased costs for these services are relatively the same burden to travelers that they are in the current model validation year. This option can be described as a "**constant cost**" approach, where increases in prices paid by consumers (approximated by the CPI) are offset by equivalent increases in their incomes. Conversely, if more detailed analysis is required where costs for various transportation services are being altered at rates either more than or less than the general inflation trends (defined by the CPI) then it would be necessary to specify the individual cost terms in future year dollars and then deflate the individual cost terms back to equivalent 2008 dollar terms. This second option can be described as a "**variable cost**" approach where each transportation cost is permitted to increase at a rate that is either higher, lower, or the same, as the anticipated growth in costs (again reflected by the CPI term). The following sections provide instructions to implement either of these options along with some clarifying examples.

Constant Cost Approach This approach requires minimal if any adjustment in the cost terms since the option assumes that all costs for existing transportation modes are increasing at the same rate and that there is an equivalent increase in incomes to offset the cost increases. Note that this approach does not preclude the user from modeling the introduction of a new service or cost in a future year. Rather it simply requires that the particular cost for the new service be deflated back to the value in 2008 dollar terms by the user. As an example, suppose that a new transit service (say light rail) is being implemented in the year 2015 and that the service will have a boarding fare of $1.50. After coding the new mode characteristics and route into the transit network, the equivalent 2008 fare must be calculated and entered into the model's fare system routine. The calculation for converting the future year cost initially requires the user to estimate the overall inflation between 2008 and the implementation year. In most cases, this estimate will be determined from several years of observed inflation (following 2008) and several years of anticipated inflation of the modeled horizon year when the service is implemented. As an example, if the analysis is being performed by the staff in the year 2011 and the new light rail line will open in 2015, the observed change in costs from 2008 to 2010 can be obtained from the CPI database, which is updated annually. If the final CPI factor for 2010 is say, 230.63, then the inflation increase is 5.0% (230.63/219.65=1.05) for this 2-year period. If an inflation rate for the period between 2010 and 2015 is, for this example, assumed to be 3.0%, then the inflation in this 5-year interval is 15.9% ((1.03**5)=1.159). Therefore the cumulative inflation is the product of observed rate of inflation for the first two years and the estimated inflation for the following five years out to 2015. This calculation yields a value of 1.217 (1.05 * 1.159). As the final step, we divide the assumed opening year fare ($1.50) by the value of 1.217 (which yields $1.23) to deflate the cost back to equivalent 2008 dollar terms. Note that the model scenario key {horizon_yr} should be set to the proper horizon year and the scenario key {inflation_rate} should be set to zero, since cost of the new mode is being manually translated back to 2008 dollar terms.

As a final note to this option's discussion, it should be recognized that costs for all modes are assumed to increase over time, but specific amounts and timing of increases is not specified. In the above hypothetical example, the stated fare of a $1.50 for the new mode was obtained from the transit operator (ABQRIDE) but the change in the cost of local bus service (and other modes) was not provided. Implicitly, the model is assuming that the cost of local bus service is also increasing at the general rate of inflation. For general planning purposes, this sort of simplified assumption is normally adequate. Similarly, if analysis for a more distant horizon year is performed, costs for all modes including new light rail mode implemented in 2015, are assumed to be increasing as well.

Variable Cost Approach Under the variable cost approach, the value of each cost term can vary either above or below the overall rate of inflation (which again we assume is being offset by income increases). This option requires that the user specifies the value of each cost term for the horizon year being analyzed while also specifying an assumed rate of general inflation between 2008 and the horizon year. As an example, assume that ABQRIDES has a policy where transit fares for local buses are being held constant to encourage transit use and recent changes in fuel prices (or proposed taxes on fuel consumption) indicate that the cost of fuel will basically triple the 2008 value by the year 2015. This change in fuel cost would significantly exceed the rate of inflation, while holding fares constant effectively diminishes the real cost of transit services as incomes increase over time.

To model this scenario, the user estimates the actual value of all cost terms including parking, tolls, and any other transit mode costs, in the year 2015. However, the cost for the local bus mode remains set at the 2008 value and the 2008 auto operating cost parameter (scenario key {aoc}) is factored by 3.0 to yield an assumed value of 49.2 cents (16.4*3) for the year 2015. The user must then code the assumed annual compounded rate of general inflation (scenario key {inflation_rate}), which the model then applies to the 7-year interval between 2008 and 2015. In this example if the assumed inflation is 3.5% then the model will automatically create an adjustment factor of 1.272. Note that the model scenario key {horizon_yr} is set to the proper horizon year, in this example, 2015.

4.4 Zone System

The total number of TAZs remained the same. Although the transit dummy zones remain in the highway network, they were not attached to the highway network. PT does not require the presence of any transit dummy zone. It must be noted that the mode choice model developed for the emme2 model was designed to handle up to 900 TAZs but it was unclear whether the TAZs beyond 865 were reserved for only transit dummy zones.

4.5 Highway Network

4.5.1 Introduction

To support the recalibration effort, MRCOG staff updated the highway network to 2008. As a result of the recalibration effort, unnecessary link attribute fields were removed from the original highway network, new link and node attribute fields were added to support the recalibrated model. Link category, speed, and capacity were modified as part of the effort to improve highway travel time.

4.5.2 Link Attributes

The updated highway link attributes are summarized in **Table 50**. The modified or new attributed are printed in *italic*. Note that attribute files MODESTR and ONEWAY are inherited from the 2004 highway network, which was converted from the emme2 highway network. These fields are not used in the model stream.

Table 50 Highway Link Attributes, Recalibrated Model

Field Name	Field Type	Description	Modifications
A	numeric	A node	
B	numeric	B node	
SCREENLINE	numeric	*Screenline ID from 1 to 28.*	*updated*
DISTANCE	numeric	Link distance	
MODESTR	character	emme2 link attribute fields as maintained by MRCOG staff.	
NLANES	numeric	Number of lanes	
FUNCTION*	numeric	Functional class, maintained by MRCOG staff	
UL1	numeric	Posted speed	
UL2	numeric	COD ID	
UL3	numeric	Subarea code, defined by MRCOG staff	
CATEGORY	numeric	Facility type. The attribute codes are *1 - High speed direct connector ramps* 2 - Urban Principal Arterials 3 - Urban minor arterials 4 - Urban collectors 5 - Urban Locals 6 - Urban freeway frontage roads 7 - Urban freeway 8 - Urban entrance Ramps 9 - Urban exit Ramps 10 - Limited Access Principal Arterials 11 - Rural minor collectors 12 - Rural principal arterials 13 - Rural minor arterials 14 - Rural major collectors 15 - Rural locals 16 - Rural freeway frontage roads 17 - Rural freeway 18 - Rural entrance Ramps 19 - Rural exit Ramps *20 - Rail Runner fixed guideway* 21-22 - dummy links *50 - transit-only links to park-ride lot nodes* 99 - centroid connector links	*New* *Updated definition* *Updated definition*

Table 50 Highway Link Attributes, Recalibrated Model (cont')

Field Name	Field Type	Description	Modifications
ISAUTO	*numeric*	*A binary field to identify auto is allowed on the link. 1=yes*	*Updated definition*
*ISBUS**	*numeric*	*A binary field to identify bus is allowed on the link. 1=yes*	*Updated definition*
ISWALK	*numeric*	*A binary field to identify a transit-only side-walk link. 1=yea*	*Updated definition*
ISPNRTOBUS	*numeric*	*A binary field to identify a transit –only link connecting the node for a park ride lot node. If ISPNTROBUS=1, Category must be coded with 50.*	*Updated definition*
ONEWAY*	numeric	Field maintained by MRCOG staff	
*AMPKDIR***	*numeric*	*A binary field to identify the AM peak travel direction for the freeway links. 1=peak direction.*	*New*
*PMPKDIR***	*numeric*	*A binary field to identify the PM peak travel direction for the freeway links. 1=peak direction.*	*New*
** These fields were not used in the model* *** These fields were used for summarizing results during recalibration*			

A new category (1) was added to separate the high speed ramps from freeway links so that lower free flow speeds and capacity could be assigned to these links.

It is important to note that the ISPNRTOBUS=1 link connected the park-ride lot nodes to the highway network. By default, auto vehicles traveling on ISPNRTOBUS=1 link to access park-ride lots. Note that ISPNRTOBUS=0 for the commuter rail station is not served by any park-ride lot (e.g. the Alvarado Transportation Center in Albuquerque Downtown). In all cases, ISWALK was coded to 1 to allow transfer walk, and ISAUTO should be coded to 0 because the ISPNRTOBUS=1 links were transit-only links.

Category 20 was one of the dummy link categories in the standard model; however, Category 20 was not coded into the highway network. In the recalibrated model, category 20 was used to code the transit-only links for the Rail Runner fixed guide way. See **Section 4.6.8** for more detailed discussion about coding commuter rail service. The AMPKHR and PMPKHR were added to identify the peak travel direction for the purpose of summarizing the results of the updated VDFs for the freeway facility type. Neither field was used in the final standard model.

4.5.3 Node Attributes

The updated node attributes are summarized in **Table 51**. Three new node attribute fields were added. A non-zero value of PARKSPACE indicates the presence of a park-ride lot at the node. RAILRUNNER and RAILRUNNERFZ are associated with the Rail Runner service. Three fare zones were coded to FAILRUNNERFZ.

Table 51 Highway Node Attributes, Recalibrated Model

Field Name	Field Type	Description	Modifications
N	numeric	Node number	
NORIG	numeric	ID number corresponds to the node in the GIS shape file	
X	numeric	X-coordinate	
Y	numeric	Y-coordinate	
PARKSPACE	*numeric*	*Number of parking spaces.* *A zero (0) value indicates the station is not served by any parking lot.* *A non-zero value indicates the station is served by a parking lot*	*New*
RAILRUNNER	*character*	*Rail Runner station name*	*New*
RAILRUNNERFZ	*numeric*	*Rail Runner fare zones ranges from 1 to 3. The coded values are shown below.* *Station — RAILRUNNERFZ* *US 550/Sandoval Co. — 3* *Downtown Bernalillo — 3* *Sandia Pueblo — 2* *Los Ranchos/Journal Center — 2* *Downtown Albuquerque — 2* *Bernalillo Co. Int'l Sunport — 2* *Isleta Pueblo — 2* *Los Lunas — 1* *Belen — 1*	*New*

See **Section 4.6.6** for more discussion about coding park-ride lots and commuter rail stations.

4.5.4 Speed and Capacity

Link free-flow speed and capacity were updated in the effort of calibrating the Akcelik VDF curves to improve highway travel time. The updated link free-flow speeds are summarized in **Table 52**. The modified categories 2 and 12 (urban and rural principal arterials) and 10 (limited access principal arterials) are shown in *italic*

A new category (1) was added to separate out the freeway high speed ramps from freeway links (CATEGORY=7). These were freeway system-to-system interchange links. Their speed and capacity should be lower compared to the lanes in the freeway mainline.

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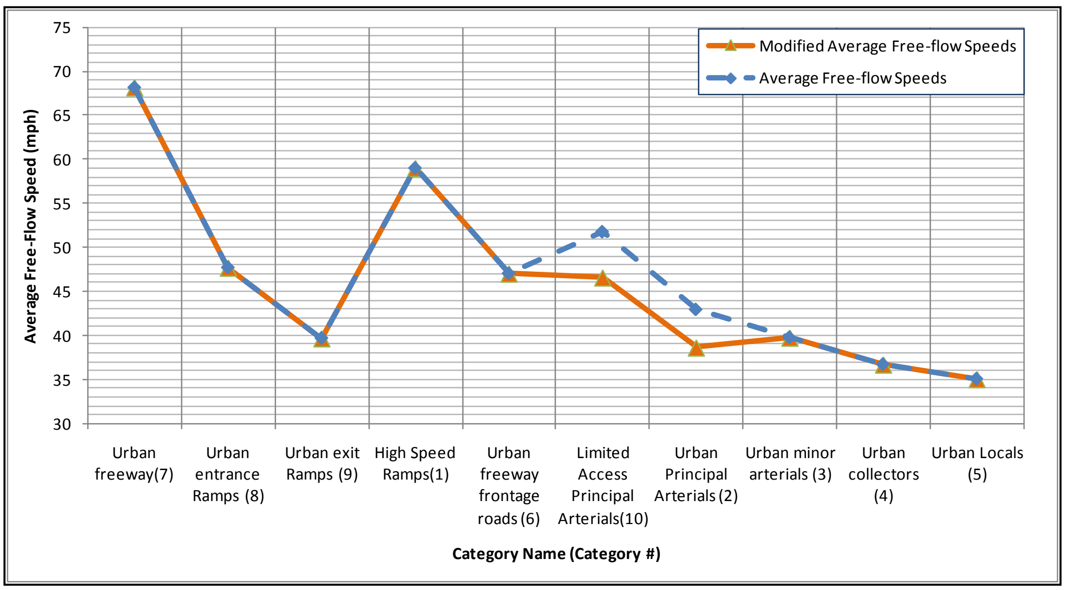
Table 52 Link Free-Flow Speed, Recalibrated Model

Category	Free-Flow Speed, mph
1,7,17	$posted\ speed\ + 0.2\ \times\ (75 - posted\ speed)$
10	$(posted\ speed\ + 0.2\ \times\ (75 - posted\ speed)) * 0.9$
11,13-14	$posted\ speed\ + 0.2\ \times\ (75 - posted\ speed)$
2,12	$(posted\ speed\ + 0.1\ \times\ (75 - posted\ speed)) * 0.9$
3-6,8-9,15-15,18-19,21-22	$posted\ speed\ + 0.1\ \times\ (75 - posted\ speed)$

The free-flow speeds for categories 2 and 12 (urban and rural principal arterials) and 10 (limited access principal arterials) were reduced by 10 percent. The resulting free-flow speeds provided a hierarchy of speeds by the type of facility, as shown in **Figure 13**.

Figure 13 Comparison of Free-Flow Speeds by Category



The adjusted per hour capacity values by category are summarized in **Table 53**. With a few exceptions, the capacity of each category has been adjusted. The modified categories are printed in *italic* in the table. Note that the capacity of the urban freeway links would be reduced by a factor 0.825 if the distance of the freeway segment in-between ramps is less than 0.50 miles. The differences of the capacities between the standard model and the recalibrated model are depicted in **Figure 14** and **Figure 15**. Similar to the free-flow speeds, the adjusted capacities provided a "smoother" hierarchy of capacities by the type of facility.

Table 53 Link Capacity, Recalibrated Model

Category #	Category Name	Capacity
7	Urban Freeway	1900
8	*Urban Entrance Ramps*	*800*
9	*Urban Exit Ramps*	*750*
1	*High Speed Ramps*	*1600*
6	*Urban Freeway Frontage Roads*	*1300*
10	Limited Access Principal Arterials	1100
2	*Urban Principal Arterials*	*1000*
3	*Urban Minor arterials*	*900*
4	*Urban Collectors*	*950*
5	*Urban Locals*	*850*
17	Rural Freeway	1900
18	Rural Entrance Ramps	900
19	*Rural Exit Ramps*	*850*
16	*Rural Freeway Frontage Roads*	*1300*
12	*Rural Principal Arterial*	*1,300*
13	*Rural Minor Arterial*	*1,200*
14	*Rural Major Collectors*	*1100*
11	*Rural Minor Collectors*	*850*
15	*Rural Locals*	*600*
21-22	Dummy Links	1,000
50	Transit-Only Links	600
99	Connector Links	600

** Capacity is reduced by a factor 0.825 if the distance in-between ramps is less than 0.5 mile to account for the weaving effect to traffic operation*

Figure 14 Comparison of Capacities, Urban Categories

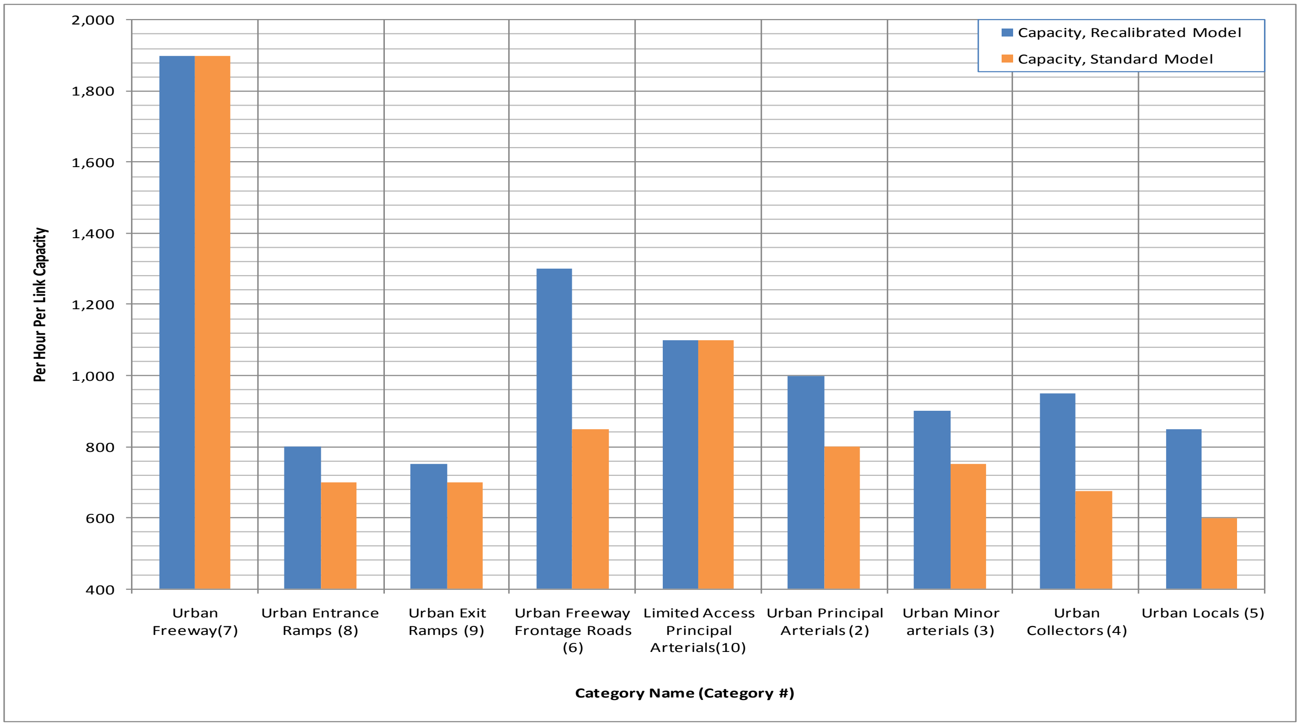
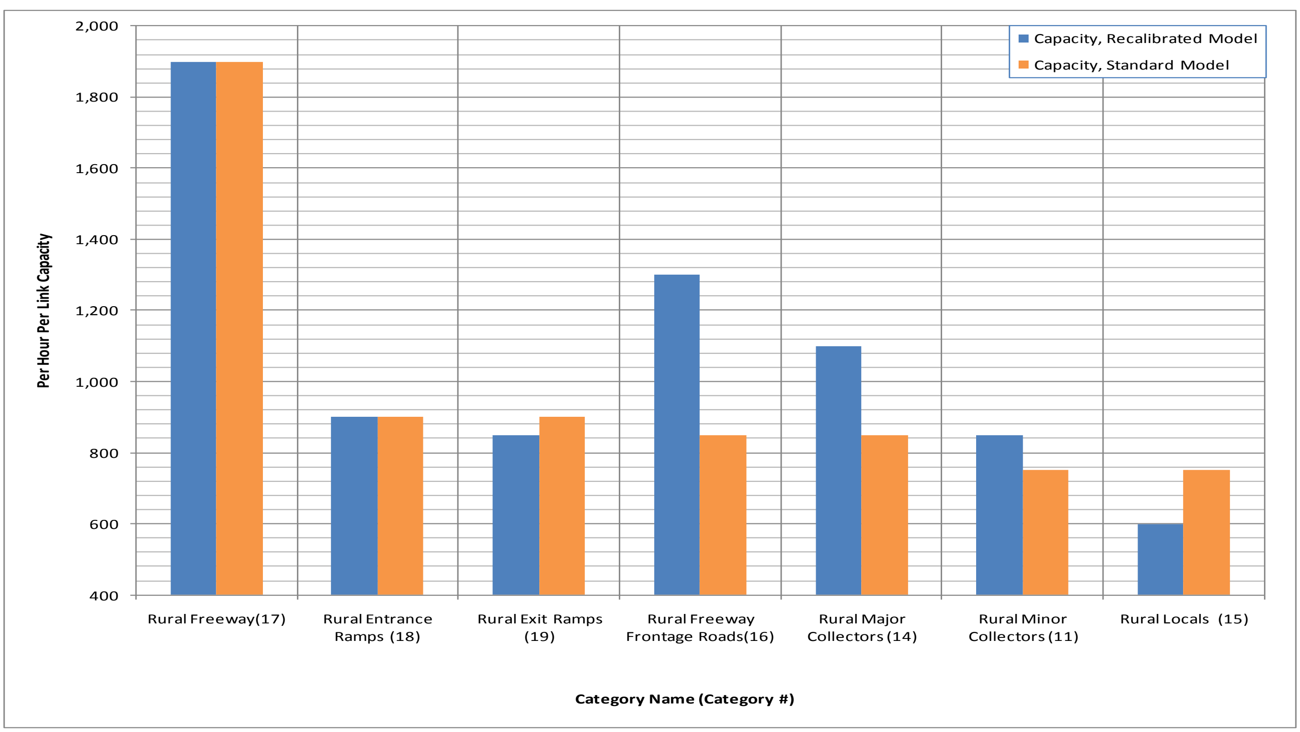


Figure 15 Comparison of Capacities, Rural Categories



4.5.5 Highway Network Coding

Modifications were made to the 2008 highway network provided by MRCOG staff. Some of the modifications were corrections of coding errors as a result of the path symmetry analysis (see **Appendix A** for validation criteria). Such coding errors included different link distances that were coded to either sides of the links, and two-way links were coded to one-way links.

Transit-only links that connected TAZs to transit dummy zones were removed because the new transit path-building procedure implemented for the drive access modes no longer required the dummy zones. Similarly the transit-only links connecting the transit dummy zones to the highway network nodes were also eliminated.

Categories of some links were recoded for the following reasons:

- The high speed ramp category (1) was added to represent the higher capacity and speeds for "direct connector" type ramps at freeway to freeway interchanges.
- Traffic count data indicated insufficient capacity. For example, the category of the link for Montano Road NW over the Rio Grande River was changed from an urban principal arterial type (category 2) to limited access principal arterial type (category 10).
- The coded category was inconsistent to the function of the link. A typical example was exit ramp link was coded as entrance ramp link.

4.5.6 Zero Volume Delay Network

In a typical regional model, the volume delay functions (VDFs) are used to estimate mid-block travel time as a function of volume-capacity ratio on the link. The effect of intersection delay, which is caused by the mere presence of a traffic control device (e.g. signal or stop sign) is often excluded. It was observed in the comparison of the estimated and observed speeds that the estimated speed was generally faster for the non-freeway categories, even when the estimated vehicle-mile traveled (VMT) matched well against the observed VMT. As a result of this condition, a decision was made to implement a zero-volume delay term that reflected the intersection delay time that would be added to the mid-block travel time in the calculation of the total travel time. The assumption was that vehicles would always experience delays when travelling in non-freeway roads even in largely uncongested conditions because of the random delay encountered as traffic signals cycle through the individual phases and delays associated with yield/stop signs. An application was developed to compute the zero volume delay. Traffic control device was assigned to intersections based upon the category types of the approach legs. The zero-volume delay was calculated for the direction approaching the node where a control device was assigned. The delay term is added to the link travel time in the initial highway network processing that is part of the first application in the recalibrated model. This section briefly describes the development, the concepts, and the assumptions for the application of the zero volume delay network.

Traffic Control Device Assignment

The regional highway network did not contain a traffic control device variable. The first step of the application was to calculate the traffic control device at the intersection based on the attribute field of CATEGORY. The highway network has 19 categories, excluding connector links, transit-only links, and dummy links. To simplify the process, these categories were collapsed into the following 7 category groups, which are listed in descending hierarchical order.

7. Frontage Roads
6. Arterials Class 1
5. Arterials Class 2
4. Collectors
3. Locals
2. Exit Ramps
1. Freeway links, high speed ramps, and entrance ramps

The next step was to map categories to category groups. This was an iterative effort, which included the following steps.

1. Assigned categories to category groups.
2. Created the zero volume delay network and ran highway assignment.
3. Compared the estimated travel time was compared to the observed travel time.
4. Adjusted the relationship between categories and category groups.

The final mapping of categories to category groups is shown in **Table 54**.

Table 54 **Categories and Category Groups, Zero Volume Delay Network**

Category	Category Description	Category Group ID	Category Group Description
1	High Speed Ramps	0	Freeway Mainline/Exit Ramps
2	Urban Principal Arterials	4	Arterials Class 2
3	Urban minor arterials	3	Collectors
4	Urban collectors	3	Collectors
5	Urban Locals	2	Locals
6	Urban freeway frontage roads	6	Frontage Roads
7	Urban freeway links	0	Freeway Mainline/Exit Ramps
8	Urban entrance Ramps	0	Freeway Mainline/Exit Ramps
9	Urban exit Ramps	1	Exit Ramps
10	Limited Access Principal Arterials	5	Arterials Class 1
11	Rural minor collectors	3	Collectors
12	Rural Principal Arterials	4	Arterials Class 2
13	Rural minor arterials	4	Arterials Class 2
14	Rural major collectors	4	Arterials Class 2
15	Rural locals	2	Locals
16	Rural freeway frontage roads	6	Frontage Roads
17	Rural freeway links	0	Freeway Mainline/Exit Ramps
18	Rural entrance Ramps	0	Freeway Mainline/Exit Ramps
19	Rural exit Ramps	1	Exit Ramps
Note: Categories 20 (rail track), 21-22 (dummy links), 50 (transit-only links), and 99 (connector links) are not applicable			

Note that a category group value of zero means that the category was excluded in the delay calculation. The rural major collector (category=14) was assigned to arterial class 2 to separate from rural minor collector (category=11) because there was only one rural principal arterial link (category=12) and no minor arterial link (category=13).

Traffic Operation Rules

A two-step process was developed to estimate the traffic control device at an intersection. The first step was to assign a traffic control device for each of the approach leg to approach leg based on the general rules shown in **Table 55**. Professional judgment and observations of aerial photos were involved in making these assumptions.

Table 55 Assumptions of Traffic Operation Rules, Zero Volume Delay Network

First Approach Legs	Category Group ID Category Group Name	Second Approach Legs					
		Frontage Roads	Arterials1	Arterials2	Collectors	Locals	Exit Ramps
	6 - Frontage Roads	Signal	Uncontrol	Uncontrol	Uncontrol	Uncontrol	Uncontrol
	5 - Arterials1	Stop	Signal	Signal	Signal	Uncontrol	Uncontrol
	4 - Arterials2	Stop	Signal	Signal	Signal	Uncontrol	Uncontrol
	3 – Collectors	Stop	Signal	Signal	Stop	Stop	Uncontrol
	2 – Locals	Stop	Stop	Stop	Stop	Stop	Uncontrol
	1 - Exit Ramps	Yield	Stop	Stop	Stop	Stop	Yield

The rules in **Table 55** served as the general guideline of either the actions to be taken or the traffic control device to be seen by the driver on the first approach leg. For example, the driver on the frontage road would be travelling non-stop while the driver on the side street (whether arterials, collectors, locals, or exit ramps) would stop or yield to the traffic on the frontage road. It was also assumed that intersections of arterials and/or collectors were always controlled by signals, while the intersections of collectors/locals were stop-controlled.

In cases where conflicting traffic control devices were indicated by the general guideline listed in **Table 55**, the second set of rules was applied.

- A signalized intersection was assumed if at least one approach leg was controlled by a signal
- An all-way stop controlled intersection was assumed if all the approach legs were either stop- or yield-controlled.

For example, if a node in the highway network was joined by an arterial class 1 link, a collector link, and a local link, the node would be treated as a signalized node.

Zero-Volume Delay Calculation

This section describes the calculation of the zero-volume delay (zdelay) for the different traffic control devices. For the yield and stop control devices, the zdelay assumptions used in the **New Jersey Regional Transportation Model "Enhanced" (NJRTME)** were adopted. The concept of calculating zdelay in the NJRTME was also adopted; however, the calculation procedure was simplified.

Unsignalized Intersections

The assumed zero-volume delays for yield and stop signs are shown in **Table 56**.

Table 56 Delay Assumptions at Unsignalized Intersections, Zero-Volume Delay Network

		Traffic Control Device	
	Category Group ID and Category Group Name	Yield	Stop
Approach Legs	5 – Arterials Class 1	N/A	5 sec
	4 – Arterials Class 2	N/A	8 sec
	3 – Collectors	N/A	8 sec
	2 – Locals	N/A	8 sec
	1 - Exit Ramps	8 sec	8 sec

Note: N/A – not applicable

Signalized Intersections

The calculation of the zero-volume delay at a signalized intersection adopted the following assumptions. Note that the calculation was approach-leg based and assumed the network coding of the field CATEGORY is reasonable.

- It was assumed that the probability of a vehicle stopping at a signalized intersection waiting for the green time was 50 percent, even if the vehicle was the only vehicle on the road; therefore, the delay would be half of the green time allocated to the approach leg.
- Two-phase signals were assumed for all signalized intersections
- The major street always comprised of two approach legs and they would have the two highest category groups. For example, if a 4-leg intersection was joined by a category group 5 (arterials class 1) link, a category group 4 (arterials class 2) link, and two collector links, the two arterial links would be major streets and the minor streets would be the collector links.
- The allocations of green time (or the cycle split) to the major and minor streets was proportional to the hierarchy order of the category group. The value of the category group ID was used as the weight. For example, at a 3-leg intersection that was joined by links of category groups 5 (arterials class 1), 4 (arterials class 2), and 3 (collector). The green time allocated to the major streets (the arterials class 1 link and the arterials class 2 link) was 75% (9/12) of the cycle length time and the remaining 25% of the cycle length time was allocated to the minor street (the collect link).
- It was unlikely that the driver would be arriving at the intersection at the beginning of the red time and had to wait the entire red time; therefore, it was assumed that the wait time was a portion of the red time.
- It was assumed that traffic signals that were closely spaced along major streets were likely to have been coordinated; therefore, the wait time at those intersections would be scaled back according to the facility type of the approach leg. The scaling factors are shown in **Table 57**.

Table 57 **Delay Scaling Factors, Zero Volume Delay Network**

Category Group ID, Category Group Name	Scaling Factor
6 - Frontage Roads	0.6
5 - Arterials1	0.7
4 - Arterials2	0.3
3 – Collectors	0.3
2 – Locals	0.4
1 - Exit Ramps	0.7

With the above assumptions, the zero-volume delay (zdelay) calculated for an approach leg on the major street is

$$Cycle\ Length\ \times \frac{\sum(Group\ ID, major\ legs)}{\sum(Group\ ID, all\ appoarch\ legs)} \times (scale\ factor, major\ leg) \times (\%\ chance)$$

Zdelay for the approach on the minor street is

$$Cycle\ Length\ \times \frac{\sum(Group\ ID, minor\ legs)}{\sum(Group\ ID, all\ appoarch\ legs)} \times (scale\ factor, minor\ leg) \times (\%\ chance)$$

Implementation

The application "**ZEROVOLDELAY.APP**" was developed to calculate zdelay. Link and node tables in DBF format were exported from the highway network. Centroid connector links (category=99), transit-only links (the rail track links and the park-ride lot links, category=20 and 50), and the dummy links (category=21-22) were excluded from the link table. The nodes were processed for the number of approach legs, which were links with the B node equal to the node number. The number of one-way approach legs was also tracked at the same time. The following rules were used to determine whether or not an intersection exists:

- If there was only one approach leg, there was no intersection
- If there were only two approach legs and both were in the same traveling direction, there was no intersection
- If all the approach legs were one-way, the intersection was uncontrolled.
- A **cycle length** of 100 seconds was assumed in the CUBE VOYAGER script. A 50 percent chance of stopping was assumed.

Four lookup tables in DBF format were used to collapse categories to category groups (CAT_GROUPS.DBF), to define traffic control devices by approach leg to approach leg movement (TRAFFICOPERATION.DBF), yield/stop delay (SIGN_DELAYS.DBF), and the delay scaling factor for signalized approach legs (TRAF_SCALE_FAC.DBF). The database structures are summarized in **Table 58** to **Table 61.**

Table 58 CAT_GROUPS.DBF, Zero Volume Delay Network

Field Name	Field Type	Description
CATEGORY	N	Category number
GROUP	N	Category group number
Note: see **Table 54** for the contents of categories and category groups		

Table 59 TRAFFICOPERATION.DBF, Zero Volume Delay Network

Field Name	Field Type	Description
GRPTOGRP	N	Category group to category group movement.
CONTROL	C	Control device name
CONTROLID	N	Control device ID associated to the control device name (CONTROL). The coded values and the associated control device name are 1 = Uncontrolled 2 = Yield 3 = Stop 4 = Signal
Note: see **Table 55** for the contents of groups and control devices		

Note that GRPTOGRP is a concatenated field to identify the category group to category group movement. The formula to compute GRPTOGRP is

$$(Category\ Group\ ID, from\ approach\ leg) \times 10 + (Category\ Group\ ID, to\ approach\ leg)$$

Table 60 SIGN_DELAYS.DBF, Zero Volume Delay Network

Field Name	Field Type	Description
GROUP	N	Category group ID
YIELD	N	Delay in seconds for yield controlled approach leg
STOP	N	Delay in seconds for stop controlled approach leg
Note: see **Table 56** for the contents of groups and sign delays		

Table 61 Delay Scaling Factors, Zero Volume Delay Network

Field Name	Field Type	Description
GROUP	N	Category group ID
SCALE_FAC	N	Delay scaling factor
Note: see **Table 57** for the contents of groups and scaling factors		

The user is advised not to modify these lookup tables as these values were calibrated to 2008 observed traffic data.

4.6 Transit Network Elements

4.6.1 Introduction

This section describes the changes made to the transit network as part of the recalibration and validation efforts. The 2008 PT line files were reviewed and modifications were made, where necessary. Other changes included simplifying non-transit modes, re-defining local and premium transit modes, updating the PT fare file to support the implementation of transit fare calculation, modifying PT factor files and the PT system file to support new path-building procedures.

4.6.2 PT Line Files

The AM and off-peak PT line files were reviewed. Transit routes and schedule information for routes that required checking were downloaded from the ABQ RIDE web site (http://www.cabq.gov/transit/). The PT line coding was checked against the downloaded information and edited where necessary. Most of the modifications were made for better connectivity among the transit routes; correcting the headway, and missing routes. In addition, the coded values of **TIMEFAC** were replaced with 1.00 in conjunction to the new calibrated transit time factors implemented as part of the new path-building procedure. Mode numbers of individual routes were updated as a result of the re-calibration efforts.

4.6.3 Transit Modes

The non-transit modes have been simplified. The one-way walk access and walk egress links (modes 30 and 31) in the standard model were consolidated into one mode. The drive egress mode was eliminated because it was not used in the model. (All transit users were assumed to walk to the final attraction zone from their last transit stops). The updated transit modes are summarized in **Table 62**.

Table 62 Transit Modes, Recalibrated Model

Mode Number	Mode Description
1	Premium mode
2	Local mode
31	Walk access/egress links
32	Interchange walk (sidewalk links)
33	Drive access links

As discussed in **Section 3.5.3**, the standard model was calibrated prior to the initiation of the Rail Runner and Rapid Ride services. There was no existing documentation regarding the characteristics used to define premium service. As part of the recalibration process, the transit route characteristics were reviewed and several lines were redefined in accordance with the actual service characteristics. Note that only two transit modes exist (Local Bus and Premium service) in the current mode choice model. The general guideline adopted for defining the premium service includes routes that have limited stops and that some of the route stops are served by park-ride lots. Based on this guideline, only the Rail Runner and two Rapid Ride routes (766 and 790) were coded as premium service. The rest of the routes were coded as local routes. The revised transit modes by route are shown in **Table 63.** The updated routes are printed in *italic text*.

Table 63 Transit Mode Coding by Route, Recalibrated Model

Route #	Route Name	Transit Mode	Route Service
766	Rapid Ride - Red Line	Premium	Peak hours commuter service
790	Rapid Ride - Blue Line	Premium	Peak hours commuter service
Rail Runner	Rail Runner	Premium	Peak hours commuter service
92	*Taylor Ranch Express*	*Local*	*Peak hours commuter service*
93	*Academy*	*Local*	*Peak hours commuter service*
94	*Unser Express*	*Local*	*Peak hours commuter service*
96	*Crosstown Commuter*	*Local*	*Peak hours commuter service*
151	*Rio Rancho/RR Conn.*	*Local*	*Local all day service*
222	*Rio Bravo/Sunport/Kirtland*	*Local*	*Local all day service*
317	*Downtown/KAFB Limited*	*Local*	*Peak hours commuter service*
1	Juan Tabo	Local	Local all day service
2	Eubank	Local	Local all day service
3	Uptown/Cottonwood	Local	Local all day service
5	Montgomery/Carlisle	Local	Local all day service
6	Indian School	Local	Peak hours commuter service
7	Candelaria	Local	Peak hours commuter service
8	Menaul	Local	Local all day service
10	N. 4th St.	Local	Local all day service
11	Lomas	Local	Local all day service
12	Constitution	Local	Peak hours commuter service
13	Comanche	Local	Peak hours commuter service
31	Wyoming	Local	Local all day service
34	San Pedro	Local	Peak hours commuter service
36	Rio Grande/12th St.	Local	Local all day service
50	Airport/Downtown	Local	Local all day service
51	Atrisco/Rio Bravo	Local	Local all day service
53	Isleta	Local	Local all day service

Table 63 Transit Mode Coding by Route, Recalibrated Model (cont')

Route #	Route Name	Transit Mode	Route Service
54	Bridge/Westgate	Local	Local all day service
66	Central	Local	Local all day service
97	Zuni	Local	Local all day service
98	Wyoming	Local	Peak hours commuter service
140	San Mateo Line	Local	Local all day service
141	San Mateo Line	Local	Local all day service
155	Coors Blvd. Line	Local	Local all day service
157	Montano Uptown	Local	Local all day service
162	Ventana Ranch/Montano Plaza	Local	Peak hours commuter service
1618	The BUG	Local	Local all day service
Route1	Route 1	Local	Local all day service
Note: All routes were operated by ABQ Ride except Route 1. Route 350 Airport/Downtown Non-Stop Express was not coded			

4.6.4 PT Transit Fare

As discussed in **Section 4.3.4**, the bus boarding fare and the Rail Runner zone fare in 2008 dollar terms were estimated. To incorporate the transit fare into the model stream, the fares were coded to the PT fare file (FARE.FAR). Two different fare structures were identified by "Operator". Operator 1 was assigned to bus service, and Operator 2 was assigned to Rail Runner. The updated PT fare file is shown below.

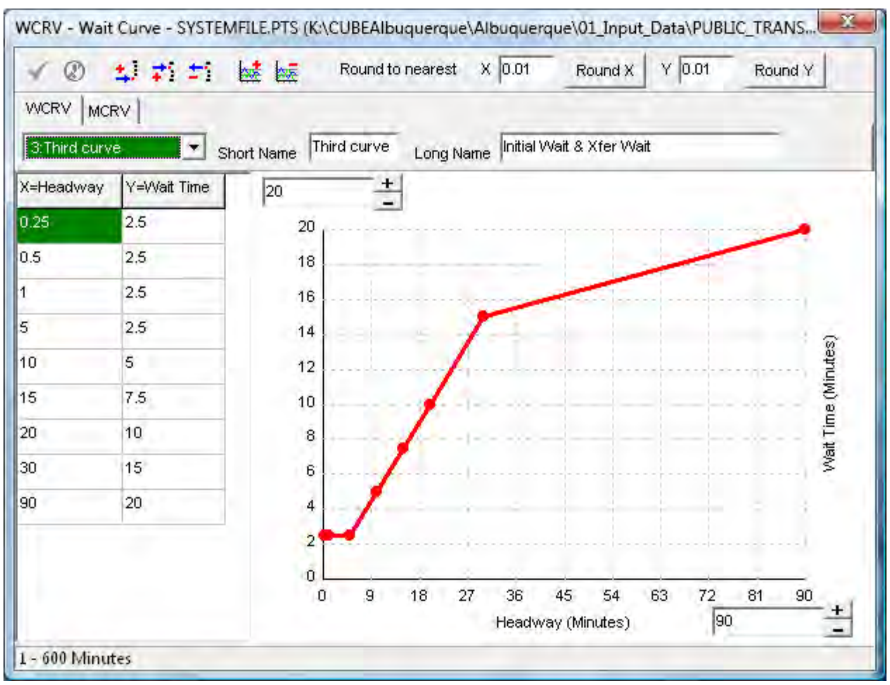
```
; Operator=1, "ABQ Bus"
FARESYSTEM  NUMBER=1,
  LONGNAME="inboard fare",
  NAME="ibfare",
  IBOARDFARE=0.65,
  STRUCTURE=FLAT,
  FAREFROMFS=0.00,0.00

; Operator=2, "ABQ Rail Runner"
FARESYSTEM, NUMBER=2,
  LONGNAME="RAIL RUNNER FARES", NAME="RAIL FARE",
  STRUCTURE="COUNT"  SAME="CUMULATIVE",
  FAREZONES=NI.RAILRUNNERFZ,
  FARETABLE=1-0.875, 2-1.250, 3-1.625, 4-2.375, 5-2.500, 6-2.750,
  IBOARDFARE=0.00,
  FAREFROMFS=0.00,0.00
```

A procedure was added to compute the average transit fare. In the path-building procedure, a transit fare matrix was also created along with other transit skims. The cell values in the fare matrix accounted for the total fare that the rider paid for boarding a bus and/or riding the commuter rail and transfer. (Transfer was free under the 2008 condition). For example, if a trip from Zone 101 required riding a local bus and transfer to a ride Rail Runner for two fare zones, the total transit fare would be $1.9 (0.65[bus]+1.25[Rail Runner]). The average transit fare was computed based on the transit fare matrix and trips in the transit trip table. The average transit fare was then automatically adjusted by the cost adjustment procedure to convert the value to 1992 dollar terms. Note that in the PT fare file, the fare zone (keyword = FAREZONES) was specified in a node attribute field name RAILRUNNERFZ. See **Section 4.5.3** for the discussion of coding fare zone.

4.6.5 Wait Curve

The wait curve was adjusted to better represent the time a transit rider would spend on waiting. The adjusted wait curve is shown in **Figure 16**. The adjusted curve could be viewed as three sub-segments. The first sub-segment assumed a 2.5 minute wait time for when the transit headway was less than or equal to 5 minutes. The second sub-segment was for the transit headway between 5 to 30 minutes. The wait time would be half of the headway which assumes a random arrival rate for frequent service. In the last sub-segment, it assumed that the wait time for those routes with headway greater than 30 minutes would increase slightly from 15 minutes, reflecting the increased tendency for travelers to coordinate their travel to minimize wait time for infrequent service.

Figure 16 Transit Wait Curve, Recalibrated Model



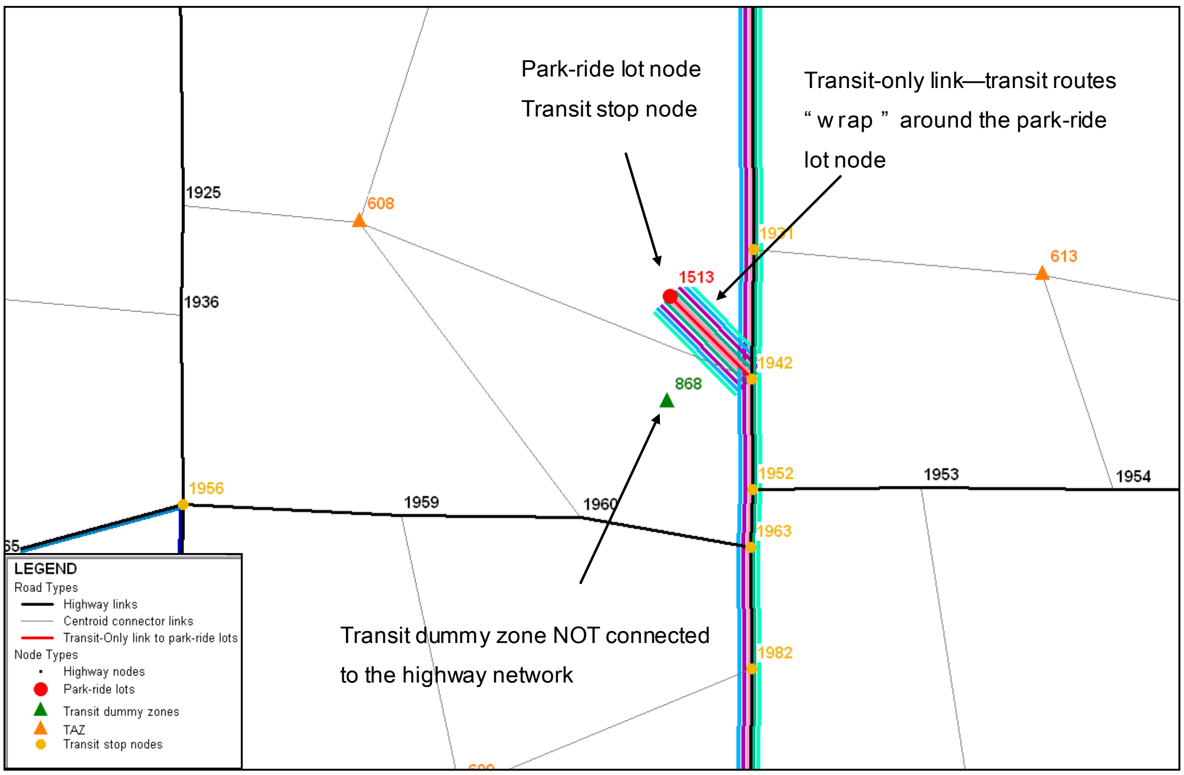
4.6.6 Park- Ride Lots

The park-ride lots that were opened to the public after 2004 were added to the highway network using node numbers between 1401 and 1500. Some of these lots were served by the Rail Runner. The recalibrated model handled the coding of the Rail Runner park-ride lots differently compared to those lots that serve only buses. The coding of both types of park-ride lots are discussed below.

Bus park-ride lots

For this type of park-ride lot, the coding of the park-ride lots with the standard model was retained; however, the transit dummy zone was not required and the routes that served the park-ride lots were re-routed to "wrap" around the park-ride lot nodes. This special coding was to ensure that those highway nodes (nodes = 1400-1515) were reserved for park-ride lots. In addition, using the reserved node for park-ride lot would make it easier to summarize transit activities at park-ride lot nodes. **Figure 17** is an example of this type of park-ride lot.

Figure 17 Bus Park-Ride Lot Coding, Recalibrated Model



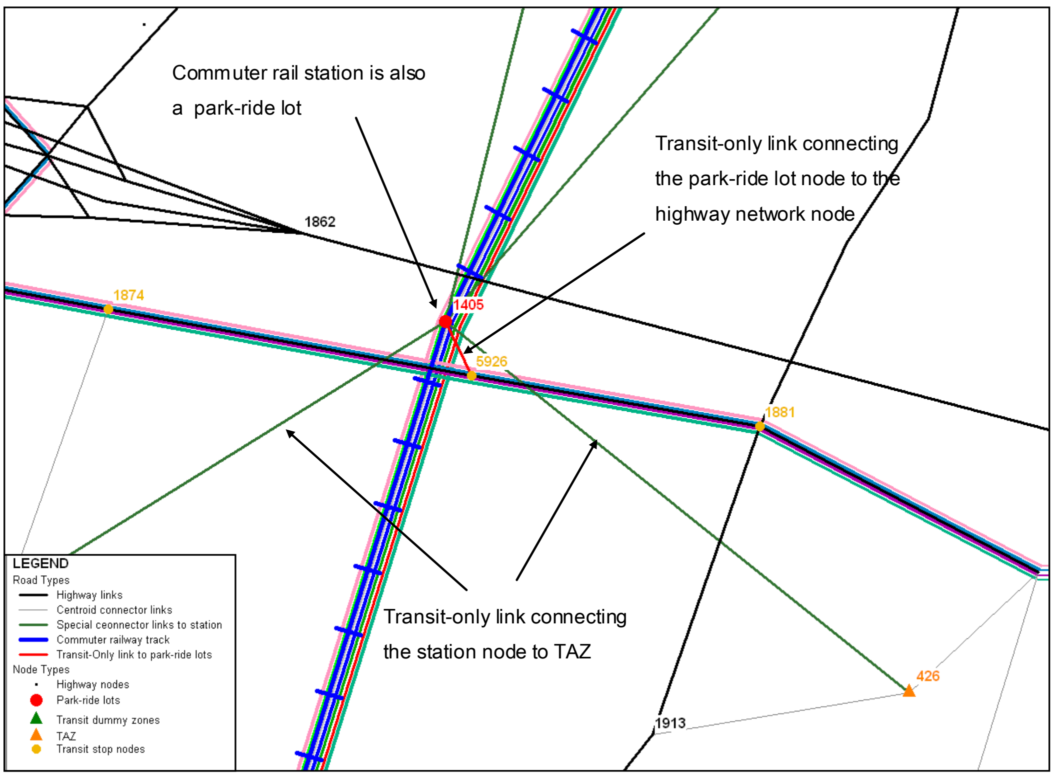
See **Section 4.5.2** and **Section 4.6.8** for the discussions of coding transit-only links and **Section 4.5.3** for the special coding rules at the park ride nodes.

Commuter rail station park-ride lots

The coding of the park-ride lots at the commuter rail stations was different. As illustrated by an example shown in **Figure 18**, both the station and park-ride lots shared the same highway node (1405). A transit-only link (ISPNRTOBUS=1) was added to connect the park-ride node to the highway network to support the abstraction of the drive access connectors for the auto access path.

Another type of transit-only link was added to connect the station node to TAZ to allow walk access and egress. These links were added due to the request of MRCOG staff to ensure the walk connectivity between the station and the TAZ. Normally, walk access and egress links are best handled by a process that automatically generates the links based on walk distance with an assumed walk speed and a reasonable dense highway network. It was recommended that the link length of these hard-coded walk access/egress links should be less than 0.5 mile to account for the relative coarse TAZ coverage and the lack of network coverage in some of the commuter rail station areas.

Figure 18 Commuter Rail Station Park-Ride Lot Coding, Recalibrated Model



See **Section 4.5.2** and **Section 4.6.8** for the discussions of coding transit-only links.

4.6.7 Transit Bus Stops

Transit bus stops were coded at nodes that were also connected to centroid connector links. In addition, the transit routes were also coded to stop at the bus park-ride lot nodes (see **Figure 17**) and the nodes connected to the commuter rail stations (see **Figure 18**).

4.6.8 Transit-Only Links

As mentioned previously, the existing transit-only links that connected the transit dummy zone to the highway network and the TAZs to the park-ride lots were removed from the highway network. In addition, transit-only links that represented the commuter rail fixed guideway were added to the highway network. This section briefly describes the coding specifications of transit-only links.

Transit-only links for commuter railway track

Unlike a bus that traveled in the mix of traffic and its level of service was affected by the traffic condition, the Rail Runner operated in a fixed guideway and the level of service of these links were not affected by the traffic conditions. The operating speed was estimated based on schedule time and hard-coded to the rail links. The link coding specification for commuter rail guideway links are depicted in **Table 64**.

Table 64 Link Coding Convention for Commuter Railway Track Transit-Only Link, Recalibrated Model

Link Attributes	Coded Values
CATEGORY	20
UL1	Operating speed (computed by the user based on schedule time)
ISAUTO	0
ISWALK	0

Transit-only links for park-ride lots

The coding specification for the transit-only links to bus park-ride lots and to commuter rail station park-ride lots are the same. ISPNRTOBUS was coded to 1 and the associated coding convention is summarized in **Table 65.** Note that by coding a value of 1 to the ISWALK variable, the transit-only links also serve as a link in the walk network for transferring. This was important for those transit-only links connecting to the commuter rail station because feeder buses were coded to stop at the adjacent highway nodes at each rail station. See **Section 4.5.2** for additional discussion of coding transit-only links for park-ride lots.

Transit-only link for walk access/egress from/to commuter rail station

The special walk access and egress links from and to commuter rail stations were transit-only centroid connector links. The link coding specification is summarized in **Table 65**.

Table 65 Link Coding Convention for Other Transit-Only Links, Recalibration Model

Link Attributes	Park-Ride Lots	Walk Access/Egress to Commuter Station from TAZ
CATEGORY	50	99
ISAUTO	1	0
ISWALK	1	1
ISPNRTOBUS	1	1
Directionality	Two-way	Two-way

4.6.9 Transit Access/Egress Links

New methodologies to generate the transit access and egress links were added for the Rail Runner stations and Rapid Ride limited bus stops. In addition, the methodologies to create these links in the standard model were modified in conjunction with the changes that simplified link attribute fields and non-transit modes. This section describes the changes made to the standard model methodologies, as well as new methodologies. Note that the original procedures for creating sidewalk "transfer" links in downtown CBD were retained. These links are designated as mode 32 links.

Walk Mode

The basic procedure of generating walk access and egress links to transit bus stops in the standard model was retained for the local transit bus stops; however, the scripts were modified as a result of the simplified highway link attribute fields and the simplified non-transit modes. New scripts were added to generate the walk access and egress links for the commuter rail stations and the limited stop nodes of Rapid Ride lines since these stop nodes were not directly connected to centroid connector links of all the adjacent zones. Note that the additional walk access links for the premium modes were merged with the original walk links for the purposes of providing walk access to the premium modes. This permitted walk access to premium modes either directly from a zone or indirectly if a walk access path first used a local bus to access the premium mode.

Local transit mode

The procedure of generating walk access and egress links to transit bus stops in the standard model was retained for the local transit bus stops. No coding was required on the centroid connector link. In the recalibrated model, a list of transit stop nodes would be compiled from processing the local transit routes in PT line file. A two-way walk link would be automatically generated if the stop node was connected to a centroid connector link. These links would be assigned a mode number of 31 and the walk time would be computed using an assumed walk speed of 3 miles per hour. This procedure was executed twice in the model stream, once for the AM transit network and the other for off-peak transit network. An example is shown in **Figure 19**.

Premium transit mode

The procedure of generation of walk access and egress links to premium transit stop nodes was added to the recalibrated model. The premium transit routes included the Rail Runner and the Rapid Ride. Their routes serve limited stops, and many of the stop nodes were not connected directly to centroid connector links. The procedure began with compiling a list of stops by processing the premium routes in the PT line file. Paths were constructed from the TAZs to the stop nodes using permitted walk links in the highway network and walk time was accumulated. A walk speed of 3.0 miles per hour was assumed to compute the walk time. It is typical to assume that a transit rider would not walk more than 0.25 mile to a transit stop. Longer walk distances were assumed in the recalibrated model. This assumption was based on that a transit rider was willing to walk further for a premium service, and that some of the Rail Runner stations were coded at where there was a lack of network coverage and the TAZ was relatively coarse. The maximum walk time assumption is shown in **Table 66**. Those paths that had the calculated walk time exceed the maximum thresholds were excluded from use in the path-building procedure.

Table 66 Maximum Walk Time Assumption for Premium Mode, Recalibrated Model

Premium Transit Service	Walk Distance	Walk Time*
Rapid Ride	0.5 mile	10 minutes
Rail Runner	0.6 mile	12 minutes
* Assumed walk speed of 3 miles per hour		

Similar to walk access and egress links for local transit routes, this procedure was executed twice, once for the AM period, and the other for off-peak time. Examples of these links are shown in **Figure 19.**

Drive Access Mode

As noted previously, the existing model did not contain a documented procedure for generating access links to park and ride lots for the drive access modes; therefore, Systra Mobility created a new process to automatically generate the necessary links to each park ride lot. The new procedure is very similar to the procedure that generates the walk access links to premium route stop nodes. Paths were built from the TAZs to the stop nodes which included the park-ride lot nodes, utilizing the highway links and accumulating the link travel time. The link travel time was the congested travel time resulted from the step of highway assignment. A limit was set on the drive time. A path would not be built if the tracked time exceeds the maximum threshold shown in **Table 67**. The maximum drive time a transit patron was willing drive to a transit stop for kiss-ride access and park-ride access. A mode number of 33 was assigned to these links. Note that the drive access link was a one-way link from TAZ to the kiss-ride and park-ride node. Egress for the drive access modes was assumed to walking from the final transit stop node to the destination zone.

Figure 19 Access/Egress Walk Links to Premium Route Stop Nodes, Recalibrated Model

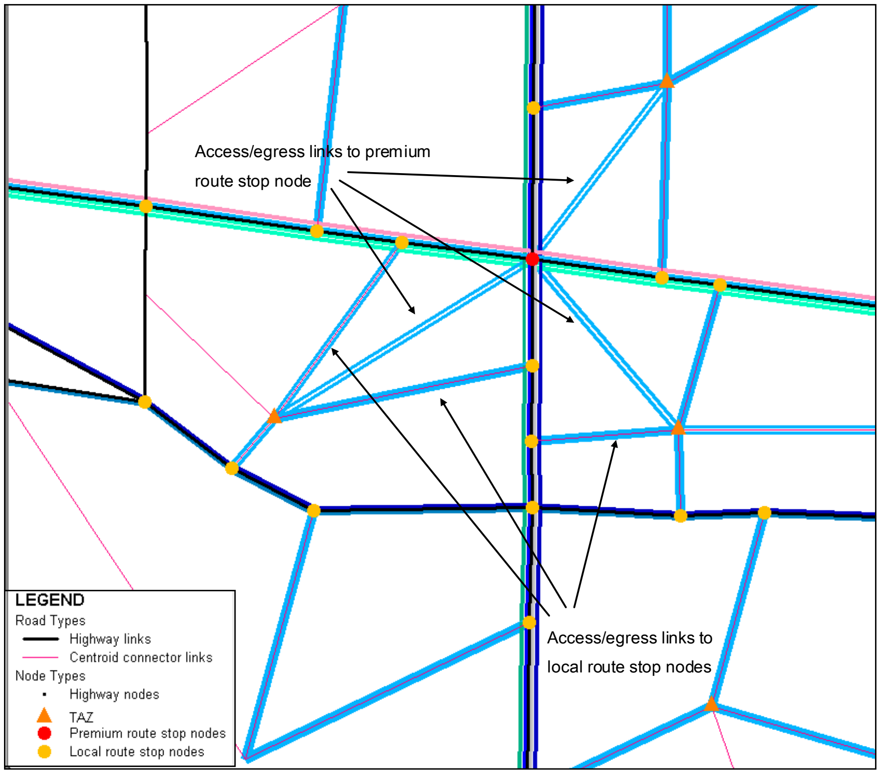


Table 67 Maximum Drive Time for Drive Access Links, Recalibrated Model

Sub-mode	Drive Time
Kiss-Ride	5 minutes
Park-Ride	10 minutes

These threshold values were estimates since the assumptions for drive time on drive access links in the standard model could not be used. In the original model the link distance was not actual distance and the link travel time was computed using an assumed auto speed of 60 miles per hour. The estimation was performed in an iterative process until the access catchment areas of the new procedure looked reasonable or closely replicated the catchment areas of the original standard model.

4.7 Highway Skims

The highway skimming procedure of the standard model was retained in the recalibrated model. The script was modified to add the formula to adjust the computed generalized cost to 1992 dollar terms. See **Section 4.3.5** for the discussion of adjusting cost to 1992 dollar terms.

4.8 Transit Skims

4.8.1 Introduction

The path-building procedures have been modified in conjunction with the changes made to the procedures that generated the walk and drive access links, as discussed in **Section 4.6.9**. In addition, the transit time factors have been replaced. This section describes that new transit time factors and the modified path-building procedures.

4.8.2 Transit Time

The global transit factor of 1.6 in the standard model has been replaced, in conjunction with replacing all the TIMEFAC values coded at the PT line level with 1.0. The new factors are depicted in **Table 68**.

Table 68 Transit Time Factors, Recalibrated Model

Time Period	Transit Mode	Factor*
AM	Premium	1.42
	Local	1.61
Off-peak	Premium	1.97
	Local	2.03
* These factors are NOT applicable to freeway and ramp links		

These factors were calibrated to the scheduled run time. In each period, the local bus mode has a higher factor since the more frequent stops resulted in additional time to board and discharge passengers thereby increasing the ratio of transit time to auto travel time. Note that the AM factors are less than the off-peak factors, since the congested conditions enable transit vehicles to board and discharge passengers while maintaining an overall speeds that are closer to the congested auto speeds than in the off-peak period.

4.8.3 Path-Building Parameters

The factor files used in the path-building procedures have been replaced with the set of files shown in **Table 69**. The parameters are summarized in **Table 70**. With the exception of RUNFACTOR[1], the same set of factors is used for walk to local and walk to premium paths in both periods. The value of 0.1 is used to favor paths built with premium modes and was retained for the original standard model. Similarly, the drive to kiss-ride and park-ride share the same set of factors for both periods.

Table 69 **Transit Factor Files, Recalibrated Model**

Time	Sub-Mode	Factor File Names		
		FACTOR_LOC_wk_*pp*.FAC	FACTOR_PREM_wk_*pp*.FAC	FACTOR_dr_*pp*.FAC
Peak/ Off-peak	WL	X		
	WP		X	
	PNR			x
	KNR			x

pp *Time period, pk for peak, op for off-peak*
WL *Walk to local*
WP Walk to premium
PNR Drive to park-ride
KNR Drive to kiss-ride

The node range has been changed to 901-9999 from 878 to 9999. The mode choice model was programmed to handle 900 TAZ; therefore, the lower bound should begin at 901. MRCOG staff would need to increase the upper bound of the node range for using new node numbers higher than 9999 for their coding needs. The peak and off-peak values of time were specified for the corresponding time periods. The zone fare system of the Rail Runner has been added and the specifications of the operators for the fare systems are consistent with the fare file. (See **Section 4.6.4** for the discussion of transit fare). The maximum number of transfers was set to 3. A transfer factor of 1.5 has been added to discourage transfer between modes. Lastly premium mode was excluded when building walk to local paths.

Table 70 Transit Factor Parameters, Recalibrated Model

Parameters	File Name		
	FACTOR_LOC_wk_pk.FAC FACTOR_LOC_wk_op.FAC	FACTOR_PREM_wk_pk.FAC FACTOR_PREM_wk_op.FAC	FACTOR_dr_pk.FAC FACTOR_dr_op.FAC
IWAITCURVE	3	3	3
NODES	901-999999	901-999999	901-999999
XWAITCURVE	3	3	3
NODES	901-999999	901-999999	901-999999
FARESYSTEM(1)	1	1	1
OPERATOR(1)	1	1	1
FARESYSTEM(2)	2	2	2
OPERATOR(2)	2	2	2
VALUEOFTIME	2*6.467 for peak	2*6.467 for peak	2*6.467 for peak
	2*3.233 for Offpeak	2*3.233 for Offpeak	2*3.233 for Offpeak
MAXFERS	3	3	3
EXTRAXFERS1	3	3	3
EXTRAXFERS2	2	2	2
RUNFACTOR[1]	1.0	0.1	0.1
RUNFACTOR[2]	1.0	1.0	1.0
RUNFACTOR[31]	1.0	1.0	1.0
RUNFACTOR[32]	2.0	2.0	2.0
RUNFACTOR[33]	1.0	1.0	1.0
WAITFACTOR	2.0	2.0	2.0
NODES	901-999999	901-999999	901-999999
XFERFACTOR	1.5	1.5	1.5
FROM	1-2	1-2	1-2
TO	1-2	1-2	1-2
BESTPATHONLY	T	T	T
DELMODE	1	NA	NA
DELACCESSMODE	33	33	31
(1) FARESYSTEM=1 . Flat fare structure for bus. FARESYSTEM=2. Zone fare structure for Rail Runner			
(2) OPERATOR=1 . ABQ bus. OPERATOR=2. Rail Runner			
NA Not applicable			

4.8.4 Path-Building Procedures

In addition to the modification of the path-building parameters there were also modifications to the path-building procedures to ensure that only viable impedances were generated for each mode. The primary refinements for the walk path-building procedures are summarized in **Table 71**. The transit-only links in the walk network served as walk transfer links between buses. A maximum walk time of five (5) minutes was assumed for the walk transfer link.

Note that both the local and premium transit routes were included in building the walk to premium path. It was therefore possible that a "walk to premium mode" path could be built which uses local transit routes exclusively if no premium routes served a particular zonal pair. To ensure only paths designated as walk to premium mode actually used a premium mode during some part of the path, the skim values were evaluated to confirm that mode 1 time was not equal to zero. If the travel time accumulated for premium modes for a given zonal pair equaled zero, then the total transit time value was replaced with zero so that the mode choice model could reject the mode.

Table 71 Primary Refinements in Walk Path-Building Procedures, Recalibrated Model

Walk to Local	Walk to Premium
Walk access and egress links to local route stops	Walk access and egress links to local route stops Walk access and egress links to premium route stops
No limit on walk time	Maximum walk time to premium bus stops = 10 min Maximum walk time to premium commuter rail stations = 12 mins
Transit time factors for local mode	Transit time factors for local mode Transit time factors for premium mode
Transit routes of premium mode are excluded	All transit routes are included

The major refinements in the drive access path-building procedures are summarized in **Table 72**. Note that park-ride access is permitted only at the formally designated park-ride lots. In contrast, kiss-ride access is permitted at any transit stop of any transit mode.

Table 72 Primary Refinements in Drive Path-Building Procedures, Recalibrated Model

Drive to Kiss-Ride	Drive to Park-Ride
Drive access links to transit stop nodes Drive access links to park-ride lot nodes	Drive access links to park-ride lot nodes
Maximum drive time for drive to kiss-ride = 5 min	Maximum drive time for drive to park-ride = 10 min

The total in-vehicle travel time, total walk time, and the total wait time were capped at 200 minutes.

4.9 Non-Motorized Skims

The path-building procedure has been modified. The changes are highlighted below.

- Highway links that represented freeways and ramps were excluded
- The path was not allowed to travel through centroids
- The same criteria is used for building distance path and time path

4.10 Highway Time Estimation

4.10.1 Introduction

As the initial task in the recalibration process (see **Section 4.2**), the focus of this task was improving estimated highway travel time. This task involved replacing the BPR VDFs with the Akcelik VDFs in the highway assignment along with other adjustments until the estimated VMT and peak speeds replicated the observed data.

4.10.2 Approach

The process began with comparing the estimated VMT results from the standard model to the observed VMT. The estimated vehicle trip tables were adjusted to account for the difference between the observed and estimated VMT. These adjusted trip tables were used throughout this task. In addition to replacing the BPR VDF with the Akcelik function, the following modifications were made.

- Added zero volume delay to the calculation of the link travel time (see **Section 4.5.6**)
- Added a category to separate the high speed ramp links from the freeway links (see **Section 4.5.2**)
- Adjusted link free-flow speed and capacity (see **Section 4.5.2**)
- Updated AM and PM capacity scaling factors (see **Section 4.10.4**)

This section focuses on the Akcelik VDFs and the updated capacity scaling factors. See the referenced sections for other modifications.

4.10.3 Akcelik Volume Delay Functions

After carefully reviewing the VDFs used in highway assignment of the standard model, it was decided that the current BPR-based VDFs did not properly reflect the characteristics of the roads that belonged to different types of facilities. Other than the Akcelik VDFs, several BPR-based alternatives were considered for modifying the VDF. These included updating the BPR parameters based on the Highway Capacity Manual 2000 (HCM2000) and a truck study conducted in Florida. Analyses were conducted and the Akcelik VDFs were selected to replace the BPR VDF. The formula of the Akcelik VDF is as follows:

$$t = t_0 + \left\{0.25T\left[(x-1) + \sqrt{(x-1)^2 + \frac{8J_A}{QT}x}\;\right]\right\}$$

Where:

t = average travel time per unit distance (h/mi),
t_0 = free-flow travel time per unit distance (h/mi),
T = flow period (typically 1 h) (h),
x = degree of saturation = volume/capacity,
Q = capacity (veh/h) , and
J_A = delay parameter.

The final parameters for the Akcelik VDFs by facility type are depicted in **Table 73**. Note that the capacity is the same as those shown in **Table 53**. The Akcelik VDF has an underlying assumption of a certain relationship between the link capacity and the value of J_A. Both the capacity and the J_A values were calibrated to the observed 2008 traffic conditions.

Table 73 Akcelik Delay Parameters and Capacity

Category	Category Description	Capacity (Q)	J_A
1	High Speed Ramps	1,600	0.08
2	Urban principal arterials	1,000	0.60
3	Urban minor arterials	900	0.71
4	Urban collectors	950	0.76
5	Urban Locals	850	2.00
6	Urban freeway frontage roads	1,300	0.40
7	Urban freeway links	1,900	0.10
8	Urban entrance Ramps	800	1.60
9	Urban exit Ramps	750	1.67
10	Limited access principal arterials	1,100	0.33
11	Rural minor collectors	850	0.67
12	Rural Principal Arterials	1,300	0.80
13	Rural minor arterials	1,200	0.86
14	Rural major collectors	1,100	0.89
15	Rural locals	600	1.33
16	Rural freeway frontage roads	1,300	0.40
17	Rural freeway links	1,900	0.10
18	Rural entrance Ramps	900	1.60
19	Rural exit Ramps	850	1.67

The "behavior" of the final Akcelik curves (urban and rural categories) are illustrated in **Figure 20** and **Figure 21**. Note the hierarchy of the curves in which the freeway is least sensitive to the volume-capacity ratio (V/C); however, the travel time would quickly deteriorate when traffic congestion begins to occur and the V/C approaches 1.0. As anticipated as freeway volumes approach capacity, speed decreases to approximately 50 miles per hour under the urban environment.

Figure 20 Volume Delay Curves of Urban Categories, Recalibrated Model

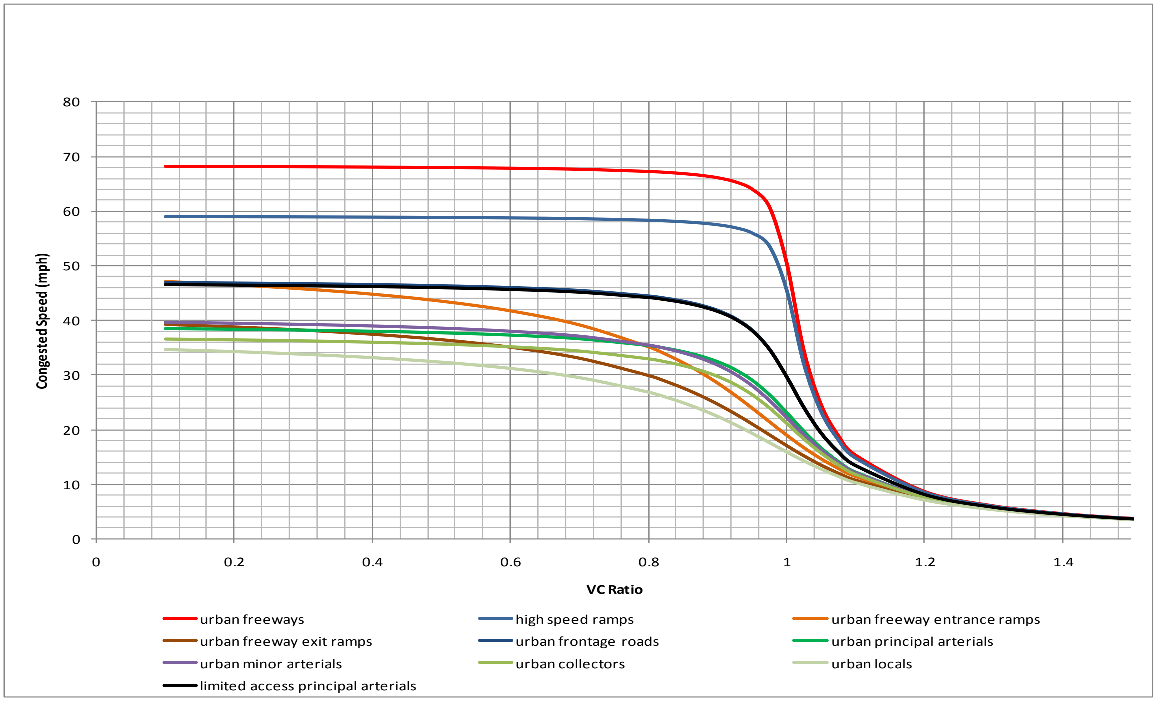
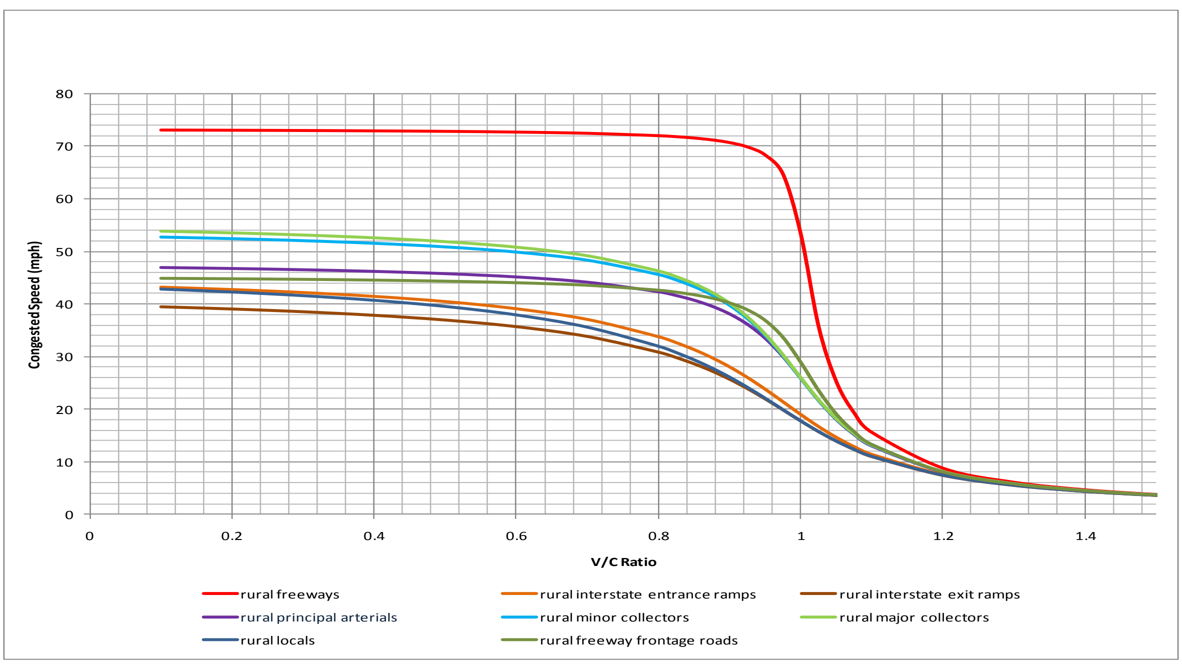


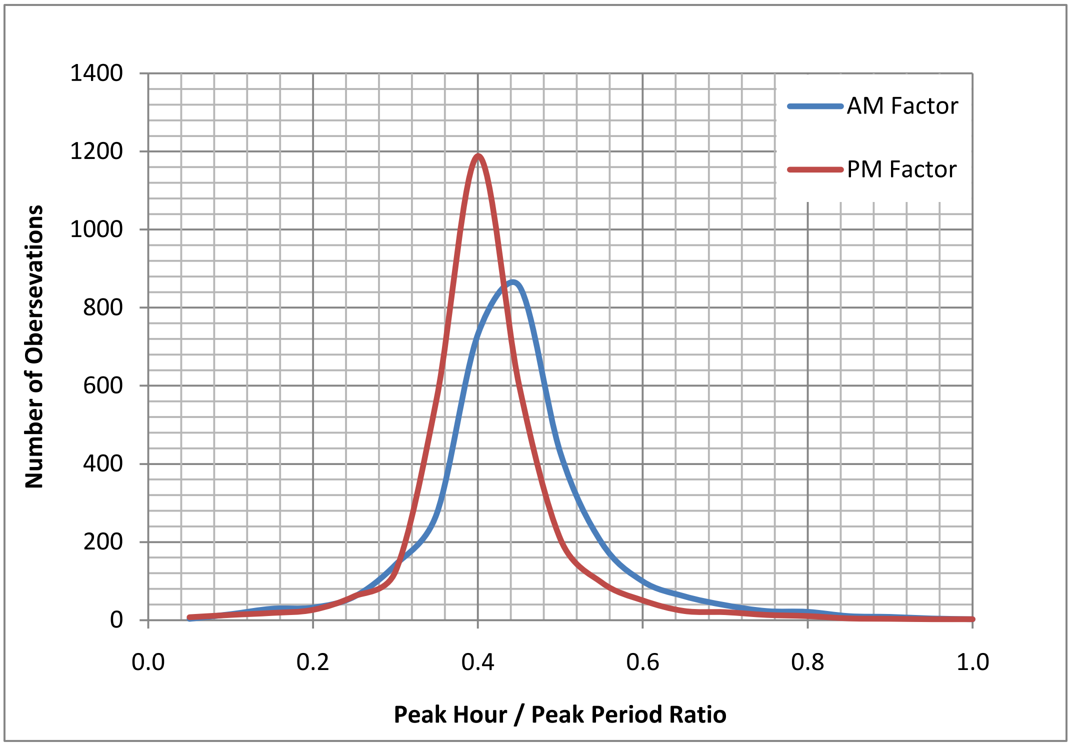
Figure 21 Volume Delay Curves of Rural Categories, Recalibrated Model



4.10.4 Peak Hour Capacity Scaling Factor

The peak hour capacity scaling factors were updated and the revised factors were estimated based on the observed peak hour and peak period traffic data. The peak hour to peak period ratio was calculated and plotted in the histogram shown in **Figure 22**. To avoid the impact of the outliers, the median, instead of the mean, was chosen as the factor for the corresponding period.

Figure 22 Histogram Charts of Scaling Factors



The final scaling factors are depicted in **Table 74**. Note that due to the lack of traffic data, the scaling factor for the off-peak period remained the same as in the standard model. In conjunction with the updated capacity scaling factors, the factor of 0.9 that was applied to the capacity for links coded with subarea=5 was removed. (See **Section 3.7.3**).

Table 74 Capacity Scaling Factors, Recalibrated Model

Time Period	Scaling Factor
AM Peak Period (6:30 to 9:30 AM)	*0.413*
PM Peak Period (3:00 to 6:00 PM)	*0.379*
Off-Peak Period (6:00PM – 6:30 AM, 9:30AM – 300 PM)	0.113

4.10.5 Results

The final estimated daily volumes and VMT are summarized and compared to observed data in **Table 75** and **Table 76**. Note that the values shown in these tables are the results after the final recalibration, but the general level of replication of the observed statistics was similar to these results when the preliminary assignment calibration was performed. A more comprehensive discussion of the highway assignment calibration is provided in **Section 5.1** of this report. As discussed previously, the primary objective of this task was to obtain reasonable estimated highway speeds which would be used as the basis for the highway modes' time and cost impedances in mode choice as well as provide a reasonable set of highway speeds to estimate factors to calibrate for the bus run time for the peak and off-peak periods. Note that these updated transit run times are also provided as input to the mode choice model.

Table 75 Comparison of Observed and Estimated Daily VMT

Category	Facility Type	Coverage %	# Links	Distance (miles)	Daily VMT. OBS.*	Daily VMT. EST.	Error %	% RMSE
7	Urban freeway	52%	181	85	3,010,319	3,273,739	9%	26%
8	Urban entrance Ramps	80%	103	18	125,430	133,807	7%	48%
9	Urban exit Ramps	78%	111	19	118,143	131,323	11%	54%
1	High speed Ramps	36%	14	2	55,973	54,513	-3%	14%
6	Urban freeway frontage roads	92%	110	18	127,507	123,786	-3%	63%
10	Limited access principal arterials	92%	583	190	2,211,427	2,218,064	0%	34%
2	Urban principal arterials	97%	1,671	392	3,690,629	3,224,880	-13%	54%
3	Urban minor arterials	93%	1,653	370	2,212,282	2,172,217	-2%	59%
4	Urban collectors	85%	2,227	550	1,245,965	1,254,487	1%	99%
5	Urban Locals	50%	76	16	24,932	22,094	-11%	120%
	Urban Sub-Total	**86%**	**6,729**	**1,660**	**12,822,606**	**12,608,908**	**-2%**	**60%**
17	Rural freeway	56%	60	82	966,062	1,182,972	22%	36%
18	Rural entrance ramps	79%	26	6	11,191	10,581	-5%	85%
19	Rural exit ramps	77%	28	7	12,701	11,556	-9%	98%
14	Rural major collectors	72%	290	235	356,979	427,970	20%	132%
11	Rural minor collectors	92%	120	130	111,569	170,766	53%	144%
15	Rural locals	48%	129	53	35,316	58,103	65%	220%
	Rural Sub-Total	**67%**	**653**	**513**	**1,493,818**	**1,861,947**	**25%**	**94%**
	Grand Total	**81%**	**7,382**	**2,174**	**14,316,424**	**14,470,855**	**1.1%**	**64.9%**

* Observed 2008 average weekday count data received in December 2009

Table 76 Comparison of Observed and Estimated Daily Volumes

Category	Facility Type	Coverage %	# Links	Distance (miles)	Daily Volume OBS.*	Daily Volume EST.	Error, %	% RMSE
7	Urban freeway	52%	181	85	7,792,347	8,224,673	6%	19%
8	Urban entrance Ramps	80%	103	18	782,182	836,233	7%	43%
9	Urban exit Ramps	78%	111	19	755,886	841,783	11%	50%
1	High speed Ramps	36%	14	2	402,128	376,976	-6%	17%
6	Urban freeway frontage roads	92%	110	18	868,278	919,485	6%	49%
10	Limited access principal arterials	92%	583	190	7,859,051	7,842,287	0%	31%
2	Urban principal arterials	97%	1,671	392	18,232,062	15,392,203	-16%	43%
3	Urban minor arterials	93%	1,653	370	10,477,742	9,805,734	-6%	47%
4	Urban collectors	85%	2,227	550	5,596,215	5,264,544	-6%	79%
5	Urban Locals	50%	76	16	128,544	129,497	1%	94%
	Urban Sub-Total	**86%**	**6,729**	**1,660**	**52,894,435**	**49,633,413**	**-6%**	**46%**
17	Rural freeway	56%	60	82	778,002	998,134	28%	37%
18	Rural entrance ramps	79%	26	6	48,842	51,992	6%	94%
19	Rural exit ramps	77%	28	7	58,442	52,361	-10%	101%
14	Rural major collectors	72%	290	235	531,228	684,666	29%	94%
11	Rural minor collectors	92%	120	130	138,608	199,080	44%	93%
15	Rural locals	48%	129	53	82,364	142,732	73%	166%
	Rural Sub-Total	**67%**	**653**	**513**	**1,637,486**	**2,128,966**	**30%**	**82%**
	Grand Total	**81%**	**7,382**	**2,174**	**54,531,921**	**51,762,379**	**-5.1%**	**47.1%**

* Observed 2008 average weekday count data received in December 2009

The comparisons of the observed and estimated AM and PM speeds are found in **Table 77**. The daily VMT was used as the primary data set that was used in the calibration process. The AM and PM speed data was the secondary data set. The traffic count data covered a series of links instead of at the discrete location where the traffic count data was actually collected. In addition, the traffic count data was not balanced at intersection nodes or between consecutive links where there was not "sink" or "source" in between the links. **Figure 23** illustrates some of the issues as a result of the traffic count data. Daily traffic count data of a series of seven consecutive links were plotted. The x-axis represents the distance between the nodes. The locations of the nodes can be identified at where the dash lines are. The first intersection (or node) was located at distance=0. Link #1 was about 0.27 miles long and the second node a centroid connector link. Link #2 was about 0.2 mile long and there was no intersection and centroid connector link between link #2 and link #3. Four numbers of daily traffic count data were provided for these seven links. Links #1 and #2 shared the same traffic data; likewise for links #3 and #4, and links #5 and #6. The traffic data provide for links #2 and #3 were inconsistent with the network, where the node between these two links were not connected to other nodes or any TAZ.

As a result, the percent error, instead of the percent RMSE was used as the primary statistics to measure the performance of the comparison. This can be illustrated by the example shown in **Figure 23**. Assigned volumes changed either because the link was connected with other links or a TAZ. The estimated daily volume on link #1 was different than link #2 because of trips absorbed by the TAZ. The difference between the observed and estimated traffic volumes on link #3 was greater than link #2, and was very small on link #4. Likewise, the assigned volume on link #5 was closer to the observed traffic count data compared to link #6. The calculated percent error for daily VMT was -14% compared to -16% for the daily volumes. The % RMSE for daily VMT was 34% compared to 39%.

It must be noted that the calibration effort was focused primarily on urban categories. Eighty-nine (89) percent of the highway links (excluding centroid connector links and transit-only links) were coded as one of the urban categories. In addition, in the network area south of Route 6 (Main Street) in Valencia County, the rural category links were coded in the mix of urban category links. Many of these rural category links were coded with faster posted speed than the urban category links in the vicinity. This had made the calibration effort difficult because of the illogical differences in free flow speed for adjacent roadways.

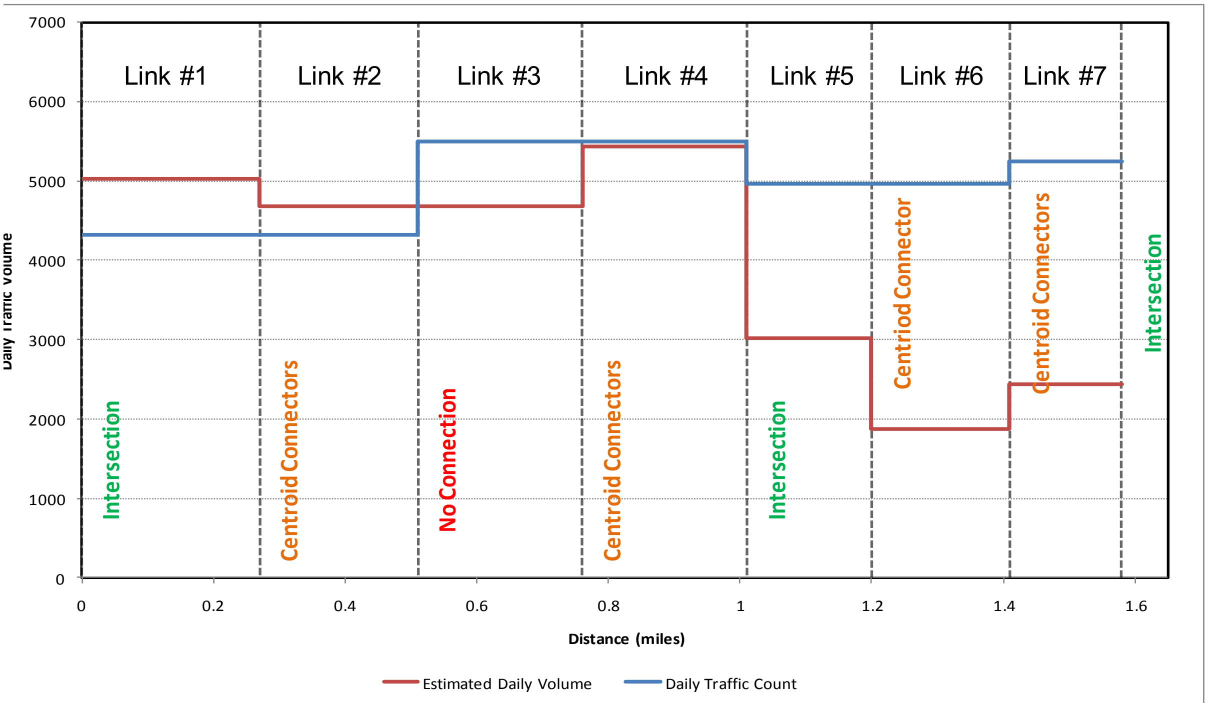
It should also be noted that at this phase of the calibration, the effort was focused primarily on obtaining reasonable loadings of vehicle traffic in an aggregate setting such that realistic speeds could be obtained for estimating highway impedances and transit run times in a congested environment for the peak periods. The preliminary calibration of the highway assignment enabled the calibration of the mode choice and trip distribution components to utilize times for path-building and skim estimation that would be similar to the congested times that would be estimated in the final highway assignment after several model "feedback" iterations.

Table 77 Comparison of Observed and Estimated AM and PM Speeds

Category	Facility Type	AM Peak Speed (mph)*			PM Peak Speed (mph)*		
		OBS.	EST.	Error %	OBS.	EST.	Error %
7	Urban freeway	61.3	57.7	-6%	58.4	56.9	-3%
	- Peak direction	58.8	52.9	-10%	57.8	55.1	-5%
	- Off-peak direction	65.6	67.8	3%	60.9	59.5	-2%
10	Limited access principal arterials	37.1	37.9	2%	36.1	38.1	6%
2	Urban principal arterials	26.4	29.9	13%	23.8	29.8	25%
3	Urban minor arterials	29.3	26.3	-10%	26.3	27.8	6%
4	Urban collectors	21.6	28.8	33%	NA	NA	NA
17	Rural freeway	77.7	74.2	-5%	70.9	74.3	5%

* Speed data at links where observed daily traffic count data were also available
NA not available

Figure 23 Example of Links with Observed and Estimateds Daily Volumes Data



It must be noted that the goal was to minimize the difference between the observed values and estimates and to balance the benefits of adjusting the speed, capacity, and the delay parameters. For example, **Table 75** shows that the estimated daily VMT of Category 4 (urban collectors) matched well against the observed, but **Table 77** indicated that the AM speed was over estimated by 33%. In addition, improving the urban freeway category was the priority. The percent error of the estimated daily VMT, daily volume, and the AM and PM speeds for the urban freeway category was within 10% of the observed values. Overall the daily VMT was about 1.1% over-estimated and the daily volumes was about 5.1% under-estimated. For the urban category, the daily VMT was under-estimated by 2% and 6% for the daily volume, compared to 25% and 30% over-estimation for the rural category.

The estimated travel time was compared to the observed times for specific corridors. The comparison is depicted in **Table 78**.

Table 78 Comparison of Observed and Estimated Travel Time on Selected Corridors

Group #	Group name	From	To	Direction	AM Travel Time (min)		PM Travel Time (min)	
					EST.	**Error**	**EST.**	**Error**
1	I-25	Tribal	I-40	NB	23	6	13	1
		I-40	315 HWY	NB	19	0	16	-1
				NB Total	**42**	**6**	**28**	**0**
		I-40	Tribal	SB	9	-1	20	4
		315 Hwy	I-40	SB	15	-1	20	0
				SB Total	**24**	**-2**	**41**	**3**
2	I-40	I-25	Unser	WB	2	0	7	0
		Tramway	I-25	WB	10	0	9	0
				WB Total	**12**	**0**	**16**	**0**
		I-25	Tramway	EB	11	10	8	0
		Unser	I-25	EB	7	1	2	0
				EB Total	**18**	**11**	**10**	**0**
3	N Valley -CBD	Coors	Lead	NB	19	-6	23	1
		Lead	Coors	SB	23	2	13	-1
4	Central Ave, E of River	New York	Eubank	EB	13	-2	16	-5
		Eubank	New York	WB	16	-3	10	-4
5	Montano Rd - Montgomery Blvd	Unser	Tramway	EB	30	8	19	-6
		Tramway	Unser	WB	11	-4	22	1
6	Central Ave, W of River	Sunset	98th	WB	6	-2	7	-1
		98th	Sunset	EB	7	-1	6	-1
7	Coal Ave/Lead Ave	2nd	Juan Tabo	EB	7	-2	16	-4
		Juan Tabo	2nd	WB	13	-1	13	-2
8	Eubank Ave	Santa Monica	Central	SB	10	-1	11	-4
		Central	Santa Monica	NB	8	-2	9	-5
9	Bridge Blvd	Louisiana	Central	WB	18	-4	19	-3
		Central	Louisiana	EB	24	0	15	-3
10	NM 47	NM 6	Coal	NB	36	12	3	0
		Coal	NM 6	SB	8	0	38	11
11	NM 6	I-25	NM 47	EB	6	0	9	1
		NM 47	I-25	WB	11	4	1	0

Table 78 Comparison of Observed and Estimated Travel Time on Selected Corridors (cont')

Group #	Group name	From	To	Direction	AM Travel Time (min) EST.	AM Travel Time (min) Error	PM Travel Time (min) EST.	PM Travel Time (min) Error
12	Rio Bravo	Coors	I-25	EB	5	-2	6	-1
		I-25	Coors	WB	5	-1	5	-1
13	Isleta	Rio Bravo	Bridge	NB	6	-1	6	-1
		Bridge	Rio Bravo	SB	6	-2	6	-1
14	Gibson	I-25	Yale	EB	1	0	1	-1
		Yale	I-25	WB	1	0	1	0
15	Unser	Central	Montano	NB	3	-2	8	1
		Montano	Central	SB	8	-2	3	0
16	Coors	I-40	NM 528	NB	12	-1	15	1
		NM 528	I-40	SB	13	0	9	-1
17	Golf Course	Montano	Southern Blvd	NB	11	-3	11	-2
		Southern Blvd	Montano	SB	12	-1	12	-1
18	4th St	Lomas	Alameda	NB	9	-3	13	-9
		Alameda	Lomas	SB	13	-3	8	-5
19	2nd St	Lomas	Alameda	NB	11	-4	12	-4
		Alameda	Lomas	SB	10	-1	7	-1
20	Menaul	2nd	Tramway	EB	3	0	13	-3
		Tramway	2nd	WB	15	-3	4	-2
21	Osuna	2nd	I-25	EB	1	-1	1	0
		I-25	2nd	WB	4	-1	4	-3
22	San Mateo	Gibson	I-25	NB	8	-3	11	-8
		I-25	Gibson	SB	12	-3	11	-7
23	Wyoming	Central	PdN	NB	8	-2	11	-2
		PdN	Central	SB	13	-5	13	-6
24	Tramway	I-40	PdN	NB	12	0	6	-2
		PdN	I-40	SB	11	0	1	0
25	Paseo del Norte	Coors	Tramway	EB	19	3	14	-1
		Tramway	Coors	WB	13	-1	17	1
26	Eubank	Central	PdN	NB	9	-2	10	-5
		PdN	Central	SB	11	-1	13	-4

Table 78 Comparison of Observed and Estimated Travel Time on Selected Corridors (cont')

Group #	Group name	From	To	Direction	AM Travel Time (min) EST.	AM Travel Time (min) Error	PM Travel Time (min) EST.	PM Travel Time (min) Error
27	Alameda	Coors Bypass	I-25	EB	17	8	10	-2
		I-25	Coors Bypass	WB	8	-1	16	4
28	NM 528	Coors Bypass	US 550	NB	16	0	16	-2
		US 550	Coors Bypass	SB	16	1	16	-2
29	US 550	NM 528	I-25	EB	9	4	4	0
		I-25	NM 528	WB	4	0	9	3
30	Southern Blvd	Unser	NM 528	EB	4	-1	3	-1
		NM 528	Unser	WB	3	-2	4	-3

An analysis was conducted to examine those corridors with big differences between the observed and the estimated time. The following highlight some of the findings.

- Group#10: The AM V/C ratio in the northbound direction and the PM V/ratio in the southbound direction in the section of the NM 47 south of NM 147 and north of N. Bosque Loop were above 1.0. The high V/C was due to too many trips being projected. See **Section 5.1** for more discussion.
- Group #18, #22, #23, 26: Observed from aerial photo, 4th Street, San Mateo Blvd., Wyoming Blvd., and Eubank Blvd. seemed to be major arterial with much curb-side activities. The free-flow speeds, which were computed from the coded posted speeds, ranged from 34 mph to 43 mph. As a result, the travel time on these roads were generally under-estimated. However, some of the observed travel time seemed questionable. For example, the observed PM travel time in the NB was 21 minutes, which was longer than the AM travel time of 16 minutes in the southbound direction. There seemed to have some abnormality with the PM NB travel time. Likewise, the observed PM travel time on San Mateo Blvd. was twice longer than the AM observed time.

4.11 Transit Run Time Estimation

4.11.1 Introduction

This was the second task in the recalibration process (see **Section 4.2**) and the objective was to improve transit time. The global transit time factor of 1.6 and the TIMEFAC coded at the PT line level were replaced. The transit mode of individual routes was adjusted. See **Table 62** and **Table 68** for the transit mode by routes and the final transit time factors.

4.11.2 Approach

The process involved several trials. Based on the highway travel time as the result of the previous task, the new factors were applied. The estimated transit run time for each of the routes were summarized and compared to the observed schedule time. Based on results of the comparison, the transit time factors and the transit mode individual routes were adjusted. The process stopped until the estimated transit run times adequately replicated the scheduled time for most of the transit routes. The estimated run time was improved significantly over the values provided by the original standard model.

4.11.3 Results

The comparison of the estimated transit run time and the observed schedule time are shown in **Table 79** and **Table 80**.

Table 79 Comparison of Observed Schedule Time and Estimated Run Time, Local Transit Routes

Route #	Name	Direction	Observed Schedule Time		Estimated Run Time		Difference	
			AM	OP	AM	OP	AM	OP
1	Juan Tabo	NB	26	26	32	31	6	5
		SB	38	35	34	33	-4	-2
2	Eubank	NB	42	28	40	42	-2	14
		SB	48	24	40	42	-8	18
3	Uptown/Cottonwood	NB/WB	30	28	23	24	-7	-4
		SB/EB	28	26	24	24	-4	-2
5	Montgomery/Carlisle	NB/EB	50	48	51	50	1	2
		WB/SB	51	51	52	50	1	-1
6	Indian School	WB	40		47		7	
7	Candelaria	WB	40		45		5	
8	Menaul	EB	53	60	57	51	4	-9
		WB	60	59	57	59	-3	0
10	N. 4th St.	NB	30	32	31	32	1	0
		SB	35	34	32	33	-3	-1
11	Lomas	EB	46	48	38	38	-8	-10
		WB	41	38	44	44	3	6
12	Constitution	WB	43		43		0	
13	Comanche	WB	38		47		9	

Table 79 Comparison of Observed Schedule Time and Estimated Run Time, Local Transit Routes (cont')

Route #	Name	Direction	Observed Schedule Time		Estimated Run Time		Difference	
			AM	OP	AM	OP	AM	OP
31	Wyoming	NB	40	37	34	34	-6	-3
		SB	39	36	34	35	-5	-1
34	San Pedro	SB	36		38		2	
36	Rio Grande/12th St.	Circ.	44	42	44	45	0	3
40#	D-Ride Downtown Shuttle	Circ.	14	14	10	10	-4	-4
50	Airport/Downtown	NB/WB	21	22	22	23	1	1
		SB/EB	26	24	19	19	-7	-5
51	Atrisco/Rio Bravo	NB/WB	26	26	30	30	4	4
		SB/EB	26	26	37	30	11	4
53	Isleta	NB	38	41	46	39	8	-2
		SB	38	36	39	39	1	3
54	Bridge/Westgate	EB	40	33	47	39	7	6
		WB	43	42	40	41	-3	-1
66	Central	EB	58	66	64	60	6	-6
		WB	59	65	57	59	-2	-6
92	Taylor Ranch Express	SB	56		73		17	
93	Academy	WB/SB	33		38		5	
94	Unser Express	SB	51		60		9	
96	Crosstown Commuter	SB	60		56		-4	
97	Zuni	EB	22	22	36	39	14	17
		WB	24	24	38	46	14	22
98	Wyoming	EB/SB	71		64		-7	
140	San Mateo Line	NB	48	55	45	46	-3	-9
		SB	45	46	40	41	-5	-6
141	San Mateo Line	NB	35		27		-8	
		SB	35		28		-7	
151	Rio Rancho/RR Conn.	EB/SB	71	51	55	45	-16	-6
		NB/WB	56	48	43	45	-13	-3
155	Coors Blvd. Line	NB	48		50		2	
		SB	49		55		6	
157	Montano Uptown	SB/EB	64	64	89	64	25	0
		WB/NB	66	62	63	64	-3	2
162	Ventana Ranch/Montano Plaza	NB	18		34		16	
		SB	20		33		13	

Table 79 Comparison of Observed Schedule Time and Estimated Run Time, Local Transit Routes (cont')

Route #	Name	Direction	Observed Schedule Time AM	Observed Schedule Time OP	Estimated Run Time AM	Estimated Run Time OP	Difference AM	Difference OP
222	Rio Bravo/Sunport/Kirtland	EB	42		43		1	
		WB	50		36		-14	
317	Downtown/KAFB Limited	EB	27		25		-2	
		WB	27		24		-3	
1618	The BUG	EB	52	52	41	42	-11	-10
		WB	64	64	42	43	-22	-21
	All Local Routes (*)						6.4	3.7

Schedule run time data was obtained directly from ABQ Ride
* Difference was computed based on the average of the absolute differences

Table 80 Comparison of Observed Schedule Time and Estimated Run Time, Premium Transit Routes

Route #	Name	Direction	Observed Schedule Time AM	Observed Schedule Time OP	Estimated Run Time AM	Estimated Run Time OP	Difference AM	Difference OP
766	Rapid Ride - Red Line	EB	49	44	45	44	-4	0
		WB	40	43	40	44	0	1
790	Rapid Ride - Blue Line	EB	41	44	45	43	4	-1
		WB	39	41	35	40	-4	-1
Rail Runner	Rail Runner	NB	69	69	69	69	0	0
		SB	69	69	69	69	0	0
	All Premium Routes (*)						2.2	0.5

* Difference was computed based on the average of the absolute differences

At the aggregate level, the estimated transit run time for the local transit routes was 6.4 minutes over the observed in the AM period and 3.7 minutes over in the off-peak time. Reasons for some of the larger variations are as follows:

- Route 2: The AM schedule time in both directions was much shorter compared to the off-peak. Based on the information shown on the schedule downloaded from the ABQ web site (http://www.cabq.gov/transit/routes-and-schedules), the operation in the peak period was different than the off-peak. The off-peak route was shorter. The route coded to the off-peak PT line was the same as the AM peak PT line, as it is indicated by the estimated run time of 42 minutes, which was two minutes less the predicted AM run time.

- Route 51: The section of Rio Bravo Blvd over the Rio Grande River was predicted to experience traffic congestion in the peak traffic direction, which was the eastbound direction in the AM. This was supported by the AM and PM peak period traffic count data. The schedule time for the route was coded 26 minutes for both directions in the AM and off-peak period. The schedule time for the peak direction did not include the extra time that could be experienced due to traffic congestion. The predicted run time was non-peak direction (westbound) in the AM and both directions for the off-peak time were 4 minutes over the observed.
- Route 97: Route 97 operated parallel to Route 66, in the section between Tramway Blvd and Alvarado Transportation Center operated along Central Avenue. The line coding of Route 66 and 97 were similar and both were local routes. The schedule time of Route 66 for the segment ranged from 35 minutes to 40 minutes, yet the schedule time for Route 97 ranged from 22 minutes to 24 minutes. There seemed to have some inconsistency in the data. Note that the highway links for Central Avenue, Zuni Road, Coal Avenue, and Lead Avenue were coded with the same category type and two lanes in each direction; although some segments of Coal Avenue and Lead Avenue were three lanes. Central Avenue, Zuni Road, Coal Avenue and Lead Avenue were predicted to operate with similar traffic conditions. The estimated run time of Route 97 matched fairly well against the schedule time for that segment of Route 66.
- Route 151: The schedule indicated that Route 151 operated with two routes. The long route was between the junction of Southern Blvd. and Unser Blvd. and Century Rio 24 Theater. The short route operated from the Rio Rancho City Hall to Century Rio 24 Theater. During the AM time, there were 5 buses in the northbound/.westbound direction and only one of them operated the long route. In the southbound/eastbound direction, three (3) of the five (5) buses operated the long route. Only the short route was operated in the off-peak time. In addition, the bus schedule had synchronized with the Rail Runner schedule at the El Pueblo Station. There was a scheduled wait time of about 7 minutes in the northbound/westbound direction and between 9 to 13 minutes in the southbound/eastbound direction.

  The observed AM schedule time listed in Table 79 was obtained from the long route. The synchronized scheduled time required special coding and control in scripts, and neither was included. If the stand time were removed from the schedule time, the AM schedule time would have been 50 minutes in the northbound/westbound direction and about 60 minutes in the southbound/eastbound direction, which were closed to the estimated run time. For the off-peak time, the listed schedule time was obtained from the short route. The difference in time between the long and the short routes was about 8 minutes, which offset the scheduled stand time at the El Pueblo Station and explained the reason why the observed schedule time and estimated run time in the off-peak match well.

- Route 157: Similar to Route 51 it seemed that the schedule time did not include the extra operating time due to traffic congestion, which was predicted to occur on bridge section of Montano Road. Again, the peak period traffic data indicated that the traffic experienced in peak travel direction was much higher compared to the other direction. The estimated run times of the off-peak travel direction in the AM time and both directions in the off-peak time were slightly different compared to the observed.
- Route 162: Route 162 operated in the suburban area northwest to the city. The main reason of the estimated run time was 13 to 16 minutes over the scheduled time was the transit time factors. The purpose of transit time factors was to account for the dwell time and the time of acceleration and deceleration because none of these times was included in the travel time estimation. The transit time factors were calibrated to minimize the total difference between the observed schedule time and estimated run time. Most of the transit routes were in the urban area where the level of congestion experienced during the peak time was projected to be more severe than the suburban area. The total free-flow time for the route was about 17 minutes, multiplied by the AM transit time factor for local routes (1.97), the total transit time become roughly 34 minutes. Based on the schedule time in the northbound direction, the transit run time would have to be about 1.18 (20/17).
- Route 222: The schedule indicated that Route 222 operated several routes which were different in the number and location of stops and the length of the route. Five (5) buses operated on two (2) routes in the eastbound direction during the AM period. These routes served limited stops. In the westbound direction, three (3) buses operated along three different routes. These seemed to have no restriction on stops. In addition, there was a scheduled stand time of about 4 to 6 minutes at the Rail Runner Station.

  In the PT line file, Route 222 was coded to operate between the intersection of Coors Blvd. and Rio Bravo Blvd. and the junction of Gibson Blvd. and Louisiana Blvd. This route was not included in five routes mentioned above. The listed schedule time was obtained from the route that served between the Coors Blvd./Rio Bravo Blvd. intersection to Building 800 inside Kirkland Air Force Base. Based on the schedule time at the two nearest landmarks before and after the intersection of Gibson Blvd. and Louisiana Blvd., the approximated schedule time in the eastbound direction would be about 39 minutes and 43 minutes in the westbound direction. After removing the stand time at the Rail Runner Station, the approximated schedule time became 33 minutes in the eastbound direction and 39 minutes in the westbound direction. The revised schedule time would estimate run time over-estimated by 10 minutes, which was expected because the "actual" route was limited to three stops while 19 stop nodes were coded for the route.

- Route 1618: The schedule indicated that the coded route was short of the actual route. The section from the intersection of Central Avenue and Broadway Blvd. to Woodward Road where the GE

Plant was located was missing. Removing the time travel on the missing schedule, the approximated schedule time would be 47 minutes in the westbound direction and 46 minutes in the eastbound direction. The estimated run time would be about 5 minutes over-estimated.

The estimated run time for the premium routes match well against the observed scheduled time. The fact that there are fewer premium routes and that the routes are more homogeneous in terms of the service characteristics contribute to the improved results.

4.12 Mode Choice Model

4.12.1 Introduction

With updated and better highway and transit time, and the fact that new transit services (the Rail Runner and Rapid Ride) were added after 2004, it was necessary to update the mode choice model. Due to the lack of more recent survey data (the previous home interview survey was conducted in 1992 and the previous transit on-board survey was carried out in 2004 prior to the opening of the Rail Runner and Rapid Ride), it was decided that the mode choice model of the standard model would continue to be used in the recalibrated model and that bias constants would be recalibrated to match the estimated mode choice targets as close to as possible.

4.12.2 Approach

As mentioned above, there was a lack of current survey data to establish observed transit shares. Therefore, the mode choice targets for each of the trip purposes were estimated using the following available data:

- 2004 transit on-board survey data
- 2008 transit ridership count data
- 1992 home-interview survey data documented in PB's report
- 2000 Census data

The general process for estimating the **initial** targets is outlined below:

- The mode share percentage of non-motorized trips, auto trips, and transit trips of the 1992 HIS survey was adopted initially.
- For the auto trips of the HBW trip purpose, the initial mode shares of drive alone (86.13%) and carpool (13.87%) from the 2000 CTPP[6] was used to split the auto trips. The carpool trips were split into 2-person share ride and 3+person shared ride using the shares developed from the 1992 HIS survey data.
- For the transit trips, the mode shares were back-calculated from the 2008 daily ridership.
- The estimation was based on the total 2008 daily ridership (39,273). The target premium transit trip total was 18,902, which was the total ridership of the Rail Runner or the Rapid Ride.
- A transfer rate of 1.76 was estimated based on the 2004 transit on-board survey data. Since the survey was conducted before the Rail Runner and the Rapid Ride were open, this rate was applied to estimate the initial local transit trips.
- Based on the 2004 transit on-board data, the auto access share for the bus services was computed as 6.3%, with the remaining 93.7% assumed as walk access.
- Based on the 2008 Rail Runner boarding by station and route number, the estimated shares for walk access mode and drive access mode were 32.6 % and 67.4% respectively. In addition, the percent of trips that occurred in the peak and off-peak periods were estimated. The same percent shares were applied to the Rapid Ride trips, the other premium service, to allocate trips to peak and off-peak periods.
- The percent share of trips by peak and off-peak periods for the local transit trips were calculated using the 1992 HIS survey data. The estimated shares were 52.1% and 47.9%, respectively.
- For the auto access trips to the bus routes, the shares for park-ride and kiss-ride access were computed based on the 2004 transit on-board survey data. The shares of park-ride and kiss-ride for bus trips were computed as 21.9% and 78.1% respectively.
- For the auto access trips of the Rail Runner service, 10% was assumed for the kiss-ride trips and 90% for the park-ride due to the lack of data.
- The non-motorized trips were used to balance the trips to the total person trips for the trip purpose.
- The AM assumptions were applied to HBW AM, HBW PM, HB Elementary School, HB High School, HB UNM, and HB TVI.
- The off-peak assumptions were applied to HBW OP, HBO, HB SHOP, NHB Work, and NHB Other.

[6] 2000 CTPP, Part 1 Profile 3 file for the Albuquerque City

The initial estimated mode share targets by trip purposes are summarized in **Table 81** to **Table 85**. For reference purposes, the observed mode shares of the 1992 HIS surveys are also listed in the tables.

Table 81 Initial Estimated Mode Shares, HBW AM

	0 Auto Ownership			1 Auto Ownership			2 Auto Ownership			3+ Auto Ownership			Total		
	1992	**2008**		**1992**	**2008**		**1992**	**2008**		**1992**	**2008**		**1992**	**2008**	
Mode	**OBS***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS***	**EST.**	**%**
NM	21.1%	326	12.3%	4.1%	889	2.3%	0.8%	514	0.5%	1.5%	799	0.9%	2.1%	2,528	1.0%
DA	0.0%	0	0.0%	78.3%	30,497	80.2%	81.0%	90,954	82.1%	84.7%	80,441	86.1%	80.2%	201,892	82.5%
SR2	25.7%	451	17.1%	11.0%	3,689	9.7%	9.8%	9,520	8.6%	9.4%	7,674	8.2%	10.2%	21,334	8.7%
SR3	11.0%	193	7.3%	2.4%	794	2.1%	6.8%	6,556	5.9%	3.1%	2,532	2.7%	4.8%	10,075	4.1%
WTL	39.5%	818	31.0%	3.9%	1,132	3.0%	1.3%	1,044	0.9%	1.1%	746	0.8%	2.5%	3,740	1.5%
WTP	1.3%	777	29.5%	0.1%	785	2.1%	0.1%	1,550	1.4%	0.0%	844	0.9%	0.1%	3,957	1.6%
PNR	0.0%	0	0.0%	0.1%	98	0.3%	0.1%	512	0.5%	0.1%	293	0.3%	0.1%	904	0.4%
KNR	1.4%	72	2.7%	0.2%	120	0.3%	0.1%	107	0.1%	0.1%	90	0.1%	0.1%	388	0.2%
ALL		**2,636**			**38,004**			**110,758**			**93,419**			**244,817**	

*** 1992 HIS survey data**

Table 82 Initial Estimated Mode Shares, HBW PM

	0 Auto Ownership			1 Auto Ownership			2 Auto Ownership			3+ Auto Ownership			Total		
	1992	**2008**		**1992**	**2008**		**1992**	**2008**		**1992**	**2008**		**1992**	**2008**	
Modes	**OBS.***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS.***	**EST.**	**%**	**OBS%***	**EST.**	**%**
NM	34.8%	547	23.5%	4.1%	665	2.6%	1.5%	714	0.9%	1.5%	633	0.9%	2.6%	2,558	1.5%
DA	0.0%	0	0.0%	72.6%	19,786	77.8%	78.4%	64,599	82.5%	84.7%	58,484	87.4%	78.3%	142,869	82.6%
SR2	21.2%	304	13.1%	14.5%	2,887	11.3%	14.0%	8,455	10.8%	9.4%	4,739	7.1%	12.4%	16,384	9.5%
SR3	9.1%	131	5.6%	7.0%	1,400	5.5%	5.3%	3,216	4.1%	3.1%	1,563	2.3%	4.8%	6,310	3.6%
WTL	32.6%	655	28.1%	1.7%	361	1.4%	0.7%	421	0.5%	1.1%	563	0.8%	1.7%	2,001	1.2%
WTP	1.1%	632	27.2%	0.0%	269	1.1%	0.0%	648	0.8%	0.0%	646	1.0%	0.1%	2,195	1.3%
PNR	0.0%	0	0.0%	0.0%	36	0.1%	0.1%	218	0.3%	0.1%	232	0.3%	0.1%	486	0.3%
KNR	1.1%	58	2.5%	0.1%	39	0.2%	0.0%	43	0.1%	0.1%	68	0.1%	0.1%	208	0.1%
ALL		**2,326**			**25,442**			**78,313**			**66,929**			**173,010**	

*** 1992 HIS survey data**

Table 83 Initial Estimated Mode Shares, HBW OP

Modes	1992 OBS.*	2008 EST.	2008 %
NM	2.2%	7,996	4.9%
DA	82.6%	131,506	80.6%
SR2	9.9%	14,899	9.1%
SR3	4.2%	6,278	3.8%
WTL	1.1%	1,671	1.0%
WTP	0.0%	606	0.4%
PNR	0.0%	24	0.0%
KNR	0.0%	155	0.1%
ALL		**163,134**	

* 1992 HIS survey data

Table 84 Initial Estimated Mode Shares, HB School Trip Purposes

	HB Elementary School			HB High School			HB UNM			HB TVI		
	1992	2008		1992	2008		1992	2008		1992	2008	
Modes	OBS.*	EST.	%	OBS.*	EST.	%	OBS.*	EST.	%	OBS.*	EST.	%
NM	35.4%	39,138	35.6%	7.7%	14,408	9.3%	18.3%	4,210	17.8%	0.0%	0	0.0%
DA	0.0%	0	0.0%	33.0%	51,166	33.0%	68.8%	16,257	68.8%	86.7%	19,472	86.7%
SR2	49.0%	53,839	49.0%	43.9%	68,042	43.9%	10.3%	2,436	10.3%	8.6%	1,935	8.6%
SR3	14.5%	15,905	14.5%	13.0%	20,101	13.0%	2.0%	462	2.0%	4.6%	1,043	4.6%
WTL	1.1%	979	0.9%	2.2%	833	0.5%	0.6%	158	0.7%	0.0%	0	0.0%
WTP	0.0%	0	0.0%	0.1%	257	0.2%	0.0%	67	0.3%	0.0%	0	0.0%
PNR	0.0%	0	0.0%	0.1%	61	0.0%	0.0%	12	0.1%	0.0%	0	0.0%
KNR	0.0%	0	0.0%	0.2%	85	0.1%	0.0%	16	0.1%	0.0%	0	0.0%
ALL		**109,860**			**154,953**			**23,617**			**22,450**	

*** 1992 HIS survey data**

Table 85 Initial Estimated Mode Shares, HB Shop, HBO, and NHB Trip Purposes

	HB Shop			HB Other			NHB Work			NHB Other		
	1992	2008		1992	2008		1992	2008		1992	2008	
Modes	OBS.*	EST.	OBS.*	OBS.%*	EST.	OBS.*	OBS.*	EST.	OBS.*	OBS.%*	EST.	OBS.*
NM	3.3%	9,817	3.4%	7.1%	65,346	7.2%	6.8%	21,821	6.8%	5.8%	34,395	5.8%
DA	46.2%	134,938	46.2%	39.7%	362,564	39.7%	70.2%	225,459	70.2%	42.6%	252,018	42.6%
SR2	36.4%	106,442	36.4%	34.5%	315,250	34.5%	17.8%	57,305	17.8%	35.7%	211,047	35.7%
SR3	13.8%	40,275	13.8%	18.1%	165,332	18.1%	4.9%	15,716	4.9%	15.5%	91,829	15.5%
WTL	0.3%	544	0.2%	0.5%	3,036	0.3%	0.3%	649	0.2%	0.3%	1,190	0.2%
WTP	0.0%	197	0.1%	0.0%	1,101	0.1%	0.0%	235	0.1%	0.0%	431	0.1%
PNR	0.0%	8	0.0%	0.0%	44	0.0%	0.0%	9	0.0%	0.0%	17	0.0%
KNR	0.0%	50	0.0%	0.0%	281	0.0%	0.0%	60	0.0%	0.0%	110	0.0%
ALL		**292,270**			**912,953**			**321,255**			**591,036**	

*** 1992 HIS survey data**

Generally, the transit shares for the HB Work trip purposes were slightly higher compared to the 1992 observed shares. Within the transit trips, the shares of walk to premium and drive to park-ride sub-modes were also higher because of the addition of the premium service of Rail Runner and Rapid Ride and park-ride lots that were associated with these services. The estimated transit share of HB Elementary School and HB High School had decreased. This was because the majority of the AM drive access transit trips was assumed HBW trips. Note that the 1992 HIS survey indicated about 1.1% to 2.6% of the elementary school and high school students took local bus to school, and some of these trips were categorized as park-ride and kiss-ride. These auto access trips for school purposes were deemed illogical.

The estimated transit share for the HB UNM trip purpose has increased. This increase was considered reasonable since the Rapid Ride routes served the university campus. Initially, the mode share for the HB TVI trip purpose was assumed to remain the same as the 1992 observed data, although there were some questionable shares for this purpose as well. The final mode share was adjusted to address the assumed inconsistencies. The transit mode share for the HBO, HB Shop, and the NHB trip purposes were very similar to the 1992 observed mode share.

The initial transit shares were adjusted in the effort to meet the transit ridership and daily traffic count data. The target shares were refined incrementally to replicate the overall ridership and assumed number of transfers. The shares were also adjusted to increase the number of vehicles trips for selected trip purposes since the model was underestimating vehicle traffic, particularly in downtown CBD. The final estimated targets for each of the trip purposes are shown in **Table 86** to **Table 89**.

Table 86 Final Estimated Mode Shares Targets, HBW AM

Modes	0 Auto Ownership		1 Auto Ownership		2 Auto Ownership		3+ Auto Ownership		Total	
	EST.	%	EST.	%	EST.	%	EST.	%	EST.	%
NM	326	12.3%	889	2.3%	514	0.5%	799	0.9%	2,528	1.0%
DA	0	0.0%	30,973	81.5%	91,392	82.5%	80,754	86.4%	203,463	83.1%
SR2	691	26.2%	3,689	9.7%	9,520	8.6%	7,674	8.2%	21,334	8.7%
SR3	296	11.2%	794	2.1%	6,556	5.9%	2,532	2.7%	10,075	4.1%
WTL	474	18.0%	657	1.7%	605	0.5%	433	0.5%	2,169	0.9%
WTP	777	29.5%	785	2.1%	1,550	1.4%	844	0.9%	3,957	1.6%
PNR	0	0.0%	98	0.3%	512	0.5%	293	0.3%	904	0.4%
KNR	72	2.7%	120	0.3%	107	0.1%	90	0.1%	388	0.2%
ALL	**2,636**		**38,004**		**110,758**		**93,419**		**244,817**	

Table 87 Final Estimated Mode Shares Targets, HBW PM

Modes	0 Auto Ownership		1 Auto Ownership		2 Auto Ownership		3+ Auto Ownership		Total	
	EST.	%	EST.	%	EST.	%	EST.	%	EST.	%
NM	547	23.5%	665	2.6%	714	0.9%	633	0.9%	2,558	1.5%
DA	0	0.0%	19,938	78.4%	64,776	82.7%	58,721	87.7%	143,709	83.1%
SR2	496	21.3%	2,887	11.3%	8,455	10.8%	4,739	7.1%	16,384	9.5%
SR3	213	9.2%	1,400	5.5%	3,216	4.1%	1,563	2.3%	6,310	3.6%
WTL	380	16.3%	210	0.8%	244	0.3%	327	0.5%	1,160	0.7%
WTP	632	27.2%	269	1.1%	648	0.8%	646	1.0%	2,195	1.3%
PNR	0	0.0%	36	0.1%	218	0.3%	232	0.3%	486	0.3%
KNR	58	2.5%	39	0.2%	43	0.1%	68	0.1%	208	0.1%
ALL	**2,326**		**25,442**		**78,313**		**66,929**		**173,010**	

Table 88 Final Estimated Mode Shares Targets, HBW OP and HB School Trip Purposes

Modes	HB OP		HB Elementary School		HB High School		HB UNM		HB TVI	
	EST.	%	EST.	%	EST.	%	EST.	%	EST.	%
NM	7,996	4.9%	39,138	35.6%	14,408	9.3%	4,210	17.8%	0	0.0%
DA	132,208	81.0%	0	0.0%	51,515	33.2%	16,323	69.1%	19,472	86.7%
SR2	14,899	9.1%	54,156	49.3%	68,042	43.9%	2,436	10.3%	1,935	8.6%
SR3	6,278	3.8%	15,999	14.6%	20,101	13.0%	462	2.0%	1,043	4.6%
WTL	969	0.6%	568	0.5%	483	0.3%	92	0.4%	0	0.0%
WTP	606	0.4%	0	0.0%	257	0.2%	67	0.3%	0	0.0%
PNR	24	0.0%	0	0.0%	61	0.0%	12	0.1%	0	0.0%
KNR	155	0.1%	0	0.0%	85	0.1%	16	0.1%	0	0.0%
ALL	**163,134**		**109,860**		**154,953**		**23,617**		**22,450**	

Table 89 Final Estimated Mode Shares Targets, HB Shop, HBO, and NHB Trip Purposes

Modes	HB Shop		HB Other		NHB Work		NHB Other	
	EST.	%	EST.	%	EST.	%	EST.	%
NM	8,835	3.0%	58,811	6.4%	19,639	6.6%	30,955	5.2%
DA	178,695	61.1%	509,742	55.8%	225,731	75.8%	343,791	58.2%
SR2	75,574	25.9%	223,828	24.5%	40,687	13.7%	149,843	25.4%
SR3	28,595	9.8%	117,385	12.9%	11,159	3.7%	65,198	11.0%
WTL	315	0.1%	1,761	0.2%	376	0.1%	690	0.1%
WTP	197	0.1%	1,101	0.1%	235	0.1%	431	0.1%
PNR	8	0.0%	44	0.0%	9	0.0%	17	0.0%
KNR	50	0.0%	281	0.0%	60	0.0%	110	0.0%
ALL	**292,270**		**912,953**		**297,897**		**591,036**	

Note that the adjusted mode shares primarily created additional vehicle trips for the network assignment and were deemed necessary to improve the highway assignment results. It was acknowledged that the additional vehicle trips could be masking other variations in the modeling, such as underestimating actual trip lengths in trip distribution. However, this assertion could not be confirmed given the age of the current household survey. More discussion of this topic is provided in the trip distribution in **Section 4.13.**

4.12.3 Results

The adjusted mode bias constants are listed in **Table 90**. Note the bias constants for HB TVI trip purpose. As discussed above, the estimated targets were based on the 1992 observed HIS survey data, but the data was questionable that there were only auto trips. In lieu of this, the bias constants for the non-motorized and transit sub-modes were "borrowed" from the HB UNM trip purpose, assuming the trip making characteristics between the University of New Mexico and Technical Vocational Institute should be similar.

Table 90 Mode Choice Bias Constants, Recalibrated Model

Trip Purposes	Auto Ownership	Non-Motorized	Drive Alone	Share Ride-2	Share Ride 3+	Walk to Local	Walk to Premium	Park-Ride	Kiss-Ride
HBW AM	0-Auto Ownership	0.00000	-20.00000	-5.33370	-6.14899	-0.00180	2.62248	-20.00000	-3.80595
	1-Auto Ownership	0.00000	-0.20085	-3.99719	-5.50174	-0.69676	1.02590	-5.40761	-6.07685
	2-Auto Ownership	0.00000	1.94950	-0.77235	-1.11335	0.38855	3.05704	-1.74341	-4.54387
	3+Auto Ownership	0.00000	0.67918	-3.12864	-4.20560	-1.88693	0.15698	-4.70077	-6.88695
HBW PM	0-Auto Ownership	0.00000	-20.00000	-12.78692	- 13.59972	-6.06011	-2.88511	-20.00000	-10.38309
	1-Auto Ownership	0.00000	0.21373	-2.91137	-3.60275	-1.88981	-0.08035	-6.03136	-7.01363
	2-Auto Ownership	0.00000	0.55171	-2.75430	-3.68887	-3.13917	-0.32931	-4.98116	-7.96864
	3+Auto Ownership	0.00000	0.30218	-4.00201	-5.07897	-2.34445	-0.19752	-5.12965	-7.31990
HBW OP	All	0.00000	0.57618	-2.74789	-3.58018	-2.15118	-1.43751	-9.98768	-8.41617
HB ESs	All	0.00000	-20.00000	-1.35608	-2.56489	-3.24912	-20.00000	-20.00000	-20.00000
HB HSs	All	0.00000	-0.37002	-0.35164	-1.56045	-3.94628	1.09729	-7.87202	-8.50125
HB TVIi	All	9.51268	0.00000	-4.46418	-5.05019	-3.72569	-2.86556	-9.05880	-9.13733
HB UNM	All	9.51268	0.00000	-4.12389	-5.75468	-3.72569	-2.86556	-9.05880	-9.13733
HBO	All	0.00000	1.22433	0.11023	-0.52462	-5.11953	-4.84748	-13.64227	-11.60134
HB SHOP	All	0.00000	2.48948	2.19954	1.23824	-3.31146	-3.20619	-11.69734	-9.94250
NHBO	All	0.00000	-0.97594	-3.29372	-4.10027	-7.47707	-7.03538	-15.12840	-13.69355
NHBW	All	0.00000	-1.61886	-5.25536	-6.52344	-8.81176	-8.44477	-16.52022	-15.01569

The estimated trips and percent shares by mode and trip purposes are listed in **Table 91** and **Table 92**. The comparison between the assumed targets and estimates are shown in **Table 93** and **Table 94**. Note the difference for the HB TVI trip purpose was due to the fact the mode share for the non-motorized and the transit trip purposes were not included in the target estimation because of the limitations of 1992 survey data. As mentioned above, bias constant from the HB UNM were "borrowed". These mode bias constants could be updated further if more recent transit on-board surveys become available.

Table 91 Estimated Person Trips by Mode and Trip Purpose

Modes	HBWAM	HBWPM	HBWOP	HBES	HBHS	HBOTH	HBSHOP	HBTVI	HBUNM	NHBO	NHBW	Total
NM	2,488	2,532	7,975	39,128	14,390	58,770	8,826	2,297	4,231	30,924	21,797	193,357
DA	203,283	143,618	132,168	0	51,571	510,068	178,803	17,403	16,339	343,451	225,688	1,822,393
SR2	21,365	16,396	14,892	54,138	67,978	223,473	75,460	1,692	2,394	150,070	57,364	685,221
SR3	10,078	6,325	6,275	15,993	20,082	117,199	28,552	912	454	65,297	15,733	286,899
WTL	2,224	1,179	991	600	515	1,859	335	63	94	724	395	8,979
WTP	3,991	2,201	620	0	259	1,165	211	56	68	453	248	9,273
PNR	920	491	20	0	65	31	6	9	11	14	8	1,576
KNR	469	269	193	0	92	405	70	18	26	139	77	1,759
Total	**244,818**	**173,011**	**163,134**	**109,860**	**154,952**	**912,971**	**292,263**	**22,450**	**23,617**	**591,073**	**321,309**	**3,009,457**

Table 92 Estimated Mode Shares by Mode and Trip Purpose

Modes	HBWAM	HBWPM	HBWOP	HBES	HBHS	HBOTH	HBSHOP	HBTVI	HBUNM	NHBO	NHBW	Total
NM	1.0%	1.5%	4.9%	35.6%	9.3%	6.4%	3.0%	10.2%	17.9%	5.2%	6.8%	6.4%
DA	83.0%	83.0%	81.0%	0.0%	33.3%	55.9%	61.2%	77.5%	69.2%	58.1%	70.2%	60.6%
SR2	8.7%	9.5%	9.1%	49.3%	43.9%	24.5%	25.8%	7.5%	10.1%	25.4%	17.9%	22.8%
SR3	4.1%	3.7%	3.8%	14.6%	13.0%	12.8%	9.8%	4.1%	1.9%	11.0%	4.9%	9.5%
WTL	0.9%	0.7%	0.6%	0.5%	0.3%	0.2%	0.1%	0.3%	0.4%	0.1%	0.1%	0.3%
WTP	1.6%	1.3%	0.4%	0.0%	0.2%	0.1%	0.1%	0.3%	0.3%	0.1%	0.1%	0.3%
PNR	0.4%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
KNR	0.2%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 93 Comparison of Targeted Trips and Estimates by Mode and Trip Purpose

Modes	HBWAM	HBWPM	HBWOP	HBES	HBHS	HBOTH	HBSHOP	HBTVI	HBUNM	NHBO	NHBW	Total
NM	-40	-26	-20	-10	-19	-42	-9	2,297	21	-31	-24	2,097
DA	164	184	-40	0	56	326	107	-2,069	16	-341	-43	-1,639
SR2	-209	-180	-7	-18	-64	-355	-114	-243	-42	227	59	-946
SR3	-100	-68	-3	-5	-19	-186	-43	-131	-8	99	16	-448
WTL	55	19	22	32	32	98	19	63	3	34	19	396
WTP	34	6	14	0	2	64	14	56	1	22	12	227
PNR	16	5	-4	0	4	-12	-2	9	-1	-3	-2	11
KNR	80	62	39	0	7	124	20	18	9	29	17	406
Total	**1**	**1**	**1**	**-1**	**-1**	**17**	**-7**	**0**	**0**	**36**	**54**	**102**

Table 94 Comparison of Targeted Mode Shares and Estimates by Mode and Trip Purpose

Modes	HBWAM	HBWPM	HBWOP	HBES	HBHS	HBOTH	HBSHOP	HBTVI	HBUNM	NHBO	NHBW	Total
NM	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.2%	0.1%	0.0%	0.0%	0.1%
DA	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-9.2%	0.1%	-0.1%	0.0%	-0.1%
SR2	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.1%	-0.2%	0.0%	0.0%	0.0%
SR3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.6%	0.0%	0.0%	0.0%	0.0%
WTL	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
WTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
PNR	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KNR	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Total	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

4.13 Trip Distribution

4.13.1 Introduction

The updated mode bias constants along with the revised times and costs for each mode resulted in changes to the "composite impedance" variables (logsum terms) generated by the mode choice model. These logsum terms were used as a measure of spatial separation or "impedance" by the trip distribution model. Since the logsum terms were being revised, it was necessary to modify the friction factors by impedance interval in order to maintain the proper distribution and average trip length.

Since the survey data was not available and MRCOG staff indicated that the distribution patterns of current standard model were acceptable, a decision was made to use the distribution patterns from the current model as the "observed" pattern for recalibrating the revised model. With the observed patterns referenced to the new logsum impedance terms, the friction factors for the HB Work, HB Shop, HB Other, NHB Work and NHB Other trip purposes were adjusted. During the course of this work it was recognized that the Fratar process used for distribution in the standard model causing spurious trips to be created. Because of this problem a decision was made to replace the Fratar process with a gravity model process commonly used in trip distribution.

Note that the friction factors for the HB Elementary School, HB High School, HB UNM, and HB TVI remained unchanged. The trip distribution procedures for these trip purposes in the standard model are heavily constrained to certain locations and patterns and the average trips lengths for these purposes are relatively short. Given that these trips are about 10% of the total trips and the replication was deemed adequate with the current trip distribution process, it was deemed unnecessary to revise the friction factors for these trip purposes.

4.13.2 Approach

The estimated trip patterns resulted from the trip distribution of the standard model was assumed to be the observed trip patterns. The friction factors were estimated via a typical gamma function. (See **Section 3.10.3** for the discussion of gamma function). The objective was to adjust the gamma function parameters until the estimated trip pattern replicated the observed distribution of trips by impedance interval.

The recalibration procedure was a two-step process. The first step involved estimating the initial gamma function parameters by performing a linear log regression. This set of parameters became an input "boundary" condition which was coupled with a second boundary condition defined by the original gamma function parameters of the standard model. These two sets of parameters essentially formed upper and lower limits and a customized calibration process was then used to adjust the parameters incrementally through a series of iterations until a set of parameters was developed which maximized the replication of the observed distribution. The performance of the comparison was measured by evaluating the average logsum values and the coincident ratio and the final gamma function parameters for each purpose were selected based on the evaluation analysis. Standard impedance terms such as the average trip time and average trip distance were reviewed to assist in the determination of optimum parameter values.

4.13.3 Results

The updated gamma-function parameters are summarized in **Table 95**. The gamma function parameters of the standard model are also listed in the table for reference purposes. Note that in the original standard model, only one set of friction factors were provided for all four auto-ownership subcategories in each of the HBW time periods. This limitation was deemed inadequate since the variation in available travel modes and the distribution pattern of travel should be heavily influenced by the availability of autos. As an example, the distribution of trips from zero auto households should be heavily correlated to locations served by transit and should be significantly different than the distribution pattern of those trips from households with single or multiple autos available. It was deemed illogical that one set of friction factors used for each of the various logsum terms by auto ownership subgroup would be adequate, so multiple friction factor sets were independently calibrated to improve the replication of the distribution pattern for each auto ownership subcategory.

Conversely, a single gamma function was calibrated for the revised HBO trip purpose, compared to four gamma functions in the standard model. The available model documentation did not indicate why it was necessary to provide separate distributions for the HBO trips by subregion, defined as "EE", "EW", "WE", and "WW". The trip pattern of the HB Other EE trips was used in calibrating the single gamma function parameter set, because the HBO EE trips had the most trips among the four area-based subcategories. Note that "East" refers to the sub-region east of the Rio Grande River.

Table 95 Gamma Function Parameters, Recalibrated Model

Trip Purposes	Sub Category	ALPHA		BETA		GAMMA	
		STD. Model	REC. Model	STD. Model	REC. Model	STD. Model	REC. Model
HBW AM	0-auto ownership	1.0000	1.0000	-0.1000	-0.1000	-0.0900	-0.0900
	1-auto ownership		1.0000		-0.4550		-0.0700
	2-auto ownership		1.0000		-0.5675		-0.0900
	3+auto ownership		1.0000		-0.0500		-0.0895
HBW PM	0-auto ownership	1.0000	1.0000	-0.1000	-0.0500	-0.0770	-0.0275
	1-auto ownership		1.0000		-0.7000		-0.0830
	2-auto ownership		1.0000		-0.0500		-0.0750
	3+auto ownership		1.0000		-0.0500		-0.0738
HBW OP		1.0000	1.0000	-0.8000	-1.3000	-0.0770	-0.0660
HBSHOP		1.0000	1.0000	-0.6000	-1.5670	-0.1500	-0.0688
HB Others	East-east (EE)	1.0000	1.0000	-0.8000	-1.5775	-0.2500	-0.0385
	East-west (EW(	1.0000		-5.0000		-0.2000	
	West-east (WE)	1.0000		-5.0000		-0.2000	
	West-West (WW)	1.0000		-0.0500		-0.0600	
NHBW		1.0000	1.0000	-0.3000	-0.4169	-0.0500	-0.0436
NHBO		1.0000	1.0000	-0.4000	-0.7124	-0.0600	-0.0486

The updated friction factor curves are shown in **Figure 24** and **Figure 25**.

Figure 24 Friction Factors of Home-Based Work Trip Purposes, Recalibrated Model

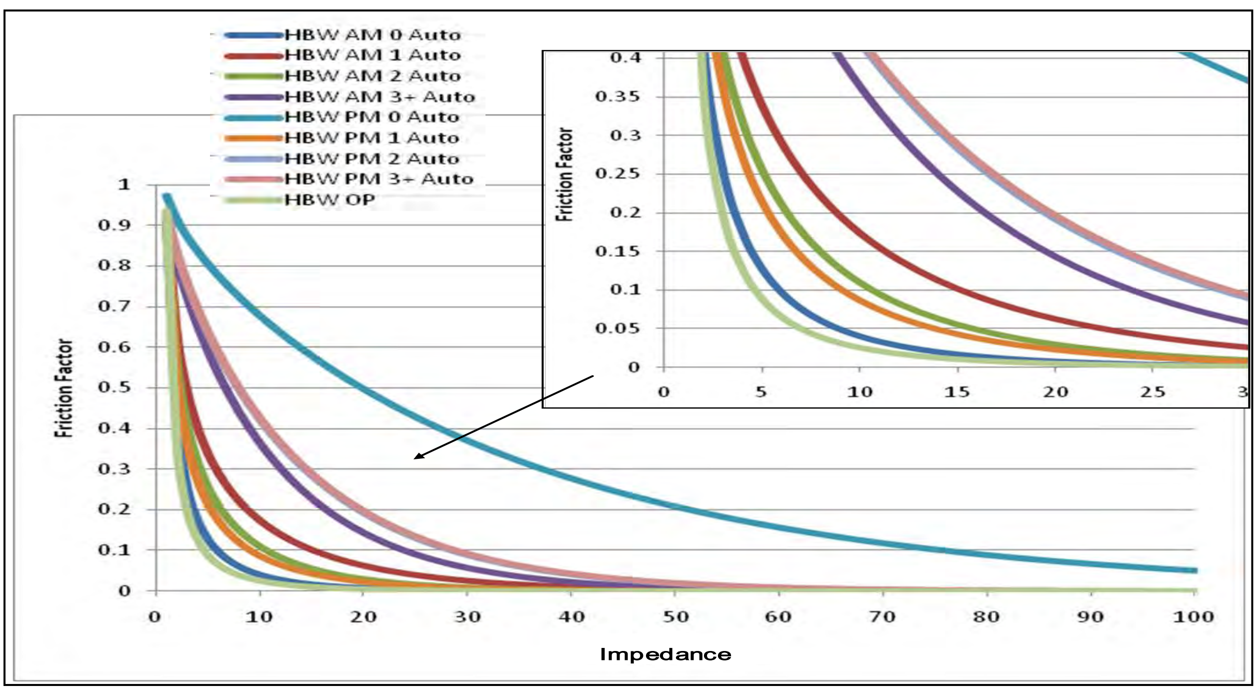
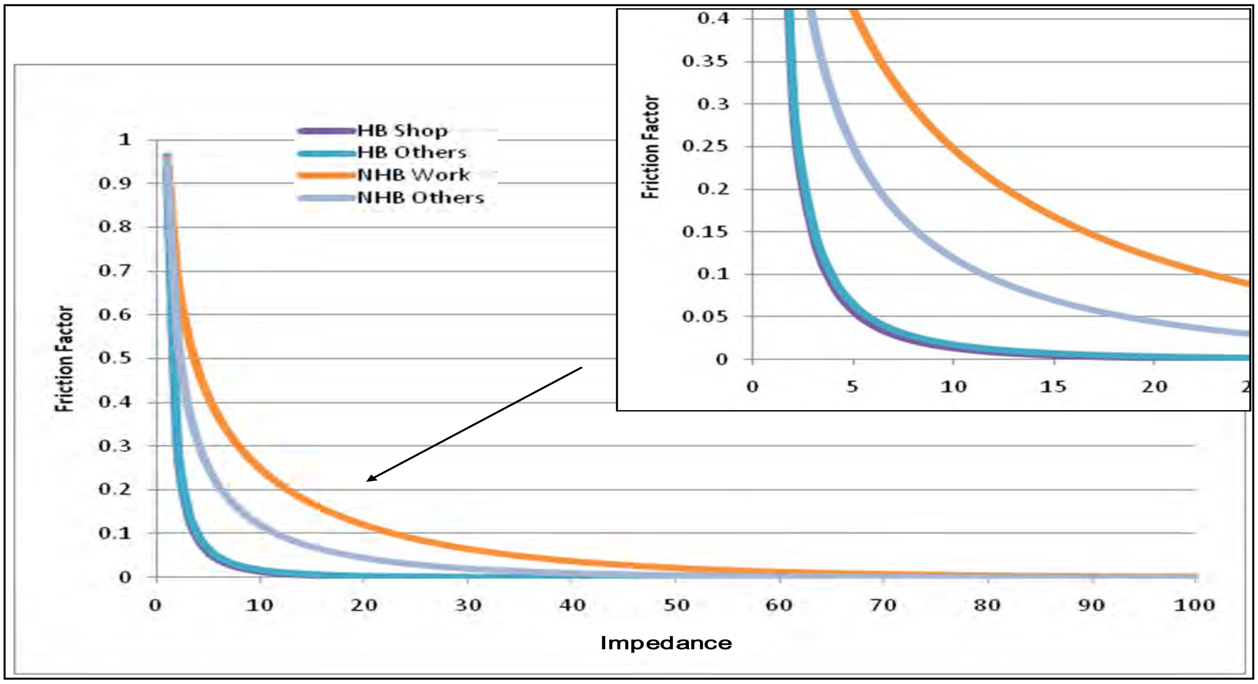


Figure 25 Friction Factors of Non-Work Trip Purposes, Recalibrated Model



Comparison of the observed and estimated average logsum by trip purpose is summarized in **Table 96**. The summaries of the average trip time and trip distance are depicted in **Table 97** and **Table 98**.

Table 96 Average Logsum by Trip Purpose, Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Logsum	
		Observed	Estimated
HBW_AM	0	0.5554	0.3439
	1	1.3002	1.3358
	2	2.7016	2.7992
	3+	1.6029	1.6149
HBW_PM	0	-2.2147	-2.5763
	1	1.6527	1.6987
	2	1.6004	1.6505
	3+	1.2649	1.2782
HBW_OP	ALL	1.8408	1.9244
HBShop	ALL	3.5060	3.5314
HBO	ALL	2.2757	2.2460
NHBW	ALL	0.1938	-0.0213
NHBO	ALL	0.8199	0.6178

Table 97 Summary of Average Trip Time by Trip Purpose, Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Trip Time (minutes)*	
		Observed	Estimated
HBW_AM	0	8.80	13.80
	1	13.58	13.13
	2	16.12	14.45
	3+	17.45	17.30
HBW_PM	0	12.70	16.91
	1	13.13	12.04
	2	16.85	15.93
	3+	18.26	18.06
HBW_OP	ALL	14.30	12.93
HBShop	ALL	9.64	9.38
HBO	ALL	12.61	12.56
NHBW	ALL	11.77	13.72
NHBO	ALL	11.25	13.25

* Terminal time was excluded in the calculation

Table 98 Summary of Average Trip Distance by Trip Purpose, Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Trip Distance (miles)	
		Observed	Estimated
HBW_AM	0	4.24	7.23
	1	6.94	6.68
	2	8.24	7.14
	3+	8.95	8.68
HBW_PM	0	6.53	9.31
	1	6.73	5.98
	2	8.71	8.10
	3+	9.46	9.20
HBW_OP	ALL	8.67	7.66
HBShop	ALL	5.33	5.23
HBO	ALL	7.43	7.51
NHBW	ALL	7.08	8.25
NHBO	ALL	6.70	7.89

It should be noted that the HBW trip distribution for the zero auto households achieved a reasonably close average logsum value compared to the observed distribution pattern (from the standard model), but the average measures of spread in terms of time and distance are significantly higher. This could be related to several issues that are beyond the scope of this project, including the adequacy of the assumed target distributions provided by the current standard model. Note also that the standard model has a significant difference in the average trip times and distances between the AM and PM zero auto household subcategories (8.8 minutes versus 12.7) minutes, while each of the other auto ownership subcategories have nearly identical times and distances in each time period. Despite this counterintuitive observed condition and the difficulty in calibrating the zero auto household subcategory, the number of person trips in the zero auto households represents a minimal percentage of total trips in the region. Therefore, the overall calibration of the HBW trip purpose was deemed adequate for the purposes of the recalibration effort.

The frequency distribution plots shown for each of the trip purposes in **Figure 26** to **Figure 38** compare the estimated and observed trips by logsum interval. Note that for all purposes the overall replication of the observed distribution of trips by logsum intervals demonstrated that the recalibrated model provided an extremely good estimation of the observed trips patterns in terms of the allocation by impedance intervals. The coincidence ratio embedded in each chart provided a numerical representation of the goodness of fit between the observed and estimated distributions for each trip purpose. Coincidence ratios above 0.70 were deemed adequate for standard calibrations. With the exception of the 0.69 value for the HBW AM zero-auto subcategory, the coincidence ratios for each purpose are 0.86 or higher.

While the frequency distribution comparisons and the coincidence ratios provide a measure of replication by impedance intervals, these comparisons do not indicate how well the estimated model replicates observed travel patterns between specific locations. In order to summarize the distribution pattern of estimated and observed trips, the trips by purpose for the region were compressed into 12 districts defined by MRCOG staff. The observed and the estimated person trip tables were subjected to linear regression analysis and R-Squared terms were calculated as a measure of goodness of fit. The comparisons are shown in **Figure 39** to **Figure 51**. With the exception of the HBW AM 0 auto-ownership trip purpose, the R-Squared values ranged from 0.86 to 0.96, which indicated strong correlation between the observed and estimated trip patterns. In summary the analysis described above indicates that the recalibrated trip distribution model, using the updated travel times and costs and mode bias terms incorporated in the revised logsum terms from the recalibrated mode choice model, provided an acceptable level of replication and was deemed more than adequate for the purposes of the model recalibration.

Figure 26 Logsum Frequency Distribution, HBW AM 0 Auto-Ownership

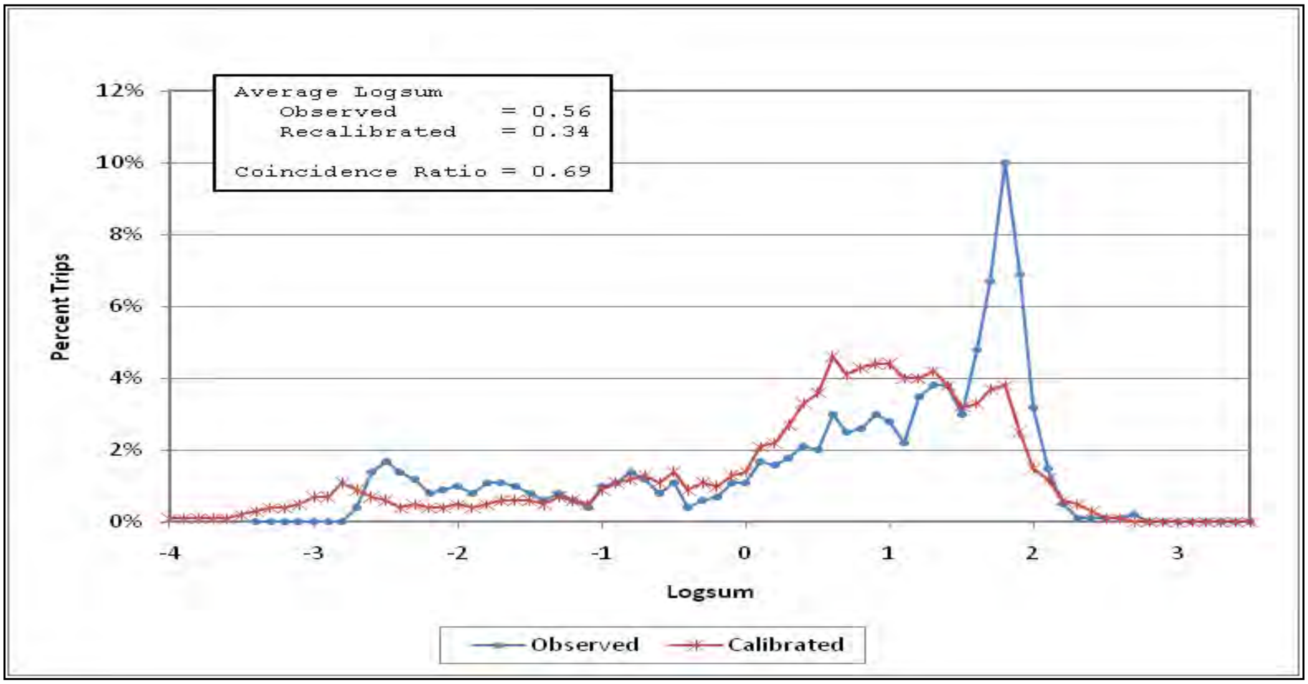


Figure 27 Logsum Frequency Distribution, HBW AM 1 Auto-Ownership

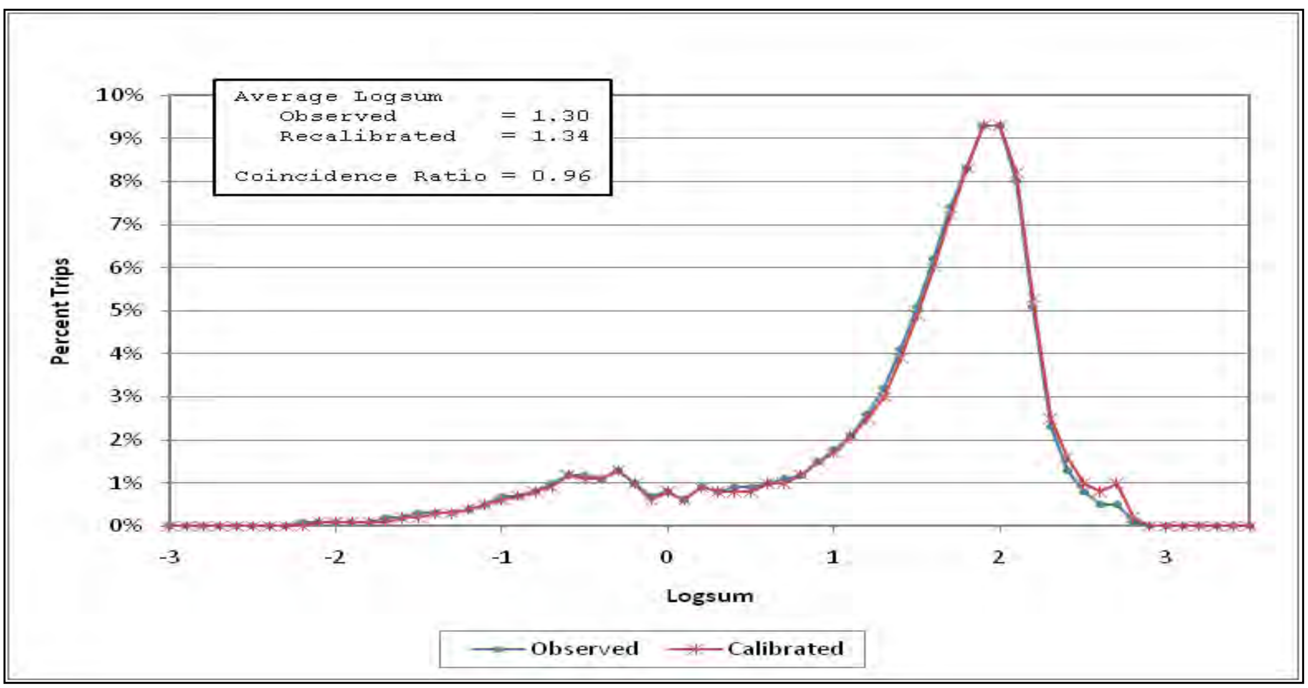


Figure 28 Logsum Frequency Distribution, HBW AM 2 Auto-Ownership

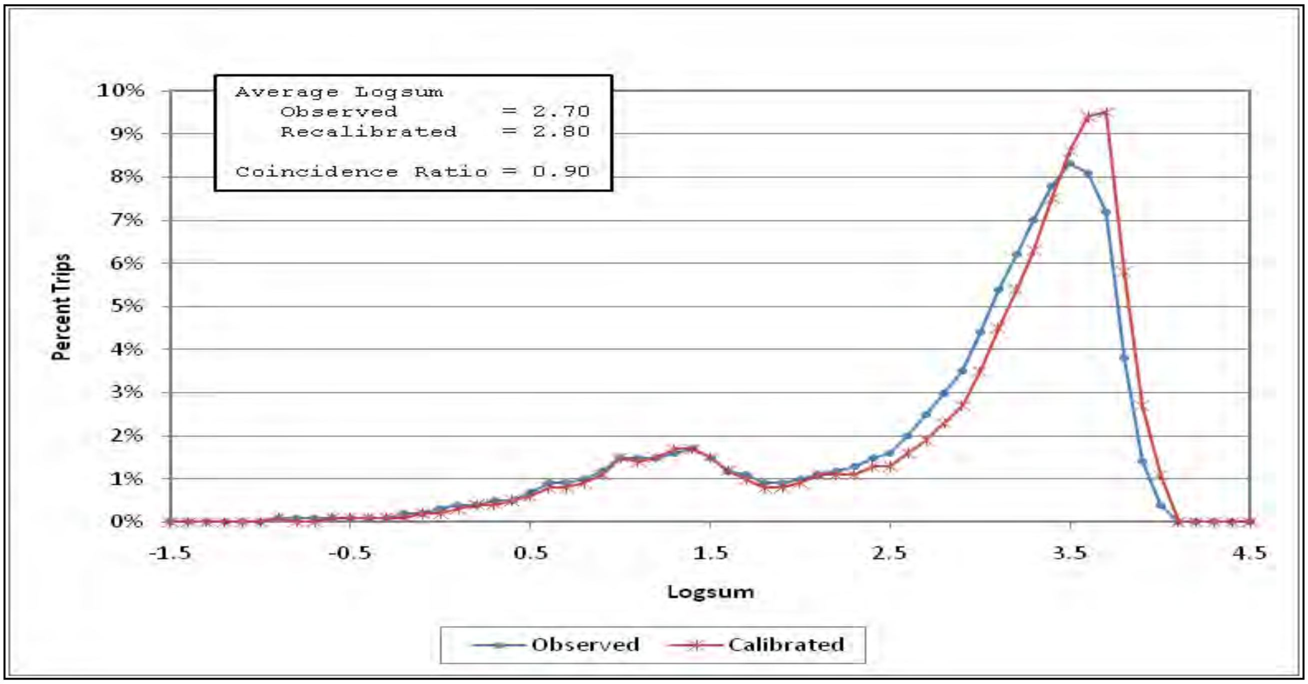


Figure 29 Logsum Frequency Distribution, HBW AM 3+ Auto-Ownership

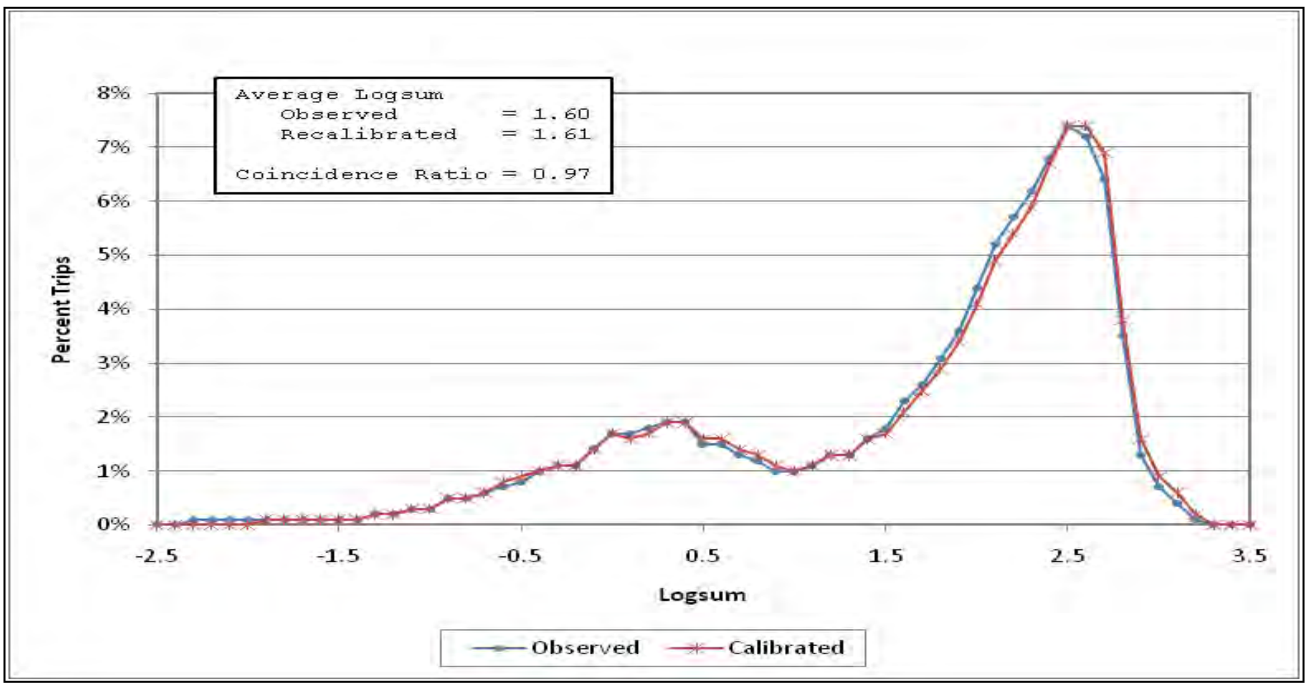


Figure 30 Logsum Frequency Distribution, HBW PM 0 Auto-Ownership

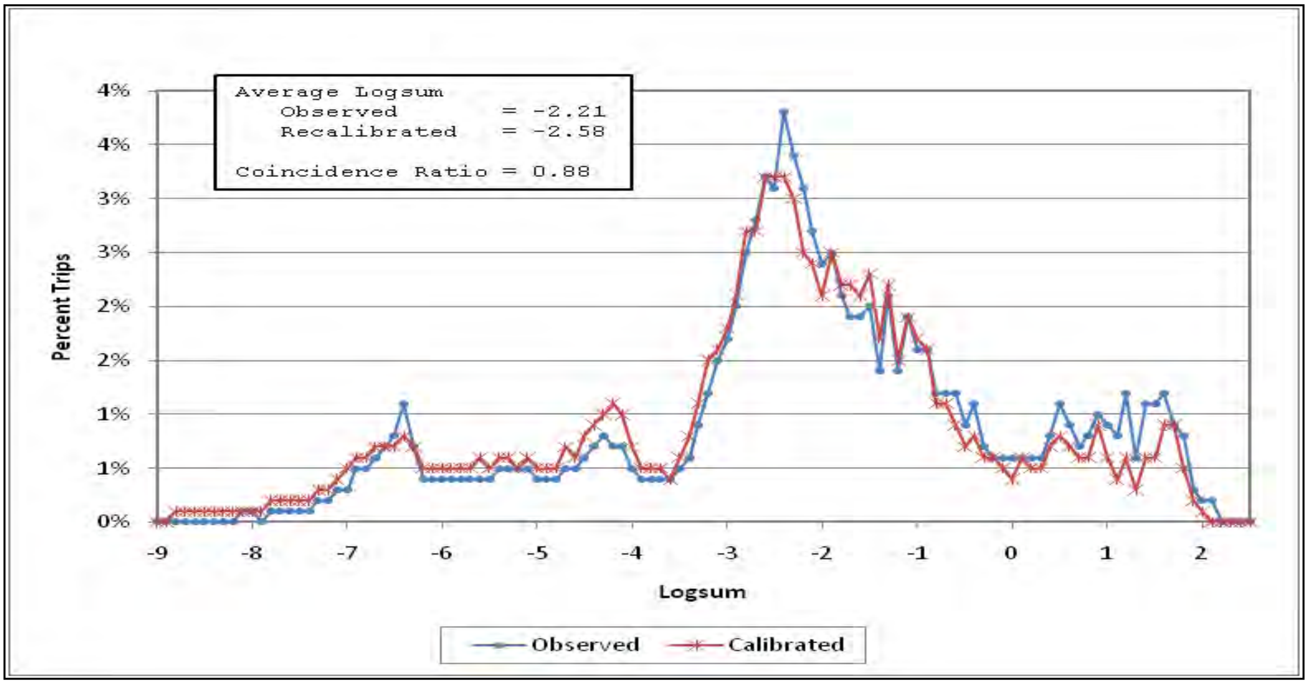


Figure 31 Logsum Frequency Distribution, HBW PM 1 Auto-Ownership

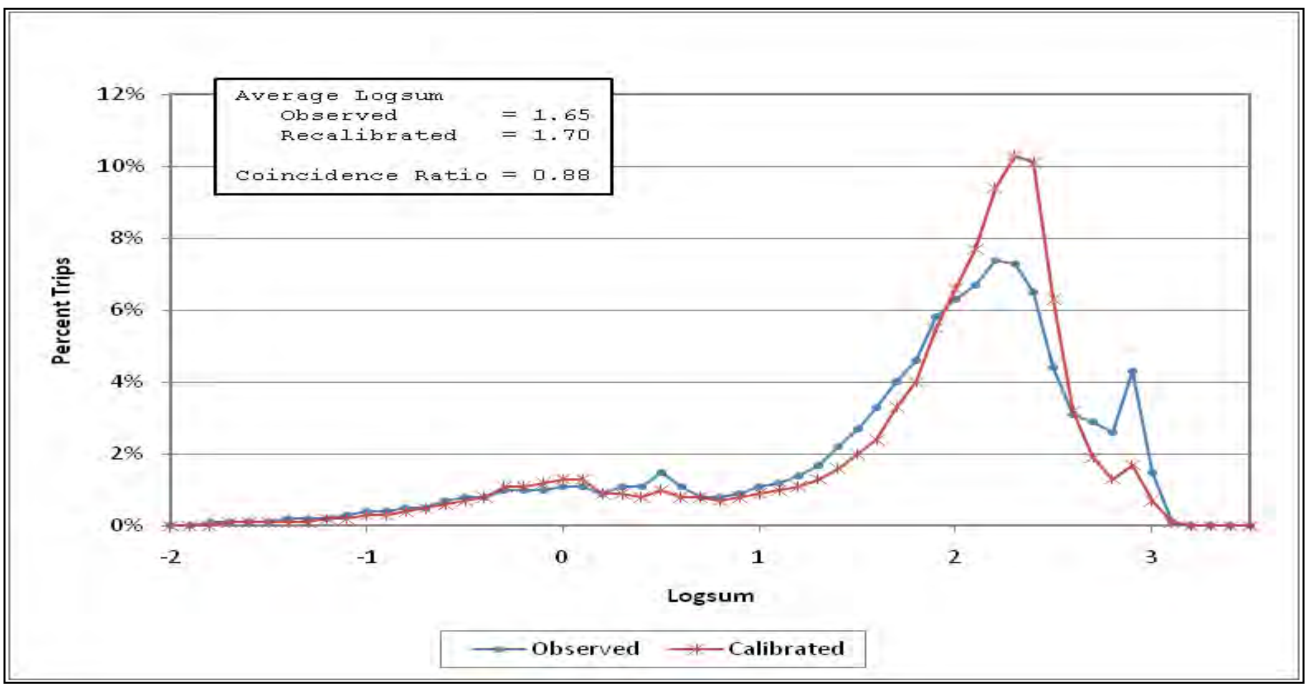


Figure 32 Logsum Frequency Distribution, HBW PM 2 Auto-Ownership

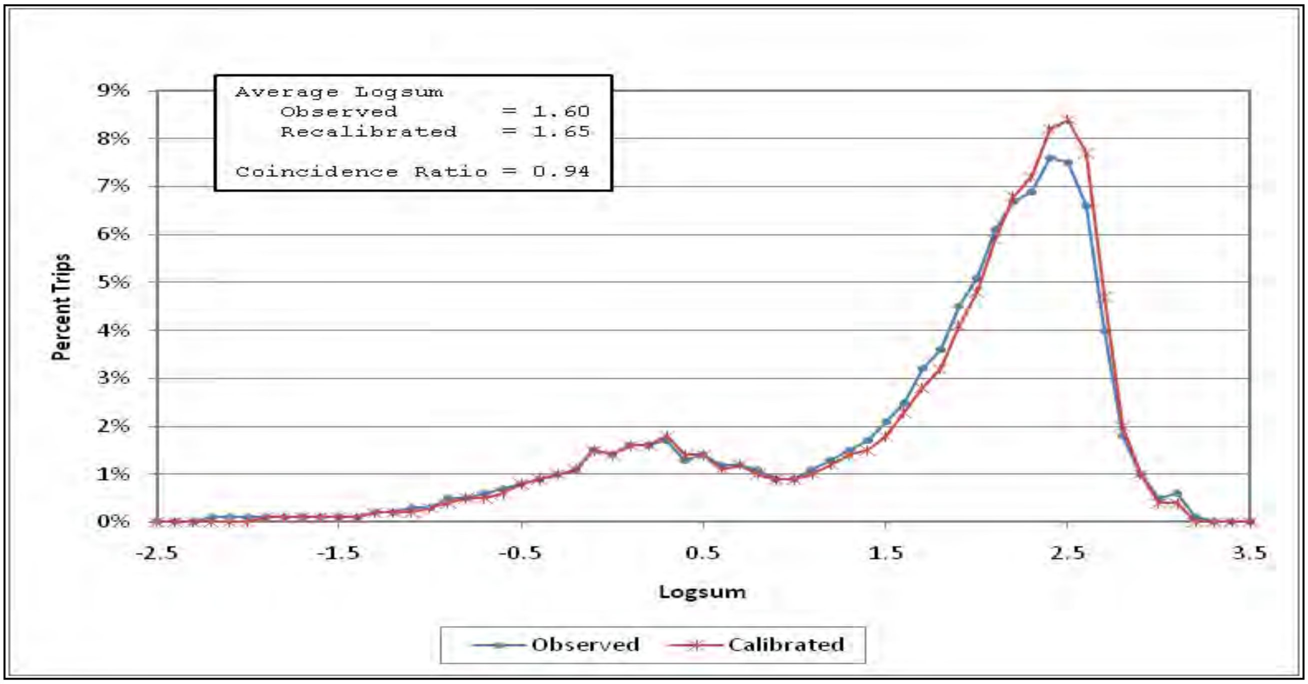


Figure 33 Logsum Frequency Distribution, HBW PM 3+Auto-Ownership

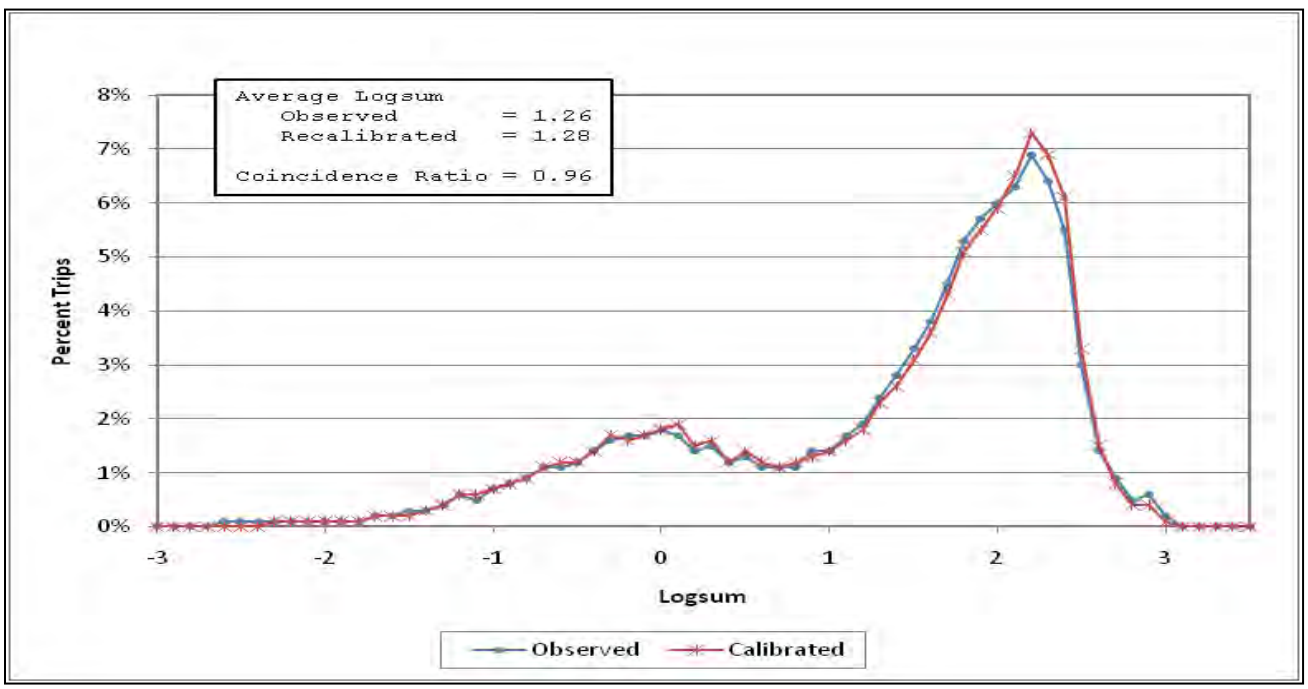


Figure 34 Logsum Frequency Distribution, HBW OP

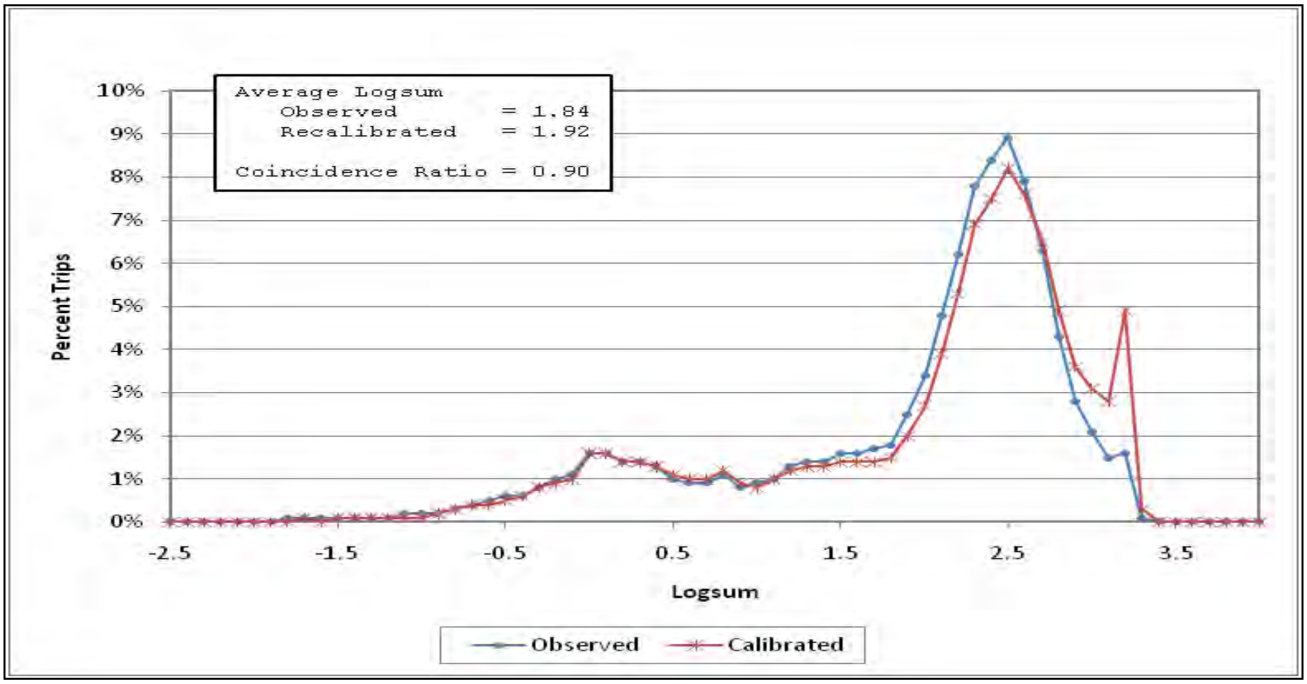


Figure 35 Logsum Frequency Distribution, HB SHOP

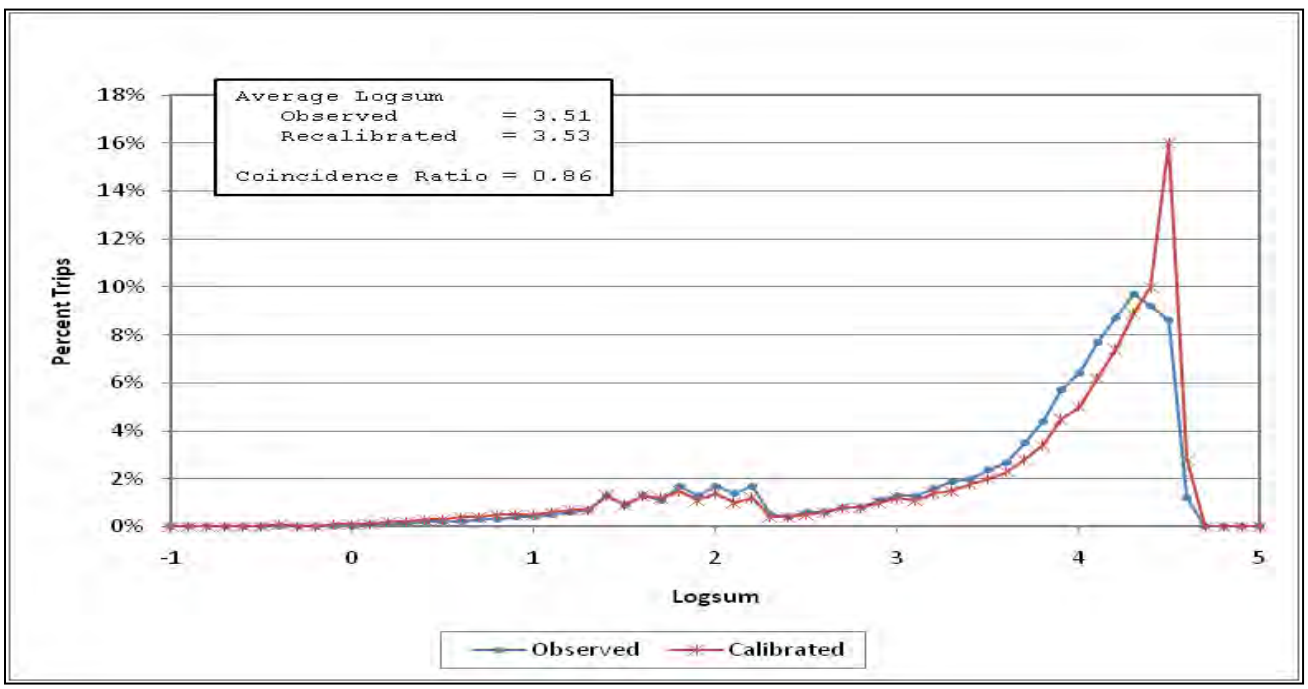


Figure 36 Logsum Frequency Distribution, HB Others

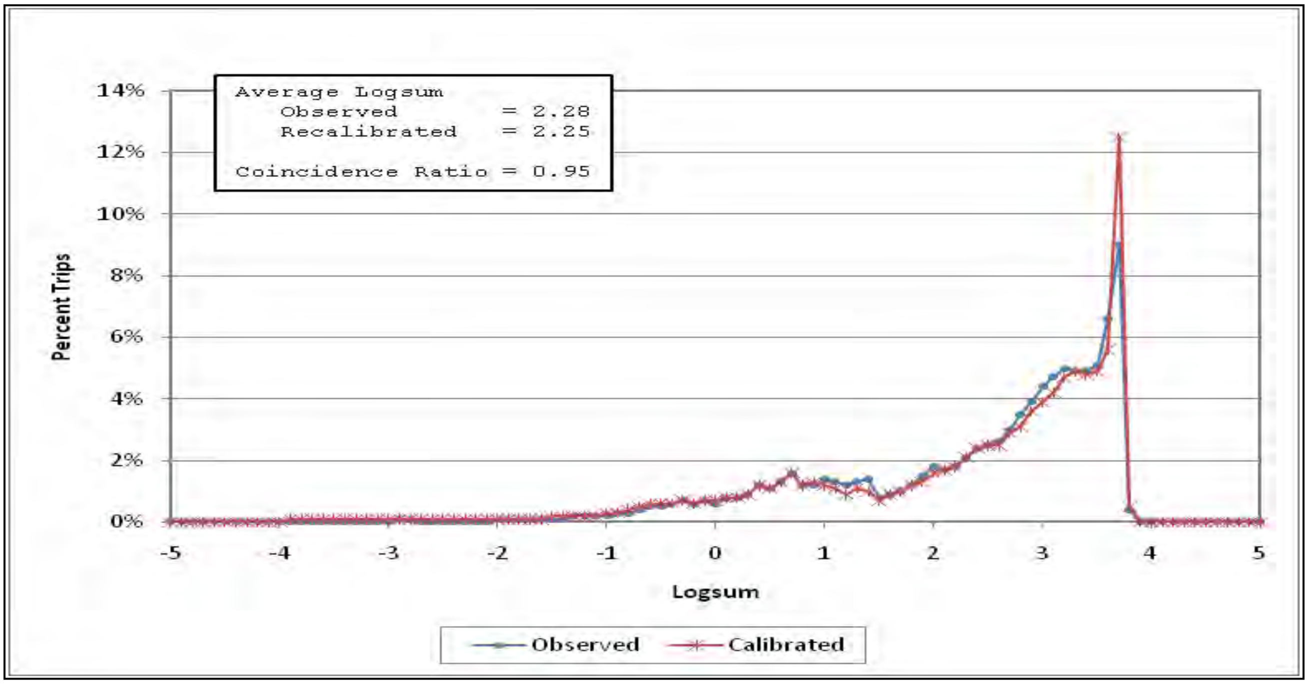


Figure 37 Logsum Frequency Distribution, NHB Work

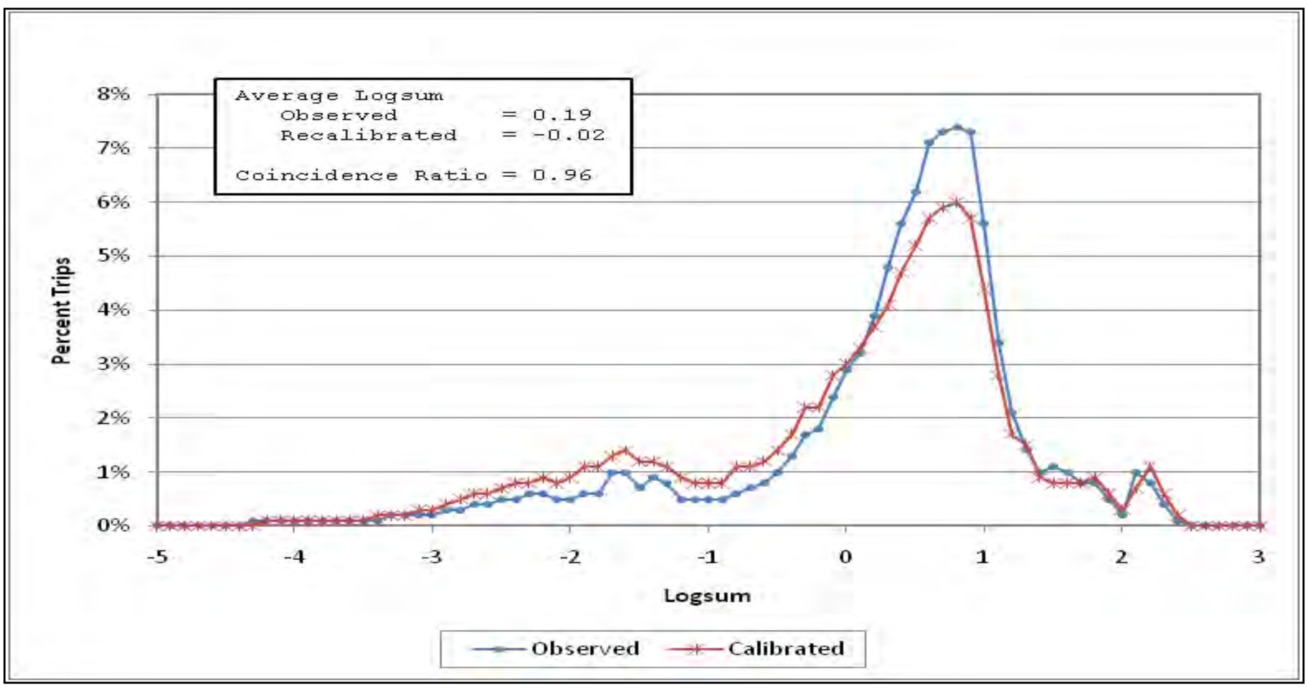


Figure 38 Logsum Frequency Distribution, NHB Others

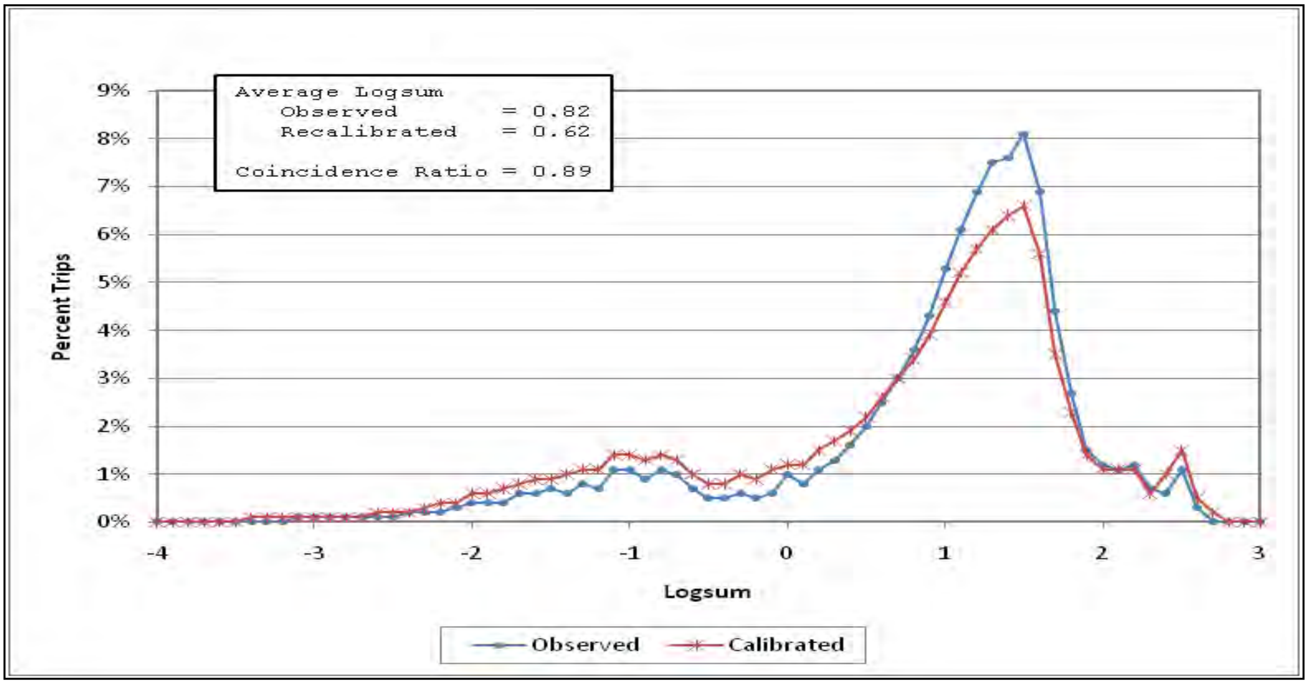


Figure 39 Goodness of Fit, HBW AM 0 Auto-Ownership

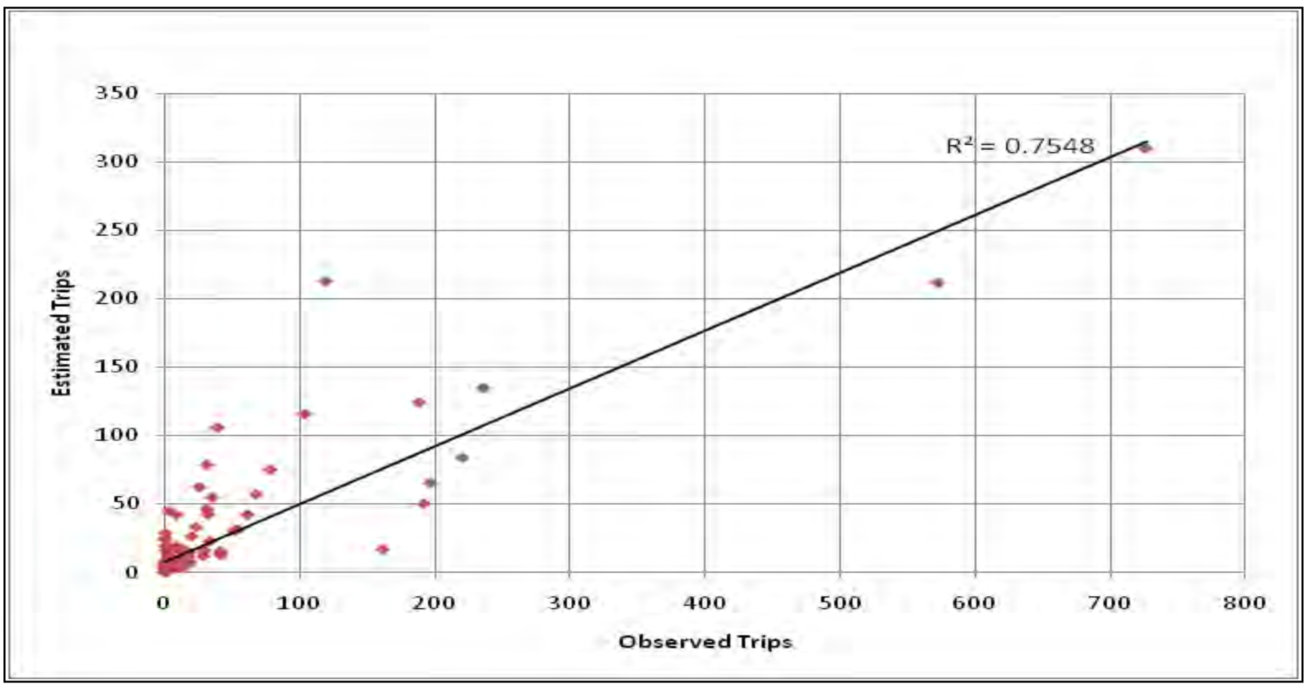


Figure 40 Goodness of Fit, HBW AM 1 Auto-Ownership

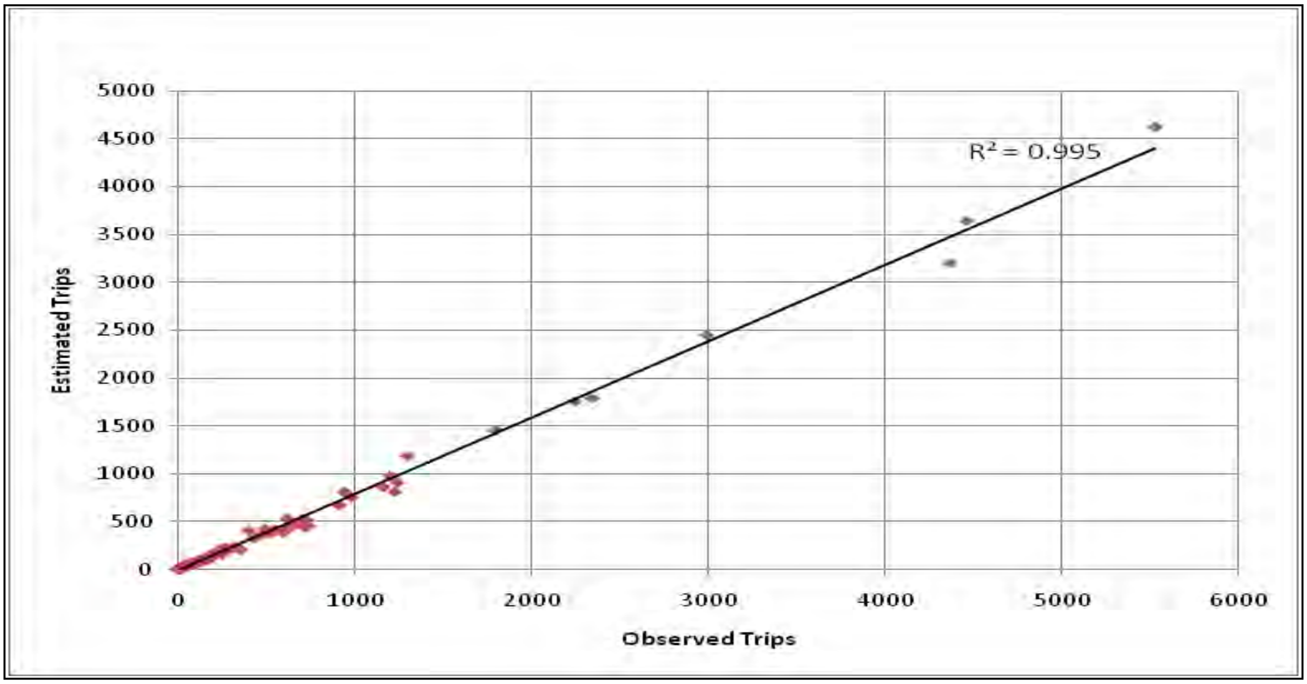


Figure 41 Goodness of Fit, HBW AM 2 Auto-Ownership

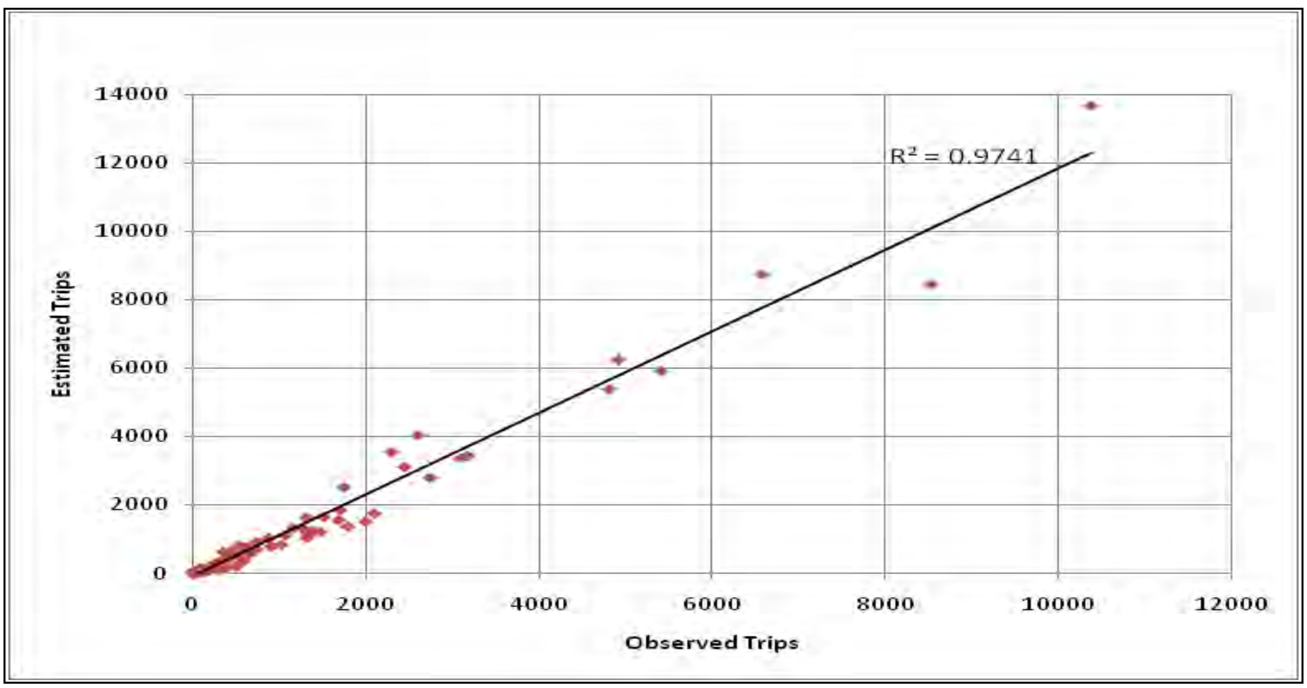


Figure 42 Goodness of Fit, HBW AM 3+ Auto Ownership

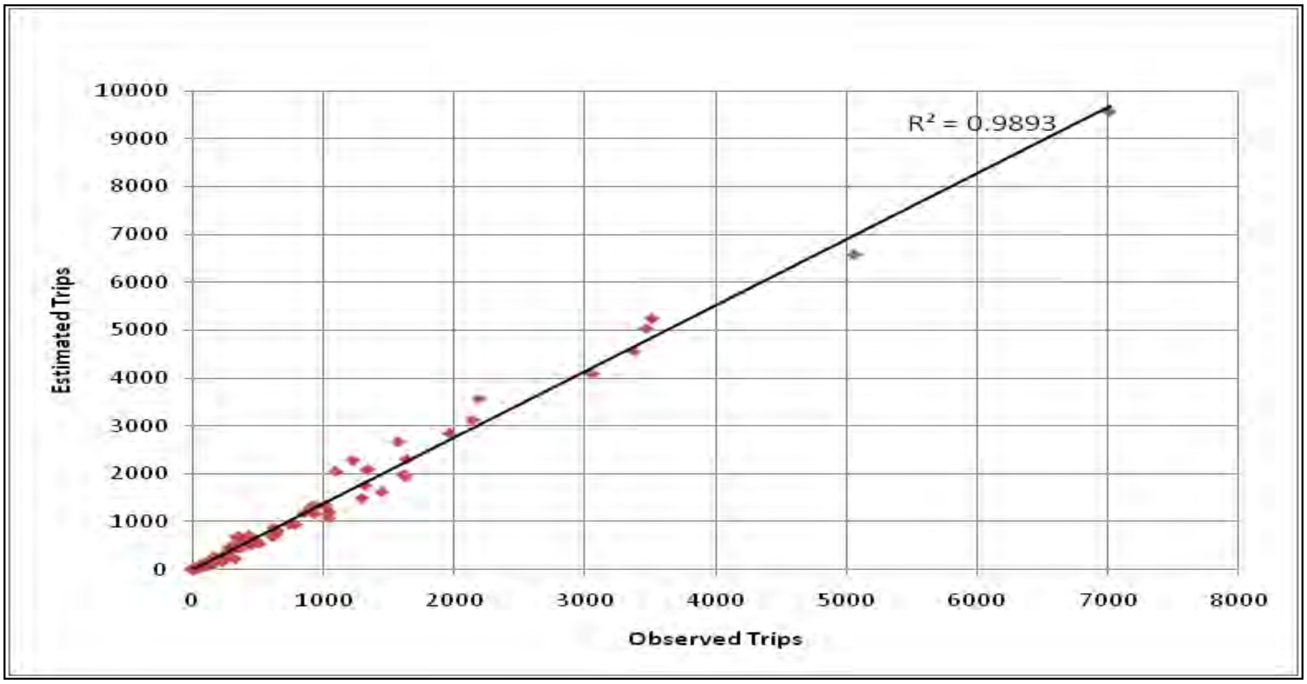


Figure 43 Goodness of Fit, HBW PM 0 Auto-Ownership

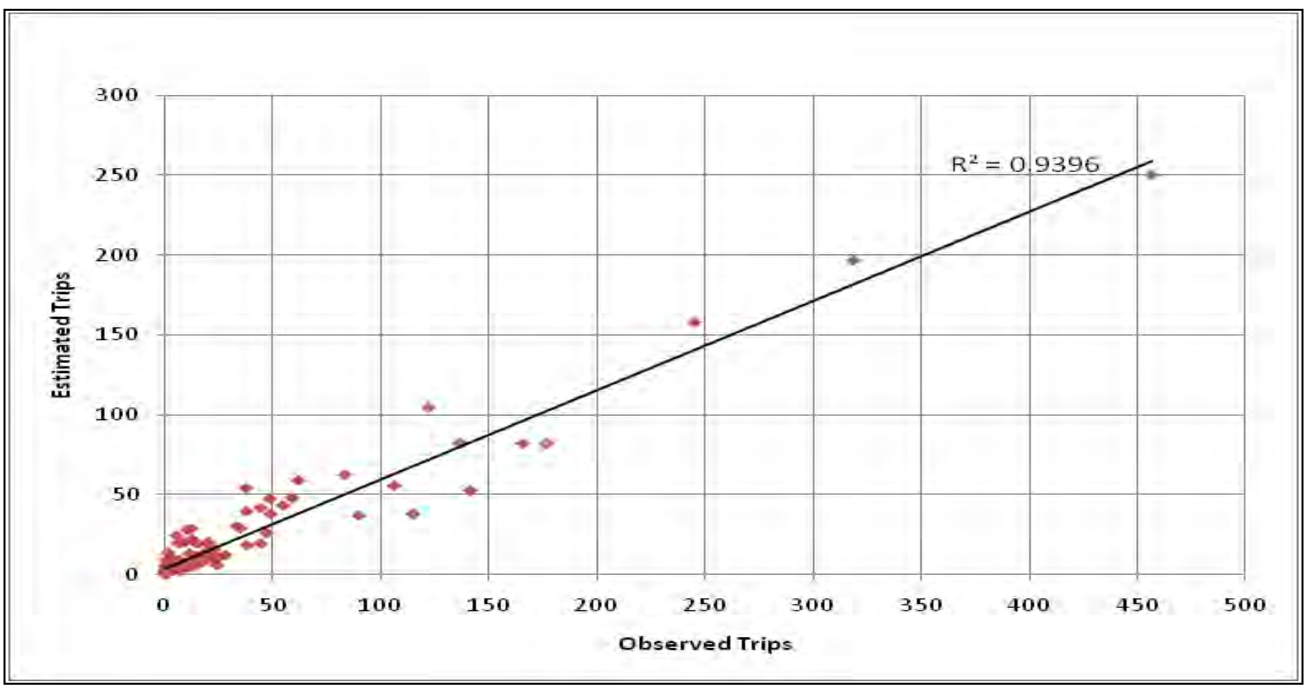


Figure 44 Goodness of Fit, HBW PM 1 Auto-Ownership

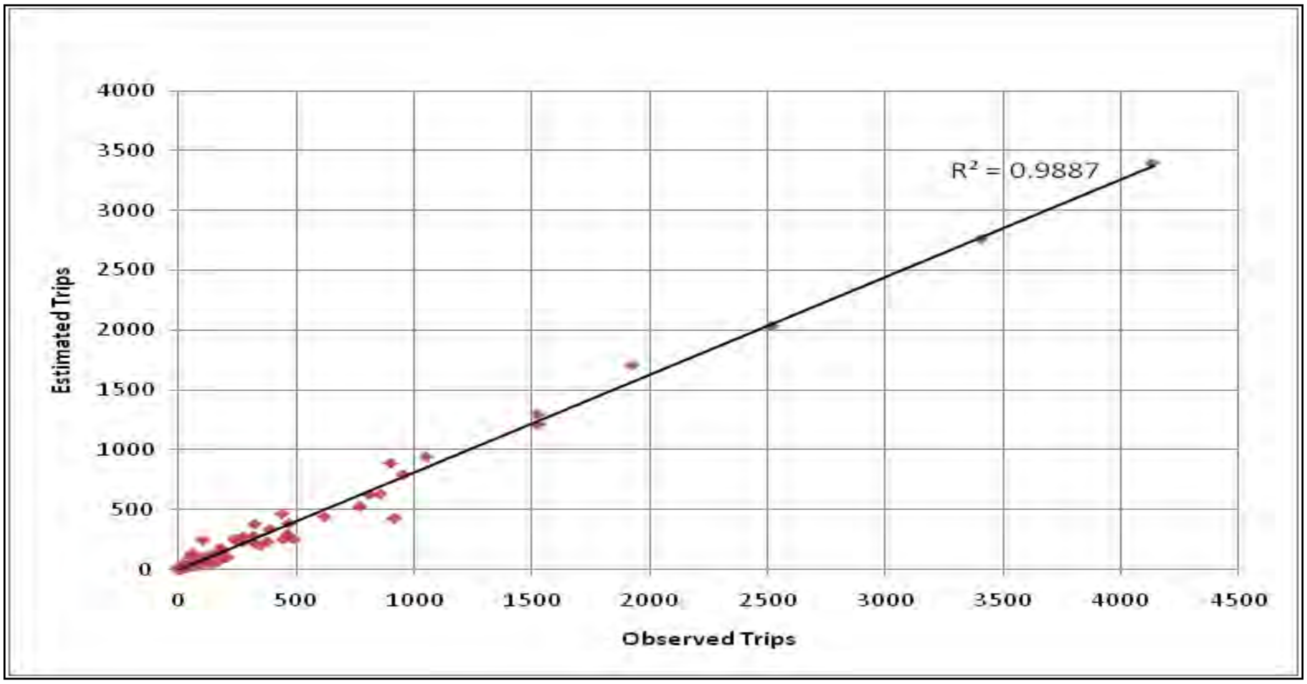


Figure 45 Goodness of Fit, HBW PM 2 Auto-Ownership

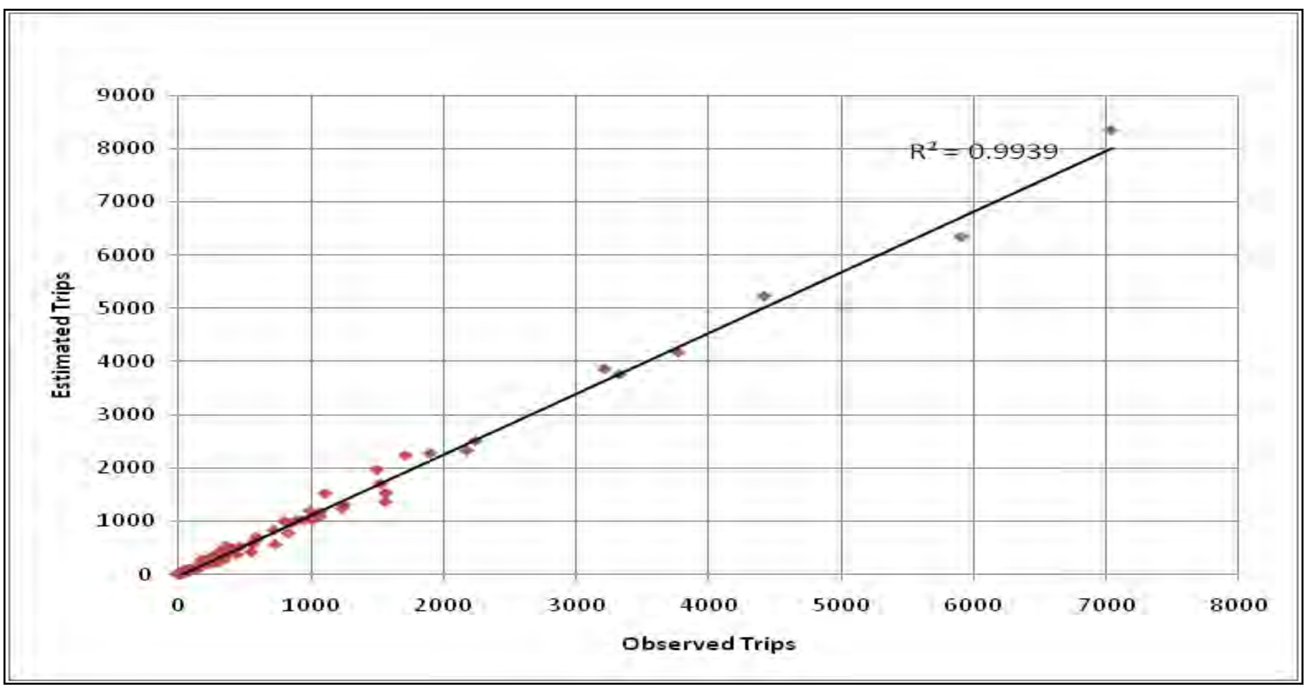


Figure 46 Goodness of Fit, HBW PM 3+ Auto-Ownership

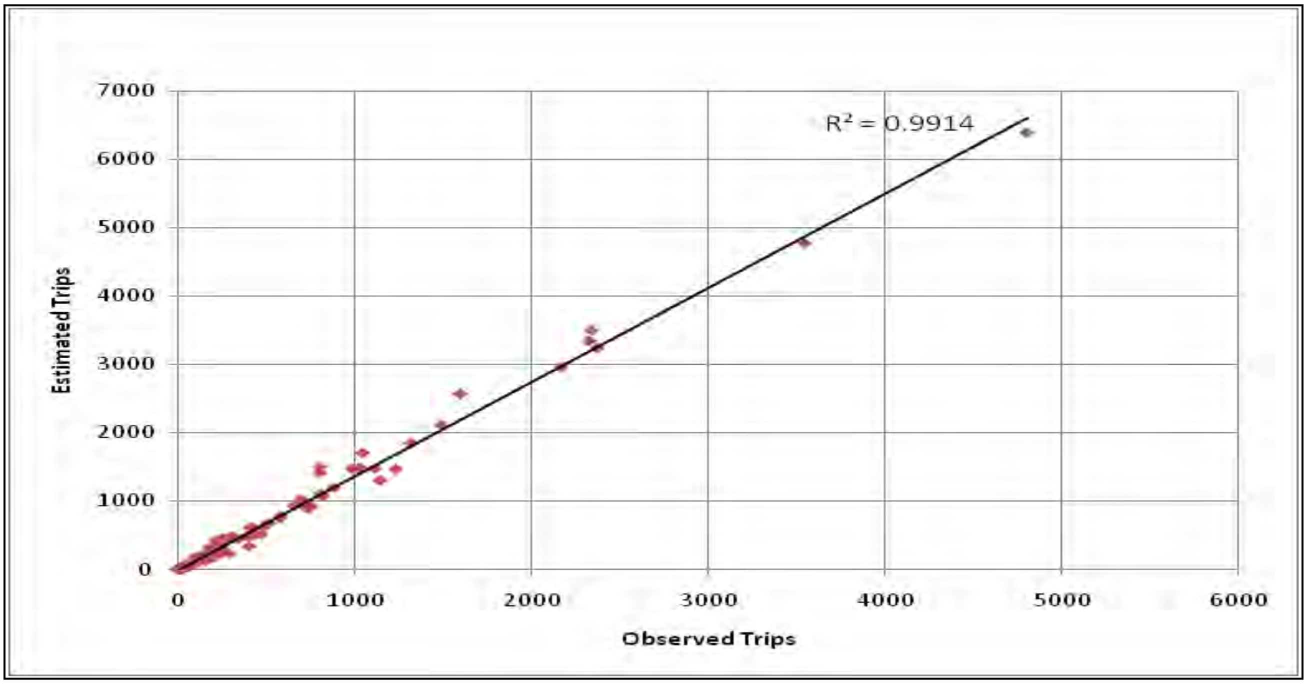


Figure 47 Goodness of Fit, HBW OP

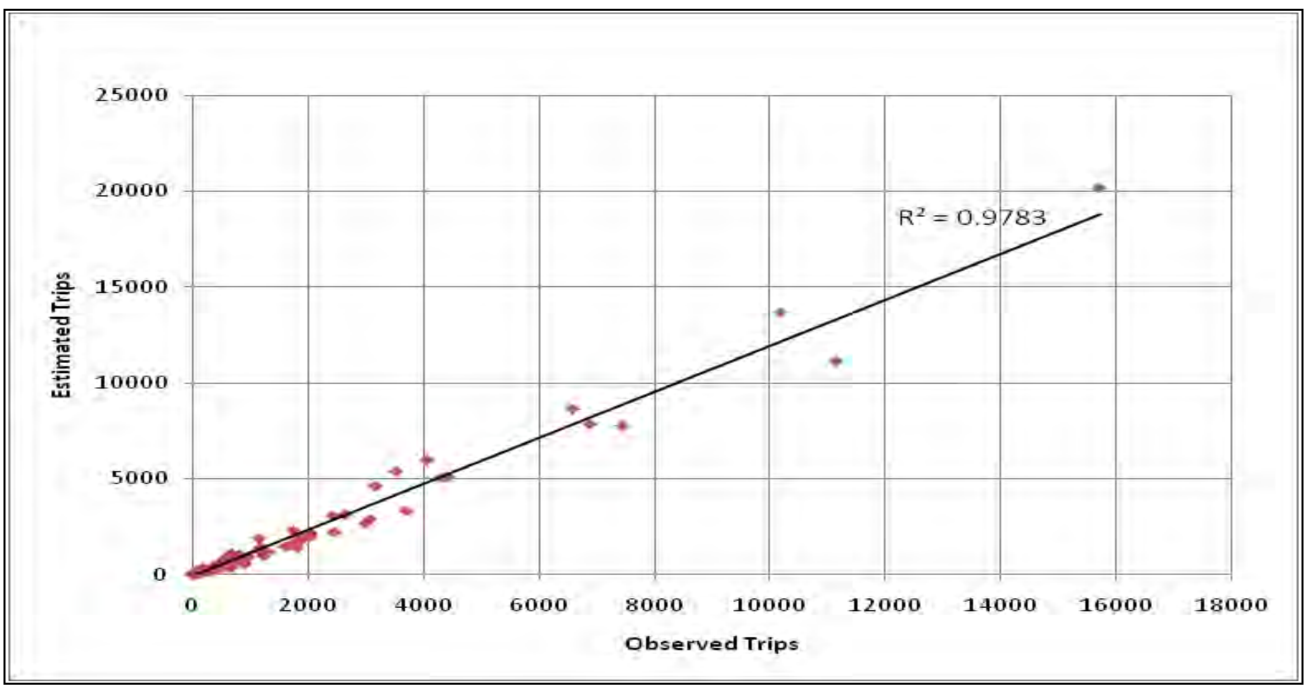


Figure 48 Goodness of Fit, HB SHOP

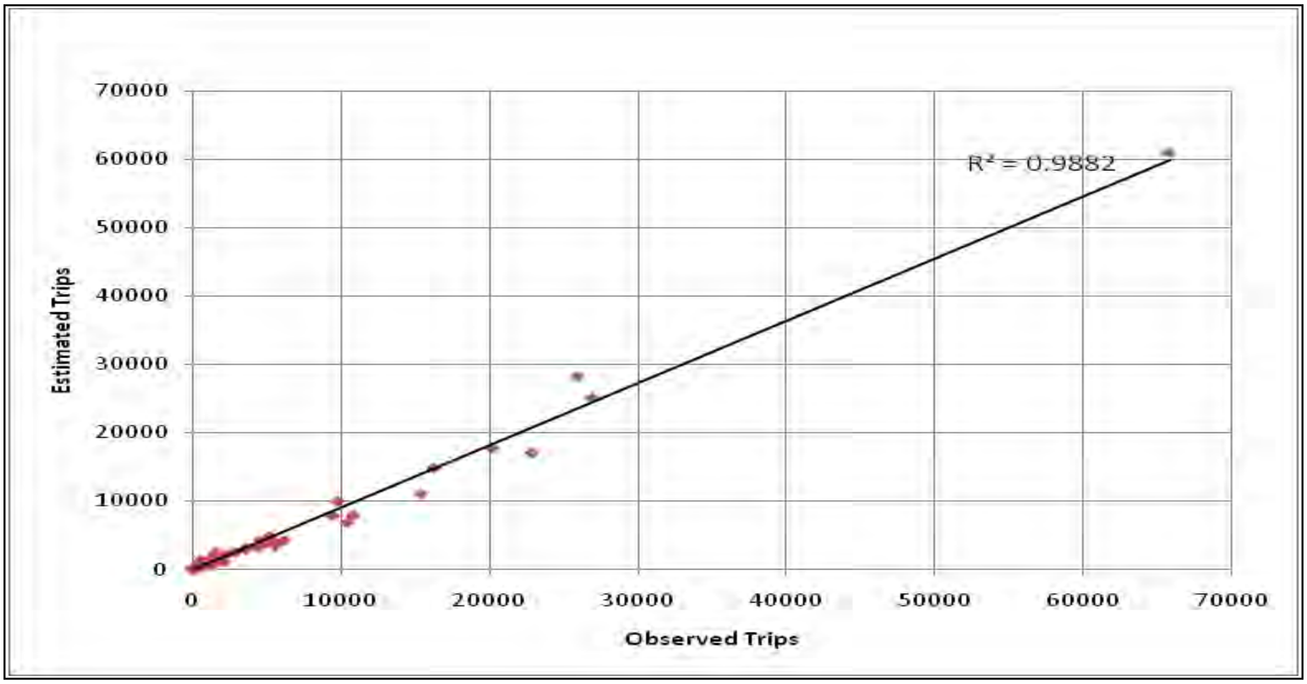


Figure 49 Goodness of Fit, HB Others

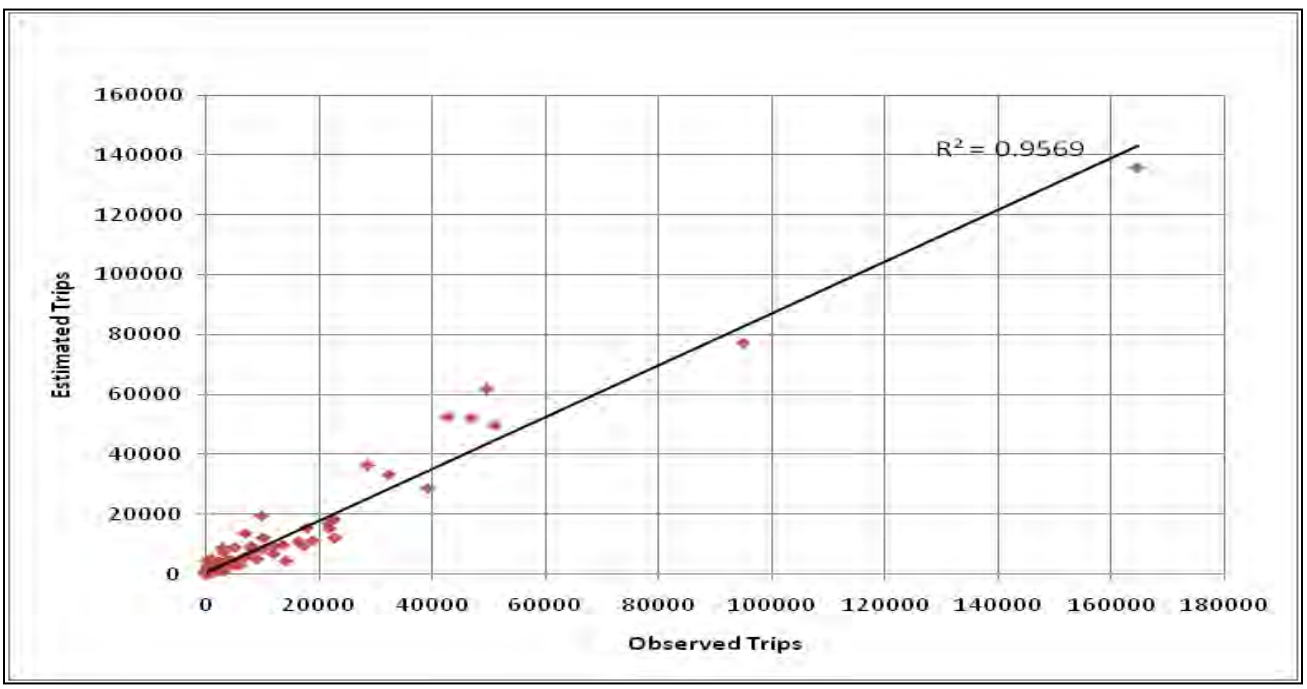


Figure 50 Goodness of Fit, NHB Work

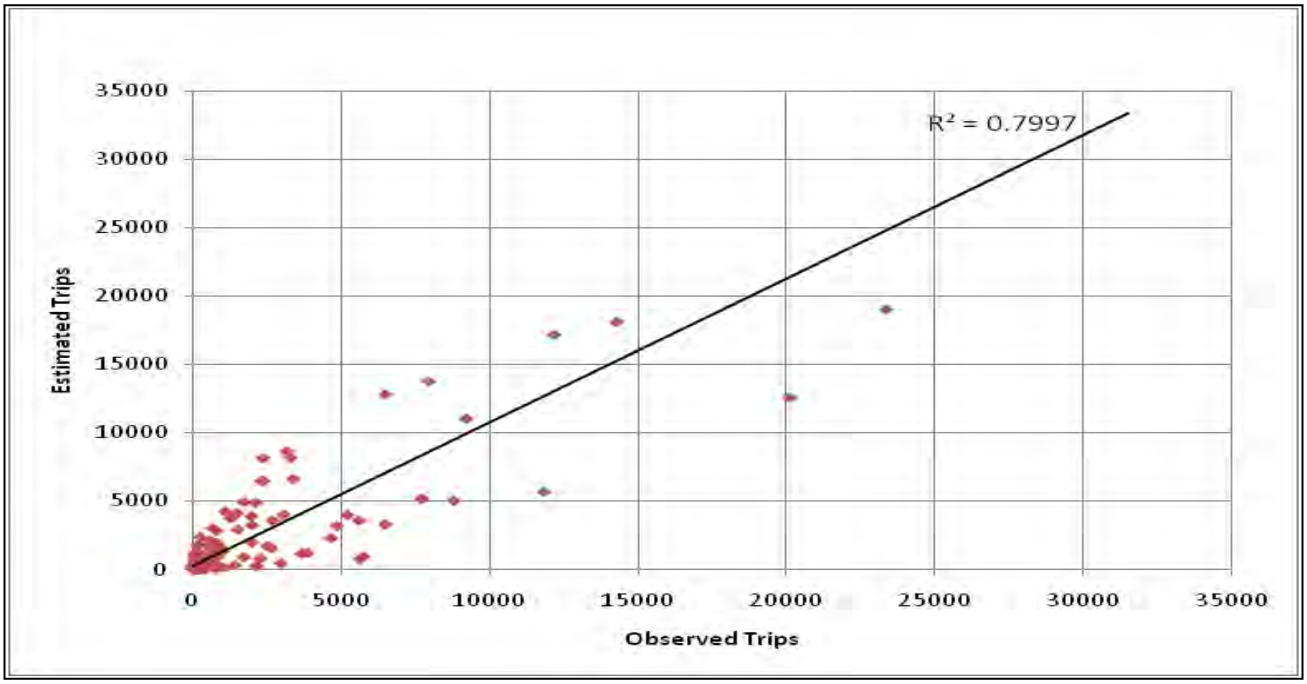
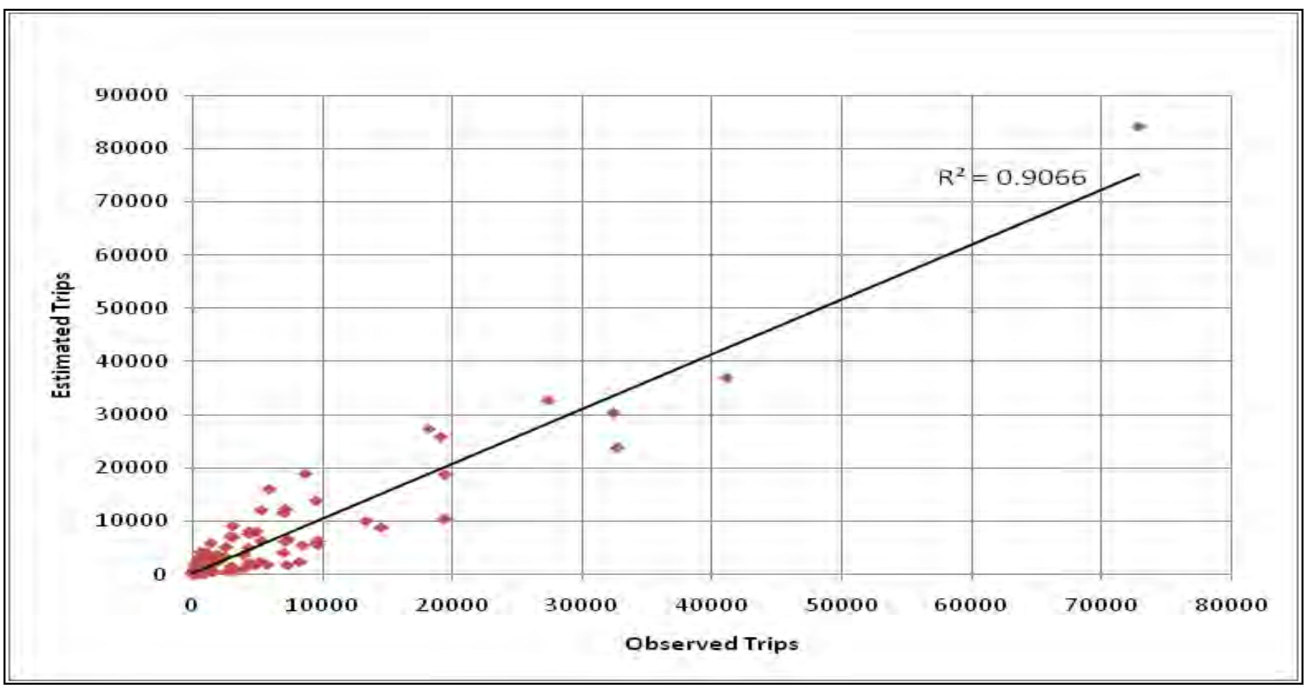


Figure 51 Goodness of Fit, NHB Others



4.14 Trip Generation

4.14.1 Introduction

The recalibrated model has adopted the trip generation of the Enhanced Regional Transit Model. The enhanced trip generation process was developed by Parsons Brinckerhoff in 2005 for a transit feasibility project and later converted to CUBE VOYAGER by Systra Mobility as part of a separate contract. The updated trip generation process features revised auto and worker sub-models and updated trip generation rates for each trip purpose. The worker sub-model estimates the number of households by number of workers for each internal zone using a joint distribution of household size and income category. The auto ownership sub-model estimates the number of households by auto ownership for each internal zone using a joint distribution of household size, income category, and number of workers. In terms of execution procedures, the enhanced trip generation process also eliminated the interactive execution of PANDANEW program to set a particular input parameter within a typical model run. The removal of the interactive step has simplified the execution of the model for MRCOG staff.

The enhanced trip generation uses nine trip purposes (HBW AM, HBW PM, and HBW OP are counted as HBW) compared to eleven purposes in the standard model. In order to maintain consistency with the remaining components in the model chain, it was necessary to disaggregate the HBO and home-based university (HBU) purposes into the original purpose definitions of the standard model. A new step was added to disaggregate trips ends of the HBO purpose into separate HBO and HB Shop purposes and to partition the trips from the HBU purpose into separate HBUNM and HBTVI purposes. This section describes the enhanced trip generation, the updated trip generation rates, and the new procedure to disaggregate trip ends.

4.14.2 Enhanced Trip Generation

The recalibrated model has adopted the trip generation of the Enhanced Regional Transit Model. A comparison of the differences between the standard trip generation model and the enhanced trip generation model are summarized below in a series of tables. The basic structure of the enhanced trip generation remained unchanged as is illustrated in **Figure 5** shown previously in **Section 3.9.2**. **Table 99** lists the trip purposes of both the standard model and the recalibrated model. The differences by purpose are listed in *italic* text. As noted previously, the primary trip purpose differences are the treatment of university trips and home-based other trips. In the standard model, The HB UNM trips and HB TVI trips were maintained as separate purposes. Similarly, in the standard model were the home-based other trips were disaggregated into two purposes (HB Shop and HB Other) while the enhanced model had one HBO purpose for both of these purposes.

Table 99 Comparison of Trip Generation Trip Purposes, Standard Model and Recalibration

STANDARD REGIONAL MODEL	ENHANCED TRANSIT REGIONAL MODEL
Home-Based Work	Home-Based Work
Home-Based Elementary/Middle School	Home-Based Elementary/Middle School
Home-Based High School	Home-Based High School
Home-Based University of New Mexico (UNM)	*Home-Based University*
Home-Based Technical Vocational Institute (TVI)	
Home-Based Shopping	*Home-Based Other*
Home-Based Other	
Non-Home-Based Work	Non-Home-Based Work
Non-Home-Based Other	Non-Home-Based Other
Truck	Truck
External-Internal	External-Internal

Another major difference is that the production trip rates for the purposes of HB Elementary School, HB High School, HB University (UNM and TVI) HBO (HB Shop and HBO) are now further stratified by auto ownership levels as are the two non home-based purposes. This comparison is summarized in **Table 100**. Again the differences are listed in *italic* text.

Table 100 Comparison of Production Trip Rates, Standard Model and Recalibrated Model

TRIP PURPOSE	STANDARD MODEL	RECALIBRATED MODEL
Home-Based Work	4 Auto Ownership Levels	4 Auto Ownership Levels
Home-Based Elementary School	*Total*	*4 Auto Ownership Levels*
Home-Based High School	*Total*	*4 Auto Ownership Levels*
Home-Based University of New Mexico (UNM)	*Total*	*4 Auto Ownership Levels*
Home-Based Technical Vocational Institute (TVI)	*Total*	
Home-Based Shopping	*Total*	*4 Auto Ownership Levels*
Home-Based Other	*Total*	
Non-Home-Based Work	*Total*	*4 Auto Ownership Levels*
Non-Home-Based Other	*Total*	*4 Auto Ownership Levels*
Truck	Total	Total
External-Internal	Total	Total

4.14.3 Production Trip Rates

The production trip rates for each of the trip purposes are shown in **Table 101** to **Table 107.**

Table 101 Home-Based Work Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.00	1.79	0.00	0.00
	2	0.00	1.79	1.79	0.00
	3	0.00	1.79	1.79	1.79
	4+	0.00	1.79	1.79	1.79
Auto 1	1	0.00	1.35	0.00	0.00
	2	0.00	1.20	2.46	0.00
	3	0.00	1.20	2.13	2.29
	4+	0.00	1.84	2.74	2.00
Auto 2	1	0.00	1.39	0.00	0.00
	2	0.00	1.53	2.88	0.00
	3	0.00	1.46	3.01	5.20
	4+	0.00	1.69	2.87	4.29
Auto 3+	1	0.00	0.89	0.00	0.00
	2	0.00	1.49	2.56	0.00
	3	0.00	1.42	2.73	4.04
	4+	0.00	1.36	2.86	4.65

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 102 Non-Home Based Work Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.00	0.40	0.40	2.12
	2	0.00	0.40	0.40	2.12
	3	0.00	0.40	0.40	2.12
	4+	0.00	0.40	0.40	2.12
Auto 1	1	0.00	0.90	0.00	0.00
	2	0.00	0.84	1.42	0.00
	3	0.00	0.60	1.06	2.12
	4+	0.00	0.60	0.74	2.12
Auto 2	1	0.00	1.39	0.00	0.00
	2	0.00	0.92	1.57	0.00
	3	0.00	0.66	1.46	2.12
	4+	0.00	0.68	1.58	2.12
Auto 3+	1	0.00	1.22	0.00	0.00
	2	0.00	0.72	1.92	0.00
	3	0.00	0.81	1.85	1.96
	4+	0.00	0.60	1.56	2.37

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 103 Home-Based Elementary School Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.00	0.00	0.00	0.00
	2	0.50	0.50	0.00	0.00
	3	1.16	1.16	1.16	0.00
	4+	4.00	4.00	4.00	4.00
Auto 1	1	0.00	0.00	0.00	0.00
	2	0.09	0.32	0.00	0.00
	3	0.57	1.04	0.69	0.00
	4+	2.44	2.36	2.50	2.50
Auto 2	1	0.00	0.00	0.00	0.00
	2	0.02	0.04	0.01	0.00
	3	0.44	0.59	0.65	0.65
	4+	3.50	2.29	2.23	1.29
Auto 3+	1	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00
	3	0.40	0.23	0.32	0.08
	4+	2.60	1.83	1.91	0.93

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 104 Home-Based High School Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.00	0.00	0.00	0.00
	2	0.10	0.29	0.00	0.00
	3	0.17	0.63	0.41	0.00
	4+	1.38	0.75	1.82	0.00
Auto 1	1	0.03	0.01	0.00	0.00
	2	0.11	0.09	0.04	0.00
	3	1.23	0.36	0.47	0.00
	4+	0.64	0.64	0.64	2.00
Auto 2	1	0.00	0.00	0.00	0.00
	2	0.01	0.06	0.04	0.00
	3	1.36	0.46	0.51	0.00
	4+	1.88	2.46	3.60	1.81
Auto 3+	1	0.00	0.00	0.00	0.00
	2	0.17	0.20	0.05	0.00
	3	1.40	0.82	0.53	0.24
	4+	2.78	2.92	1.35	1.03

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 105 Home-Based Other Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	3.50	2.00	0.00	0.00
	2	2.50	2.00	1.00	0.00
	3	2.50	2.00	1.00	1.00
	4+	2.50	2.00	1.00	1.00
Auto 1	1	3.12	1.32	0.00	0.00
	2	4.61	2.83	2.77	0.00
	3	5.00	3.09	4.69	4.66
	4+	2.11	3.84	4.63	4.66
Auto 2	1	3.17	1.73	0.00	0.00
	2	5.65	3.17	2.88	0.00
	3	5.78	3.44	3.38	1.20
	4+	4.30	5.10	4.55	6.76
Auto 3+	1	2.75	1.22	0.00	0.00
	2	4.83	2.49	3.33	0.00
	3	3.20	4.52	3.67	1.23
	4+	4.00	3.74	4.84	5.65

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 106 Non-Home-Based Other Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.60	0.60	0.60	0.60
	2	1.50	1.50	1.50	1.50
	3	1.50	1.50	1.50	1.50
	4+	2.00	2.00	2.00	2.00
Auto 1	1	1.50	0.76	0.00	0.00
	2	1.91	1.26	0.77	0.00
	3	1.06	1.47	1.56	1.56
	4+	1.06	1.96	2.60	2.60
Auto 2	1	1.50	0.88	0.00	0.00
	2	1.88	1.46	1.45	0.00
	3	2.44	1.58	2.11	3.24
	4+	2.25	2.65	2.61	3.24
Auto 3+	1	1.00	1.44	0.00	0.00
	2	2.42	1.69	1.47	0.00
	3	1.00	2.39	1.85	2.40
	4+	2.90	2.36	2.75	3.13

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

Table 107 Home-Based University Production Trip Rates, Recalibrated Model

AutoOwnership		Number of Workers 0	1	2	3+
Auto 0	1	0.14	0.14	0.14	0.14
	2	0.03	0.03	0.03	0.03
	3	0.10	0.10	0.10	0.10
	4+	0.51	0.51	0.51	0.51
Auto 1	1	0.05	0.05	0.05	0.05
	2	0.14	0.14	0.14	0.14
	3	0.18	0.18	0.18	0.18
	4+	0.06	0.06	0.06	0.06
Auto 2	1	0.02	0.02	0.02	0.02
	2	0.20	0.20	0.20	0.20
	3	0.10	0.10	0.10	0.10
	4+	0.07	0.07	0.07	0.07
Auto 3+	1	0.00	0.00	0.00	0.00
	2	0.12	0.12	0.12	0.12
	3	0.25	0.25	0.25	0.25
	4+	0.35	0.35	0.35	0.35

Source : (A) Albuquerque Travel Demand Model Documentation, PB Consult Inc., August 15, 2005.
(B) Referred from an input file ('Tgdataba.h') compiled with 'Panda2.C'

The production trip rates for the truck and internal-external remain unchanged from the standard model. (See **Section 3.9.3** for details).

4.14.4 Attraction Trip Rates

The attraction trip rates of the enhanced trip generation process are the same as those in the standard model. (See **Section 3.9.4** for the trip rates).

4.14.5 Trip Ends Disaggregation

The trip ends of the home-based other (HBO) and the home-based university trip purposes were disaggregated into home-based other (HBO) and home-based shop (HBSHOP) trip purposes, home-based University of New Mexico (HBUNM) and home-based TVI trip purposes. Due to the lack of data, a set of split factors by TAZ was developed based on the estimated trip ends of these purposes in the standard model. The split factors are stored in a DBF file named PA_FACTORS.DBF, which resides in the 01_Input_Data\GENERAL_INFO\ sub-folder. The content of the PA_FACTORS.DBF is summarized in **Table 108**.

Table 108 Split Factor File Description

Field Name	Field Description
ZONE	TAZ
MO8_HBUNMP	Split factor applies to production trip ends of HB University
MD8_HBUNMA	Split factor applies to attraction trip ends of HB University
MO9_HBTVIP	Split factor applies to production trip ends of HB University
MD9_HBTVIA	Split factor applies to attraction trip ends of HB University
MO10HBSHPP	Split factor applies to production trip ends of HBO
MD10HBSHPA	Split factor applies to attraction trip ends of HBO
MO11_HBOP	Split factor applies to production trip ends of HBO
MD11_HBOA	Split factor applies to attraction trip ends of HBO

4.14.6 Results

The trip ends by auto-ownership estimated by the enhanced trip generation model were aggregated to match the trip purpose designations used in the standard model in order to be consistent with the structure of the remaining model components. **Table 109** summarizes the estimated trip ends by trip purposes and compares to the estimates by the standard model. Compared to the standard model the total trip ends increased by about 5 percent. The trip ends of the HBW trip purpose increased by about 12 percent. The biggest increases occurred with the home-based high school trip purpose, which had a 174 percent increase most likely attributed to the way this purpose was defined in the enhanced trip generation model. There is a significant reduction in work trips for the lower auto ownership categories in the home based work purpose, which is consistent with expectations since overall auto ownership has been increasing nationally for some time. Note that the trip ends for the university purposes (HBUM, HBTVI) have declined by approximately 32 percent, and that the HBShop, and HBO purposes have also decreased from 6 percent to 13 percent. In contrast, the non-home-based purpose trips have increased suggesting that the more recent survey data had higher levels of trip chaining. Further review of these differences by purpose was not conducted as it was beyond the scope of services for this project.

Note that while there was a minor difference in the total trip ends for the truck and external-internal purposes, the variation was due to minor revisions to the socioeconomic data from the last execution of the standard model and final execution of the recalibrated model.

Table 109 Comparison of Trip Ends by Trip Purpose, Standard Model and Recalibrated Model

TRIP PURPOSE	Trip Ends							
	Production				Attraction			
	Std. Mode	Rec. Model	Diff	% Diff	Std. Mode	Rec. Model	Diff	% Diff
HBW – 0 Auto-Ownership	9,674	6,899	-2,775	-29%	9,657	6,899	-2,758	-29%
HBW – 1 Auto-Ownership	111,980	88,220	-23,760	-21%	111,978	88,220	-23,758	-21%
HBW – 2 Auto-Ownership	237,054	262,890	25,836	11%	237,061	262,890	25,829	11%
HBW – 3+Auto-Ownership	161,173	222,953	61,780	38%	161,184	222,953	61,769	38%
HBW – SUBTOTAL	**519,881**	**580,962**	**61,081**	**12%**	**519,880**	**580,962**	**61,082**	**12%**
Home-Based Elementary School	186,341	192,399	6,058	3%	186,352	192,399	6,047	3%
Home-Based High School	75,278	206,602	131,324	174%	75,269	206,602	131,333	174%
Home-Based UNM	36,588	22,696	-13,892	-38%	36,594	24,871	-11,723	-32%
Home-Based TVI	35,938	26,599	-9,339	-26%	35,936	24,424	-11,512	-32%
Home-Based Shopping	335,319	292,263	-43,056	-13%	335,318	292,151	-43,167	-13%
Home-Based Other	977,297	916,085	-61,212	-6%	977,287	916,197	-61,090	-6%
Non-Home-Based Work	280,111	321,392	41,281	15%	280,123	321,392	41,269	15%
Non-Home-Based Other	561,220	606,602	45,382	8%	561,220	606,602	45,382	8%
Truck	30,667	30,724	57	0%	30,686	30,724	38	0%
Internal-External	78,236	78,236	0	0%	78,243	78,236	-7	0%
TOTAL	**3,116,876**	**3,274,560**	**157,684**	**5%**	**3,116,908**	**3,274,560**	**157,652**	**5%**

Based on the 2008 regional socioeconomic statistics, the overall trip end rates were calculated and compared in **Table 110**. As expected, the trip end rates by category have increased slightly compared to the rate from the standard model trip generation program.

Table 110 Comparison of Regional Trip End Rates, Standard Model and Recalibrated Model

Category	Trip End Rates	
	Standard. Model	Recalibrated. Model
Trip ends per person	3.68	3.87
Trip ends per household	9.33	9.81
Trip ends per employment	7.48	7.86
Trip ends per worker	7.51	7.89
2008 regional total population = 846,397 2008 regional total household = 333,900 2008 regional total employment = 416,851 2008 regional total workers = 415,060		

4.15 Time of Day Trips

4.15.1 Introduction

The procedure to create the time of data trips were modified as part of the recalibration process. This section describes the modifications.

4.15.2 Highway Trip Tables

The scaling factor of 1.90, which was applied to the NHBW and NHBO vehicle trips after the vehicle person trips were converted to vehicle trips, was removed. (See **Section 3.12.2** for the discussion). The application of the scaling factor in the standard model was not documented; however, the factor had made the overall vehicle occupancy rate for the NHBW and NHBO trips below 1.0, which was illogical. The 3+ vehicle occupancy rates remained unchanged.

4.15.3 Transit Trip Tables

The output transit trip tables from mode choice were referenced within transit assignment to the identical transit path-building procedures (by time of day) that were used to generate the paths and impedances for mode choice. This modification was implemented to ensure consistency with the predictive frame work of the mode choice model. The updated transit trip table components are shown in **Table 111**. The changes are listed in *italic* text.

Table 111 Transit Trip Table Components, Recalibrated Model

Trip Purpose	Sub-Mode	Transit Network
HBWAM	Walk to Local	AM
HBWPM		AM
HBWOP		*Off-peak*
HBWAM	Walk to Premium	AM
HBWPM		AM
HBWOP		Off-peak
HBWAM	Park-Ride	AM
HBWPM		AM
HBWOP		Off-peak
HBWAM	Kiss-Ride	AM
HBWPM		AM
HBWOP		Off-peak

Table 111 Transit Trip Table Components, Recalibrated Model (cont')

Trip Purpose	Sub-Mode	Transit Network
HBEM	*All sub-modes*	*AM*
HBHS		*AM*
HBUNM		*AM*
HBTVI		*AM*
HBSHOP		Off-peak
HBO		Off-peak
NHBW		Off-peak
NHBO		Off-peak

4.16 Highway Assignment

Most of the changes in the highway assignment process were discussed previously since these changes were implemented to improve the model's ability to properly load trips and estimate congested speeds. **Section 4.10** provides a detailed description of these changes. During the final model calibration, additional refinements were considered, such as the treatment of the existing dummy penalty links used by MRCOG staff to assist the previous model calibration. After some discussion with MRCOG staff regarding the assignment results, a decision was made to retain these penalty links (categories 21 and 22) in the highway assignment scripts.

4.17 Transit Assignment

The transit assignment procedures in the PT routine were modified to be consistent with the methods used to create transit paths for mode choice. Beyond the referencing adjustments of the transit trip tables discussed above, it was also necessary to modify the transit assignment parameters. Note that the mode choice model is structured to predict modal shares using either the AM skims or off-peak skims for each the trip purposes. The setup in the PT assignment scripts must be consistent with the path-building skims developed for the mode choice model. This lack of consistency in the original standard model resulted in transit trips predicted by the mode choice model that could not be assigned in the transit assignment process.

To implement the necessary modifications, the PT assignment script was modified to be consistent with the mode choice model methodology in terms of path generation and time of day assumptions for each trip purpose. As a result, the previous single assignment of all off-peak transit trips was replaced. In addition, the PT assignment parameters for both the AM and off-peak trips were modified to ensure that the transit paths generated for the mode choice model were also generated for assigning transit trips. See the discussion in **Section 4.8** for the changes related to the PT assignment routines.

5 VALIDATION

Validation analysis was performed by comparing observed usage data for both highway and transit facilities against the available count and ridership data. These comparisons were then reviewed against standard industry guidelines and other general standards used in calibrating and validating models. This section of the report discusses the validation for both the highway assignment and the transit assignment. Comparisons of results between the standard model and the recalibrated model are shown in **Appendix B**.

5.1 Highway Assignment

As an initial review of the assignment process, the aggregate vehicle miles of travel (VMT) on a per capita and household basis were compared with national statistics. The typical VMT per person ranges from 24 to 32 VMT and the VMT per household ranges from 60 to 75 VMT , with smaller regions similar to Albuquerque at the lower end of each range. For the recalibrated model, the estimated VMT per person was approximately 25 and the VMT per household was approximately 62. Both figures were within the expected ranges and indicate that the recalibrated model is providing adequate estimates of travel on an aggregate basis for the population and households of the region.

The estimated demand on the highway network, both in terms of volumes and VMT, was also compared to the observed traffic statistics. In this analysis the estimated demand for only those links with observed traffic counts compared. The adopted validation criteria suggested that the daily VMT should be within 1% of the observed values on a regional basis. Ideally, the aggregate daily VMT for each aggregate facility type category should be within 5% of the observed values. The same criterion was suggested for the aggregate VMT by area type. On a more disaggregate basis the VMT for individual combinations of facility type and area type should generally be within the range of 15 to 20 %. This range for the more disaggregate categories recognizes that some of these facility type/area type combinations will have very few links and/or a limited number of links with count data. The same set of validation criteria was adopted for evaluating the loaded volumes.

Table 112 lists the same information of comparing the observed daily VMT against the estimated presented in **Table 75**. It is repeated here for the convenience of the reader. The daily VMT was over-estimated by 1% at the regional level and under-estimated by 2% for the urban category but 25% over-estimated for the rural category. For the facility type / area type combinations, all of the urban facility types were within 13% of the observed values and most facility types were within 5 % of the observed values.

Table 112 Validation Check of Daily VMT

Category.	Category Name	Coverage %	# Links	Distance (miles)	Daily VMT. OBS.*	Daily VMT. EST.	% Error
7	Urban freeway	52%	181	85	3,010,319	3,273,739	9%
8	Urban entrance Ramps	80%	103	18	125,430	133,807	7%
9	Urban exit Ramps	78%	111	19	118,143	131,323	11%
1	High speed Ramps	36%	14	2	55,973	54,513	-3%
6	Urban freeway frontage roads	92%	110	18	127,507	123,786	-3%
10	Limited access principal arterials	92%	583	190	2,211,427	2,218,064	0%
2	Urban principal arterials	97%	1,671	392	3,690,629	3,224,880	-13%
3	Urban minor arterials	93%	1,653	370	2,212,282	2,172,217	-2%
4	Urban collectors	85%	2,227	550	1,245,965	1,254,487	1%
5	Urban Locals	50%	76	16	24,932	22,094	-11%
	Urban Sub-Total	**86%**	**6,729**	**1,660**	**12,822,606**	**12,608,908**	**-2%**
17	Rural freeway	56%	60	82	966,062	1,182,972	22%
18	Rural entrance ramps	79%	26	6	11,191	10,581	-5%
19	Rural exit ramps	77%	28	7	12,701	11,556	-9%
14	Rural major collectors	72%	290	235	356,979	427,970	20%
11	Rural minor collectors	92%	120	130	111,569	170,766	53%
15	Rural locals	48%	129	53	35,316	58,103	65%
	Rural Sub-Total	**67%**	**653**	**513**	**1,493,818**	**1,861,947**	**25%**
	Grand Total	**81%**	**7,382**	**2,174**	**14,316,424**	**14,470,855**	**1%**

* Observed 2008 average weekday count data received in December 2009

For the facilities in the rural areas, the estimated VMT was significantly higher than the observed data. Upon further review, it appeared that there were significant problems with some of the counts, particularly those counts at selected external centroids that might be contributing problems to the rural freeway category.

Similar to the VMT summary above, **Table 113** repeats the same information of comparing the observed daily counts against the estimated volumes presented in **Table 76**. With respect to the volume comparisons, the daily volume was under-estimated by 5% at the regional level and under-estimated by 6% for the urban category but 30% over-estimated for the rural category. For specific facility type/area type categories category level, all of the urban categories, except principal arterials are approximately within 10 percent (+/-) of the observed values. Again the rural facility types were generally over-estimated but do represent a relatively minor share of overall system volumes.

Table 113 Validation Check of Daily Volumes

Category	Facility Type	Coverage %	# Links	Distance (miles)	Daily Volume OBS.*	Daily Volume EST.	Error, %	% RMSE
7	Urban freeway	52%	181	85	7,792,347	8,224,673	6%	19%
8	Urban entrance Ramps	80%	103	18	782,182	836,233	7%	43%
9	Urban exit Ramps	78%	111	19	755,886	841,783	11%	50%
1	High speed Ramps	36%	14	2	402,128	376,976	-6%	17%
6	Urban freeway frontage roads	92%	110	18	868,278	919,485	6%	49%
10	Limited access principal arterials	92%	583	190	7,859,051	7,842,287	0%	31%
2	Urban principal arterials	97%	1,671	392	18,232,062	15,392,203	-16%	43%
3	Urban minor arterials	93%	1,653	370	10,477,742	9,805,734	-6%	47%
4	Urban collectors	85%	2,227	550	5,596,215	5,264,544	-6%	79%
5	Urban Locals	50%	76	16	128,544	129,497	1%	94%
	Urban Sub-Total	**86%**	**6,729**	**1,660**	**52,894,435**	**49,633,413**	**-6%**	**46%**
17	Rural freeway	56%	60	82	778,002	998,134	28%	37%
18	Rural entrance ramps	79%	26	6	48,842	51,992	6%	94%
19	Rural exit ramps	77%	28	7	58,442	52,361	-10%	101%
14	Rural major collectors	72%	290	235	531,228	684,666	29%	94%
11	Rural minor collectors	92%	120	130	138,608	199,080	44%	93%
15	Rural locals	48%	129	53	82,364	142,732	73%	166%
	Rural Sub-Total	**67%**	**653**	**513**	**1,637,486**	**2,128,966**	**30%**	**82%**
	Grand Total	**81%**	**7,382**	**2,174**	**54,531,921**	**51,762,379**	**-5%**	**47%**

* Observed 2008 average weekday count data received in December 2009

The inability to achieve the individual criteria for specific facility type/area type combinations was reviewed in detail and several contributing factors were identified. A brief discussion of these factors is provided as follows:

- Traffic count data was not provided at the links where the traffic count data were collected. The issue was briefly discussed in **Section 4.10.5**. Also, the traffic count data was not "smoothed", which should have been done for the modeling exercise. The issue was discussed previously in **Section 4.10.5**.
- The daily traffic volume at the external stations provided in the INEX data file was inconsistent with the observed traffic count data in several locations, as summarized in **Table 114**. The observed traffic count data was updated several times by MRCOG staff due to various issues that were identified during recalibration effort. Since the estimated volumes at the external stations were provided as one-way volumes, one-way counts were computed by averaging the directional counts for comparison purposes.

Table 114 Comparison of External Volume Data and Daily Traffic Count

Region	Facility	Ext. Station	One-way Volume at External Station	Average One-way Traffic Count Data	Difference
Rural – East	I-40	11	9,053	7,277	1,776
	Non-Freeway	1	1,678	488	1,190
	Non-Freeway	9	1,236	9,348	-8,112
	Non-Freeway	10	1,642	2,151	-509
	Non-Freeway	13	4,615	1,932	2,683
Rural – North	I-25	2	27,122	18,133	8,989
	Non-Freeway	12	1,943	1,540	403
Rural – South	I-25	5	6,720	4,663	2,058
	Non-Freeway	6	1,174	272	902
	Non-Freeway	7	3,490	1,473	2,017
	Non-Freeway	8	952	416	536
Rural – West	I-40	4	11,092	11,216	-124
Sub-total	**Freeway**		**53,987**	**41,288**	**12,699**
	Non-Freeway		**16,730**	**17,619**	**-899**
	All		**70,717**	**58,907**	**11,810**
Urban	Non-Freeway	3	7,519	3,830	3,689
Grand Total			**78,236**	**62,737**	**15,499**

- The total estimated volume for the rural freeway category was about 12,700 (about 31%) higher than the daily traffic count data. This would account for much of over-estimates on rural freeways and to some extent the other rural categories and the urban freeway.
- With the exception of the rural category links coded in the area south of the network, there seemed to be insufficient highway links in the other three areas. The lack of highway links could cause overestimation.
- The rural category links coded to the south of the highway network were in the mix with urban category links. These rural links typically were coded with higher posted speeds which in turn produced higher free-flow speeds that made the rural links more attractive than the competing parallel urban links. This contributed to the over-estimation with the rural non-freeway links and to some extent the under-estimation with the urban non-freeway links.

Table 115 summarizes the observed and estimated daily volume by volume groups. The last column in the table is the industry acceptable % RMSE. The estimated daily traffic volumes for all volume groups above 20,000 were within the acceptable % RMSE. The volume groups from 5,001 to 19,999, while close to the targets, did not achieve the criteria. It should be noted that these were primarily low-volume roadways where estimated traffic volumes were heavily influenced by the location of centroid connectors and accuracy of the observed counts.

The previous discussion related to the validity of count data on the minor roadways was relevant to the difficulty in achieving the criteria for low volume links.

Table 115 Comparison of Observed and Estimated Daily Volume by Volume Group

Volume Group	Coverage	# Links	Observed*	Estimates	% RMSE	Acceptable % RMSE
Less than 5,000	48.9%	3887	8,614,999	9,277,641	85%	100%
5,001 – 9,999	13.6%	1561	11,432,186	9,926,766	47%	45%
10,000 – 14,999	10.4%	1106	13,683,283	12,362,753	38%	35%
15,000 – 19,999	3.7%	429	7,357,324	6,661,966	33%	30%
20,000 – 29,999	2.1%	245	5,629,245	5,658,356	27%	27%
30,000 – 49,999	1.2%	81	2,998,465	3,201,660	20%	25%
50,000 – 59,999	0.2%	19	1,039,938	1,073,032	11%	20%
Greater than 60,000	0.6%	52	3,776,315	3,599,971	14%	19%
Grand Total	**80.8%**	**7380**	**54,531,755**	**51,762,145**	**47%**	**45%**

* Daily traffic count data received in December 2009
# Source: New Calibration and Validation Standards for Travel Demand Modeling, TRB 2009 Annual Meeting CD-ROM

The comparison of the observed and estimated daily volumes at screen-lines is presented in **Table 116**. The last column lists the acceptable percent error, which is based on magnitude of the total screen-line traffic. A total of 29 was established by MRCOG staff. Note that Screen-line 99 provides a standard aggregation check which groups all the remaining links with counts that were not assigned to any of the 29 MRCOG staff screen-lines.

Table 116 Comparison of Observed and Estimated Daily Volumes at Screen-Line

	Screen-Line Name	# Links	Observed*	Estimates	% Error	Acceptable % Error #
1	Rio Grande - Val. Co.	8	51,020	58,082	14%	±15%
2	Rio Grande - Bern. Co.	16	423,340	489,843	16%	±10%
3	Rio Grande - Sand. Co.	2	42,784	45,039	5%	±15%
10	N. of I-40 - Abq. W. of B	21	193,211	183,228	-5%	±10%
5	N. of I-40 - Abq. E. of B	25	323,721	325,237	0%	±10%
6	N. of I-40 - E. Mnts.	16	33,288	50,457	52%	±20%
7	S. of I-40 - Abq. W. of B	19	202,505	197,810	-2%	±10%
8	S. of I-40 - Abq. E. of B	27	351,484	324,122	-8%	±10%
9	S. of I-40 - E. Mnts.	14	35,210	50,035	42%	±15%
10	E. of I-25 - Val. Co.	10	48,962	61,600	26%	±15%
11	E. of I-25 - S. of Big-I	21	192,257	174,994	-9%	±10%
12	E. of I-25 - N. of Big-I	23	298,836	311,912	4%	±10%
13	E. of I-25 - Sand. Co.	4	9,874	16,600	68%	±20%
14	W. of I-25 - Val. Co.	4	21,484	21,901	2%	±20%
15	W. of I-25 - S. of Big-I	19	177,075	171,904	-3%	±10%
16	W. of I-25 - N. of Big-I	21	262,619	262,925	0%	±10%
17	W. of I-25 - Sand. Co.	4	46,278	49,169	6%	±15%
18	Sandoval Co. - W. of River	10	110,624	142,118	28%	±10%
19	Sandoval Co. - E. of River	4	77,213	78,523	2%	±10%
20	Valencia Co. - W. of River	4	34,985	51,511	47%	±5%
21	Valencia Co. - E. of River	2	23,388	34,906	49%	±20%
22	Tijeras Canyon	4	59,190	82,646	40%	±15%
23	CBD	30	225,035	149,522	-34%	±10%
24	Big-I I-25 S. of Interchange	2	154,013	153,375	0%	±10%
25	Big-I I-25 N. of Interchange	2	174,007	154,418	-11%	±10%
26	Big-I I-40 W of Interchange	2	139,030	159,391	15%	±10%
27	Big-I I-40 E. of Interchange	2	161,942	171,477	6%	±10%
28	NA	8	111,645	110,093	-1%	±10%
99	Other Counts	7,058 0	50,546,901 0	47,679,543 0	-6%	±5%
	Screen Line Subtotal	**324**	**3,985,020**	**4,082,836**	**2%**	
	Grand Total	**7,382**	**54,531,921**	**51,762,379**	**-5%**	

* Daily traffic count data received in December 2009
\# Source: New Calibration and Validation Standards for Travel Demand Modeling, TRB 2009 Annual Meeting CD-ROM
NA not available. Not provided by MRCOG staff

A total of 16 of these screen-lines have percent error values within the acceptable error. Analysis was conducted to examine those screen-lines that did not the meet the criteria. The primary focus of the evaluation was on those screen-lines that had observed daily volumes greater than 70,000. The analysis is stated below.

- Screen-line #2: This screenline was located at the river crossing in Bernalillo County. All the links with this screenline were overestimated with traffic volumes. Too many trips were projected to cross the river. Although the total number of trip ends increased by only 5% as a result of the enhanced trip generation, about 59% of the increased trip ends were from the HBW trip purpose. Among the HBW trip purposes, increased trips were primarily with the HBW 2 and 3+ auto-ownership trip purposes. Trip lengths of these two trip purposes were longer compared to the HBW 1 auto-ownership shown in previously in **Table 97**. This longer trip length, coupled with the predominately residential land use west of the river resulted in many additional work trips destined to the employment centers located east of the river. Note that the gravity model forced the HBW productions that could not be matched to attractions west of the river to seek corresponding attractions east of the river thereby increasing screen-line traffic.
- Screen-line #18: This screen-line intercepted the north-south movement in the Rio Rancho area. The over-estimation of this screen-line was probably closely related with the overestimation of Screen-line #2. Trips from north of the Rio Rancho had to use one of these links in order to get to the river crossing points.
- Screen-line #23: This screen-line was the cordon line for the CBD area. It was believed that much of the underestimated was related to the land use type in the CBD area. Total employment inside the CBD was about 17,400 and more than 50 percent was service employment. About 15 percent of the trips were HBW trips, while 35 percent were HBO and HB Shop trips, and the remaining 50% were NHB trips. The average vehicle occupancy rates with non-work trips were higher; therefore, the number of vehicles was lower. The accuracy of the attraction rates and model's allocation of home-based nonwork trips to the CBD might be contributing factors to the underestimation.
- Screen-line # 22: Screen-line #22 separated the canyon area from the rest of the model area. The inconsistent traffic data provided at the external stations, particularly on I-40, was believed to have contributed to the overestimation (see **Table 114**). In addition, the land use type in the canyon area was predominantly residential. Similar to the situation with Screen-line #2, too many trips were projected between the canyon area and the rest of the region. This seemed to be an issue with the original standard model because dummy links with large travel time penalties were coded in the highway network to discourage trips between these two areas. Although the coded travel time of the dummy links were retained in the final model, the trip distribution process may need further refinements, along with more recent survey data to confirm patterns between these regions by trip purpose.

5.2 Transit Assignment

The estimated transit mode of access between walk and drive mode were 90% and 10%. The observed mode of access from the 2004 transit on-board survey was 94% and 6%, respectively. Although the estimated percentage for walk mode seemed to be lower than the observed, the estimates were considered reasonable. The 2004 survey was conducted before the services of the Rail Runner and Rapid Ride which included new park-ride lots. It is reasonable to assume that the percentage of auto access trips has increased in response to these new services.

The total estimated daily transit ridership was 40,597. The total estimated transit trips were 21,584. The transfer rate was computed to be 1.88. The average transfer rate from the 2004 survey was 1.74. As mentioned above, the survey was conducted before the Rail Runner and Rapid Ride services were opened. The Rail Runner is a north-south service operating on fixed guideway. The Rapid Ride is east-west service coded with two routes. Both the Rail Runner and Rapid Bus were supported by local feeder bus lines. Therefore, it is reasonable to have the estimated transfer rate higher than the 2004 observed.

The estimated transit ridership is summarized in **Table 117** and compared to the observed ridership count. Listed in the last two columns in the table are the acceptable and preferable errors by the industry standard.

Table 117 Comparison of Observed and Estimated Transit Daily Ridership

Route #	Name	OBS*	EST.	Diff.	% Error	Service	Mode	Acceptable Error, %	Preference Error, %
1	Juan Tabo	587	943	356	61%	Local All Day	Local	150%	100%
2	Eubank	447	867	420	94%	Local All Day	Local	150%	100%
3	Uptown/Cottonwood	484	468	-16	-3%	Local All Day	Local	150%	100%
5	Montgomery/Carlisle	2,272	1,789	-483	-21%	Local All Day	Local	65%	35%
6	Indian School	59	397	338	574%	Commuter	Local	150%	100%
7	Candelaria	33	201	168	513%	Commuter	Local	150%	100%
8	Menaul	2,219	1,772	-447	-20%	Local All Day	Local	65%	35%
10	N. 4th St.	1,362	894	-468	-34%	Local All Day	Local	100%	65%
11	Lomas	2,334	2,622	288	12%	Local All Day	Local	65%	35%
12	Constitution	46	79	34	74%	Commuter	Local	150%	100%
13	Comanche	55	159	104	191%	Commuter	Local	150%	100%
31	Wyoming	574	1,230	656	114%	Local All Day	Local	150%	100%
34	San Pedro	39	106	68	174%	Commuter	Local	150%	100%
36	Rio Grande/12th St.	103	653	550	533%	Local All Day	Local	150%	100%
40	D-Ride Downtown Shuttle**	602	2,841	2,240	372%	"Free" Ride Circulator	Local	150%	100%
50	Airport/Downtown	780	544	-236	-30%	Local All Day	Local	150%	100%

Table 117 Comparison of Observed and Estimated Transit Daily Ridership (cont')

Route #	Name	OBS*	EST.	Diff.	% Error	Service	Mode	Acceptable Error, %	Preferable error, %
51	Atrisco/Rio Bravo	182	229	48	26%	Local All Day	Local	150%	100%
53	Isleta	733	442	-291	-40%	Local All Day	Local	150%	100%
54	Bridge/Westgate	620	1,362	743	120%	Local All Day	Local	150%	100%
66	Central	7,746	3,467	-4,279	-55%	Local All Day	Local	35%	25%
97	Zuni	290	269	-21	-7%	Local All Day	Local	150%	100%
92	Taylor Ranch Express	51	117	66	130%	Commuter	Local	150%	100%
93	Academy	78	139	60	77%	Commuter	Local	150%	100%
94	Unser Express	52	222	170	326%	Commuter	Local	150%	100%
96	Crosstown Commuter	273	81	-191	-70%	Commuter	Local	150%	100%
98	Wyoming	101	128	26	26%	Commuter	Local	150%	100%
140	San Mateo Line	2,622	1,957	-666	-25%	Local All Day	Local	65%	35%
141	San Mateo Line	801	742	-58	-7%	Local All Day	Local	150%	100%
151	Rio Rancho/RR Conn.	275	589	314	114%	Local All Day	Local	150%	100%
155	Coors Blvd. Line	904	427	-476	-53%	Local All Day	Local	150%	100%
157	Montano Uptown	896	1,185	289	32%	Local All Day	Local	150%	100%
162	Ventana Ranch/Montano Plaza	47	253	206	440%	Commuter	Local	150%	100%
222	Rio Bravo/Sunport/Kirtland	207	99	-108	-52%	Local All Day	Local	150%	100%
317	Downtown/KAFB Limited	128	50	-78	-61%	Commuter	Local	150%	100%
1618	The BUG	869	465	-403	-46%	Local All Day	Local	150%	100%
Route1	Route 1	n/a	179	n/a	n/a	n/a	Local	n/a	n/a
	Local Subtotal	**28,869**	**27,970**	**-899**	**-3%**			**9%**	**3%**
766	Rapid Ride - Red Line	6,535	7,805	1,271	19%	Rapid Ride	Premium	35%	25%
790	Rapid Ride - Blue Line	1,853	2,960	1,107	60%	Rapid Ride	Premium	100%	65%
Rail Runner	Rail Runner	2,017	1,862	-155	-8%	Commuter Rail	Premium	65%	35%
	Premium Subtotal	**10,404**	**12,627**	**2,222**	**21%**			**9%**	**3%**
	Grand Total	**39,273**	**40,597**	**1,323**	**3%**			**9%**	**3%**

(green) % error <= preference % error
(yellow) % error > preference % error & <= acceptable % error
(orange) % error > acceptable % error
* Daily ridership observed in October, 2008
** The route was coded the same as the other local routes

The estimated daily ridership at aggregate level was 3% over-estimated, which was well below the acceptable error and at the preferable error. The local buses daily ridership was under-estimated by 3% but over-estimated by 21% for the premium service. Note that the Rapid Ride Red Line over-estimation was partially compensated by the underestimation of the Route 66 bus which traversed the same route alignment. Note also that the Rail Runner observed ridership value included only those "intra-city" within Albuquerque, but not the rail trips to external regions north of Albuquerque.

Although error for some of the routes was high, the focus should be on only those routes where the error was above the proposed criteria and the route had either high observed ridership or the estimated ridership was significantly over-estimated. Analysis was conducted to identify the source of any significant variation and the findings of the analysis are stated as follows:

- Route 40: the D Ride was a downtown shuttle route that was well connected with other transit routes and serves the Alvarado Transportation Center. This route has headway of 7 minutes in both the AM and off-peak time. This headway, combined with headways of the other connected routes, provides a minimal estimated wait time and transfer time. This coupled with the fact that the estimated run time of this route was 4 minutes under the actual schedule time of 14 minutes has made Route 40 very attractive. (See the discussion of estimated run time verses actual schedule time in **Section 4.11.3**).
- Route 66: Route 66 Central was a heavily utilized east-west route that crosses the CBD and the river. The route operates on Central Avenue along with the Rapid Ride Red Line (Route 766). While the underestimation of Route 66 was offset partially by the over-estimation of the Rapid Ride Red line, other competing routes in the corridor and standard model access coding procedures were also contributing factors to the underestimation of Route 66. Together, the combined estimated ridership of Routes 66 and 766 were about 3,000 (or 21 percent) fewer than the observed was a major contributing factor of the under-estimation of Route 66.

Transit ridership for routes that served the defined corridors was also aggregated and listed in **Table 118**. The largest line group in terms of ridership is the "Downtown – River" group which has lines serving the downtown and traversing the river. This line group was underestimated by approximately 21 percent. While most of the line groups had relatively low ridership, the variation between the observed and estimated ridership was generally within expectations. As discussed above, the routes that served across downtown and cross the river are Route 66 and Route 766 and the transit ridership in this corridor was under-estimated.

Table 118 Comparison of Daily Transit Ridership by Line Group

Line Group Name	Daily Ridership by Line Group			
	Obs.	Est.	Diff	% Error
East Side	5,554	6,314	759	14%
Downtown - East	7,385	7,427	42	1%
Downtown - North	3,482	3,409	-73	-2%
Downtown - Southeast	1,777	1,059	-717	-40%
Downtown - Southwest	1,535	2,034	499	33%
Downtown & River	14,280	11,272	-3,008	-21%
Downtown - NW Transit Center	2,231	3,889	1,658	74%
Kirtland - NW transit center	1,270	1,394	124	10%
Other	1,760	3,799	2,040	116%
Grand Total	**39,273**	**40,597**	**1,323**	**3%**

Appendix A
Model Validation Criteria

MEMORANDUM

To: Nathan Masek - MRCOG

From: David Schellinger

CC: Mike Corlett – Planning Technologies

Date: 8/18/2009

Subject: Validation Criteria for Standard Regional Model

The following list of criteria by model component is proposed for the validation of the standard regional model. While all of these criteria may not be achieved in the final model validation task, the criteria provide a reasonable set of targets for this project study.

1. Transportation Networks

a. Highway Network Verification

- Summarize route miles or lane miles by facility type, capacity, or speed.
- Summarize average speed or per-lane-mile capacity by facility type and area type
- Connectivity / Routing Logic Analysis
  - Check for dangling links (CUBE feature)
  - Check for small node gaps
  - Skim matrices by distance and free flow travel time
    - Disconnected TAZ – if path cannot be build
    - Path Symmetry Analysis – ratio between path impedances by direction for zonal pairs should be approximately 1.0

b. Transit Network Verification

- Check transit operation schedule – minimum and maximum headways
- Check auto and walk access time to stops and stations. Values can be posted on GIS map or network as objects (e.g. solid circle) and the size of the objects varies by the values.
- Summarize relationship between transit speed and highway speed by facility type and area type. Bus speed should always be less than or equal to auto speed on Interstate freeway facility. Bus speed should be less than auto speed on other facility types.
- Compare the observed and estimated bus run time by line. The estimates should be within 10% difference of the observed.

MEMORANDUM

2. Trip Generation

- Summarize trip production rates by auto ownership and household size by trip purpose. Compare to previous report documentation and other statistics.
- Summarize trip attraction rates by auto ownership and household size by trip purpose. Compare to previous report documentation and other statistics.

3. Trip Distribution

- Compare l**ogsum** between observed and estimated by purpose and auto ownership. Observed logsum values for work trips are computed based on survey results or Census data. Observed logsum values reported in the Albuquerque Travel Demand Model Document (dated 2005) for non-work purposes will be used.
- Compute **coincidence ratio** between the observed and estimated log sum values by purpose and auto ownership. The ratio lies between zero and one, where one indicates identical distribution and zero indicates two disjoint distributions. A ratio that ranges from 0.95 to 1.0 is considered desirable.
- Compare observed and estimated **trip time** distribution by purpose by auto ownership. Observed trip time distribution for work trips will be developed using Census data. Observed trip time values for non-work trip purposes reported in either the 2001 and 2005 travel demand model documentation will be used. These values will be assessed for reasonableness since the model is calibrated against the logsum term, not distance.
- Compare observed and estimated **trip distance** distribution by purpose by auto ownership. Observed trip distance distribution for work trips will be developed using Census data. Observed trip time values for non-work trip purposes reported in either the 2001 and 2005 travel demand model documentation will be used. These values will be assessed for reasonableness since the model is calibrated against the logsum term, not distance.
- Summarize average travel time and distance for non-work trips and compare against the estimated travel time and distance of work trips. The average trip time and distance for the non-work trips should be less compare to work trips.
- Compare observed and estimated person flows at screen lines. The difference should be within 10-15 percent depending on the aggregate screenline volumes.
- Summarize and compare the observed and estimated flow patterns using the 46-district system for work purposed trips only. Observed flow pattern will be summarized using Census data. The difference between the major origins and destinations should be within 10-15 percent.

4. Mode Choice

- Summarize the estimated mode percentage shares at the regional level. Compare the estimates against observed data. Observed percentage shares will be derived using data from Census and the survey by trip purpose where feasible. The estimates should be within 5 percent of the observed values.
- Summarize the share of the estimated mode of access for bus and commuter rail modes at system level. Compare the estimates against observed values.

5. Highway Assignment

- Daily VMT Comparison - Aggregate VMT should be within 1% of observed values. Aggregate VMT by each facility type should be within 5% of observed values. Aggregate VMT by each area type should be within 5% of observed values. VMT by combination of individual facility types and area types should be within 10% of observed values.

- Daily Volume Comparison - Aggregate Volumes should be within 1% of observed values. Aggregate Volumes by each facility type should be within 5% of observed values. Aggregate Volumes by each area type should be within 5% of observed values. Volumes by combination of individual facility types and area types should be within 10% of observed values.

- RMSE Analysis by Volume Group – System-Level RMSE should not exceed 35 percent. RMSE should meet FHWA critieria by volume level.

- Screenline Comparisons – Aggregate volumes across screenline should be within FHWA criteria.

- Time of Day Analysis – aggregate values for VMT by time of day should be within 10 percent of the observed values. This is applicable to locations where accurate count data by time of day is available for comparison.

- Summarize the estimated average travel time for selected corridors during AM peak and PM peak. Compare the estimated travel time against observed travel time. The difference should be within 10%.

MEMORANDUM

6. Transit Assignment

- At a system level, overall ridership should be within 1 percent of the total observed and the RMSE should be 50 percent or less. Compare observed and estimated total boardings by line or line group. As an aggregate measure, it is anticipated that 80 percent of the lines or line groups should be within 20% of the observed values. For individual line groups by passenger trip level, the following variations are acceptable:
  - <1000 passengers per day - <100 percent error.
  - 1000-2000 passengers per day - <65 percent error
  - 2000-5000 passengers per day - <35 percent error
  - 5000-10000 passengers per day - <25 percent error
  - 10000-20000 passengers per day -< 20 percent error
  - >20000 passengers per day -< 15 percent error

- Compute the average number of transfers per trip at the regional level and compared against observed value from the transit on-board survey. The estimated value should be within 10 percent of the observed value.

Appendix B

Comparisons of Standard Model and Recalibrated Model

Appendix B - 1
Comparison of Observed and Estimated AM Peak Speed, Standard Model and Recalibrated Model

Category	Facility Type	AM Peak Speed (mph)				
			Estimates.		Error %	
		Observed	STD. Model	REC. Model	STD. Model	REC. Model
7	Urban freeway	61.3	63.5	57.7	4%	-6%
	- Peak Direction	58.8	62.5	52.9	6%	-10%
	- Off-Peak Direction	65.6	68.4	67.8	4%	3%
10	Limited Access Principal Arterials	37.1	52.6	37.9	42%	2%
2	Urban Principal Arterials	26.4	34.9	29.9	32%	13%
3	Urban minor arterials	29.3	33.7	26.3	15%	-10%
4	Urban collectors	21.6	33.1	28.8	53%	33%
17	Rural freeway	77.7	70.0	74.2	-10%	-5%

Better

Worse

Appendix B - 2
Comparison of Observed and Estimated PM Peak Speed, Standard Model and Recalibrated Model

Category	Facility Type	AM Peak Speed (mph)				
			Estimates.		Error %	
		Observed	STD. Model	REC. Model	STD. Model	REC. Model
7	Urban freeway	58.4	61.2	56.9	5%	-3%
	- Peak Direction	57.8	60.6	55.1	5%	-5%
	- Off-Peak Direction	60.9	64.1	59.5	5%	-2%
10	Limited Access Principal Arterials	36.1	49.5	38.1	37%	6%
2	Urban Principal Arterials	23.8	33.2	29.8	40%	25%
3	Urban minor arterials	26.3	32.0	27.8	21%	6%
17	Rural freeway	70.9	70.7	74.3	0%	5%

Better

Worse

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model

GP#	Gp name	From	To	Dir	Cover-age,%	AM Travel Time (min)				
							EST.		EST. - OBS.	
						OBS.	STD. Model	REC. Model	STD. Model	REC. Model
1	I-25	Tribal	Rio Bravo	NB	100	11.39	11.89	15.20	0.49	3.81
		Rio Bravo	I-40	NB	100	6.13	6.29	7.85	0.16	1.72
		I-40	315 HWY	NB	100	18.86	19.03	18.93	0.17	0.07
				NB Total		**36.38**	**37.21**	**41.98**	**0.83**	**5.59**
		Rio Bravo	Tribal	SB	100	4.36	4.37	4.38	0.01	0.01
		I-40	Rio Bravo	SB	100	5.72	5.10	5.11	-0.62	-0.61
		315 Hwy	I-40	SB	100	15.86	14.23	14.65	-1.62	-1.21
				SB Total		**25.94**	**23.71**	**24.13**	**-2.24**	**-1.81**
2	I-40	I-25	Unser	WB	100	2.29	2.20	2.21	-0.09	-0.08
		Tramway	I-25	WB	100	9.05	8.24	9.52	-0.81	0.47
				WB Total		**11.34**	**10.44**	**11.73**	**-0.90**	**0.39**
		I-25	Tramway	EB	100	1.18	11.08	11.08	9.90	9.90
		Unser	I-25	EB	100	6.25	5.14	6.86	-1.12	0.61
				EB Total		**7.43**	**16.21**	**17.94**	**8.78**	**10.51**
3	N Valley -CBD	Coors	2nd	NB	100	12.34	9.26	9.98	-3.08	-2.36
		Osuna	Lead	NB	100	12.42	6.84	8.98	-5.58	-3.44
				NB Total		**24.76**	**16.10**	**18.96**	**-8.66**	**-5.80**
		2nd	Coors	SB	100	10.50	10.06	14.59	-0.44	4.09
		Lead	Osuna	SB	100	9.78	7.13	8.18	-2.65	-1.60
				SB Total		**20.28**	**17.19**	**22.77**	**-3.09**	**2.49**
4s	Central Ave, E of River	Louisiana	Eubank	EB	100	2.15	1.46	1.72	-0.69	-0.43
		New York	Louisiana	EB	100	12.37	9.20	11.21	-3.17	-1.17
				EB Total		**14.53**	**10.66**	**12.93**	**-3.86**	**-1.60**
		Eubank	Louisiana	WB	100	4.37	3.66	3.83	-0.71	-0.53
		Louisiana	New York	WB	100	13.77	10.01	11.74	-3.77	-2.03
				WB Total		**18.14**	**13.67**	**15.57**	**-4.48**	**-2.57**

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	AM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
5	Montano Rd - Montgomery Blvd	Unser	Tramway	EB	100	21.37	18.53	29.68	-2.84	8.31
		Tramway	Unser	WB	100	15.75	9.83	11.30	-5.92	-4.45
6	Central Ave, W of River	Sunset	98th	WB	100	8.16	4.72	6.05	-3.45	-2.12
		98th	Sunset	EB	100	8.26	5.64	7.08	-2.62	-1.18
7	Coal Ave/Lead Ave	2nd	Juan Tabo	EB	100	8.45	5.50	6.54	-2.96	-1.91
		Juan Tabo	2nd	WB	100	13.64	11.40	13.02	-2.24	-0.62
8	Eubank Ave	Santa Monica	Central	SB	100	11.04	8.64	9.68	-2.39	-1.36
		Central	Santa Monica	NB	100	9.96	6.34	7.66	-3.62	-2.30
9	Bridge Blvd	Louisiana	Central	WB	100	22.07	15.50	18.46	-6.57	-3.61
		Central	Louisiana	EB	100	23.67	19.03	23.53	-4.64	-0.14
10	NM 47	NM 6	I-25	NB	99%	14.20	20.68	26.49	6.49	12.29
		I-25	Rio Bravo	NB	52%	3.30	3.00	3.27	-0.31	-0.03
		Rio Bravo	Coal	NB	100%	6.99	5.77	6.53	-1.22	-0.46
				NB Total	**88%**	**24.49**	**29.45**	**36.29**	**4.96**	**11.80**
		NM 6	I-25	SB	17%	2.30	2.26	2.70	-0.04	0.40
		I-25	Rio Bravo	SB	52%	3.05	2.63	3.03	-0.43	-0.02
		Rio Bravo	Coal	SB	43%	2.55	2.06	2.43	-0.49	-0.12
				SB Total	**31%**	**7.90**	**6.95**	**8.16**	**-0.95**	**0.26**
11	NM 6	I-25	NM 47	EB	93%	5.88	4.80	5.77	-1.08	-0.11
		NM 47	I-25	WB	100%	7.42	7.25	11.09	-0.17	3.66
12	Rio Bravo	Coors	Isleta	EB	100%	3.61	2.42	2.82	-1.19	-0.79
		Isleta	I-25	EB	47%	3.27	1.50	1.88	-1.77	-1.39
				EB Total	**71%**	**6.88**	**3.92**	**4.70**	**-2.96**	**-2.18**
		Isleta	Coors	WB	100%	3.36	2.25	2.77	-1.11	-0.60
		I-25	Isleta	WB	47%	2.29	1.32	1.94	-0.96	-0.34
				WB Total	**71%**	**5.65**	**3.58**	**4.71**	**-2.07**	**-0.94**

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	AM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
13	Isleta	Rio Bravo	Bridge	NB	100%	7.14	5.37	5.96	-1.77	-1.18
		Bridge	Rio Bravo	SB	100%	7.57	5.20	5.97	-2.37	-1.59
14	Gibson	I-25	Yale	EB	100%	1.70	1.03	1.41	-0.67	-0.29
		Yale	I-25	WB	100%	1.58	0.95	1.23	-0.63	-0.35
15	Unser	Central	I-40	NB	100%	3.65	1.34	1.86	-2.31	-1.80
		I-40	Montano	NB	13%	0.73	0.58	0.86	-0.16	0.13
				NB Total	**32%**	**4.38**	**1.92**	**2.72**	**-2.47**	**-1.67**
		I-40	Central	SB	100%	3.60	1.30	2.06	-2.30	-1.55
		Montano	I-40	SB	100%	6.27	4.72	5.98	-1.55	-0.29
				SB Total	**100%**	**9.88**	**6.02**	**8.04**	**-3.86**	**-1.84**
16	Coors	I-40	PdN	NB	91%	9.11	6.15	7.80	-2.96	-1.31
		PdN	NM 528	NB	100%	3.91	2.97	3.81	-0.95	-0.10
				NB Total	**94%**	**13.02**	**9.12**	**11.61**	**-3.90**	**-1.41**
		PdN	I-40	SB	100%	8.53	7.55	8.77	-0.98	0.24
		NM 528	PdN	SB	100%	3.97	3.53	4.13	-0.43	0.16
				SB Total	**100%**	**12.50**	**11.09**	**12.91**	**-1.42**	**0.40**
17	Golf Course	Montano	Southern Blvd	NB	100%	13.61	9.27	10.83	-4.34	-2.78
		Southern Blvd	Montano	SB	100%	12.71	10.77	12.09	-1.94	-0.62
18	4th St	Lomas	Montano	NB	40%	3.33	2.03	2.32	-1.30	-1.01
		Montano	Alameda	NB	100%	8.47	5.89	6.83	-2.58	-1.64
				NB Total	**72%**	**11.81**	**7.92**	**9.15**	**-3.88**	**-2.65**
		Montano	Lomas	SB	100%	7.24	5.69	6.40	-1.54	-0.84
		Alameda	Montano	SB	100%	9.06	5.92	6.98	-3.14	-2.08
				SB Total	**100%**	**16.30**	**11.61**	**13.38**	**-4.68**	**-2.92**

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model (cont')

						AM Travel Time (min)				
							EST.		EST. - OBS.	
GP#	Gp name	From	To	Dir	Cover-age,%	OBS.	STD. Model	REC. Model	STD. Model	REC. Model
19	2nd St	Lomas	Menaul	NB	46%	3.06	1.04	1.52	-2.02	-1.54
		Menaul	Osuna	NB	100%	6.42	4.33	5.00	-2.09	-1.42
		Osuna	Alameda	NB	100%	5.30	3.47	4.25	-1.83	-1.04
				NB Total	**89%**	**14.78**	**8.84**	**10.77**	**-5.94**	**-4.00**
		Menaul	Lomas	SB	100%	0.80	0.57	0.76	-0.23	-0.04
		Osuna	Menaul	SB	100%	5.71	4.69	5.05	-1.01	-0.66
		Alameda	Osuna	SB	100%	4.47	4.03	4.36	-0.44	-0.10
				SB Total	**100%**	**10.97**	**9.30**	**10.17**	**-1.68**	**-0.80**
20	Menaul	2nd	San Mateo	EB	15%	0.94	0.77	0.91	-0.17	-0.03
		San Mateo	Tramway	EB	20%	1.93	1.47	1.84	-0.46	-0.09
				EB Total	**18%**	**2.86**	**2.24**	**2.75**	**-0.62**	**-0.11**
		San Mateo	2nd	WB	100%	6.90	4.61	5.80	-2.30	-1.10
		Tramway	San Mateo	WB	100%	10.94	8.50	9.52	-2.43	-1.42
				WB Total	**100%**	**17.84**	**13.11**	**15.32**	**-4.73**	**-2.52**
21	Osuna	2nd	I-25	EB	10%	1.26	0.36	0.58	-0.89	-0.68
		I-25	2nd	WB	100%	5.64	3.56	4.14	-2.08	-1.49
22	San Mateo	Gibson	I-40	NB	66%	4.68	3.11	3.77	-1.57	-0.92
		I-40	Menaul	NB	13%	0.12	0.08	0.14	-0.03	0.02
		Menaul	I-25	NB	66%	5.90	3.55	3.72	-2.35	-2.18
				NB Total	**63%**	**10.70**	**6.75**	**7.62**	**-3.95**	**-3.08**
		I-40	Gibson	SB	100%	7.97	5.05	5.74	-2.92	-2.22
		Menaul	I-40	SB	100%	0.52	0.65	0.66	0.13	0.14
		I-25	Menaul	SB	100%	6.42	5.37	5.75	-1.04	-0.66
				SB Total	**100%**	**14.90**	**11.07**	**12.16**	**-3.83**	**-2.74**

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	AM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
23	Wyoming	Central	I-40	NB	100%	3.65	1.34	1.86	-2.31	-1.80
		I-40	Montgomery	NB	18%	1.61	0.75	0.89	-0.86	-0.71
		Montgomery	PdN	NB	100%	6.73	5.00	5.57	-1.73	-1.16
				NB Total	**68%**	**11.99**	**7.09**	**8.32**	**-4.90**	**-3.67**
		I-40	Central	SB	100%	3.60	1.30	2.06	-2.30	-1.55
		Montgomery	I-40	SB	100%	8.13	4.35	4.94	-3.78	-3.19
		PdN	Montgomery	SB	100%	6.71	5.40	5.70	-1.31	-1.01
				SB Total	**100%**	**18.44**	**11.05**	**12.69**	**-7.39**	**-5.74**
24	Tramway	I-40	Menaul	NB	13%	0.12	0.08	0.14	-0.03	0.02
		Menaul	Montgomery	NB	100%	2.62	1.65	2.50	-0.97	-0.13
		Montgomery	PdN	NB	100%	6.73	5.00	5.57	-1.73	-1.16
				NB Total	**95%**	**9.47**	**6.73**	**8.21**	**-2.74**	**-1.27**
		Menaul	I-40	SB	100%	0.52	0.65	0.66	0.13	0.14
		Montgomery	Menaul	SB	100%	2.40	1.65	2.49	-0.75	0.09
		PdN	Montgomery	SB	100%	6.71	5.40	5.70	-1.31	-1.01
				SB Total	**100%**	**9.62**	**7.70**	**8.84**	**-1.93**	**-0.78**
25	Paseo del Norte	Coors	I-25	EB	100%	7.47	7.44	11.34	-0.03	3.86
		I-25	Wyoming	EB	100%	3.38	1.46	2.18	-1.92	-1.20
		Wyoming	Eubank	EB	100%	1.57	1.03	1.58	-0.53	0.01
		Eubank	Tramway	EB	100%	3.67	2.66	3.93	-1.01	0.26
				EB Total	**100%**	**16.09**	**12.59**	**19.02**	**-3.50**	**2.94**
		I-25	Coors	WB	100%	5.09	4.81	5.18	-0.28	0.09
		Wyoming	I-25	WB	100%	3.68	1.79	2.13	-1.89	-1.55
		Eubank	Wyoming	WB	100%	1.68	1.15	1.62	-0.53	-0.06
		Tramway	Eubank	WB	100%	3.36	2.74	3.98	-0.62	0.62
				WB Total	**100%**	**13.80**	**10.48**	**12.90**	**-3.32**	**-0.90**
26	Eubank	Central	PdN	NB	73%	11.40	7.95	9.40	-3.45	-2.00
		PdN	Central	SB	86%	12.58	10.15	11.23	-2.43	-1.34

Appendix B - 3
Comparison of Observed and Estimated AM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	AM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
27	Alameda	Coors Bypass	2nd	EB	97%	6.71	8.83	14.82	2.12	8.11
		2nd	I-25	EB	10%	1.26	0.36	0.58	-0.89	-0.68
				EB Total	**59%**	**7.97**	**9.20**	**15.40**	**1.23**	**7.44**
		2nd	Coors Bypass	WB	100%	6.05	5.24	5.66	-0.81	-0.38
		I-25	2nd	WB	100%	5.64	3.56	4.14	-2.08	-1.49
				WB Total	**100%**	**11.68**	**8.80**	**9.81**	**-2.88**	**-1.88**
28	NM 528	Coors Bypass	Southern Blvd	NB	100%	3.86	2.49	3.45	-1.37	-0.41
		Southern Blvd	Northern Blvd	NB	100%	4.16	3.19	4.26	-0.97	0.10
		Northern Blvd	US 550	NB	100%	8.01	6.19	8.09	-1.82	0.09
				NB Total	**100%**	**16.03**	**11.87**	**15.80**	**-4.16**	**-0.23**
		Southern Blvd	Coors Bypass	SB	100%	3.32	2.72	3.31	-0.61	-0.01
		Northern Blvd	Southern Blvd	SB	100%	4.08	3.39	4.58	-0.69	0.50
		US 550	Northern Blvd	SB	100%	7.30	6.12	7.98	-1.19	0.67
				SB Total	**100%**	**14.70**	**12.23**	**15.86**	**-2.48**	**1.16**
29	US 550	NM 528	I-25	EB	100%	5.23	7.29	9.33	2.06	4.10
		I-25	NM 528	WB	100%	3.83	4.15	3.70	0.32	-0.14
30	Southern Blvd	Unser	NM 528	EB	100%	5.78	3.83	4.29	-1.94	-1.49
		NM 528	Unser	WB	68%	4.29	2.20	2.75	-2.09	-1.54

Better

Worse

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model

GP#	Gp name	From	To	Dir	Cover-age,%	OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
1	I-25	Tribal	Rio Bravo	NB	100	5.74	6.17	6.19	0.43	0.46
		Rio Bravo	I-40	NB	100	5.90	5.56	6.44	-0.33	0.54
		I-40	315 HWY	NB	100	16.51	15.26	15.80	-1.26	-0.72
				NB Total		**28.15**	**26.98**	**28.43**	**-1.16**	**0.28**
		Rio Bravo	Tribal	SB	100	10.94	12.02	13.79	1.08	2.85
		I-40	Rio Bravo	SB	100	5.92	5.69	6.59	-0.23	0.67
		315 Hwy	I-40	SB	100	20.61	19.77	20.38	-0.84	-0.23
				SB Total		**37.47**	**37.49**	**40.75**	**0.02**	**3.29**
2	I-40	I-25	Unser	WB	100	7.85	6.11	7.43	-1.74	-0.43
		Tramway	I-25	WB	100	8.90	7.94	8.96	-0.96	0.06
				WB Total		**16.75**	**14.05**	**16.39**	**-2.70**	**-0.37**
		I-25	Tramway	EB	100	8.09	7.87	7.97	-0.22	-0.11
		Unser	I-25	EB	100	2.48	2.25	2.26	-0.23	-0.22
				EB Total		**10.57**	**10.11**	**10.23**	**-0.45**	**-0.33**
3	N Valley -CBD	Coors	2nd	NB	100	9.45	9.94	13.79	0.49	4.34
		Osuna	Lead	NB	100	12.62	7.67	9.29	-4.95	-3.33
				NB Total		**22.07**	**17.61**	**23.08**	**-4.46**	**1.01**
		2nd	Coors	SB	100	7.64	7.12	7.37	-0.52	-0.27
		Lead	Osuna	SB	100	6.31	4.73	5.32	-1.59	-0.99
				SB Total		**13.96**	**11.84**	**12.69**	**-2.11**	**-1.26**
4s	Central Ave, E of River	Louisiana	Eubank	EB	100	6.47	3.84	3.84	-2.63	-2.63
		New York	Louisiana	EB	100	14.17	10.19	12.08	-3.98	-2.08
				EB Total		**20.64**	**14.03**	**15.92**	**-6.61**	**-4.71**
		Eubank	Louisiana	WB	100	2.73	1.53	1.73	-1.20	-1.00
		Louisiana	New York	WB	100	11.31	6.60	7.85	-4.71	-3.46
				WB Total		**14.04**	**8.13**	**9.58**	**-5.91**	**-4.46**

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	PM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
5	Montano Rd - Montgomery Blvd	Unser	Tramway	EB	100	24.96	18.02	19.29	-6.94	-5.67
		Tramway	Unser	WB	100	20.56	17.03	21.60	-3.53	1.04
6	Central Ave, W of River	Sunset	98th	WB	100	8.82	5.87	7.37	-2.95	-1.45
		98th	Sunset	EB	100	7.17	4.89	6.01	-2.29	-1.16
7	Coal Ave/Lead Ave	2nd	Juan Tabo	EB	100	19.40	14.04	15.55	-5.36	-3.85
		Juan Tabo	2nd	WB	100	14.63	11.15	13.01	-3.48	-1.62
8	Eubank Ave	Santa Monica	Central	SB	100	15.66	9.56	11.38	-6.10	-4.28
		Central	Santa Monica	NB	100	13.54	7.99	8.76	-5.55	-4.78
9	Bridge Blvd	Louisiana	Central	WB	100	22.45	15.91	19.35	-6.54	-3.10
		Central	Louisiana	EB	100	18.48	13.43	15.18	-5.05	-3.29
10	NM 47	NM 6	I-25	NB	0%	0.00	0.00	0.00		
		I-25	Rio Bravo	NB	0%	0.00	0.00	0.00		
		Rio Bravo	Coal	NB	34%	2.58	2.09	2.54	-0.49	-0.04
				NB Total	**7%**	**2.58**	**2.09**	**2.54**	**-0.49**	**-0.04**
		NM 6	I-25	SB	99%	14.72	21.99	24.96	7.27	10.24
		I-25	Rio Bravo	SB	100%	5.18	6.55	6.21	1.37	1.03
		Rio Bravo	Coal	SB	100%	6.62	6.69	6.56	0.07	-0.06
				SB Total	**99%**	**26.52**	**35.22**	**37.73**	**8.71**	**11.21**
11	NM 6	I-25	NM 47	EB	100%	8.12	7.66	8.92	-0.46	0.80
		NM 47	I-25	WB	11%	0.65	0.56	0.70	-0.09	0.05
12	Rio Bravo	Coors	Isleta	EB	100%	3.19	2.27	2.77	-0.91	-0.41
		Isleta	I-25	EB	100%	4.47	2.90	3.66	-1.57	-0.81
				EB Total	**100%**	**7.66**	**5.17**	**6.43**	**-2.48**	**-1.22**
		Isleta	Coors	WB	100%	3.38	2.46	2.83	-0.93	-0.56
		I-25	Isleta	WB	47%	2.50	1.54	2.03	-0.96	-0.47
				WB Total	**71%**	**5.89**	**4.00**	**4.86**	**-1.89**	**-1.03**

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
13	Isleta	Rio Bravo	Bridge	NB	100%	6.96	5.52	5.94	-1.44	-1.02
		Bridge	Rio Bravo	SB	100%	7.50	5.61	6.03	-1.90	-1.47
14	Gibson	I-25	Yale	EB	100%	2.10	0.96	1.40	-1.14	-0.70
		Yale	I-25	WB	100%	1.32	1.01	1.25	-0.31	-0.07
15	Unser	Central	I-40	NB	100%	2.06	1.33	1.86	-0.73	-0.20
		I-40	Montano	NB	100%	5.16	4.75	6.06	-0.40	0.90
				NB Total	**100%**	**7.22**	**6.08**	**7.91**	**-1.13**	**0.70**
		I-40	Central	SB	100%	2.01	1.33	2.06	-0.68	0.05
		Montano	I-40	SB	13%	0.74	0.58	0.69	-0.16	-0.05
				SB Total	**32%**	**2.75**	**1.91**	**2.75**	**-0.84**	**0.00**
16	Coors	I-40	PdN	NB	100%	9.55	8.53	10.41	-1.03	0.85
		PdN	NM 528	NB	100%	3.66	3.85	4.23	0.19	0.56
				NB Total	**100%**	**13.22**	**12.38**	**14.63**	**-0.84**	**1.42**
		PdN	I-40	SB	74%	6.41	5.28	6.39	-1.13	-0.02
		NM 528	PdN	SB	68%	3.93	2.26	2.78	-1.66	-1.15
				SB Total	**72%**	**10.34**	**7.54**	**9.17**	**-2.80**	**-1.17**
17	Golf Course	Montano	Southern Blvd	NB	93%	13.19	11.48	10.73	-1.71	-2.46
		Southern Blvd	Montano	SB	100%	12.98	10.00	11.61	-2.98	-1.37
18	4th St	Lomas	Montano	NB	91%	11.69	5.19	5.70	-6.50	-5.99
		Montano	Alameda	NB	100%	10.05	5.92	6.85	-4.13	-3.19
				NB Total	**96%**	**21.74**	**11.10**	**12.56**	**-10.63**	**-9.18**
		Montano	Lomas	SB	40%	4.31	2.09	2.34	-2.22	-1.96
		Alameda	Montano	SB	83%	8.74	4.88	5.80	-3.87	-2.95
				SB Total	**63%**	**13.05**	**6.96**	**8.14**	**-6.09**	**-4.91**

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model (cont')

						PM Travel Time (min)				
							EST.		EST. - OBS.	
GP#	Gp name	From	To	Dir	Cover-age,%	OBS.	STD. Model	REC. Model	STD. Model	REC. Model
19	2nd St	Lomas	Menaul	NB	100%	2.99	2.28	2.95	-0.70	-0.04
		Menaul	Osuna	NB	100%	8.24	4.62	5.10	-3.63	-3.14
		Osuna	Alameda	NB	100%	5.51	3.89	4.45	-1.62	-1.07
				NB Total	**100%**	**16.74**	**10.80**	**12.50**	**-5.95**	**-4.25**
		Menaul	Lomas	SB	0%	0.00	0.00	0.00		
		Osuna	Menaul	SB	79%	4.60	3.47	3.84	-1.13	-0.75
		Alameda	Osuna	SB	83%	3.48	3.01	3.43	-0.48	-0.06
				SB Total	**73%**	**8.08**	**6.47**	**7.27**	**-1.60**	**-0.81**
20	Menaul	2nd	San Mateo	EB	100%	7.18	4.80	5.83	-2.37	-1.35
		San Mateo	Tramway	EB	70%	7.97	6.45	6.70	-1.52	-1.27
				EB Total	**82%**	**15.14**	**11.25**	**12.52**	**-3.89**	**-2.62**
		San Mateo	2nd	WB	16%	1.69	0.85	0.98	-0.84	-0.71
		Tramway	San Mateo	WB	29%	3.97	2.27	2.67	-1.70	-1.30
				WB Total	**24%**	**5.66**	**3.12**	**3.65**	**-2.54**	**-2.01**
21	Osuna	2nd	I-25	EB	20%	1.10	0.79	0.99	-0.30	-0.11
		I-25	2nd	WB	90%	6.55	3.33	3.70	-3.22	-2.85
22	San Mateo	Gibson	I-40	NB	100%	9.08	5.60	5.69	-3.48	-3.39
		I-40	Menaul	NB	100%	1.14	0.67	0.76	-0.48	-0.39
		Menaul	I-25	NB	88%	9.71	4.71	5.00	-4.99	-4.71
				NB Total	**94%**	**19.93**	**10.98**	**11.44**	**-8.95**	**-8.49**
		I-40	Gibson	SB	100%	8.10	4.79	5.70	-3.32	-2.40
		Menaul	I-40	SB	100%	0.59	0.68	0.67	0.09	0.08
		I-25	Menaul	SB	86%	10.08	4.87	5.08	-5.21	-5.00
				SB Total	**93%**	**18.78**	**10.34**	**11.46**	**-8.44**	**-7.33**

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	PM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
23	Wyoming	Central	I-40	NB	100%	2.06	1.33	1.86	-0.73	-0.20
		I-40	Montgomery	NB	63%	3.89	2.86	3.24	-1.03	-0.65
		Montgomery	PdN	NB	100%	6.67	5.65	5.90	-1.02	-0.77
				NB Total	**86%**	**12.62**	**9.83**	**10.99**	**-2.78**	**-1.62**
		I-40	Central	SB	100%	2.01	1.33	2.06	-0.68	0.05
		Montgomery	I-40	SB	100%	6.75	4.24	4.91	-2.51	-1.84
		PdN	Montgomery	SB	100%	8.38	5.48	5.82	-2.90	-2.56
				SB Total	**100%**	**17.14**	**11.04**	**12.79**	**-6.10**	**-4.35**
24	Tramway	I-40	Menaul	NB	100%	1.14	0.67	0.76	-0.48	-0.39
		Menaul	Montgomery	NB	34%	1.55	0.56	0.85	-1.00	-0.70
		Montgomery	PdN	NB	100%	6.67	5.65	5.90	-1.02	-0.77
				NB Total	**80%**	**9.37**	**6.87**	**7.51**	**-2.49**	**-1.85**
		Menaul	I-40	SB	100%	0.59	0.68	0.67	0.09	0.08
		Montgomery	Menaul	SB	0%	0.00	0.00	0.00		
		PdN	Montgomery	SB	100%	8.38	5.48	5.82	-2.90	-2.56
				SB Total	**70%**	**8.97**	**6.16**	**6.49**	**-2.81**	**-2.48**
25	Paseo del Norte	Coors	I-25	EB	100%	6.00	5.12	5.49	-0.88	-0.51
		I-25	Wyoming	EB	100%	2.70	1.93	2.51	-0.77	-0.19
		Wyoming	Eubank	EB	100%	1.83	1.17	1.60	-0.66	-0.23
		Eubank	Tramway	EB	100%	3.80	2.76	3.96	-1.04	0.16
				EB Total	**100%**	**14.33**	**10.99**	**13.56**	**-3.35**	**-0.78**
		I-25	Coors	WB	100%	7.93	8.09	9.40	0.16	1.47
		Wyoming	I-25	WB	100%	2.35	1.59	2.04	-0.77	-0.32
		Eubank	Wyoming	WB	100%	1.65	1.06	1.60	-0.59	-0.05
		Tramway	Eubank	WB	100%	3.86	2.67	3.96	-1.19	0.11
				WB Total	**100%**	**15.80**	**13.41**	**17.01**	**-2.39**	**1.21**
26	Eubank	Central	PdN	NB	79%	15.24	9.56	10.50	-5.68	-4.74
		PdN	Central	SB	100%	17.10	11.22	12.97	-5.88	-4.12

Appendix B - 4
Comparison of Observed and Estimated PM Travel Time, Standard Model and Recalibrated Model (cont')

GP#	Gp name	From	To	Dir	Cover-age,%	PM Travel Time (min) OBS.	EST. STD. Model	EST. REC. Model	EST. - OBS. STD. Model	EST. - OBS. REC. Model
27	Alameda	Coors Bypass	2nd	EB	100%	7.27	6.62	6.38	-0.65	-0.89
		2nd	I-25	EB	20%	1.10	0.79	0.99	-0.30	-0.11
				EB Total	**65%**	**8.37**	**7.42**	**7.36**	**-0.95**	**-1.00**
		2nd	Coors Bypass	WB	68%	6.11	6.97	12.20	0.85	6.09
		I-25	2nd	WB	90%	6.55	3.33	3.70	-3.22	-2.85
				WB Total	**78%**	**12.66**	**10.30**	**15.90**	**-2.37**	**3.24**
28	NM 528	Coors Bypass	Southern Blvd	NB	100%	5.19	2.83	3.59	-2.36	-1.60
		Southern Blvd	Northern Blvd	NB	100%	4.50	3.66	4.80	-0.84	0.30
		Northern Blvd	US 550	NB	100%	9.23	6.26	8.04	-2.96	-1.19
				NB Total	**100%**	**18.91**	**12.75**	**16.42**	**-6.16**	**-2.48**
		Southern Blvd	Coors Bypass	SB	100%	4.82	2.62	3.25	-2.20	-1.57
		Northern Blvd	Southern Blvd	SB	100%	5.27	3.40	4.42	-1.88	-0.85
		US 550	Northern Blvd	SB	100%	8.02	6.31	8.09	-1.71	0.07
				SB Total	**100%**	**18.12**	**12.33**	**15.76**	**-5.79**	**-2.35**
29	US 550	NM 528	I-25	EB	100%	4.09	5.64	3.83	1.55	-0.26
		I-25	NM 528	WB	100%	5.50	7.44	8.75	1.94	3.25
30	Southern Blvd	Unser	NM 528	EB	76%	4.08	2.57	3.02	-1.52	-1.06
		NM 528	Unser	WB	100%	7.75	3.96	4.28	-3.79	-3.48

Better

Worse

Appendix B - 5
Comparison of Observed Schedule Time and Estimated Run Time of Local Transit Routes, Standard Model and Recalibrated Model

			Transit Run Time (min)									
			Observed Schedule		Estimated							
					STD. Model				REC. Model			
					Run Time		Difference		Run Time		Difference	
Rt.#	Name	Direction	AM	OP	AM	OP	AM	OP	AM	OP	AM	OP
1	Juan Tabo	NB	26	26	35	33	9	7	32	31	6	5
		SB	38	35	37	35	-1	0	34	33	-4	-2
2	Eubank	NB	42	28	44	45	2	17	40	42	-2	14
		SB	48	24	44	44	-4	20	40	42	-8	18
3	Uptown/Cottonwood	NB/WB	30	28	25	25	-5	-3	23	24	-7	-4
		SB/EB	28	26	26	25	-2	-1	24	24	-4	-2
5	Montgomery/Carlisle	NB/EB	50	48	56	54	6	6	51	50	1	2
		WB/SB	51	51	58	54	7	3	52	50	1	-1
6	Indian School	WB	40		52		12		47		7	
7	Candelaria	WB	40		50		10		45		5	
8	Menaul	EB	53	60	63	54	10	-6	57	51	4	-9
		WB	60	59	63	63	3	4	57	59	-3	0
10	N. 4th St.	NB	30	32	35	35	5	3	31	32	1	0
		SB	35	34	35	35	0	1	32	33	-3	-1
11	Lomas	EB	46	48	42	41	-4	-7	38	38	-8	-10
		WB	41	38	49	48	8	10	44	44	3	6
12	Constitution	WB	43		48		5		43		0	
13	Comanche	WB	38		52		14		47		9	
31	Wyoming	NB	40	37	36	36	-4	-1	34	34	-6	-3
		SB	39	36	38	36	-1	0	34	35	-5	-1
34	San Pedro	SB	36		42		6		38		2	
36	Rio Grande/12th St.	Circ.	44	42	48	48	4	6	44	45	0	3
40	D-Ride Downtown Shuttle	Circ.	14	14	5	5	-9	-9	10	10	-4	-4
50	Airport/Downtown	NB/WB	21	22	25	25	4	3	22	23	1	1
		SB/EB	26	24	22	20	-4	-4	19	19	-7	-5
51	Atrisco/Rio Bravo	NB/WB	26	26	33	32	7	6	30	30	4	4
		SB/EB	26	26	39	32	13	6	37	30	11	4
53	Isleta	NB	38	41	49	41	11	0	46	39	8	-2
		SB	38	36	43	41	5	5	39	39	1	3
54	Bridge/Westgate	EB	40	33	50	42	10	9	47	39	7	6
		WB	43	42	44	44	1	2	40	41	-3	-1
66	Central	EB	58	66	69	64	11	-2	64	60	6	-6
		WB	59	65	63	63	4	-2	57	59	-2	-6

Appendix B - 5
Comparisons of Observed Schedule Time and Estimated Run Time of Local Transit Routes, Standard Model and Recalibrated Model (cont')

Rt.#	Name	Direction	Transit Run Time (min)									
			Observed Schedule		Estimated							
					STD. Model				REC. Model			
					Run Time		Difference		Run Time		Difference	
			AM	OP	AM	OP	AM	OP	AM	OP	AM	OP
92	Taylor Ranch Express	SB	56		121		65		73		17	
93	Academy	WB/SB	33		68		35		38		5	
94	Unser Express	SB	51		102		51		60		9	
96	Crosstown Commuter	SB	60		113		53		56		-4	
97	Zuni	EB	22	22	39	42	17	20	36	39	14	17
		WB	24	24	42	49	18	25	38	46	14	22
98	Wyoming	EB/SB	71		79		8		64		-7	
140	San Mateo Line	NB	48	55	50	49	2	-6	45	46	-3	-9
		SB	45	46	45	44	0	-2	40	41	-5	-6
141	San Mateo Line	NB	35		30		-5		27		-8	
		SB	35		31		-4		28		-7	
151	Rio Rancho/RR Conn.	EB/SB	71	51	104	67	33	16	55	45	-16	-6
		NB/WB	56	48	68	70	12	22	43	45	-13	-3
155	Coors Blvd. Line	NB	48		56		8		50		2	
		SB	49		66		17		55		6	
157	Montano Uptown	SB/EB	64	64	94	68	30	4	89	64	25	0
		WB/NB	66	62	69	71	3	9	63	64	-3	2
162	Ventana Ranch/Montano Plaza	NB	18		42		24		34		16	
		SB	20		37		17		33		13	
222	Rio Bravo/Sunport/Kirtland	EB	42		61		19		43		1	
		WB	50		52		2		36		-14	
317	Downtown/KAFB Limited	EB	27		36		9		25		-2	
		WB	27		35		8		24		-3	
1618	The BUG	EB	52	52	46	45	-6	-7	41	42	-11	-10
		WB	64	64	47	46	-17	-18	42	43	-22	-21
	All Local Routes (*)						11.1	4.5			6.4	3.7

Worse

Better

(*) Difference calculated based on the average of absolute differences

Appendix B - 6
Comparison of Observed Schedule Time and Estimated Run Time of Premium Transit Routes, Standard Model and Recalibrated Model

Route #	Name	Direction	Transit Run Time (min)									
			Observed Schedule		Estimated							
					STD. Model				Rec. Model			
					Run Time		Difference		Run Time		Difference	
			AM	OP	AM	OP	AM	OP	AM	OP	AM	OP
766	Rapid Ride - Red Line	EB	49	44	90		41		45	44	-4	0
		WB	40	43	85		45		40	44	0	1
790	Rapid Ride - Blue Line	EB	41	44	108		67		45	43	4	-1
		WB	39	41	73		34		35	40	-4	-1
Rail Runner	Rail Runner (1)	NB	69	69	69	69	69	69	69		0	0
Rail Runner	Rail Runner (1)	SB	69	69	69	69	69	69	69		0	0
	All Premium Routes(*)						**26.8**	**0.0**			**1.8**	**0.5**

Worse

Better

(1) Rail Runner (transit run time hard coded in network)

(*) Difference calculated based on the average of absolute differences

Appendix B - 7
Comparison of Average Logsum, Standard Model and Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Logsum		
		STD. Model(1)	Observed(2)	REC. Model(3)
HBW_AM	0	2.3808	0.5554	0.3439
	1	0.0315	1.3002	1.3358
	2	2.1596	2.7016	2.7992
	3+	0.8394	1.6029	1.6149
sHBW_PM	0	-3.5398	-2.2147	-2.5763
	1	1.8690	1.6527	1.6987
	2	1.3937	1.6004	1.6505
	3+	1.4967	1.2649	1.2782
HBW_OP	ALL	2.2494	1.8408	1.9244
HBShop	ALL	3.3538	3.5060	3.5314
HBO	ALL	2.3761	2.2757	2.2460
NHBW	ALL	0.2509	0.1938	-0.0213
NHBO	ALL	0.7854	0.8199	0.6178

(1) Computed using trips and logsum from the Standard Model
(2) Computed using trips from the Standard Model and logsum from the Recalibrated Model
(3) Computed using trips and logsum from the Recalibrated Model

Appendix B - 8
Comparison of Average Trip Distance, Standard Model and Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Trip Distance (mile)		
		STD. Model (1)	Observed	REC. Model(3)
HBW_AM	0	4.27	4.24	7.23
	1	6.97	6.94	6.68
	2	8.28	8.24	7.14
	3+	8.99	8.95	8.68
HBW_PM	0	6.56	6.53	9.31
	1	6.76	6.73	5.98
	2	8.75	8.71	8.10
	3+	9.51	9.46	9.20
HBW_OP	ALL	8.66	8.67	7.66
HBShop	ALL	5.33	5.33	5.23
HBO	ALL	7.44	7.43	7.51
NHBW	ALL	7.12	7.08	8.25
NHBO	ALL	6.73	6.70	7.89

(1) Standard Model
(2) Computed using trips from the Standard Model and the highway skim distance from the Recalibrated Model
(3) Computed using trips and the highway skim distance from the Recalibrated Model

Appendix B - 9
Comparison of Average Trip Time,
Standard Model and Recalibrated Model

Trip Purposes	Auto Ownership	Avg. Trip Time (minutes) (4)		
		STD. Model(1)	Observed(2)	REC. Model(3)
HBW_AM	0	8.54	8.80	13.80
	1	13.43	13.58	13.13
	2	15.87	16.12	14.45
	3+	17.13	17.45	17.30
HBW_PM	0	12.46	12.70	16.91
	1	12.96	13.13	12.04
	2	16.60	16.85	15.93
	3+	17.93	18.26	18.06
HBW_OP	ALL	14.32	14.30	12.93
HBShop	ALL	9.60	9.64	9.38
HBO	ALL	12.59	12.61	12.56
NHBW	ALL	11.80	11.77	13.72
NHBO	ALL	11.27	11.25	13.25

(1) Standard Model
(2) Computed using trips from the Standard Model and highway skim time from the Recalibrated Model
(3) Computed using trips and the highway skim time from the Recalibrated Model
(4) Terminal time was excluded

Appendix B - 10
Comparison of Observed and Estimated Daily VMT, Standard Model and Recalibrated Model

Cat.	Facility Type	Coverage %	# Links	Dist. (miles)	OBS.*	Daily Volume Est. Std. Model	Daily Volume Est. Rec.Model	Error % Std. Model	Error % Rec.Model	% RMSE Std. Model	% RMSE Rec.Model
7	Urban freeway	52%	181	85	3,010,319	3,129,661	3,273,739	4%	9%	25%	26%
8	Urban entrance Ramps	80%	103	18	125,430	114,791	133,807	-8%	7%	53%	48%
9	Urban exit Ramps	78%	111	19	118,143	110,831	131,323	-6%	11%	44%	54%
1	High Speed Ramps	36%	14	2	55,973	NA	54,513	NA	-3%	NA	14%
6	Urban freeway frontage roads	92%	110	18	127,507	148,312	123,786	16%	-3%	54%	63%
10	Limited Access Principal Arterials	92%	583	190	2,211,427	2,561,034	2,218,064	16%	0%	52%	34%
2	Urban Principal Arterials	97%	1,671	392	3,690,629	3,186,109	3,224,880	-14%	-13%	45%	54%
3	Urban minor arterials	93%	1,653	370	2,212,282	1,961,964	2,172,217	-11%	-2%	52%	59%
4	Urban collectors	85%	2,227	550	1,245,965	1,056,906	1,254,487	-15%	1%	86%	99%
5	Urban Locals	50%	76	16	24,932	21,431	22,094	-14%	-11%	118%	120%
	Urban Sub-Total	86%	6,729	1,660	12,822,606	12,291,040	12,608,908	-4%	-2%	58%	60%
17	Rural freeway	56%	60	82	966,062	1,140,120	1,182,972	18%	22%	28%	36%
18	Rural entrance Ramps	79%	26	6	11,191	9,206	10,581	-18%	-5%	80%	85%
19	Rural exit Ramps	77%	28	7	12,701	10,082	11,556	-21%	-9%	90%	98%
14	Rural major collectors	72%	290	235	356,979	328,523	427,970	-8%	20%	111%	132%
11	Rural minor collectors	92%	120	130	111,569	153,853	170,766	38%	53%	149%	144%
15	Rural locals	48%	129	53	35,316	53,153	58,103	51%	65%	171%	220%
	Rural Sub-Total	67%	653	513	1,493,818	1,694,937	1,861,947	13%	25%	77%	94%
	Grand Total	81%	7,382	2,174	14,316,424	13,985,977	14,470,855	-2.3%	1.1%	60.9%	64.9%

* Daily traffic count provided in December 2009

Appendix B - 11
Comparison of Observed and Estimated Daily Volumes, Standard Model and Recalibrated Model

Cat.	Facility Type	Coverage %	# Links	Dist. (miles)	OBS.*	Daily Volume Est. Std. Model	Daily Volume Est. Rec.Model	Error % Std. Model	Error % Rec.Model	% RMSE Std. Model	% RMSE Rec.Model
7	Urban freeway	52%	181	85	7,792,347	8,098,400	8,224,673	4%	6%	20%	19%
8	Urban entrance Ramps	80%	103	18	782,182	721,659	836,233	-8%	7%	52%	43%
9	Urban exit Ramps	78%	111	19	755,886	688,874	841,783	-9%	11%	48%	50%
1	High Speed Ramps	36%	14	2	402,128	NA	376,976	NA	-6%	NA	17%
6	Urban freeway frontage roads	92%	110	18	868,278	1,099,561	919,485	27%	6%	45%	49%
10	Limited Access Principal Arterials	92%	583	190	7,859,051	9,060,711	7,842,287	15%	0%	49%	31%
2	Urban Principal Arterials	97%	1,671	392	18,232,062	15,409,586	15,392,203	-15%	-16%	36%	43%
3	Urban minor arterials	93%	1,653	370	10,477,742	9,286,330	9,805,734	-11%	-6%	46%	47%
4	Urban collectors	85%	2,227	550	5,596,215	4,598,823	5,264,544	-18%	-6%	70%	79%
5	Urban Locals	50%	76	16	128,544	134,699	129,497	5%	1%	107%	94%
	Urban Sub-Total	86%	6,729	1,660	52,894,435	49,098,643	49,633,413	-7%	-6%	46%	46%
17	Rural freeway	56%	60	82	778,002	947,866	998,134	22%	28%	28%	37%
18	Rural entrance Ramps	79%	26	6	48,842	45,066	51,992	-8%	6%	81%	94%
19	Rural exit Ramps	77%	28	7	58,442	45,699	52,361	-22%	-10%	95%	101%
14	Rural major collectors	72%	290	235	531,228	548,104	684,666	3%	29%	69%	94%
11	Rural minor collectors	92%	120	130	138,608	163,148	199,080	18%	44%	75%	93%
15	Rural locals	48%	129	53	82,364	134,172	142,732	63%	73%	151%	166%
	Rural Sub-Total	67%	653	513	1,637,486	1,884,056	2,128,966	15%	30%	63%	82%
	Grand Total	81%	7,382	2,174	54,531,921	50,982,699	51,762,379	-6.5%	-5.1%	47.4%	47.1%

* Daily traffic count provided in December 2009

Appendix B - 12
Comparison of Observed and Estimated Daily Volume at Screen-Lines, Standard Model and Recalibrated Model

	Screen-Line Name	# Links	Daily Volume						
				EST.		Error %		% RMSE	
			OBS. (1)	Std. Model	Rec. Model	Std. Model	Rec. Model	Std. Model	Rec. Model
1	Rio Grande - Val. Co.	8	51,020	50,359	58,082	-1%	14%	22%	30%
2	Rio Grande - Bern. Co.	16	423,340	462,160	489,843	9%	16%	21%	20%
3	Rio Grande - Sand. Co.	2	42,784	39,831	45,039	-7%	5%	10%	7%
4	N. of I-40 - Abq. W. of B	21	193,211	190,539	183,228	-1%	-5%	61%	35%
5	N. of I-40 - Abq. E. of B	25	323,721	333,391	325,237	3%	0%	27%	22%
6	N. of I-40 - E. Mnts.	16	33,288	40,443	50,457	21%	52%	49%	82%
7	S. of I-40 - Abq. W. of B	19	202,505	201,963	197,810	0%	-2%	33%	22%
8	S. of I-40 - Abq. E. of B	27	351,484	330,895	324,122	-6%	-8%	35%	37%
9	S. of I-40 - E. Mnts.	14	35,210	43,123	50,035	22%	42%	74%	91%
10	E. of I-25 - Val. Co.	10	48,962	52,738	61,600	8%	26%	59%	68%
11	E. of I-25 - S. of Big-I	21	192,257	185,913	174,994	-3%	-9%	45%	39%
12	E. of I-25 - N. of Big-I	23	298,836	318,378	311,912	7%	4%	54%	45%
13	E. of I-25 - Sand. Co.	4	9,874	13,041	16,600	32%	68%	56%	108%
14	W. of I-25 - Val. Co.	4	21,484	21,755	21,901	1%	2%	33%	38%
15	W. of I-25 - S. of Big-I	19	177,075	166,759	171,904	-6%	-3%	46%	52%
16	W. of I-25 - N. of Big-I	21	262,619	270,968	262,925	3%	0%	56%	50%
17	W. of I-25 - Sand. Co.	4	46,278	43,254	49,169	-7%	6%	41%	35%
18	Sandoval Co. - W. of Rive	10	110,624	150,022	142,118	36%	28%	71%	50%
19	Sandoval Co. - E. of Rive	4	77,213	71,726	78,523	-7%	2%	15%	18%
20	Valencial Co. - W. of Riv	4	34,985	45,187	51,511	29%	47%	39%	56%
21	Valencial Co. - E. of Riv	2	23,388	29,799	34,906	27%	49%	39%	70%
22	Tijeras Canyon	4	59,190	72,209	82,646	22%	40%	49%	72%
23	CBD	30	225,035	141,875	149,522	-37%	-34%	54%	58%
24	Big-I I-25 S. of Intch.	2	154,013	152,456	153,375	-1%	0%	6%	5%
25	Big-I I-25 N. of Intch.	2	174,007	142,715	154,418	-18%	-11%	26%	16%
26	Big-I I-40 W of Intch.	2	139,030	150,320	159,391	8%	15%	12%	21%
27	Big-I I-40 E. of Intch.	2	161,942	163,376	171,477	1%	6%	2%	9%
28		8	111,645	102,251	110,093	-8%	-1%	16%	19%
99	Other Counts	7,058	50,546,901	46,995,254	47,679,543	-7%	-6%	48%	48%
	Screen Line Subtotal	**324**	**3,985,020**	**3,987,445**	**4,082,836**	**0.1%**	**2.5%**	**37.9%**	**34.9%**
	Grand Total	**7,382**	**54,531,921**	**50,982,699**	**51,762,379**	**-6.5%**	**-5.1%**	**47.6%**	**47.2%**

Better

Worse

Appendix B - 13
Comparison of Observed and Estimated Daily Ridership by Route, Standard Model and Recalibrated Model

			Daily Ridership			
			Std. Model		Rec. Model	
Rt #	Route Name	OBS.(1)	Est.	Diff	Est.	Diff
1	Juan Tabo	587	865	278	943	356
2	Eubank	447	839	391	867	420
3	Uptown/Cottonwood	484	698	214	468	-16
5	Montgomery/Carlisle	2,272	3,631	1,359	1,789	-483
6	Indian School	59	224	165	397	338
7	Candelaria	33	396	363	201	168
8	Menaul	2,219	3,331	1,112	1,772	-447
10	N. 4th St.	1,362	1,155	-207	894	-468
11	Lomas	2,334	3,278	944	2,622	288
12	Constitution	46	249	204	79	34
13	Comanche	55	143	89	159	104
31	Wyoming	574	973	399	1,230	656
34	San Pedro	39	136	97	106	68
36	Rio Grande/12th St.	103	1,164	1,061	653	550
40	D-Ride Downtown Shuttle	602	1,991	1,389	2,841	2,240
50	Airport/Downtown	780	630	-150	544	-236
51	Atrisco/Rio Bravo	182	114	-67	229	48
53	Isleta	733	681	-52	442	-291
54	Bridge/Westgate	620	1,198	578	1,362	743
66	Central	7,746	5,927	-1,819	3,467	-4,279
97	Zuni	290	383	94	269	-21
92	Taylor Ranch Express	51	245	194	117	66
93	Academy	78	38	-40	139	60
94	Unser Express	52	65	12	222	170
96	Crosstown Commuter	273	58	-215	81	-191
98	Wyoming	101	374	273	128	26
140	San Mateo Line	2,622	2,482	-141	1,957	-666
141	San Mateo Line	801	548	-253	742	-58
151	Rio Rancho/RR Conn.	275	444	169	589	314
155	Coors Blvd. Line	904	178	-725	427	-476
157	Montano Uptown	896	1,358	462	1,185	289
162	Ventana Ranch/Montano Plaza	47	81	34	253	206
222	Rio Bravo/Sunport/Kirtland	207	60	-147	99	-108

Appendix B - 13
Comparison of Observed and Estimated Daily Ridership by Route, Standard Model and Recalibrated Model (cont')

			Daily Ridership			
			Std. Model		Rec. Model	
Rt #	**Route Name**	**OBS.(1)**	**Est.**	**Diff**	**Est.**	**Diff**
317	Downtown/KAFB Limited	128	87	-41	50	-78
1618	The BUG	869	445	-424	465	-403
Route1	Route 1	n/a	27	n/a	179	n/a
	Local Subtotal	**28,869**	**34,497**	**5,628**	**27,970**	**-899**
766	Rapid Ride - Red Line	6,535	280	-6,255	7,805	1,271
790	Rapid Ride - Blue Line	1,853	275	-1,578	2,960	1,107
Rail Runner	Rail Runner	2,017	245	-1,772	1,862	-155
	Premium Subtotal	**10,404**	**800**	**-9,604**	**12,627**	**2,222**
	Grand Total	**39,273**	**35,297**	**-3,976**	**40,597**	**1,323**
						Better
						Worse

(1) Observed daily ridership in October, 2008