WORKING

TOGETHER

TO PLAN

FOR THE

FUTURE

COMPASS

COMMUNITY PLANNING ASSOCIATION

of Southwest Idaho

2002 Travel Demand Forecast Model Calibration Report for Ada and Canyon Counties

Report No. 09-2006
Accepted by the Transportation Model Advisory Committee on June 22, 2006

EXECUTIVE SUMMARY - COMPASS TRAVEL DEMAND MODEL QUICK FACTS

MODEL GEOGRAPHY (2002 CALIBRATION)

- Ada and Canyon Counties (a.k.a. Treasure Valley, Idaho)
- 480,000 people
- 2,100 centerline miles in the model network classified as a collector or higher
- 534 Traffic Analysis Zones (TAZs) - 346 in Ada County and 188 in Canyon County

METHODOLOGY

The 2002 calibration of COMPASS' travel demand model is a 3-Step model which includes a land use/trip generation module, a gravity based trip distribution, and a capacity constrained equilibrium traffic assignment process.

VALIDATION CRITERIA AND RESULTS

COMPASS' Transportation Model Advisory Committee (TMAC) approved the 2002 calibration of the 24-hour model on June 29, 2004. The peak hour model was subsequently approved on October 12, 2004. The following are the validation criteria and results for the 2002 calibration.

24-Hour Model						
Percent Root Mean Square Error (RMSE) by Functional Class				Percent Error by Functional Class		
Facility Type	%RMSE	MAX	Validation	Volume to Count % Difference	MAX	Validation
Interstate & Ramps	23.9%	< 40%	PASS	-0.2%	< 7%	PASS
Principal Arterials	22.1%	< 40%	PASS	-4.4%	< 10%	PASS
Minor Arterials	39.0%	< 40%	PASS	-11.5%	< 15%	PASS
Collectors	70.4%	< 40%		-16.8%	< 25%	PASS
Locals	82.2%	< 40%		11.6%	< 25%	PASS
Overall	**34.9%**	**< 40%**	**PASS**	**-7.6%**		
Without Locals	34.5%	< 40%	PASS	R-Squared = 0.90 Correlation Coefficient = 0.96 Screenlines = 85% passed		
Without Collectors and Locals	28.9%	< 40%	PASS			
Peak Hour Model						
Percent Root Mean Square Error (RMSE) by Functional Class				Percent Error by Functional Class		
Facility Type	%RMSE	MAX	Validation	Volume to Count % Difference	MAX	Validation
Interstate & Ramps	28.6%	< 40%	PASS	3.9%	< 7%	PASS
Principal Arterials	25.0%	< 40%	PASS	-1.2%	< 10%	PASS
Minor Arterials	40.9%	< 40%		-20.4%	< 15%	
Collectors	79.5%	< 40%		-25.7%	< 25%	
Locals	82.9%	< 40%		17.8%	< 25%	PASS
Overall	**37.8%**	**< 40%**	**PASS**	**-9.5%**		
Without Locals	37.4%	< 40%	PASS	R-Squared = 0.87 Correlation Coefficient = 0.94		
Without Collectors and Locals	31.4%	< 40%	PASS			

The 24-hour and peak hour model also went through a "Dynamic Validation" process. This process, documented by Fehr & Peers, evaluates how the model responds to changes in households and employment for selected TAZs. The COMPASS model responded appropriately.

APPLICATIONS

- Roadway System Deficiencies
- Level of Service Analysis
- Air Quality Conformity
- Long-Range Transportation Planning
- Transportation Improvement Programs
- Impact Fee Program for Ada County Highway District
- Special Studies

SOFTWARE

COMPASS uses Cube Voyager and TP+ developed by Citilabs.

OVERSIGHT

COMPASS' Transportation Model Advisory Committee is made up of 18 voting members (as of December 2005) from the public and private sectors of the community. This committee is charged with making policy decisions about model inputs and its appropriate uses. Meeting dates, agendas, and packets can be found on the COMPASS web site at http://www.compassidaho.org/people/tmac.htm .

FORECAST YEARS

- 2002 calibration year
- Interim year based on the horizon year of the current transportation improvement program
- Motor vehicle emission budget years
- Horizon year for the long-range transportation plan

AIR QUALITY

Northern Ada County is currently a maintenance area in attainment of the PM_{10} standards and a limited maintenance area in attainment of the CO standards. Therefore, COMPASS performs a regional emissions analysis each year corresponding with the state's annual project programming cycle. The results of the regional emissions analyses are compared to motor vehicle emission budgets for PM_{10}, oxides of nitrogen (NO_X), and volatile organic compounds (VOC) in order to support transportation conformity findings.

FUTURE ENHANCEMENTS

- Mode choice model – complete in May 2005 and used in limited applications
- Peak spreading methodology
- 4-D Process for evaluating different land use scenarios (developed by Fehr & Peers) – complete in May 2005 and used in limited applications
- Feedback congested link speeds and costs from assignment back into trip distribution - completed in February 2006
- Truck trip tables – received funding for a freight study for fiscal year 2007

HISTORY

Travel demand forecast models are not new to the State of Idaho, especially in Ada County. The earliest record of a travel demand model for Ada County is 1975. At this time the model and demographics were developed and managed by Idaho Transportation Department Headquarters. Some characteristics of the 1975 model and area are as follows:

- Covered Boise Urbanized Area
  - Estimated population was 108,000
  - Estimated Vehicle Miles of Travel was 1,021,760
  - Average number of trips per household was 6.3
- Contained 240 traffic analysis zones
- Included interstates, highways, principal and minor arterials
- Used a gravity based method
- Included modal choice and time of day estimates
- Documented in *Boise Urban Area Transportation Planning Models* by COMSIS Corporation, December 1978

Sometime in the early 1980s, the model and demographic responsibilities were given to Ada Planning Association (APA), the metropolitan planning organization for Ada County. The 1975 model was refined and recalibrated using 1980 census data and updated traffic counts. Some characteristics of the 1980 model and area are as follows:

- Covered Ada County
  - Estimated population was 173,036 – 1980 Census
  - Estimated Vehicle Miles of Travel was 2,786,450
- Contained 265 traffic analysis zones
- Included interstates, highways, principal and minor arterials
- Used a gravity based method
- Documented in *Transportation Model Recalibration Report 1980 Based* by Ada Planning Association, March 1985

The 1980 model was used for about 10 years. This model was developed using UTPS software and converted to TranPlan in the early 1990s.

In 1995 Ada County became a "beta test site" for a tour base model and it was one of the first applied by an MPO. Some of the characteristics of this model are as follows:

- Covered Ada County
  - Estimated 1994 population was 241,201 developed by Intermountain Demographics
- Contained 285 traffic analysis zones
- Included interstates, highways, principal and minor arterials and collectors
- Incremental Model-Destination Choice Model
- Planning Application
  - Bench / Valley Study commissioned by Ada County Highway District

After further review of the 1995 model and the tremendous growth occurring to the west, APA decided to develop a two-county traditional 3-step model.

In 1997, APA began a household travel characteristics survey for both counties. This survey was conducted in the typical fashion and over 1800 households participated. Detailed travel logs were kept for household members over 15 years of age and a general one was kept for members under 15 years of age. The first two-county 3-step model was developed with this data. Some characteristics of this model are as follows:

- Covered Ada County and Canyon County
  - Estimated 1997 population was 378,013 developed by Ada Planning Association
  - Average number of trips per household were 10.0
  - Four trip types (work, shop, other and non-home)
- Contained 463 traffic analysis zones
- Included interstates, highways, principal and minor arterials and collectors
- Documented in *1997 Travel Model Calibration Report* by COMPASS, September 2001

This was the first two-county model accepted by TMAC in June 1999 and used until 2004. Also in 1999, the Ada-Canyon partnership was final in November and APA became Community Planning Association of Southwest Idaho (COMPASS).

A few short years later COMPASS began another update and calibration effort. It started in summer 2002 and ended with acceptance of a new model by TMAC in June 2004 and is documented in this report.

INTRODUCTION

OVERVIEW

The development and calibration effort of the 2002 COMPASS model took more than two years and includes many refinements. This report does not only address the generalities of the model but also documents the calibration and validation process undergone to complete the COMPASS model. The following is a summary of the enhancements made for the 2002 model:

- Conducted a household travel survey
- Collection of posted speed limit data
- Refinement of roadway network
- Increase in the number of traffic count location data
- Refined Traffic Analysis Zones (TAZ) - added 61 zones
- Improved demographic forecast method
- Improved validation criteria for both 24-hour and peak hour model
    - Percent error and Root Mean Square Error by facility type
- Addition of a validated peak hour model
- Dynamic Validation method assisted by Fehr and Peers and applied to both models

In 2002, the two-county area consisted of over 480,000 people and 4,300 centerline miles. The 2002 model includes about half of those centerline miles and includes 534 TAZs boundaries (346 in Ada County and 188 in Canyon County). The zones range in size from a couple of city blocks in the downtown areas to several square miles in the rural areas.

Currently, the model outputs an average weekday 24-hour and peak hour (5 P.M. to 6 P.M.) traffic projection for collectors or higher. Some local roads have been added for connectivity and modeling purposes only.

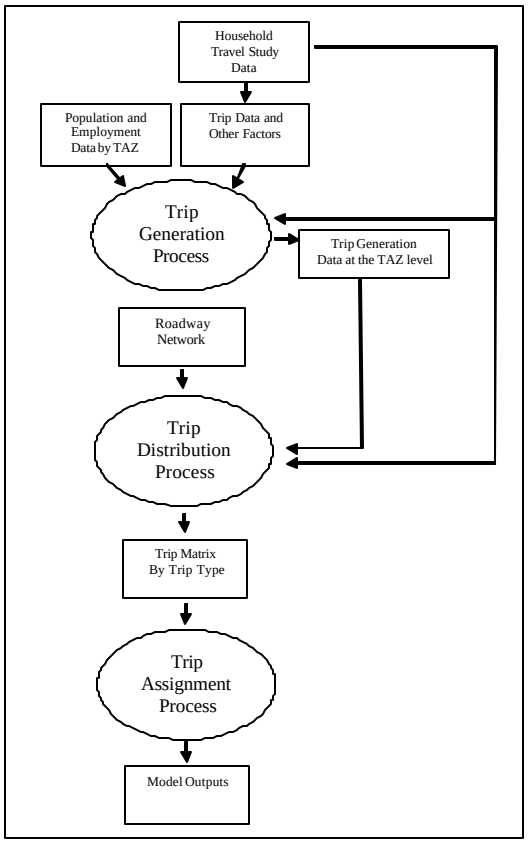
The COMPASS model is used to perform analyses such as:

- Roadway system deficiencies
- Level of Service
- Air Quality Conformity
- Long Range Planning
- Transportation Improvement Programs
- Impact Fee Program for Ada County Highway District
- Special Studies

Travel demand models are helpful tools and offer a myriad of opportunities for transportation planning and decision-making. However, models have limits and the outputs from models should be used responsibly. TMAC oversees the COMPASS model. This committee is made up of 18 voting members from the public and private sectors of the community. This committee is charged with making decisions about the inputs for the model, the betterment of the model and appropriate uses of the model.

TMAC approved the 2002 COMPASS Travel Demand Forecast Model on June 29, 2004 and subsequently approved the peak hour model on October 12, 2004. The 24-hour model uses three steps of the 4-Step modeling process. The development of a mode choice model was completed in May 2005 and has been used on a limited basis. The approved 3-step model process is shown in Figure 1. Each step in the figure is discussed throughout this report, starting with the household travel survey done in fall of 2002.

Figure 1



HOUSEHOLD TRAVEL CHARACTERISTICS SURVEY

COMPASS contracted with NuStats Partners, L.P. located in Austin, Texas to develop and conduct a household travel characteristics survey for the two-county area. A pilot study was conducted during August 2002 to test the full survey procedures. Very few changes were made as a result of this pilot test.

The 2002 household travel survey entailed the collection of activity and travel information for all household members, regardless of age, during an assigned 24-hour period on Tuesday, Wednesday, or Thursday. In addition to providing basic demographic information about each household and its members, the survey documented specific travel characteristics and trips made, including number of occupants, trip purpose, time-of-day, and trip mode use. COMPASS engaged in additional publicity efforts before and during the survey.

The survey conformed to standard procedures for conducting household travel behavior surveys. These procedures included:

- Geo-code Home Addresses
- Advance Postcard Mailing
- Recruitment Telephone Interview
- Respondent Packet Mailing
- Reminder Call
- Data Retrieval Telephone Interview
- Geo-code Trips
- Data Edit Checks and Cleaning
- Data Delivery

Travel days for the full survey started on September 3, 2002 and ended on October 31, 2002. In total, 3,488 households were recruited to participate in the study. Of these 2,582 completed travel diaries (fully completed and passed edit check procedures). This resulted in a 26% response rate calculated per the Council of American Survey Research Organizations (CASRO) methods. This response rate is comparable to other household travel surveys of this type.

The following are some statistics for the Treasure Valley region based on the survey results:

- The average household size is 2.6
- The average number of vehicles per household is 2.1
- The average number of workers per household is 1.2
- 96% of employed Ada county residents work in Ada county; while 34% of employed Canyon county residents work in Ada county
- The number of trips generated per household is 11.1
- The average trip duration for all trips is 16 minutes
- The number of trips generated per person is 4.2

The final report and appendices are available on the COMPASS website at http://www.compassidaho.org/model.html

The survey data are used to develop model factors such as:

- Average number of vehicles available per TAZ
- Vehicle-person cross-classification tables
- Auto occupancy rates by county by trip type
- Trip length frequency by trip type verification

Travel survey data combined with demographic data, is essential to developing travel demand forecast models. Demographic data for the purposes of the 2002 COMPASS model includes population, households, vehicle ownership, and employment. Each element is discussed in more detail in Appendix A.

DEMOGRAPHICS

Base Year (2002)

Demographics are one of the most important inputs to a travel demand model and with the readily available 2000 Census information it makes the establishment of base year demographics easier. Building permit information for both counties was used in addition to the 2000 Census data to estimate the 2002 population and households at the TAZ level. The demographic model input file includes population, households, vehicles, and employment.

Population and Households

The 2000 Census population, housing units and households for both Ada and Canyon Counties were available at the block level and were attributed to the 534 TAZs. These maps are available on the COMPASS web site (http://www.compassidaho.org/maps.html). The block geography for the Treasure Valley ranged from one-half an acre to over 20 square miles. Creating a database relating block level population and households to TAZ required four major steps:

- Clean the block data
- Create unique number for each block (tract number + block number = tract block)
- Create a tract block to TAZ equivalency table
- Develop one database containing the 2000 Census data at the block and TAZ level

This exercise resulted in a less than one percent difference between the 2000 Census data versus the adjusted data. A comparison is shown in Table 1.

Table 1

2000 Demographics				
	Adjusted	2000 Census	Difference	% Difference
Population	432,175	432,345	-170	-0.04%
Housing Units	166,772	166,481	291	0.17%
Households	158,374	158,426	-52	-0.03%

Next, COMPASS staff estimated the 2002 population and households at the TAZ level. This was accomplished by adding two years of building permit information from Ada and Canyon Counties to the 2000 Census data. The residential building permit data collected are for new, demolished, and converted residential construction; and new or converted commercial construction. The residential data are recorded at the address level which allows permits to be geo-coded to a TAZ. Since the 2000 Census covers up to April 1, 2000, all the building permit data collected from January 2000 through December 31, 2002 were used. The three-month overlap was not a concern because the time between permitting and completion is at least three months. To convert the number of residential permits to population, housing units, and households staff used of occupancy and persons per household rates from the 2000 Census. Each of these rates were calculated and applied at the TAZ level. A detailed explanation and examples of this process are in Appendix A. Once 2002 population and households by TAZ were estimated, vehicle per TAZ were calculated using information from the 2002 household travel survey.

Vehicles

The numbers of vehicles available in a household influences their trip making characteristics of a household, much like the number of persons in a household. The COMPASS model uses number of vehicles per TAZ as one of the items in the demographic input file. According to the 2002 travel survey results, the average vehicle ownership was 2.11 for the Treasure Valley, 2.10 for Ada County and 2.14 for Canyon County. In order to assign average vehicles per household factor to each TAZ, zones were grouped into the appropriate Demographic Area and an average was calculated as shown in Figure 2. Next, the average vehicles per household for a given Demographic Area were then assigned to TAZs.

Figure 2

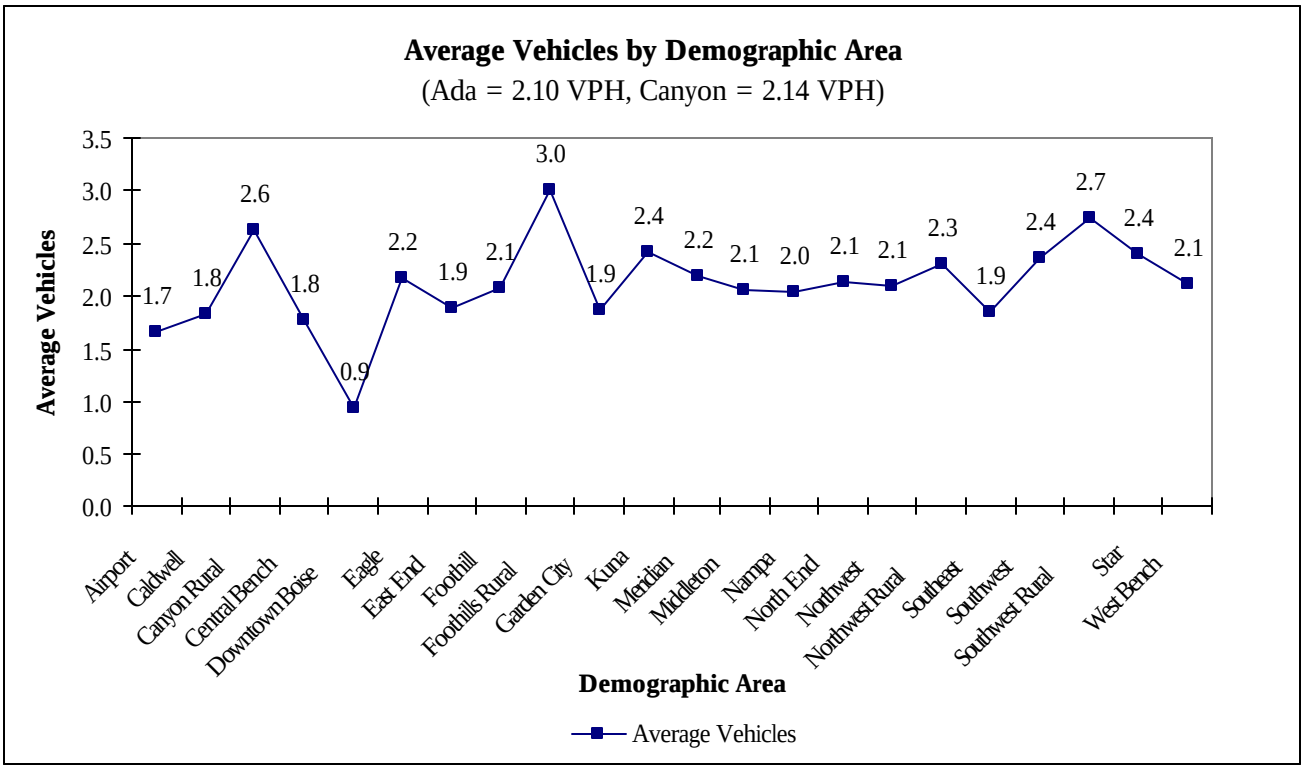
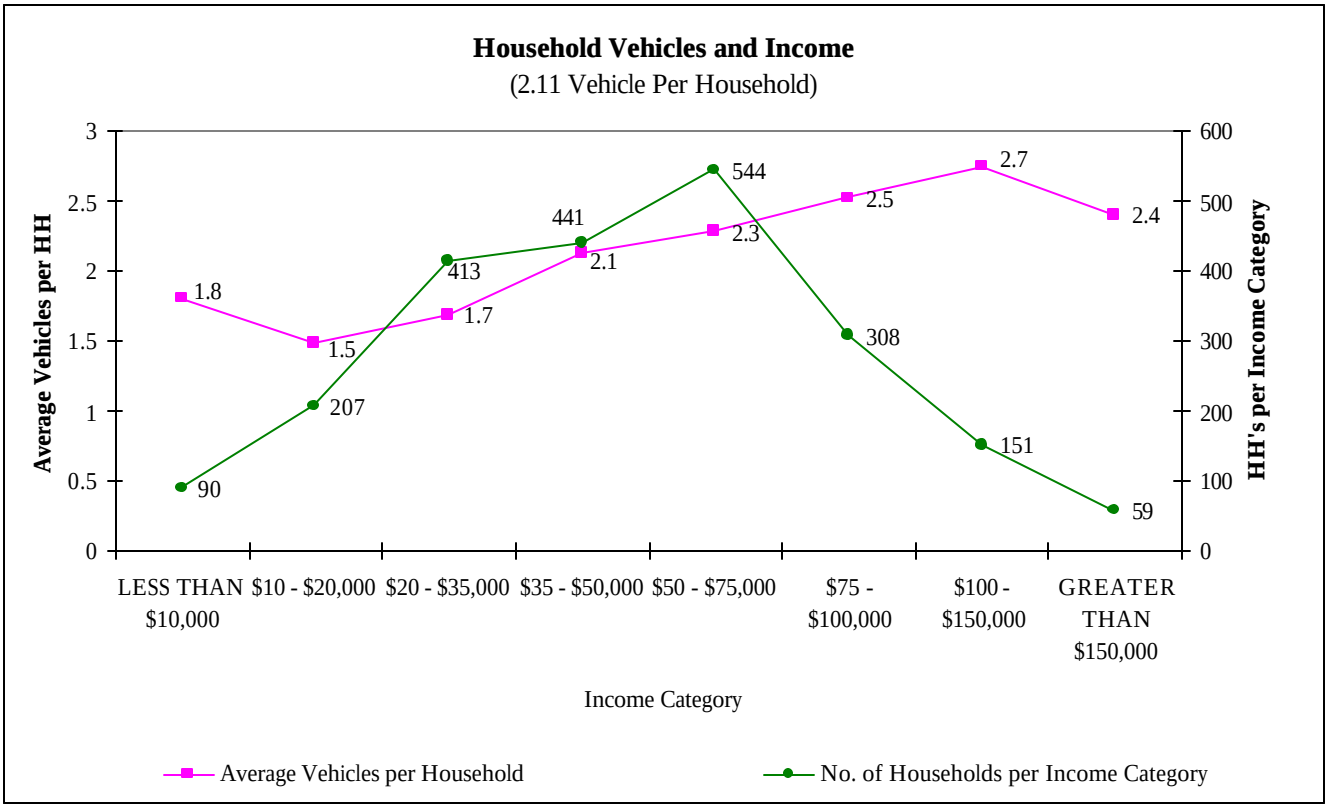


Figure 3 shows the number of households surveyed per income group and the average number of vehicles available per household per income group. The 2002 household travel data indicates as income goes up so does the number of vehicles available.

Figure 3



The COMPASS model uses vehicles per household for a couple of reasons; vehicles are more comfortable to forecast versus income. Second, the annual number of passenger vehicles registered is readily available on Idaho Transportation Department's website.

Employment

Currently, employment data are readily available at the county, region, and state level from the Department of Labor and John Church, a local economist. The best source for detailed level employment data is the Department of Labor and unfortunately COMPASS was unable to obtain that data due to our private/public status. COMPASS purchased employment data for Ada and Canyon Counties from Polk Directories, a private company focused on compiling a comprehensive list of business and residential information. The database contained over 17,000 records with business name, address, Standard Industrial Classification (SIC), and number of employees by category.

The Polk Directory data set required some work such as, the need to add all the bank branches and replacing P.O. boxes with actual addresses when available. Some P.O. boxes and non-traditional street addresses could not be located which resulted in 2,663 unaccounted employees. Additionally, the business list did not have the number of employees but instead provided ranges. To estimate number of employees a mid-point of the number of employees range was used.

Table 2 shows the comparison between COMPASS' 2002 employment estimates based on Polk compared to John Church's estimates and the Department of Labor's data.

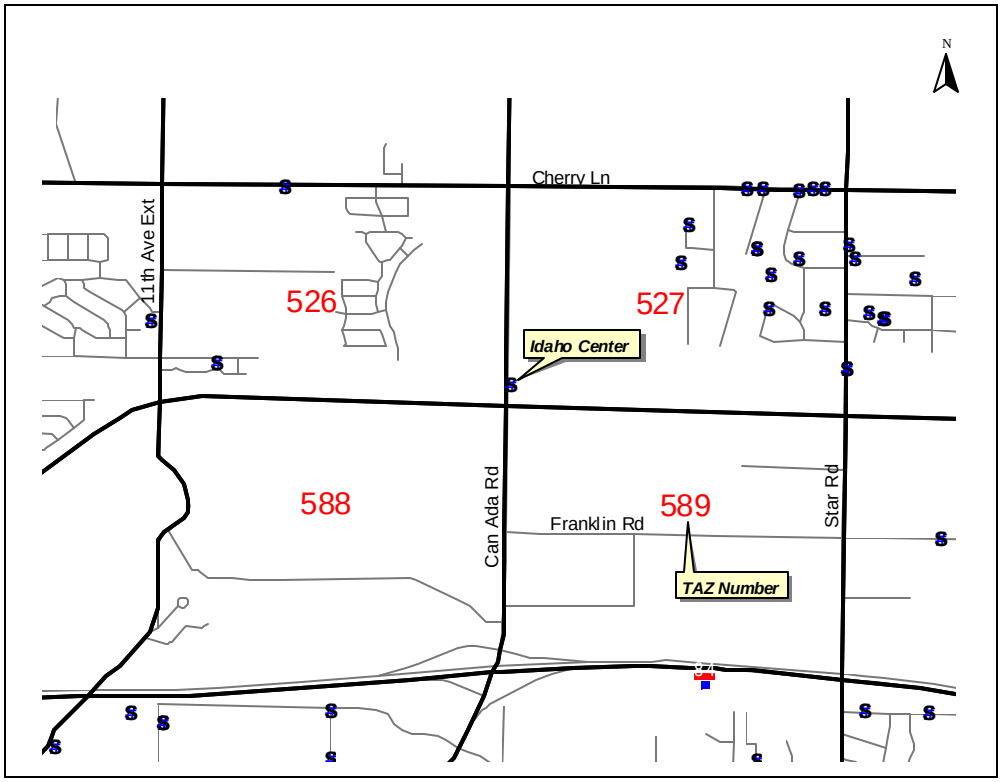
Table 2

Comparison of Employment Data, 2002			
	Polk Directory	John Church*	Difference
Ada and Canyon Total	241,411	234,670	2.8%
	Polk Directory	Department of Labor	Difference
Ada and Canyon Total	241,411	235,494	2.5%
*Source: 2002 State & County Economic Forecast (2001-2025)			

The two-county estimates are almost three percent higher, but the county-level estimates were 10% higher in Ada County and 27% lower in Canyon County. COMPASS intends to use more complete data sources in future model calibration efforts.

Addresses of employers were then geo-coded producing a point on a map showing the location of the business. The addresses were then assigned to its respective TAZ. Figure 4 below shows an example of the geo-coded addresses within TAZs.

Figure 4



Unfortunately, not all businesses were attributed to a TAZ using the geo-coding process. Remaining businesses were assigned to TAZs manually.

One of the last steps was to assign an industry category to each employer based on SIC codes. Using the Census website each employment record was assigned an industry type. Table 3 summarizes all the 2002 demographic estimates.

Table 3

Population and Housing Estimates, 2002 Adjusted for Group Quarters			
	Population	Households	Vehicles
Grand Total	481,235	176,666	368,434
Ada County	328,810	124,522	257,043
Canyon County	152,425	52,144	111,391
Employees by Industry Type Estimates, 2002			
Industry Type	Total	Ada County	Canyon County
Agriculture	946	143	803
Church	1,883	1,325	558
Education	16,415	11,954	4,461
Government	21,629	18,246	3,383
Industrial	257	173	84
Manufacturing	23,895	17,219	6,676
Retail	51,422	40,342	11,080
Service - Assisted Living	1,984	1,381	603
Service - Daycare	1,329	1,117	212
Service - Financial	8,157	6,559	1,598
Service - Lodging	2,994	2,741	253
Service - Medical	20,975	15,921	5,054
Service - Pet	689	537	152
Service - Postal	460	283	177
Service - Professional	59,124	51,112	8,012
Service - Social	9,441	7,528	1,913
Service - Storage	269	140	129
Service - Transportation	4,493	3,141	1,352
Service Utility	3,160	2,753	407
Wholesale/Retail	11,889	8,128	3,761
Grand Total	241,411	190,743	50,668
Source: Polk City Directory			
The above information is for calibration of the 2002 COMPASS Travel Demand Forecast Model. The figures may differ slightly from other adopted estimates. The model requires the data at the Traffic Analysis Zone level and if the individual data could not be attributed to a zone then the record was not used.			

Two more adjustments were made to the employment data. First, the 20 industry categories shown above were grouped into five model employment categories: retail, office, industrial, government or agriculture. Second, education jobs were removed from the government jobs because school trips are based on number of students. Education employment accounts for more than eight percent of total jobs. Additional details regarding school trips are in the Trip Generation and Trip Distribution chapters. Table 4 shows number of employees by category as used in the model.

Table 4

Adjusted Employment by Category, 2002						
	Retail	Office	Industrial	Government*	Agriculture	Total Jobs
Ada	48,493	81,595	26,784	24,722	64	181,658
Canyon	12,968	18,837	8,124	5,313	813	46,055
Total	61,461	100,432	34,908	30,035	877	227,713
*Government employment does not include all education jobs						

Forecasts

COMPASS is also responsible for the demographic forecasts for both counties with oversight by the Demographic Advisory Committee (http://www.compassidaho.org/committees/dac/dac.html). The forecasts developed in 2002 were a trend forecast out to 2030 in five-year increments. The trend was developed based on parcel level data, comprehensive plans, and available land. Please refer to the COMPASS website for demographic forecasts http://www.compassidaho.org/demographics.html.

TRIP GENERATION

The trip generation step converts the demographic / land use data into productions and attractions. The households are converted into "productions" and the employment (retail, office, industrial, government and agriculture) is converted into "attractions". Most models balance productions to attractions because the verification and forecasting of households is easier and more reliable. This is the case for all trip purposes except non-home base. Many pieces of data go into the trip generation step of the model and much of that information comes from household travel characteristics surveys.

PERSON TRIP DATA

COMPASS has expanded the trip types used by the model from four to six trip types by adding school and social trip types. The definitions of the trip types are as follows:

- Home Base Work: trips with one end at home and one end at work
- Home Base Shop: trips with one end at home and one end at a shopping establishment
- Home Base Social: trips with one end at home and one end at a social establishment (i.e. movies)
- Home Base School: trips with one end at home and one end at school (i.e. elementary through high school)
- Home Base Other: one end at home and one end anywhere but work, shopping, school or social
- Non-Home Base: neither end of the trip at home

Adding two more trip types will offer more refinement to the model and better results. The 2002 household travel survey collected the "primary purpose of the trip" and this information was used to assign a trip type. The addition of these two trip types was presented to the TMAC and approved in July 2003. The following table summarizes the percent distribution of each trip type.

Table 5

Person Trip Data, 2002 Household Survey		
Trip Type	**Trips**	**Percent**
Home Base Work	4,233	16.5%
Home Base Shop	2,571	10.0%
Home Base Social	2,946	11.5%
Home Base School	2,298	9.0%
Home Base Other	5,614	21.9%
Non-Home Base	7,965	31.1%
Total	25,627	
Tag Along	1,615	
Home Base "out of area"	5	
Grand Total	27,247	

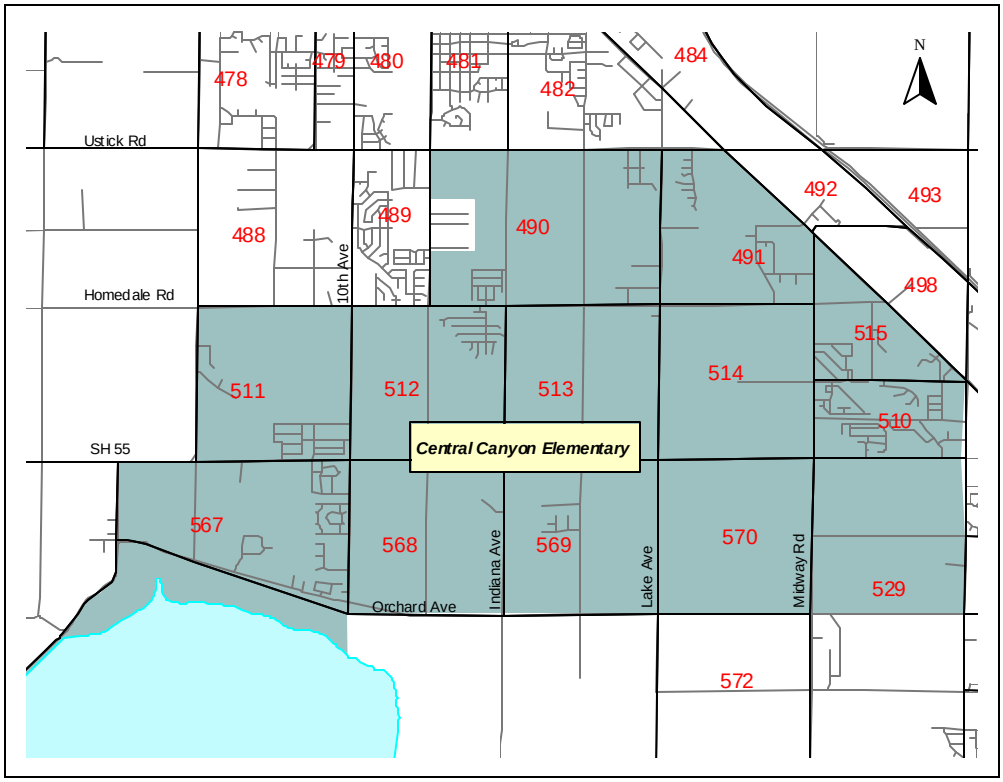
University, private, charter and alternative schools are included in the school trip but handled differently because attendance is not solely based upon where the student lives. Based upon enrollment numbers provided by the Department of Education for public, charter and alternative schools, and research on private schools, the enrollment distribution is the following:

Table 6

School Enrollment, 2002		
Alternative	1,682	1.5%
Charter	959	0.9%
Private	4,933	4.5%
University	19,961	18.3%
Public	81,547	74.8%
Total	109,082	

Enrollment in public schools account for 75% percent and those trips will be limited to enrollment boundaries for each school-by-school type. The data was set up using GIS and the data from the Department of Education. Figure 5 below is an example of the Central Canyon Elementary enrollment boundary in the Vallivue School District. Some TAZs are split by enrollment boundaries and percent attributable was determined by number of TAZ acres within each enrollment boundary.

Figure 5



Detail school enrollment for both public and private schools is located in Appendix B Table 56 and Table 57. These tables list the number of students by school type, and school name(s) for each TAZ.

CROSS-CLASSIFICATION TABLES

The number of people and vehicles in the household influences the number of person trips a household creates. Also, trips are made for various reasons. According to the 2002 household data survey, Treasure Valley residents make an average of 11 trips per household and the range is between 3.8 to 19.80 trips per household. The following tables summarize the trip rates by number of vehicles and persons in the household (cross-classification) and will be used in the trip generation step of the model to "produce" trips. The following data is from the 2002 Household Survey but adjusted for categories with no or few trip data; such as zero vehicle-3 person households. In these cases, the trip rate figures were established based upon "best fit". Cross-classification data was presented and accepted by TMAC in May 2004 with the understanding that some minor adjustments maybe needed during the calibration process. Table 7 and Table 8 show the final set of trips rates and the shaded cells indicate the rates adjusted due to the lack of data or very few samples. In Appendix B, Figure 23 through Figure 34 show the unadjusted versus adjusted rates data and charts.

Table 7

Ada County Final Cross-Classification Rates									
Vehicles (equal to or greater than)	Vehicles (less than)	Home base Work	Home base Shop	Home base Social	Home base School	Home base Other	Non-home base	Total Trips	NCHRP 365 Rates (page 26)
Greater than 1 person per household but less than 2 persons per household									
0	1	0.42	1.22	0.44	0.40	0.44	1.44	4.36	2.10
1	2	0.93	0.65	0.49	0.40	0.94	1.51	4.92	4.30
2	3	0.95	0.60	0.67	0.40	0.82	1.75	5.19	4.30
3	4	1.11	0.50	0.44	0.40	0.83	1.22	4.50	4.30
4	99	1.45	0.55	0.82	0.40	0.73	3.09	7.04	4.30
Greater than 2 persons per household but less than 3 persons per household									
0	1	0.96	1.22	1.14	0.57	2.71	1.86	8.46	4.00
1	2	1.20	1.11	0.82	1.15	2.00	2.44	8.72	6.30
2	3	1.87	1.15	0.93	0.98	1.77	2.86	9.56	7.50
3	4	2.20	0.94	0.90	1.19	1.43	3.23	9.89	7.50
4	99	2.17	1.18	0.97	0.96	1.53	3.17	9.98	7.50
Greater than 3 persons per household but less than 4 persons per household									
0	1	2.00	1.22	1.50	1.00	2.00	3.00	10.72	6.00
1	2	1.42	1.06	1.27	1.39	2.61	3.42	11.17	8.80
2	3	1.99	1.34	0.92	1.11	2.75	4.06	12.17	10.60
3	4	3.28	1.48	1.12	1.13	2.07	4.13	13.21	13.00
4	99	2.65	1.13	1.68	0.97	1.35	3.35	11.13	13.00
Greater than 4 persons per household									
0	1	2.00	2.00	3.00	1.50	2.00	2.00	12.50	7.00
1	2	1.77	1.00	2.68	3.55	3.45	2.55	15.00	11.20
2	3	1.94	1.30	2.40	2.81	4.50	5.08	18.03	13.00
3	4	2.46	1.34	2.39	3.33	4.88	5.42	19.82	15.30
4	99	2.86	1.38	2.29	2.86	5.04	6.43	20.86	15.30

Table 8

Canyon County Cross-Classification Rates									
Vehicles (equal to or greater than)	Vehicles (less than)	Home base Work	Home base Shop	Home base Social	Home base School	Home base Other	Non-home base	Total Trips	NCHRP 365 Rates
Greater than 1 person per household but less than 2 persons per household									
0	1	0.13	1.50	0.44	0.50	0.63	1.38	4.58	2.10
1	2	0.81	0.56	0.49	0.81	0.81	1.48	4.96	4.30
2	3	0.90	0.48	0.67	1.05	1.33	2.38	6.81	4.30
3	4	1.56	0.11	0.44	0.56	0.44	1.22	4.33	4.30
4	99	1.00	0.60	0.82	0.60	1.40	2.00	6.42	4.30
Greater than 2 persons per household but less than 3 persons per household									
0	1	0.29	1.00	1.14	0.57	1.00	3.00	7.00	4.00
1	2	1.34	1.10	0.82	1.15	2.17	3.71	10.29	6.30
2	3	1.91	0.93	0.93	0.98	1.80	3.16	9.71	7.50
3	4	1.85	1.19	0.90	1.19	1.54	4.17	10.84	7.50
4	99	1.29	0.71	0.97	0.96	2.83	3.00	9.76	7.50
Greater than 3 persons per household but less than 4 persons per household									
0	1	2.00	1.00	1.50	1.00	2.00	3.00	10.50	6.00
1	2	1.56	1.06	1.44	1.78	3.33	2.94	12.11	8.80
2	3	2.37	1.02	1.28	1.02	2.13	3.70	11.52	10.60
3	4	2.40	0.88	0.80	0.84	2.32	3.36	10.60	13.00
4	99	2.00	1.23	0.85	1.08	2.69	3.62	11.47	13.00
Greater than 4 persons per household									
0	1	2.00	4.00	2.00	1.50	2.00	2.00	13.50	7.00
1	2	1.93	1.20	3.40	0.73	1.53	1.40	10.19	11.20
2	3	1.96	1.30	2.27	1.98	4.84	4.97	17.32	13.00
3	4	2.23	1.81	3.36	2.85	3.79	5.60	19.64	15.30
4	99	3.07	1.24	3.62	1.90	4.34	4.10	18.27	15.30

Attraction Rates

Establishing trip attraction rates by type started with rates documented in NCHRP 365 (page 28) but adjustments were needed to better reflect the number of trips by trip type estimated from the 2002 household data survey. The final set of attraction rates are shown in Table 9**.** School trips were based trips per student per school type using the ITE Trip Generation Manual 7th Edition rates as guidance. The trip attraction rates used in the model are slightly higher than the average weekday rate per student but within the "range of rates".

Table 9

Trip Attraction Rates by Trip Type							
	Total Employment	Retail	Office	Government	Industrial	Agriculture	Households
Downtown Boise TAZs (1-27)							
Home Base Work	1.25	Not applicable					
Home Base Shop	Not applicable	1.10	Not applicable				
Home Base Social	Not applicable		0.90	0.25	Not applicable		0.30
Home Base Other	Not applicable	0.70	0.80	0.25	0.25	0.25	0.70
Non-Home Base	Not applicable	1.60	1.10	0.50	0.50	0.50	0.70
All Other Ada County TAZs (28-399)							
Home Base Work	1.35	Not applicable					
Home Base Shop	Not applicable	5.80	Not applicable				
Home Base Social	Not applicable		0.90	0.50	Not applicable		0.30
Home Base Other	Not applicable	2.60	0.70	0.25	0.70	0.25	0.70
Non-Home Base	Not applicable	4.50	1.00	0.25	0.70	0.25	0.70
Canyon County TAZs (400-602)							
Home Base Work	1.75	Not applicable					
Home Base Shop	Not applicable	5.80	Not applicable				
Home Base Social	Not applicable		1.80	0.60	Not applicable		0.50
Home Base Other	Not applicable	3.00	0.90	0.25	0.25	0.25	0.70
Non-Home Base	Not applicable	4.50	1.00	0.25	0.25	0.25	0.70

Table 10

School Trip Attraction Rates (per student)				
	Elementary	Middle	High School	University
Home Base School	1.18	1.68	2.08	2.76

Canyon County attraction rates are higher to account for the 27% shortfall estimated based on the Department of Labor's county-level data and Polk. This is addressed in the demographics section in the Introduction chapter.

SPECIAL GENERATORS

During calibration special generators were added in the following TAZs. Please refer to this list of special generators in Table 58 in Appendix B for the number of trips added by trip type.

Ada County

1. Boise High School (open campus) and YMCA (TAZ 3)
2. Main Post Office located on Shoreline Drive and 13th Street (TAZ 26)
3. St. Luke's Meridian Hospital on Eagle Road (TAZ 162)
4. Boondocks Fun Center (TAZ 288)
5. Crossroads Shopping Center on Eagle Road and Fairview Avenue (TAZ 342)
6. Outlet Mall and Ice World (TAZ 345)

Canyon County

7. Canyon County Courthouse and Jail (TAZ 466)
8. Mercy North Medical Center on Garrity Boulevard (TAZ 535)
9. Commercial Center including Super Wal-Mart, Mercy Medical Hospital, Nampa Recreation Center (TAZ 560)

EXTERNAL TRIPS

The 1997 model used one factor for calculating internal to external (IX) and another factor for external to internal (XI) trips. State-of-the-practice recommends using an IX and XI factor for each trip type. Home base work data was easily obtained using work place data from the 2000 Census. The non-work internal-external and external-internal factors shown in Table 11 were generated based on professional judgment, reasonable assumption about trip characteristic of commuters and the used of an iterative process during calibration. The availability of recent traffic count data was available at all the external stations was also helpful. The rates for external-internal are about three times higher than the internal-external because the capitol city, Boise, is located in Ada County and Ada and Canyon Counties combined make up more than 30% of Idaho's population.

Table 11

Trip Rate Factors for Internal to External (IX) and External to Internal (XI)		
Trip Type	Ada County to "External"	Canyon County to "External"
Home Base Work	0.014	0.023
Home Base Shop	0.001	0.004
Home Base Social	0.006	0.018
Home Base School	0.003	0.011
Home Base Other	0.015	0.018
Non-Home Base	0.018	0.025
	"External" to Ada County	"External" to Canyon County
Home Base Work	0.04709	0.06440
Home Base Shop	0.05810	0.04810
Home Base Social	0.04181	0.04381
Home Base School	0.04810	0.04381
Home Base Other	0.04181	0.04510
Non-Home Base	0.04181	0.04881

The following information in Table 12 was used to estimate the raw production external attraction internal and the raw production internal attraction external and the external-to-external trips (discussed in the Trip Distribution chapter). Table 13 includes the road name per external and a map, Figure 35 in Appendix B.

Table 12

External Station Data and Estimates													
TAZ 's?	**738**	**739**	**740**	**741**	**742**	**743**	**744**	**745**	**746**	**747**	**748**	**749**	**750**
Actual Traffic Counts	9,000	6,000	2,144	3,200	250	21,000	*959	2,000	8,400	7,300	310	4,200	17,500
Estimated % Thru Trips	8.0%	8.0%	0.5%	7.0%	0.5%	22.5%	0.5%	0.5%	12.5%	8.0%	0.5%	13.0%	22.5%
Thru Trips	720	480	11	224	1	4,725	5	10	1,050	584	2	546	3,938
X2I & I2X Trips	8,280	5,520	2,133	2,976	249	16,275	954	1,990	7,350	6,716	308	3,654	13,563
Outbound (area out)*	4,500	3,000	1,072	1,600	125	10,500	480	1,000	4,200	3,650	155	2,100	8,750
Inbound (into area)*	4,500	3,000	1,072	1,600	125	10,500	480	1,000	4,200	3,650	155	2,100	8,750
Out Trips (x2x)	360	240	5	112	1	2,363	2	5	525	292	1	273	1,969
In Trips (x2x)	360	240	5	112	1	2,363	2	5	525	292	1	273	1,969
Out Trips (i2X)	4,140	2,760	1,067	1,488	124	8,138	477	995	3,675	3,358	154	1,827	6,781
In Trips (x2i)	4,140	2,760	1,067	1,488	124	8,138	477	995	3,675	3,358	154	1,827	6,781
Total Trips	9,000	6,000	2,144	3,200	250	21,000	959	2,000	8,400	7,300	310	4,200	17,500
Commercial Vehicles	500	380	n/a	190	n/a	4,800	n/a	180	380	400	n/a	470	4,600
Commercial Vehicles % of Total	5.6%	6.3%	n/a	5.9%	n/a	22.9%	n/a	9.0%	4.5%	5.5%	n/a	11.2%	26.3%
*Updated counts were not available for this location and the traffic volumes vary greatly depending on the season.													

Table 13 summarized the raw (prior to balancing) productions and attractions for internal-external (IX) and external-internal (XI). These raw productions are included in the demographic file used in the model. Some of the numbers used are higher than the traffic counts for that reason – they are vehicle trips and person trips are needed. The "On Going and Next Steps" section briefly discusses a truck freight study that may provide better external vehicle and possibly external person trip data.

Table 13

Internal-External Raw P and As, 2002			
		RPXAI	RPIAX
738	SH 16 – Ada/Gem County Line	4,900	4,900
739	SH 55 – Ada/Boise County Line	3,200	3,200
740	Bogus Basin Road – Ada/Boise County Line	1,072	1,072
741	SH 21– Ada/Boise County Line	1,800	1,800
742	Black's Creek Road	125	125
743	I-84 - Ada/Elmore County Line	10,500	10,500
744	Swan Falls Road	480	480
745	SH 45	1,000	1,000
746	SH 55 - Canyon/Owyhee County Line	4,200	4,200
747	US 95 - Canyon/Owyhee County Line	3,650	3,650
748	Old Hwy 18	155	155
749	US 20/26 – Canyon/Payette County Line	2,100	2,100
750	I-84 - Canyon/Payett County Line	8,750	8,750

The raw production external attraction internal (RPXAI) and the raw production internal attraction external (RPIAX) columns total 41,932 each. This number is found in Table 16 the unbalanced trip generation results for IX attractions and XI productions. The IX productions use the trip rate factors for Ada or Canyon to "External" listed above in Table 11 and the I-I unbalanced productions per county per trip type (the total I to I unbalanced productions are shown in Table 14). The XI attractions are calculated during the balancing step and method is similar to IX productions. The XI attractions use the trip rate factors for "External" to Ada or Canyon listed above in Table 11 and the I-I unbalanced attractions per county per trip type (the total I to I unbalanced attractions are shown in Table 14.

TRIP GENERATION RESULTS AND CONCLUSIONS

The following four tables summarize the trip generation results before and after balancing and compare total trips generated based on the 2002 household travel data and the model results. Before production-attraction balancing the productions were 5.3% higher than attractions. After the balancing step, the percent distributions by trip type results were comparable to the 2002 household results and NCHRP 365 weighted average.

Table 14 summarizes the productions and attractions prior to balancing. Overall, productions were 5.3% higher. Table 15 summarizes the balanced productions and attractions. All trips types except non-home base were balanced to productions. Table 16 shows the number of internal-external and external-internal after balancing.

Table 14

Unbalanced Production and Attractions (I to I)			
Trip Type	Productions	Attractions	Percent Difference
Home Base Work	327,351	325,758	0.5%
Home Base Shop	211,648	328,837	-35.6%
Home Base Social	201,362	189,345	6.3%
Home Base School	216,577	198,867	8.9%
Home Base Other	438,449	375,673	16.7%
Non-Home Base	641,813	515,947	24.4%
Total	2,037,200	1,934,427	5.3%

Table 15

Balanced Production and Attractions			
Trip Type	Productions	Attractions	Percent Distribution
Home Base Work	321,825	321,825	17.1%
Home Base Shop	211,275	211,275	11.3%
Home Base Social	199,315	199,315	10.6%
Home Base School	197,817	197,817	10.5%
Home Base Other	431,510	431,510	23.0%
Non-Home Base	515,947	515,947	27.5%
Total	1,877,689	1,877,689	100.0%
		HBS, HBSC, HBSO, HBO	55.4%

Table 16 summarizes the internal-external and external-internal productions and attraction before and after balancing. The previous page references these numbers and attempts to explain how they were calculated. Details on the IX and XI calculations are in Appendix E which contains the full model script.

Table 16

Unbalanced IX XI Production and Attractions				Balanced IX XI Production and Attractions	
	Productions	Attractions		Productions	Attractions
Internal to External	28,827	41,932		28,827	28,827
External to Internal	41,932	--		87,637	87,637

The data in Table 17 and Table 18 were used to estimate the number of person trips based on the 2002 household travel survey and for comparison to the model results shown above in Table 15. As a result, the person trip estimate from the model and the 2002 household travel survey is -4%. Table 19 summarizes the trip type distribution between the 2002 survey, model, and NCHRP.

Table 17

Total Person Trips Estimated, 2002 Household Survey		
Households	Trip Rate	Total Trips Estimated
177,026	11.1	1,957,908

Table 18

Total Person Trips by Trip Type, 2002 Household Survey		
	Trips per Type Estimate based on 2002 Household Survey (PCT dist x total trips estimate)	Percent Distribution
Home Base Work	323,055	16.5%
Home Base Shop	195,791	10.0%
Home Base Social	225,159	11.5%
Home Base School	176,212	9.0%
Home Base Other	428,782	21.9%
Non-Home Base	608,909	31.1%
Total	1,957,908	100.0%

Table 19

Comparison of Trips per Trip Type			
	Percent Distribution from 2002 Household Survey (Table 19)	Percent Distribution from Model (Table 15)	NCHRP 365 (page 29)
Home Base Work	16.5%	17.1%	21%
Home Base Shop	10.0%	11.3%	
Home Base Social	11.5%	10.6%	
Home Base School	9.0%	10.5%	
Home Base Other	21.9%	23.0%	56%
Non-Home Base	31.1%	27.5%	23%
Total	100.0%	100.0%	100.0%
HBS, HBSC, HBSO, HBO	55.4%	52.4%	

Based on the comparison of model results to the 2002 household travel survey and some of the information provided in NCHRP 365 the conclusion was made that the trip generation inputs were reasonable and the results were acceptable.

Forecasts

Only two trip generation inputs needed forecasting. First, the internal-external and external-internal trip factors per county were needed for 2005 through 2030 in five-year increments. These factors and the growth rate used are shown in Table 20. Second, the number of students per school, the location of new schools, type of new school and capacity were forecasted. This was accomplished by meeting with school district staff and gathering the appropriate information from each of the school districts. Some information could not be obtained for the schools in three small cities in Canyon County. Therefore, a student per population ratio was used to estimate the number of students in the out years. Table 21 and Table 22 summarize the public and private enrollment respectively for the base year and the forecast years 2005 through 2030.

Table 20

Forecasted Trip Rate Factors for Internal to External (IX) and External to Internal (XI)							
Ada County to "External"							
Trip Type	Growth Rate	Forecast Year					
		2005	2010	2015	2020	2025	2030
Home Base Work	0.0050	0.019	0.024	0.029	0.034	0.039	0.044
Home Base Shop	0.0000	0.001	0.001	0.001	0.001	0.001	0.001
Home Base Social	0.0000	0.006	0.006	0.006	0.006	0.006	0.006
Home Base School	0.0000	0.003	0.003	0.003	0.003	0.003	0.003
Home Base Other	0.0050	0.020	0.025	0.030	0.035	0.040	0.045
Non-Home Base	0.0050	0.023	0.028	0.033	0.038	0.043	0.048
Canyon County to "External"							
Home Base Work	0.0010	0.024	0.024	0.025	0.025	0.026	0.026
Home Base Shop	0.0000	0.004	0.004	0.004	0.004	0.004	0.004
Home Base Social	0.0000	0.018	0.018	0.018	0.018	0.018	0.018
Home Base School	0.0000	0.011	0.011	0.011	0.011	0.011	0.011
Home Base Other	0.0050	0.023	0.028	0.033	0.038	0.043	0.048
Non-Home Base	0.0050	0.030	0.035	0.040	0.045	0.050	0.055
"External" to Ada County							
Home Base Work	0.0050	0.05210	0.05710	0.06210	0.06710	0.07210	0.07709
Home Base Shop	0.0050	0.06310	0.06810	0.07310	0.07810	0.08310	0.08810
Home Base Social	0.0000	0.04181	0.04181	0.04181	0.04181	0.04181	0.04181
Home Base School	0.0025	0.05060	0.05310	0.05560	0.05810	0.06060	0.06310
Home Base Other	0.0025	0.04431	0.04681	0.04931	0.05181	0.05431	0.05681
Non-Home Base	0.0000	0.04181	0.04181	0.04181	0.04181	0.04181	0.04181

"External" to Canyon County							
Home Base Work	0.0085	0.07290	0.08140	0.08990	0.09840	0.10690	0.11540
Home Base Shop	0.0085	0.05660	0.06510	0.07360	0.08210	0.09060	0.09910
Home Base Social	0.0000	0.04381	0.04381	0.04381	0.04381	0.04381	0.04381
Home Base School	0.0025	0.04631	0.04881	0.05131	0.05381	0.05631	0.05880
Home Base Other	0.0025	0.04760	0.05010	0.05260	0.05510	0.05760	0.06010
Non-Home Base	0.0000	0.04881	0.04881	0.04881	0.04881	0.04881	0.04881

Table 21

Forecasted Public School Enrollment				
Year	Elementary	Middle/Junior	Senior High	University
2005	42,958	20,114	22,148	24,384
2010	49,543	24,683	26,136	26,284
2015	54,320	24,896	29,408	29,884
2020	57,319	29,121	29,693	35,084
2025	61,399	31,061	30,297	40,684
2030	63,648	31,786	30,684	44,684

Table 22

Forecasted Private School Enrollment				
Year	Elementary	Middle/Junior	Senior High	University
2005	3,438	2,188	2,383	326
2010	3,502	2,242	2,469	338
2015	3,752	2,384	2,895	380
2020	3,842	2,454	2,935	410
2025	3,919	2,516	2,985	445
2030	3,989	2,586	3,145	484

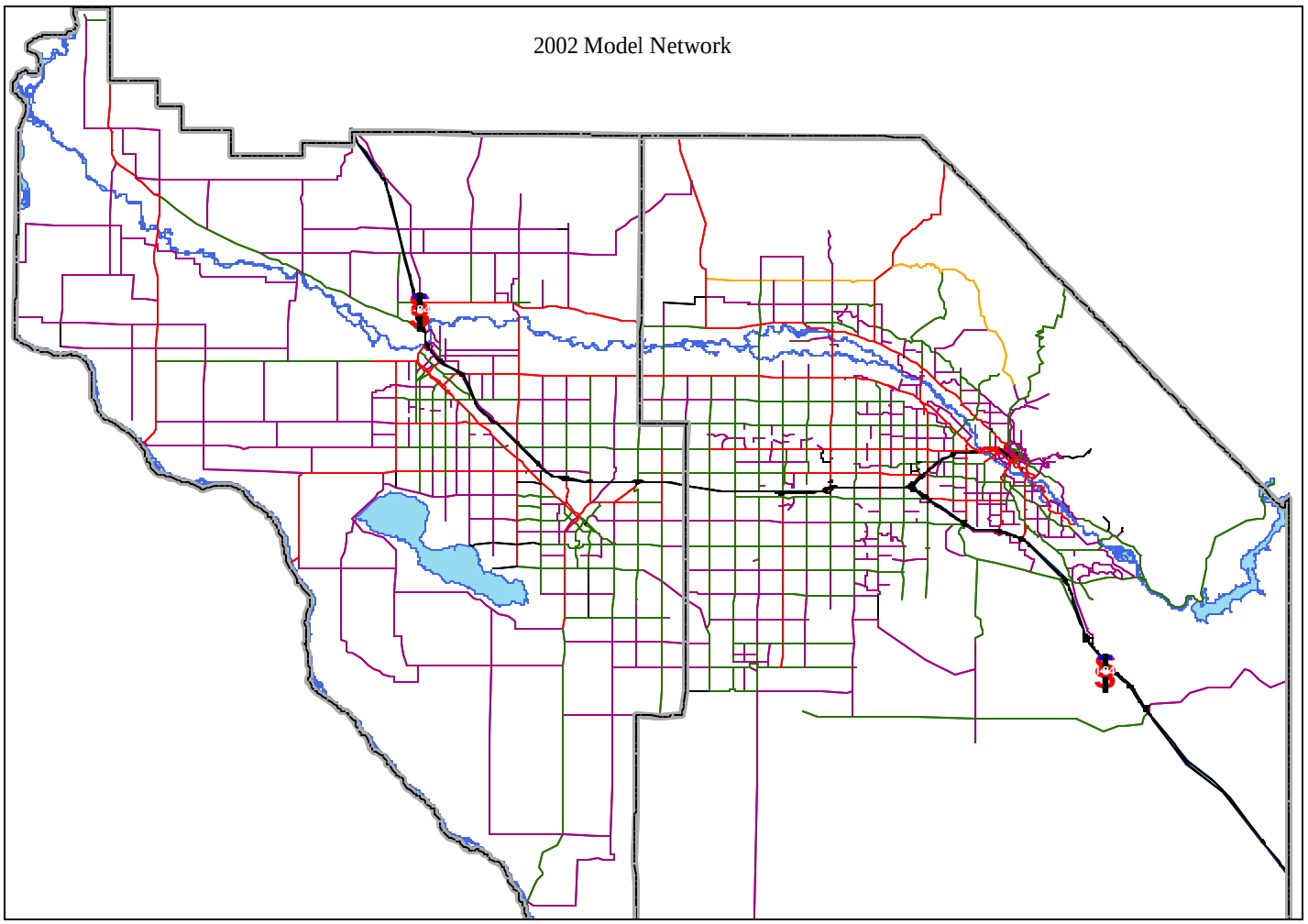
TRIP DISTRIBUTION

The trip distribution step involves the roadway networks, travel times, and converting the productions and attractions from the trip generation step into a TAZ level person trip matrix. The data needed for trip distribution comes from household surveys and basic data collection efforts typically performed by staff such as, speed and number of lanes.

NETWORK

The 1997 network was a starting point to developing the 2002 model network. The 2002 model network, shown in Figure 6 consists of functionally classified roads collector and higher from the Long Range Highway and Street Map official in 2002, the addition of section line roadways and local roads for circulation purposes only. These changes were presented to TMAC and accepted by the committee in August 2002 and January 2003, respectively. Also in 2003 roadway data was collected throughout the two-county area by COMPASS staff. The data collected was posted speed, number of travel lanes, and total lanes and traffic count data from local agencies and cities. Table 59 in Appendix C lists all the input network link attributes with brief descriptions.

Figure 6



Traffic count data throughout the two-county area are collected by Idaho Transportation Department, Ada County Highway District, all four highway districts and some cities in Canyon County (Canyon Highway District, Nampa Highway District, Notus-Parma Highway District, Golden Gate Highway District). Figure 7 and Figure 8 shows the traffic count coverage for both the 24-hour and peak hour (highlighted in red). Most traffic count data in the model were taken between 2001 and 2003. Fewer peak hour counts were available but the amount of information was sufficient to develop the peak hour model.

Figure 7

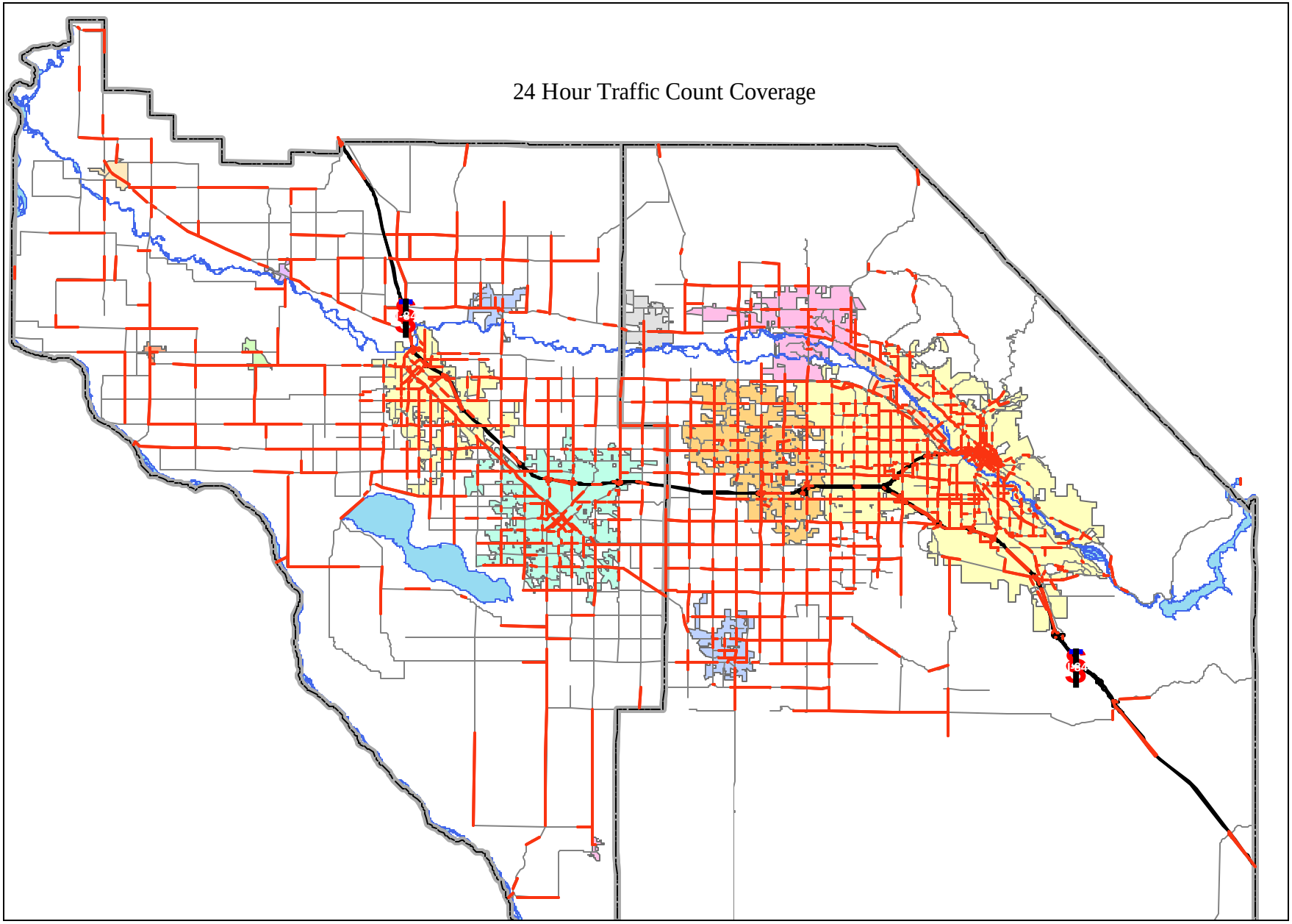
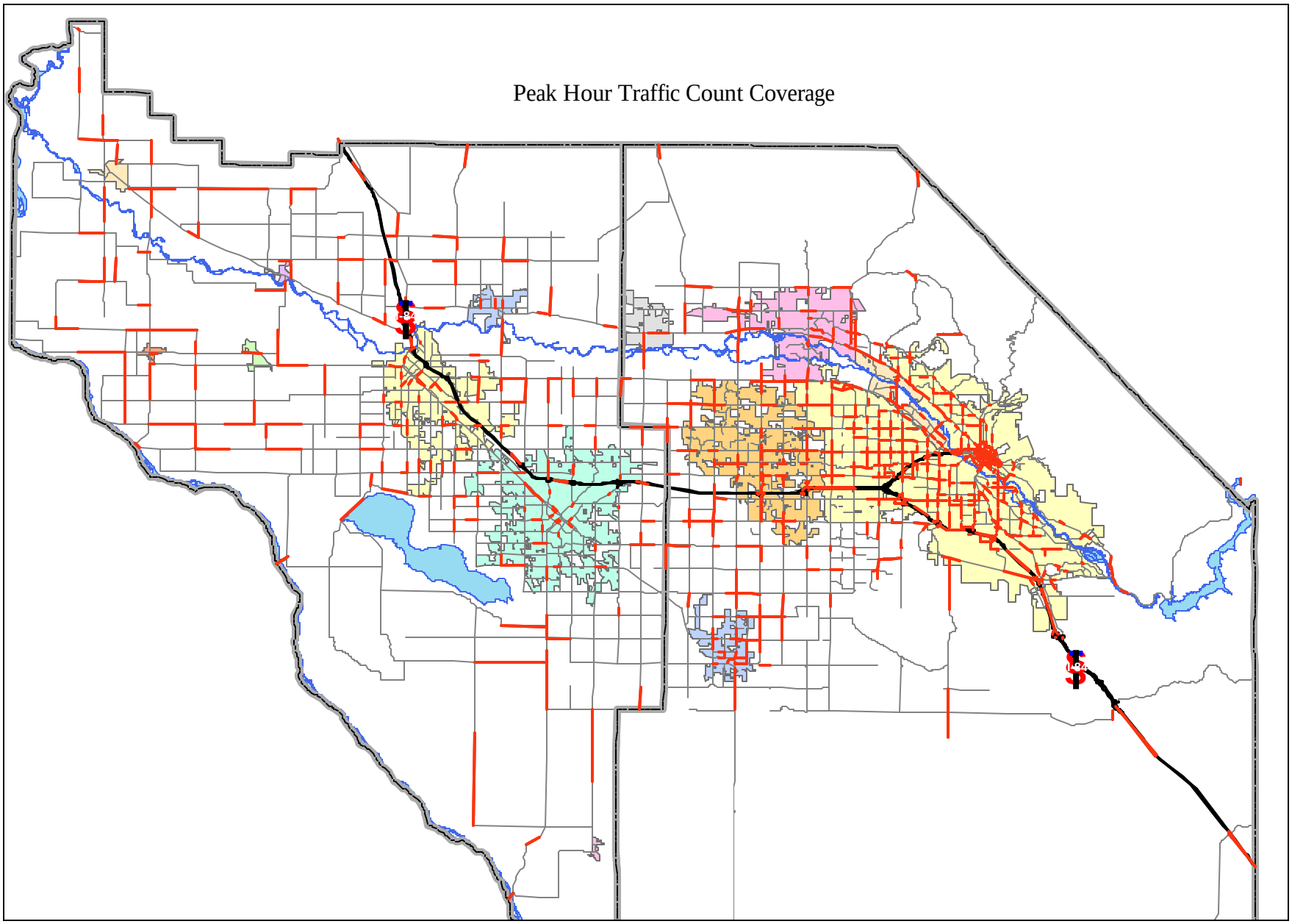


Figure 8



Model Capacities

Model input capacities are based on information found in Table 23-2 of the Highway Capacity Manual 2000 (generalized for planning purposes) for mid-LOS D. The roadway capacities listed in Table 23 through Table 28 were presented to TMAC and accepted by the committee in April 2003. Some model input capacities were adjusted to better reflect local conditions. The most notable difference is the capacity for freeways is estimated at 1,940 vehicles per hour per lane (veh/hr/ln) using HCM 2000 but the COMPASS model uses 1,750 veh/hr/ln for 65 MPH segments and 1,600 veh/hr/ln – this lower capacity is more reflective of local conditions. Also, in 2002 the interstate between Meridian and WYE Interchanges had been under construction for a few years and the posted speed limit was 55 MPH. Therefore, the input capacity for that section of interstate was 1,600 vehicles per hour per lane. However, model networks for 2005 and later were changed to reflect the completion of construction with 65 MPH and 1,750 vehicles per hour per lane.

Table 23

Freeways							
Free Flow Rates	Maximum Service Flow Rates	Level of Service					
		A	B	C	D	E	F
@65 mph	pc/hr/ln	710	1170	1680	2090	2350	
	veh/hr/ln	660	1090	1560	1940	2180	
4 Lane	AADT	24,000	39,600	56,700	70,500	87,200	
6 Lane	AADT	36,000	59,500	85,000	105,800	130,800	
@55 mph	pc/hr/ln	600	990	1430	1910	2250	
	veh/hr/ln	560	920	1330	1780	2090	
4 Lane	AADT	20,400	33,500	48,400	64,700	83,600	
6 Lane	AADT	30,500	50,200	72,500	97,100	125,400	

Table 24

Two-lane Highway						
Maximum Service Flow Rates	Level of Service					
	A	B	C	D	E	F
Peak Hour	200	450	700	1100	1800	
AADT Basic	2,800	5,600	9000	14,400	23,200	
AADT Adjusted	2,600	5,300	8,500	13,700	22,000	

Table 25

Collectors - Business District									
						Level of Service			
	Lanes	Direction	Left Turns	Parking	V/C Ratio	C	D	E	F
With Parking	2	two-way	0.800	0.765	0.400	6300	7100	7900	
Without Parking			0.800	0.900	0.400	7500	8400	9300	
					veh/hr/ln	315	355	395	
					veh/hr/ln	375	420	465	
With Parking	3	two-way	0.950	0.765	0.400	7500	8500	9400	
Without Parking			0.950	0.900	0.400	8900	10,000	11,100	
					veh/hr/ln	375	425	470	
					veh/hr/ln	445	500	555	
With Parking	2	one-way	1.000	0.765	0.400	8,000	9,000	10,000	
Without Parking			1.000	0.900	0.400	9,400	10,500	11,700	
					veh/hr/ln	400	450	500	
					veh/hr/ln	470	525	585	
With Parking	3	one-way	1.000	0.765	0.400	11,900	13,400	15,000	
Without Parking			1.000	0.900	0.400	14,000	15,800	17,500	
					veh/hr/ln	400	450	500	
					veh/hr/ln	470	530	580	

Table 26

Collectors – Non-Business District									
						Level of Service			
	Lanes	Direction	Left Turns	Parking	V/C Ratio	C	D	E	F
With Parking	2	two-way	0.800	0.925	0.400	7,700	8,600	9,600	
Without Parking			0.800	1.000	0.400	8,300	9,400	10,400	
					veh/hr/ln	385	430	480	
					veh/hr/ln	415	470	520	
With Parking	3	two-way	0.950	0.925	0.400	9,100	10,300	11,400	
Without Parking			0.950	1.000	0.400	9,900	11,100	12,300	
					veh/hr/ln	455	515	570	
					veh/hr/ln	495	555	615	

Table 27

Arterial - Business District									
						Level of Service			
	Lanes	Direction	Left Turns	Parking	V/C Ratio	C	D	E	F
With Parking	2	two-way	0.800	0.765	0.600	9,500	10,700	11,900	
Without Parking			0.800	0.900	0.600	11,200	12,600	14,000	
					veh/hr/ln	475	535	595	
					veh/hr/ln	560	630	700	
With Parking	3	two-way	0.950	0.765	0.600	11,300	12,700	14,100	
Without Parking			0.950	0.900	0.600	13,300	15,000	16,600	
					veh/hr/ln	565	635	705	
					veh/hr/ln	665	750	830	
With Parking	2	one-way	1.000	0.765	0.600	11,900	13,400	14,900	
Without Parking			1.000	0.900	0.600	14,000	15,700	17,500	
					veh/hr/ln	595	670	745	
					veh/hr/ln	700	785	875	
With Parking	3	one-way	1.000	0.765	0.600	17,800	20,000	22,300	
Without Parking			1.000	0.900	0.600	20,100	23,600	26,200	
					veh/hr/ln	590	670	740	
					veh/hr/ln	670	790	870	

Table 28

Arterial - Non-Business District								
					Level of Service			
Lanes	Direction	Left Turns	Parking	V/C Ratio	C	D	E	F
2	two-way	0.800		0.600	12,400	14,000	15,600	
				veh/hr/ln	620	700	780	
3	two-way	0.950		0.600	14,800	16,600	18,500	
				veh/hr/ln	740	830	925	
4	two-way	0.800		0.600	24,900	28,000	31,100	
				veh/hr/ln	620	700	780	
5	two-way	0.950		0.600	29,500	33,200	36,900	
				veh/hr/ln	740	830	920	
6	two-way	0.800	0.900	0.600	33,600	37,800	42,000	
				veh/hr/ln	560	630	700	
7	two-way	0.950	0.900	0.600	39,900	44,900	49,900	
				veh/hr/ln	665	750	830	

TERMINAL TIMES

Terminal times are added to the beginning and end of a trip (TAZ to TAZ) and vary by area type. According to NCHRP 365 terminal times represent the amount of time and time value of money required to walk to and from a transit mode, to park or access a parked car, and so on. Table 29 summarizes the terminal times by area used in the 2002 model. Appendix C lists the terminal times and area type per TAZ. Area types were established using areas of impact and professional judgment. The trip generation step also uses different attraction rates for CDB and non-CBD. Therefore, that same set of TAZs, 1 through 27, have a terminal time of three or four minutes. The highest terminal time is five minutes in two TAZs, 40 and 41, because Boise State University is a "commuter" type campus with limited on-campus parking therefore, some students park elsewhere.

Table 29

Summary of Terminal Times (minutes)		
Area Type	2002 Model	NCHRP 365
CBD	3	5
CBD (TAZ with parking garage)	4	n/a
CBD Fringe	2.5	4
CBD Fringe / BSU	5	n/a
Urban	2	3
Suburban	1.5	2
Rural	1	1

TURN RESTRICTIONS/PENALTIES

The model includes turn restrictions in 14 locations to reflect actual traffic operations. The following list contains a brief description of the prohibited traffic movements that the model may not recognize.

1. 9th St (southbound one-way) - U-turn not permitted to northbound Capitol Blvd
2. Boise Ave to Capitol Blvd one-lane connections (Boise Hills) - cannot turn southbound on Capitol Blvd
3. Main St ramp to Chinden Blvd - westbound direction cannot turn eastbound to the connector
4. Cole / Overland Interchange
    - Cole/Overland IC westbound off ramp Overland Rd - cannot go westbound on Overland Rd
    - Cole/Overland IC eastbound off ramp from WYE flyover - cannot turn onto Entertainment Dr
5. Franklin Rd IC to Franklin Rd and Boise Towne Square - can not turn onto loop ramp to go eastbound I-184
6. I-184 westbound to the Milwaukee St Exit - cannot turn onto the westbound on ramp for I-84
7. Federal Way northwest bound - cannot turn on to southbound Vista Ave
8. Boise Ave - cannot turn west on to University Dr to Capitol Blvd
9. Capitol Blvd - southbound cannot turn on to Boise Hills to access Boise Ave
10. Meridian Rd Interchange
    - southbound on Meridian Rd, cannot use the eastbound on ramp (must use loop ramp)
    - northbound on Meridian Rd, cannot use the eastbound loop on ramp (must use other on ramp)
11. Eagle Rd Interchange
    - northbound on Eagle Rd, cannot use the eastbound on ramp loop (must use other on ramp)
    - southbound on Eagle Rd, cannot use the eastbound on ramp (must use loop ramp)
12. Eagle Rd / Fairveiw Ave Intersection - drivers must use free-right turn lanes
13. State St - eastbound can not turn north on 28th St (must use 26th/27th – added two small sections of local road to accomodate)
14. Eagle / US 2026 intersection - must use free right

The model also includes 30 second turn penalties in five locations in an attempt to reflect actual conditions. In two cases these penalties were added to improve model estimates

15. Sunset Ave to 28th St is indirect and drivers must turn on 32nd St
16. Kings Corner Railroad Crossing two intersections divided by the railroad. Improvements to this area are underway and should be complete in 2007. Therefore, this 30 second penalty is removed from out-year models
17. Happy Valley Rd at grade railroad crossing – delay at crossing
18. Kuna Rd westbound to southbound on Linder Rd – two stops in short section compared to the "sweeping" roadway going northbound into downtown Kuna

19. Linder Rd railroad crossing south of Kuna Rd – delay at the crossing

EXTERNAL TO EXTERNAL (FRATAR)

The FRATAR step in the model balances to the following external to external (XX) trip ends shown in Table 30. An initial estimate of through trips per station is shown in Table 12 in the Trip Generation chapter and based on traffic count data. Through an iterative process the trip ends were adjusted upward in order to better match the traffic counts at two external stations - SH 16 and SH 55. Both of which are located at the northern Ada County line.

Table 30

2002 External to External (Trip Ends)			
TAZ	Location	In	Out
738	SH 16	460	460
739	SH 55 Ada	340	340
740	Bogus Basin	5	5
741	SH 21	112	112
742	Black's Creek	1	1
743	I-84 Ada	2363	2363
744	Swan Falls	2	2
745	SH 45	3	3
746	SH 55 Canyon	525	525
747	US 95	292	292
748	Old Hwy 18	1	1
749	US 20/26	273	273
750	I-84 Canyon	1969	1969

FRICTION FACTORS

Table 60 in Appendix C shows the actual friction factors used in the 2002 model calibration. The home base work and shop friction factors were changed slightly from the factors used in the 1997 model. Since two trip types were added in this model friction factors were developed for home base social and school trips. The home base social factors are the same as the home base other. An iterative process was used to achieve the model results.

Since a majority (75%) of the home base school trips are restricted to enrollment boundaries the friction factors for school trips had little influence on the resulting model frequency curves. This was confirmed by testing different home base school friction factors and reviewing the results. The friction factors used in the 2002 model produced reasonable results compared to the 2002 survey data.

Trip Length Frequency Distribution Curves comparisons

Figure 9 through Figure 14 compare the trip length frequency distribution developed from the 2002 household travel survey data and the 2002 model results per trip type. Figure 36 through Figure 41 in Appendix C contains the detailed (per minute) and cumulative summary of trip length frequency data by trip type from the 2002 household survey and model results.

Figure 9

Home base Work		
Travel Time (minutes)	2002 Household Survey	Model
1 to 10	28.18%	24.14%
11 to 15	22.75%	31.20%
15 to 20	14.15%	22.98%
21 to 25	8.74%	11.10%
26 to 30	13.96%	6.06%
31 to 35	3.85%	2.67%
over 35	8.36%	1.85%

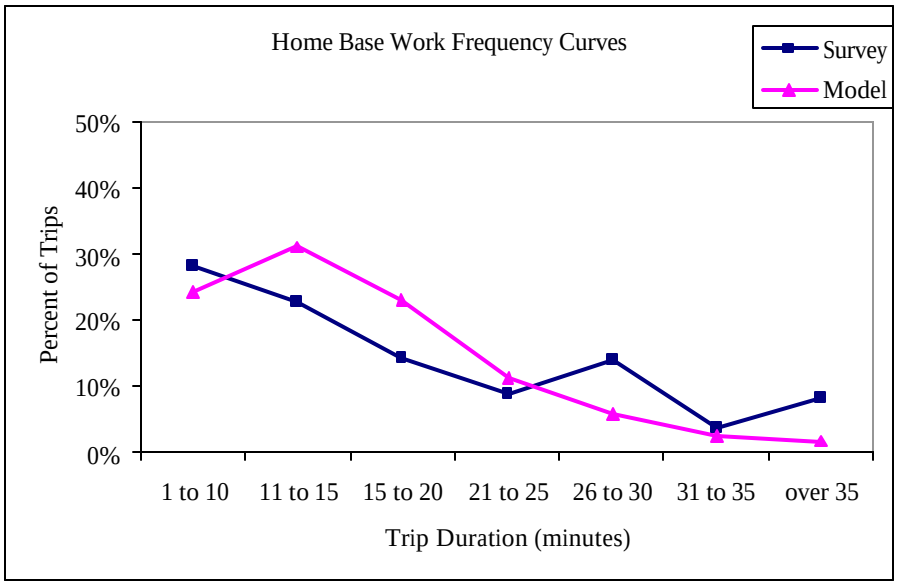


Figure 10

Home base Shop		
Travel Time (minutes)	Survey	Model
1 to 10	55.78%	56.64%
11 to 15	23.26%	22.30%
15 to 20	9.33%	9.21%
21 to 25	3.50%	5.11%
26 to 30	4.20%	3.18%
31 to 35	1.40%	1.89%
over 35	2.53%	2.29%

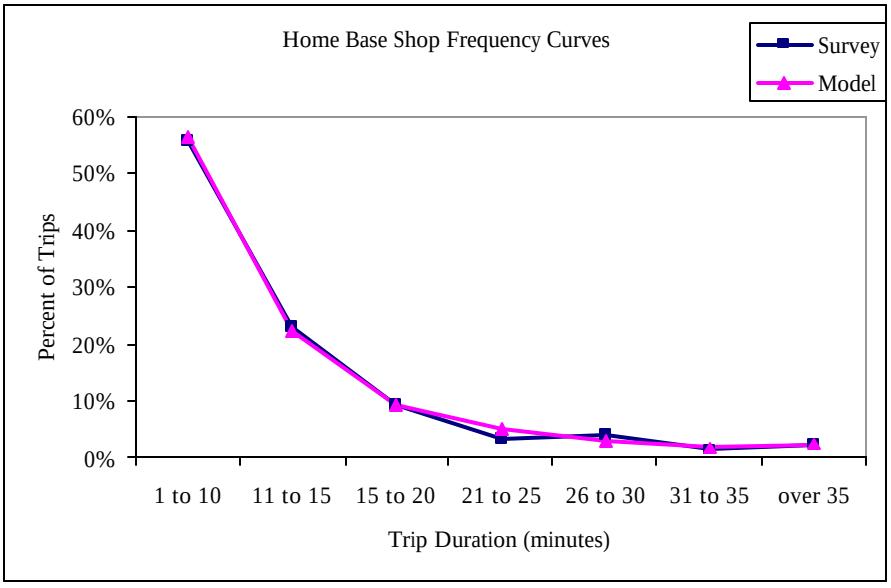


Figure 11

Home base Social		
Travel Time (minutes)	Survey	Model
1 to 10	47.42%	41.44%
11 to 15	22.03%	31.15%
15 to 20	9.98%	15.41%
21 to 25	4.68%	5.43%
26 to 30	8.66%	3.41%
31 to 35	1.97%	1.83%
over 35	5.26%	1.32%

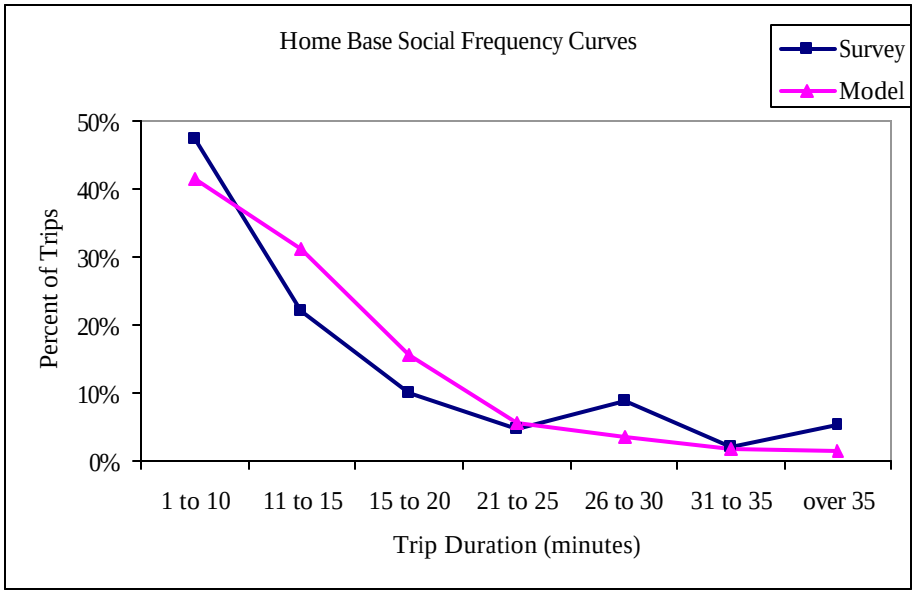


Figure 12

Home base School		
Travel Time (minutes)	Survey	Model
1 to 10	45.13%	65.43%
11 to 15	15.58%	19.30%
15 to 20	12.62%	6.12%
21 to 25	8.14%	3.77%
26 to 30	8.57%	2.61%
31 to 35	3.09%	1.72%
over 35	6.88%	1.03%

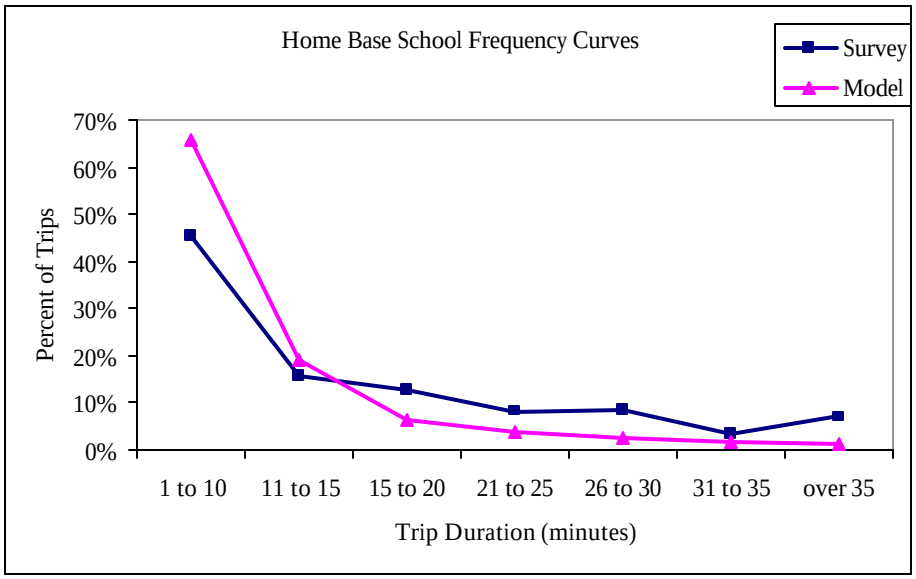


Figure 13

Home base Other		
Travel Time (minutes)	Survey	Model
1 to 10	54.61%	41.13%
11 to 15	20.68%	33.10%
15 to 20	8.57%	15.72%
21 to 25	4.90%	5.03%
26 to 30	5.86%	2.74%
31 to 35	1.73%	1.26%
over 35	3.65%	1.01%

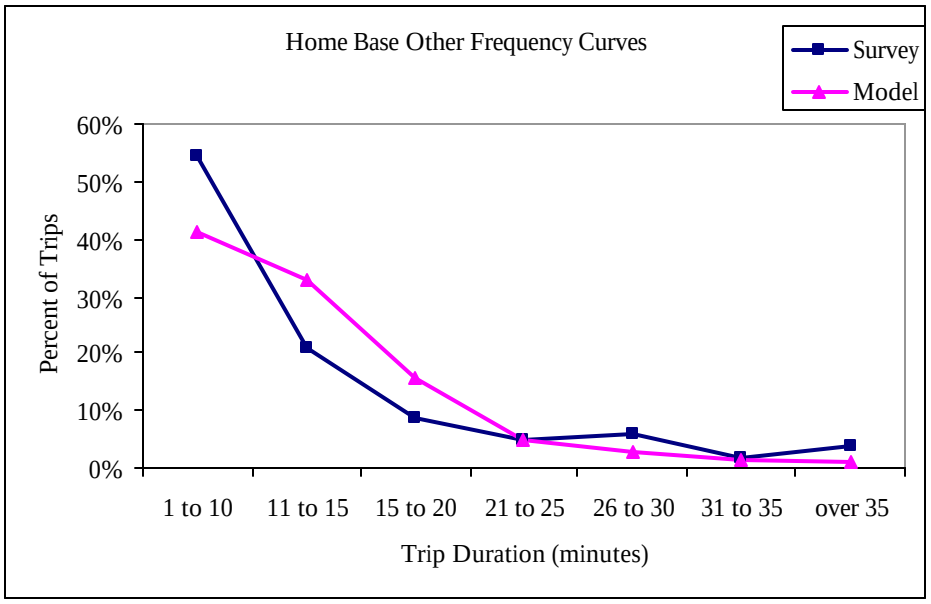
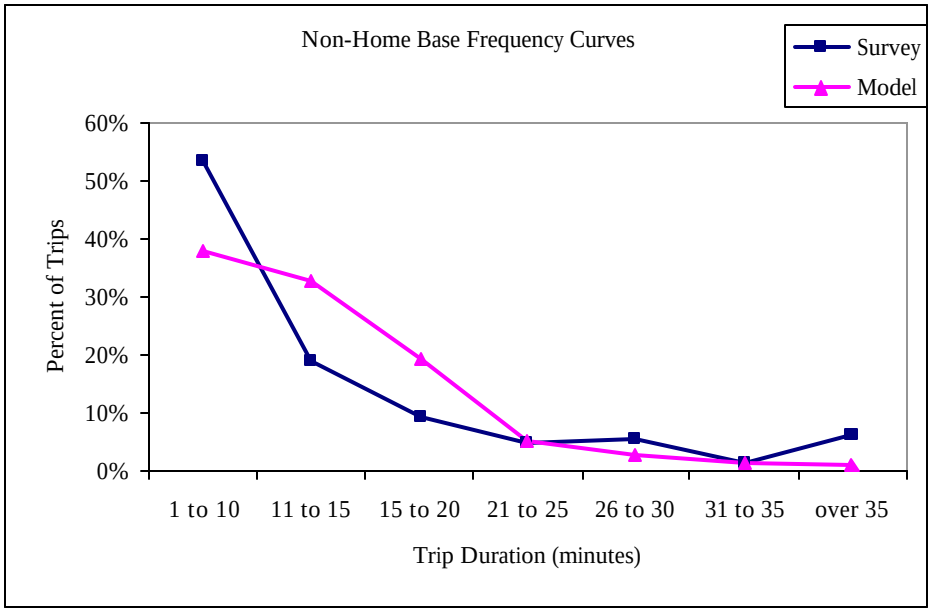


Figure 14

Non-home base		
Travel Time (minutes)	Survey	Model
1 to 10	53.31%	37.68%
11 to 15	19.22%	32.51%
15 to 20	9.30%	19.41%
21 to 25	4.91%	5.31%
26 to 30	5.52%	2.87%
31 to 35	1.52%	1.26%
over 35	6.21%	0.95%



TRIP DISTRIBUTION CONCLUSIONS

Overall the data needed for the trip distribution step were readily available from the 2002 household travel survey and based on trip length frequency distribution curve comparisons the results seem reasonable. However, after reviewing trip distribution by trip type between the two counties, three of the six trip types model distribution estimates were too high compared to survey data. For example, over 50% of home base work trips from Canyon County were going into Ada County. According to the 2002 household survey data, it should be closer to 23%. This issue caused refinements to the trip generation step and the need for improving some trip distribution results. In an effort to avoid using a formula to establish a better home base work trip distribution split between counties the following items were tested:

- stratification of internal-external and external-internal factors,
- increasing the attraction rates for Canyon County TAZs and
- different set of friction factors for Canyon County.

The first two tests remained in the model. Details on the attraction rates and stratified internal-external / external-internal factors are in the Trip Generation section of the report starting on page 19. The trip length frequency distribution curves for Canyon County were almost identical to the regional curves therefore; the model uses a regional set of friction factors. The previous two-county model, 1997 model, also encountered the same home base work distribution challenge and included k-factors. This model applies a percent to the person trip table. The trip distribution step includes a 23% / 77% Canyon County to Ada County split to the home base work person trip tables; and a 90% / 10% split to home base social and home base other person trip tables. Please refer to Appendix C, Table 62 through Table 65, for more details and comparisons of the county-to-county trip distribution. Also, Appendix E includes the full model script and shows how these "fixes" were included.

External to External (FRATAR)

The estimate of external to external trips was forecasted out to 2030 in five-year increments. This was accomplished by using county level forecasts obtained from the 2003 Idaho Economics Report, COMPASS, and the Department of Administrative Office, Office of Economic Analysis, for the State of Oregon. Table 31 summarizes the county level population forecasts for the six surrounding counties and the two counties within the modeling domain (Ada and Canyon).

Table 31

Population Estimates and Projections						
County	2005	2010	2015	2020	2025	2030
Ada*	343,000	367,000	408,000	450,000	493,000	540,000
Canyon*	154,000	159,000	173,000	187,000	202,000	218,000
Boise^	7,581	8,437	9,472	10,684	11,841	13,268
Elmore^	30,188	31,340	32,758	34,173	35,557	36,882
Gem^	15,830	16,526	17,363	18,201	19,025	19,824
Owyhee^	11,257	11,869	12,554	13,214	13,839	14,444
Payette^	21,458	22,402	23,536	24,672	25,788	26,871
Oregon (state)**	3,631,000	3,857,000	4,091,000	4,326,000	4,556,000	4,776,000
Sources: *Community Planning Association and 2005 - 2030 endorsed by the DAC on March 20, 2003 ^2003 Economic Forecast by John Church **Department of Administrative Office, Office of Economic Analysis, State of Oregon						

Table 32 summarizes the percent change in population per five-year increment for each county. The percent change is used to estimate the external to external trips for model forecasts.

Table 32

Population Estimates and Projections Growth Rates						
County	2002 - 2005 growth	2005 - 2010 growth	2010 - 2015 growth	2015 - 2020 growth	2020 - 2025 growth	2025 - 2030 growth
Ada*	6.1%	7.0%	11.2%	10.3%	9.6%	9.5%
Canyon*	6.6%	3.2%	8.8%	8.1%	8.0%	7.9%
Boise^	7.4%	11.3%	12.3%	12.8%	10.8%	12.1%
Elmore^	1.7%	3.8%	4.5%	4.3%	4.0%	3.7%
Gem^	2.1%	4.4%	5.1%	4.8%	4.5%	4.2%
Owyhee^	4.3%	5.4%	5.8%	5.3%	4.7%	4.4%
Payette^	2.1%	4.4%	5.1%	4.8%	4.5%	4.2%
Oregon (state)**	3.6%	6.2%	6.1%	5.7%	5.3%	4.8%

Table 33 shows the results of applying the growth rate shown above to the 2002 external to external trips. The calculation was 2002 External Trips x (1 + Percent Growth). The growth rates used were dependent of the external station location.

Table 33

Forecasted External to External (Trip Ends)													
		2005		2010		2015		2020		2025		2030	
TAZ	Location	in	out	in	out	in	out	in	out	in	out	in	out
738	SH 16	503	503	582	582	683	683	804	804	927	927	1078	1078
739	SH 55 Ada	372	372	431	431	505	505	594	594	685	685	797	797
740	Bogus Basin	5	5	6	6	7	7	8	8	8	8	9	9
741	SH 21	120	120	134	134	150	150	169	169	188	188	210	210
742	Black' Creek	1	1	1	1	1	1	1	1	1	1	1	1
743	I-84 Ada	2,403	2,403	2,495	2,495	2,608	2,608	2721	2,721	2,831	2,831	2,936	2,936
744	Swan Falls	2	2	2	2	2	2	2	2	2	2	2	2
745	SH 45	5	5	6	6	6	6	6	6	6	6	7	7
746	SH 55 Canyon	548	548	578	578	611	611	643	643	673	673	703	703
747	US 95	298	298	311	311	327	327	343	343	358	358	373	373
748	Old Hwy 18	1	1	1	1	1	1	1	1	1	1	1	1
749	US 20/26	279	279	291	291	306	306	320	320	335	335	349	349
750	I-84 Canyon	2,040	2,040	2,167	2,167	2,298	2,298	2,430	2,430	2,560	2,560	2,683	2,683

TRIP ASSIGNMENT

This model step assigns vehicle trips to the roadway network using an equilibrium multi-class assignment. One of the assumptions under this step is that people will use the shortest time path and have "perfect" information about the routes available. The trip assignment results are the most requested and utilized model output. Travel forecast models have existed in this region since the 1970s providing vehicle trip estimates and forecasts.

24-HOUR ASSIGNMENT

Prior to assigning vehicle trips to the roadway network the conversion from person trips to vehicles is necessary. This step is done at the end of the trip distribution for each county and each trip type.

Auto Occupancy Rates

The following auto occupancy rates were established using the 2002 household travel survey data based on the driver and passenger mode. Originally, one set of auto-occupancy rates for the two-county region was presented to TMAC in July 2003. Upon further review of the survey data the difference between Canyon and Ada rates became more apparent. This refinement improved the performance of the model. Table 34 summarizes the auto occupancy rates per county per trip type and the rates found in NCHRP 365 - Table 37. The NCHRP 365 auto occupancy rates are for information only. The auto occupancy rates derived from the 2002 household survey yielded the best results plus, it is local data. An auto occupancy rate for Boise State University was separated from the home base school trips due to the number of students (Table 56), proximity to downtown Boise, parking, availability of on-campus housing and jobs.

Table 34

Auto Occupancy Rates, 2002			
	Ada County Rates	Canyon County Rates	NCHRP 365
Home Base Work	1.08	1.11	1.12
Home Base Shop	1.60	1.96	1.48
Home Base Social	2.15	2.47	1.72
Home Base School	1.00	1.00	N/A
Home Base School - University	1.50	1.50	BSU
Home Base Other	1.82	2.07	1.65
Non-Home Base	1.57	1.84	1.66
Internal - External	1.67	1.67	

The auto occupancy rates in Table 34 were used from June 2004 until May 2006. On May 2, 2006 TMAC accepted the use of a 4-step model. The mode choice step was added to this model in the summer of 2005 and used throughout the development of the recent regional long-range transportation plan, *Communities in Motion*. Although a mode choice step was added, the conversion from person trips to vehicle trips is still necessary. The auto-person trips are converted to vehicle trips by first splitting them into the single-occupant or high-occupant vehicle category. Then, the person trips in the HOV category are converted into vehicle trips by using auto occupancy rates from the 2002 household survey data for two or more passengers. The model structure and performance will be summarized and appended to this document at a later date. Detailed documentation developed by Fehr and Peers is available by contacting COMPASS staff.

Once the person trips are converted to vehicle trips they are assigned to the network using a gap parameter of 0.0001 and volume-delay functions. The assignment step for the base year, 2002, converged on the 20th iteration.

Volume – Delay Functions (BPR Coefficients)

The traffic assignment step is influenced by the relationship between assigned volume and the delay caused by congestion. The BPR formulas are used to estimate the network (link level) travel times as a function of the volume-to-capacity ratio (NCHRP 365 pg 94). The early phases of model development used the standard BPR coefficients, α=.15 and β=4.0, for all roadway types. Through an iterative process different BPR coefficients were tested and then reviewed. The coefficients shown in Table 35 yielded the best results supported by comparing traffic volumes on I-84 and parallel routes.

Table 35

BPR Coefficients, 2002	
Interstate – Ada County	α=.56 and β=4.0
Interstate – Canyon County	α=.56 and β=3.6
All other roadways	α=.15 and β=5.0
Congested link travel time = Link free-flow travel time * $(1 + \alpha * (V/C)^{\beta})$	

Multi-Class Assignment

The 2002 COMPASS model added a multi-class assignment. This type of assignment provides the number of vehicle trips per trip type for every link in the model. This method was recommended by Fehr and Peers and it provides another tool of analysis - the ability to evaluate the demand for non-discretionary (work and school) versus discretionary vehicle trips at a corridor level. Another addition was the peak hour model completed about four months later. Further refinements were made throughout the development of the peak hour model, which caused a slight improvement to the 24-hour model results.

PEAK HOUR ASSIGNMENT

The peak hour model structure starts with the unbalanced daily person trip tables produced by the trip distribution step then, they are factored to produce peak hour person trip tables. This requires a lookup table, developed from the 2002 household travel survey, which identifies the percentage of trips, by purpose, leaving and returning between 5 P.M. and 6 P.M. The percent of peak hour trips based on the household survey are summarized in Table 36. The peak hour model was completed and accepted by TMAC on October 12, 2004. This is the first regional peak hour model for the two-county region. However, the 1975 model documentation referenced time-of-day estimates and a sub-area peak hour model was developed in spring 2004 for the Downtown Boise Mobility Study (DBMS). This sub-area model was based on the 1997 model but used updated traffic counts and data from the 2002 household travel survey. Refer to the model history for more information regarding the 1997 model. The regional peak hour model was tested using peak hour factors by trip type from the 2002 household survey data and peak hour factors used in the DBMS model. The regional model performed best with the peak hour factors from the DBMS model but did require some refinement to the home base other factor which, was split among home base social, home base school, and home base other. The DBMS peak hour factors were based on the 2002 household travel survey data and documented in a technical memo by Fehr and Peers (please contact COMPASS staff for a copy).

Table 36

2002 Household Survey 5PM to 6PM Percentage of Trips					
		Departure		Arrival	
Trip Type	Total Trips	5 P.M. to 6 P.M. Trips	Percent Distribution	5 P.M. to 6 P.M. Trips	Percent Distribution
Home Base Work	4,134	528	12.8%	537	13.0%
Home Base Shop	2,560	255	10.0%	255	10.0%
Home Base Social	2,862	351	12.3%	303	10.6%
Home Base School	2,283	115	5.0%	110	4.8%
Home Base Other	5,531	515	9.3%	499	9.0%
Non-Home Base	7,660	616	8.0%	639	8.3%
Internal-External	222	13	5.9%	11	5.0%
External-Internal	227	29	12.8%	37	16.3%
External-External	96	5	5.2%	7	7.3%
Total Trips or Overall Percent Distribution	25,575	2,427	9.5%	2,398	9.4%

Table 37 summarizes the person trips departing and arriving between 5 P.M. and 6 P.M. adjusted by the average auto occupancy rate for the two-county area. Using the trips departing and arriving within the specified time period seemed reasonable because trip departing or arriving between 5 P.M and 6 P.M is off by only 29 person trips.

Table 37

2002 Household Survey 5PM to 6PM Percentage of Trips, Adjusted by Auto Occupancy					
		Departure and Arrival			
Trip Type	Total Trips	5 P.M. to 6 P.M. Trips	Percent Distribution	Regional Average Auto Occupancy	Adjusted Peak Hour Factors
Home Base Work	4,134	398	9.6%	1.08	8.91%
Home Base Shop	2,560	198	7.7%	1.70	4.55%
Home Base Social	2,862	254	8.9%	2.20	4.03%
Home Base School	2,283	92	4.0%	1.00	4.03%
Home Base Other	5,531	398	7.2%	1.89	3.81%
Non-Home Base	7,660	502	6.6%	1.65	3.97%
Internal-External	222	8	3.6%	1.67	2.11%
External-Internal	227	18	7.9%	1.67	4.75%
External-External	96	5	5.2%	1.00	5.21%
Total Trips or Overall Percent Distribution	25,575	1,873	7.3%		41.37%

The peak hour person trips percentages are adjusted by the two-county average auto occupancy rate per trip type therefore, the peak hour factors used in the model are lower than the percent distribution shown above. Table 38 shows the final set of peak hour factors used in the regional model.

Table 38

Peak Hour Factors, 2002			
Trip Type	Departure	Return	Total
Home Base Work	0.13	8.00	8.13
Home Base Shop	3.00	4.00	7.00
Home Base Social	3.60	2.92	6.52
Home Base School	1.80	0.75	2.55
Home Base Other	3.00	2.00	5.00
Non-Home Base	2.70	2.45	5.15
Internal-External	2.25	2.13	4.38
External-Internal	2.13	2.25	4.38
External-External	3.40	3.40	6.80
			49.91

TRIP ASSIGNMENT CONCLUSIONS

The 24-hour and peak hour model produced reasonable traffic assignment results throughout the two-county region and passed both static and dynamic validation tests. The following sections discuss the static and dynamic validation process and results for both model.

STATIC MODEL VALIDATION RESULTS

The validation tests are the last step to developing travel demand forecast models and the results determine whether a model is ready for release. This section of the report focuses on the validation process and performance of both models.

24-HOUR MODEL

On May 25, 2004 COMPASS staff and TMAC agreed to use the following four specific static validation criteria for the 24-hour model:

- Minimum of 75% of screenlines should be within their maximum desirable deviation
- Minimum of 75% of roadway links should be within their maximum desirable deviation
- Model-wide correlation coefficient should be greater than 0.88
- Maximum acceptable root-mean-squared-error should not exceed 40%

These criteria come from various sources such as the TMIP Model Validation and Reasonableness Checking Manual, NCHRP Report 255 and Caltrans Travel Forecasting Guidelines. These same guidelines were used to calibrate the peak hour model and presented to TMAC in August 2004.

The following two tables, Table 39 and Table 40, summarize the performance of the regional 24-hour model per facility type. Overall, the model performs reasonably well and achieved a correlation coefficient of 0.96 and R-Squared of 0.90.

Table 39

Percent Root Mean Square Error (RMSE) by Functional Class			
Facility Type	%RMSE	MAX	Validation
Interstate & Ramps	23.9%	< 40%	PASS
Principal Arterials	22.1%	< 40%	PASS
Minor Arterials	39.0%	< 40%	PASS
Collectors	70.4%	< 40%	
Locals	82.2%	< 40%	
Overall	**34.9%**	**< 40%**	**PASS**
Without Locals	34.5%	< 40%	PASS
Without Collectors and Locals	28.9%	< 40%	PASS

Table 40

Model Volume to Actual Count Percent Difference by Functional Class			
Facility Type	Volume to Count % Difference	MAX	Validation
Interstate & Ramps	-0.2%	< 7%	PASS
Principal Arterials	-4.4%	< 10%	PASS
Minor Arterials	-11.5%	< 15%	PASS
Collectors	-16.8%	< 25%	PASS
Locals	11.6%	< 25%	PASS
Overall	**-7.6%**		

Screenlines throughout the two-county area were established in 2003 prior to completing the collection of the roadway data or any model calibration efforts. Table 41 summarizes the overall screenline results. The location and number of screenlines were determined by staff but presented to TMAC in September 2003 and again in November 2003 for their acceptance. The areas of focus were the Ada-Canyon County line, all river crossings, all directions of travel north and south of I-84 and along I-84 between interchanges and at externals. A total of 130 screenlines were established but a few locations did not have actual traffic count data available. In Appendix D, Table 66 lists the location, direction, actual traffic count, and model estimate for each screenlines and is followed by a map, Figure 35.

Table 41

Screenline Results		
Pass	106	85%
Did not pass	19	15%
Total	**125**	**100.0%**

PEAK HOUR MODEL

As stated above the 24-hour and peak hour models use the same validation criteria. The following two tables, Table 42 and Table 43, summarize the performance of the regional peak hour model per facility type. This model also performs reasonably well and achieved a correlation coefficient of 0.90 and R-Squared of 0.87.

Table 42

Percent Root Mean Square Error (RMSE) by Functional Class			
Facility Type	%RMSE	MAX	Validation
Interstate & Ramps	28.6%	< 40%	PASS
Principal Arterials	25.0%	< 40%	PASS
Minor Arterials	40.9%	< 40%	
Collectors	79.5%	< 40%	
Locals	82.9%	< 40%	
Overall	**37.8%**	**< 40%**	**PASS**
Without Locals	37.4%	< 40%	PASS
Without Collectors and Locals	31.4%	< 40%	PASS

Table 43

Model Volume to Actual Count Percent Difference by Functional Class			
Facility Type	Volume to Count % Difference	MAX	Validation
Interstate & Ramps	3.9%	< 7%	PASS
Principal Arterials	-1.2%	< 10%	PASS
Minor Arterials	-20.4%	< 15%	
Collectors	-25.7%	< 25%	
Locals	17.8%	< 25%	PASS
Overall	**-9.5%**		

DYNAMIC MODEL VALIDATION RESULTS

Dynamic model validation is a technique to evaluate a model's ability to respond appropriately to various demographic and network changes. Results of the dynamic validation tests are evaluated in terms of meeting an expected trend and magnitude in change. This technique is documented in a white paper by Fehr & Peers and serves as a guide on dynamic validation. COMPASS staff performed three dynamic validation tests on both the 24-hour and peak hour models. Two of the three tests involve evaluating the model's ability to forecast network impacts when the demographic data of a Traffic Analysis Zone (TAZ) are changed. The third test involved the model's response to the deletion of a major link in the regional roadway network. Both models responded appropriately to changes in households, jobs and the network.

24-HOUR MODEL

The 24-hour dynamic validation results are shown in Table 44 and Table 45 for Ada County TAZs 144 and 299. Table 46 and Table 47 summarize the results for Canyon County TAZs 475 and 566. All four TAZs responded as expected to the household and job changes. Figure 43 in Appendix D contains a map highlighting all four TAZs used for the dynamic validation.

Table 44

Results from TAZ 144 (Ada - Suburban)								
Baseline: 236 households				Baseline: 19 Retail Jobs				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	7.31	0.00	0	0.00	20.40	0.00	164.21
-1	-3.91	7.31	-24.13	-1	-1.97	20.40	-9.07	164.21
-10	-54.26	7.31	-402.99	-10	-23.14	20.40	-179.45	164.23
-100	-526.37	7.31	-3,599.25	Non-applicable				
1	7.31	7.31	25.41	1	2.80	20.40	-15.44	164.21
10	49.91	7.31	2.41	10	26.96	20.40	111.97	164.19
100	530.28	7.31	3,415.34	100	258.68	20.37	1,697.84	163.98
1,000	5,262.83	7.30	36,434.54	1,000	2,562.56	20.12	15,855.75	161.90
5,000	26,354.60	7.25	187,525.56	5,000	12,809.78	19.09	84,627.45	153.43
10,000	52,721.12	7.20	380,311.43	10,000	25,617.21	17.97	170,888.47	144.14

Table 45

Results from TAZ 299 (Ada – Rural)								
Baseline: 34 households				Baseline: 7 Retail Jobs				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	7.31	0.00	0	0.00	20.40	0.00	164.21
-1	-4.33	7.31	-93.57	-1	-1.48	20.40	-20.75	164.21
-10	-54.04	7.31	-614.51	Non-applicable				
1	6.54	7.31	66.01	1	2.99	20.40	33.64	164.21
10	51.94	7.31	255.76	10	27.22	20.40	293.29	164.19
100	540.91	7.31	5,494.44	100	257.56	20.37	2,791.30	164.00
1,000	5,381.43	7.30	56,559.80	1,000	2,563.19	20.12	29,830.62	162.12
5,000	26,933.90	7.26	293,003.01	5,000	12,807.61	19.09	148,962.79	154.37
10,000	53,886.61	7.21	586,994.77	10,000	25,618.39	17.97	285,941.85	145.71

Table 46

Results from TAZ 475 (Canyon – Suburban)								
Baseline: 238 households				**Baseline: 166 Retail Jobs**				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	7.31	0.00	0	0.00	20.40	0.00	164.21
-1	-4.80	7.31	-102.15	-1	-2.36	20.40	0.92	164.21
-10	-66.48	7.31	-644.00	-10	-23.04	20.40	15.19	164.24
-100	-480.28	7.31	-6,524.78	-100	-255.92	20.43	-61.38	164.47
1	7.93	7.31	89.66	1	3.40	20.40	22.72	164.21
10	48.43	7.31	678.34	10	27.08	20.40	-15.16	164.18
100	473.75	7.31	6,339.05	100	258.53	20.37	285.51	163.96
1,000	4,775.28	7.30	67,645.29	1,000	2,566.23	20.12	3,421.98	161.71
5,000	23,873.48	7.24	347,804.57	5,000	12,822.29	19.10	76,643.43	153.31
10,000	47,762.74	7.17	695,064.61	10,000	25,644.22	17.97	248,190.20	145.20

Table 47

Results from TAZ 566 (Canyon – Rural)								
Baseline: 284 households				**Baseline: 69 Retail Jobs**				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	7.31	0.00	0	0.00	20.40	0.00	164.21
-1	-4.29	7.31	-117.39	-1	-2.07	20.40	-18.83	164.21
-10	-56.09	7.31	-893.79	-10	-23.64	20.40	-216.65	164.23
-100	-550.93	7.31	-8,873.88	Non-applicable				
1	7.75	7.31	103.84	1	3.01	20.40	-6.20	164.17
10	54.44	7.31	878.40	10	28.35	20.40	213.36	164.19
100	553.36	7.31	8,961.77	100	260.45	20.37	2,422.44	163.99
1,000	5,517.33	7.30	92,174.53	1,000	2,564.47	20.12	25,505.88	162.05
5,000	25,941.43	7.25	510,302.50	5,000	12,826.19	19.10	181,046.02	154.84
10,000	55,232.50	7.21	1,133,912.91	10,000	25,642.13	17.97	472,789.38	148.26

A section of Eagle Road north of Fairview Avenue was deleted from the base year. Eagle Road is a primary north-south route and Eagle Road / Fairview Avenue is one of the busiest intersections in Ada County - ranked second in 2002 with over 5,500 vehicles in the peak hour. Figure 15 and Figure 16 are maps of the area where a network link was deleted. The model responded appropriately to the removal of a link by diverting trips to other parallel facilities.

Figure 15

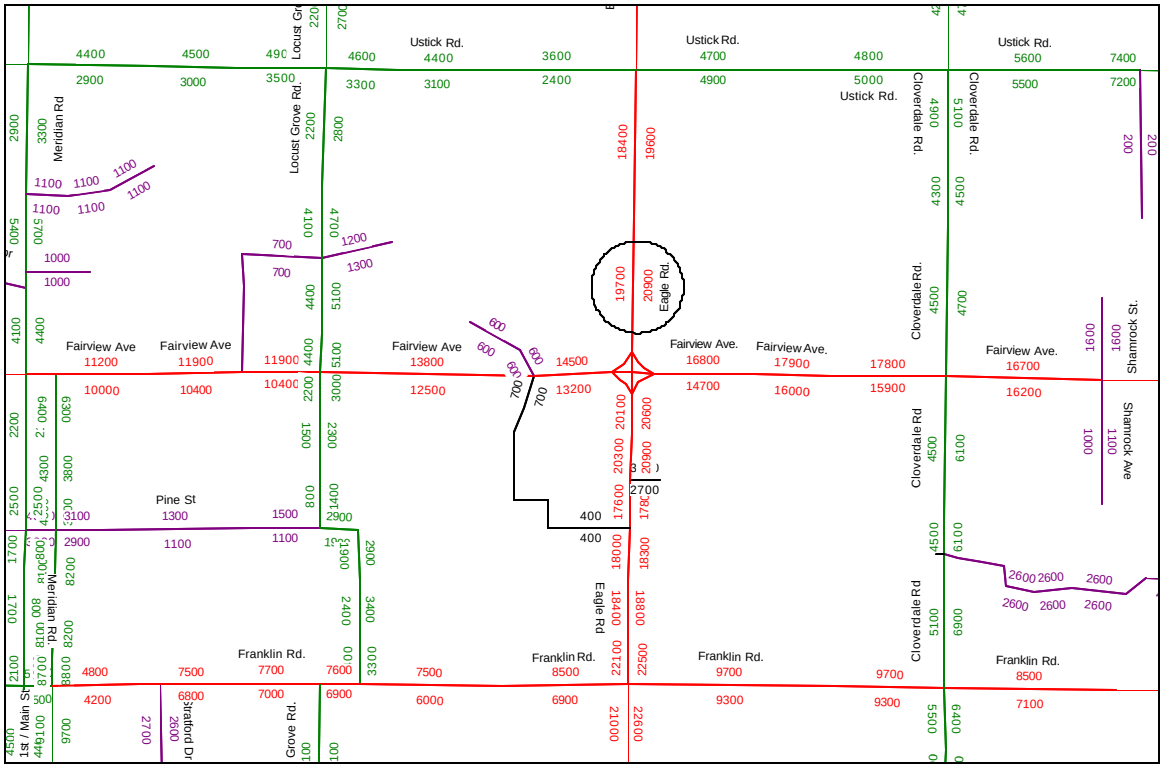
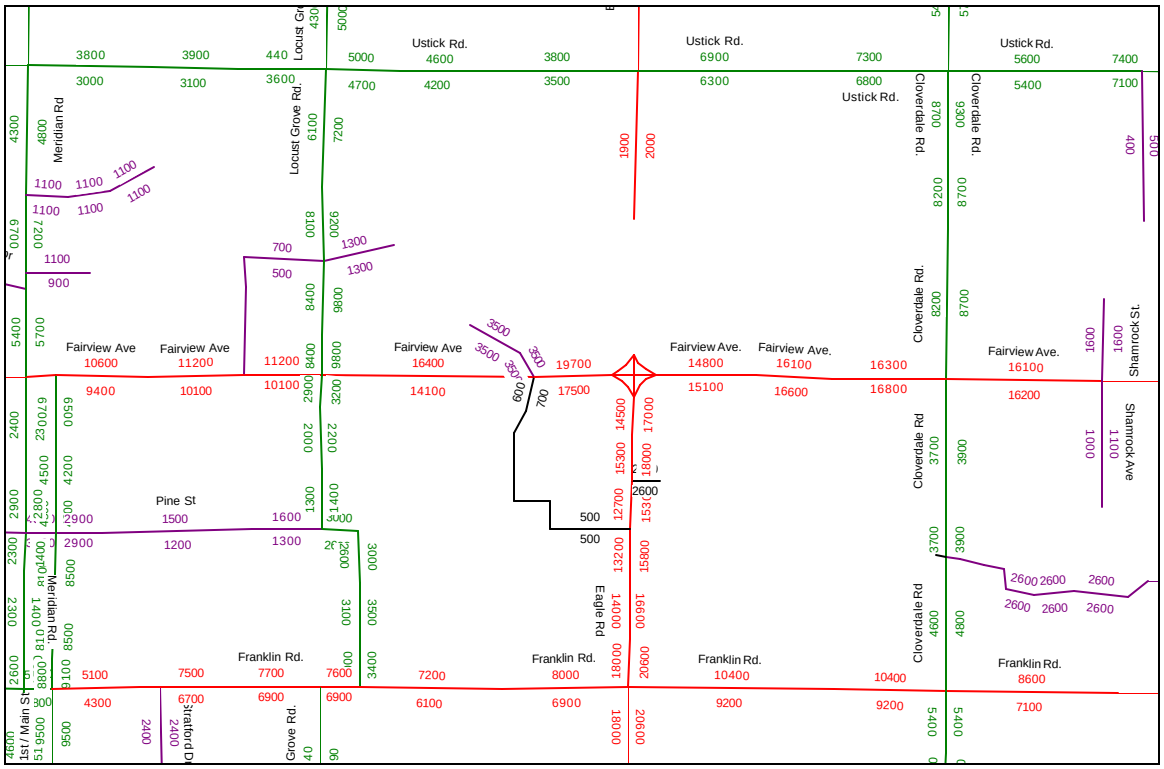


Figure 16



PEAK HOUR MODEL

The peak hour dynamic validation results are shown in Table 48 and Table 49 and for Ada County TAZs 115 and 238; and Table 50 and Table 51 for Canyon County TAZs 420 and 540. Different TAZs were used for the peak hour validation in order to test if another set of TAZs that contained a higher number of households (over 1300 in TAZ 540) would also respond appropriately. Also, if the TAZs used in the 24-hour tests responded as expected, staff figured those same zones would respond the same under the peak hour tests.

Table 48

Results from TAZ 115 (Ada - Suburban)								
Baseline: 775 households				Baseline: 220 Retail Jobs				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	0.48	0.00	0	0.00	1.39	0.00	11.38
-1	-0.34	0.48	-1.79	-1	-0.15	1.39	-1.93	11.38
-10	-2.66	0.48	-12.45	-10	-2.21	1.39	-5.51	11.38
-100	-29.60	0.48	-223.36	-100	-21.29	1.39	-165.04	11.40
1	0.35	0.48	1.27	1	0.43	1.39	5.07	11.38
10	3.05	0.48	17.61	10	2.13	1.39	15.12	11.38
100	29.93	0.48	220.62	100	21.98	1.39	141.28	11.37
1,000	296.47	0.48	1,713.76	1,000	214.88	1.37	1,054.02	11.22
5,000	1,487.18	0.48	8,421.87	5,000	1,069.23	1.30	5,991.84	10.62
10,000	2,970.73	0.47	17,114.65	10,000	2,140.47	1.23	12,766.68	9.97

Table 49

Results from TAZ 238 (Ada - Rural)								
Baseline: 381 households				Baseline: 77 Retail Jobs				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	0.48	0.00	0	0.00	1.39	0.00	11.38
-1	-0.26	0.48	-2.88	-1	-0.12	1.39	-1.90	11.38
-10	-3.67	0.48	-43.00	-10	-2.63	1.39	-140.53	11.38
-100	-37.39	0.48	-484.98	Non-applicable				
1	0.43	0.48	3.96	1	0.41	1.39	-125.17	11.38
10	4.03	0.48	19.51	10	2.22	1.39	14.34	11.38
100	38.33	0.48	338.20	100	21.39	1.39	136.34	11.37
1,000	374.24	0.48	3,902.65	1,000	213.89	1.37	1,315.83	11.22
5,000	1,874.23	0.48	19,756.91	5,000	1,070.94	1.30	7,744.09	10.64
10,000	3,745.88	0.48	41,770.21	10,000	2,141.67	1.23	19,109.10	10.06

Table 50

Results from TAZ 420 (Canyon – Rural)								
Baseline: 449 households				**Baseline: 18 Retail Jobs**				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0.00	0.48	0.00	0	0.00	1.39	0.00	11.38
-1	-0.31	0.48	-3.70	-1	-0.21	1.39	-131.71	11.38
-10	-2.85	0.48	-34.25	-10	-1.89	1.39	-16.22	11.38
-100	-28.31	0.48	-271.26	Non-applicable				
1	0.36	0.48	4.65	1	0.40	1.39	4.29	11.38
10	2.98	0.48	32.82	10	2.34	1.39	20.77	11.38
100	28.09	0.48	231.60	100	21.83	1.39	146.81	11.37
1,000	278.26	0.48	3,409.42	1,000	219.49	1.37	3,081.73	11.25
5,000	1,386.59	0.48	16,919.08	5,000	1,087.63	1.30	21,561.80	10.85
10,000	2,776.16	0.47	34,295.98	10,000	2,173.95	1.23	49,838.61	10.49

Table 51

Results from TAZ 540 (Canyon – Suburban)								
Baseline: 1,361 households				**Baseline: 14 Retail Jobs**				
Change in Households	Change in Vehicle Trips	Vehicle Trips per Household	Change in VMT	Change in Retail Jobs	Change in Vehicle Trips	Vehicle Trips per Retail Job	Change in VMT	VMT per Retail Job
0	0	0.48	0	0	0.00	1.39	0.00	11.38
-1	-0.47	0.48	-4.12	-1	-0.21	1.39	-130.92	11.38
-10	-3.95	0.48	-10.79	-10	-2.54	1.39	4.22	11.38
-100	-75.13	0.48	-592.38	Non-applicable				
1	0.68	0.48	-126.58	1	0.43	1.39	-126.09	11.38
10	3.95	0.48	38.34	10	2.47	1.39	17.06	11.38
100	38.65	0.48	226.89	100	20.54	1.39	48.37	11.36
1,000	380.14	0.48	2,508.83	1,000	219.06	1.37	1,617.16	11.23
5,000	1,923.81	0.48	14,298.63	5,000	1,087.89	1.30	12,261.90	10.71
10,000	4,358.58	0.48	39,815.90	10,000	2,171.48	1.23	30,000.00	10.21

A section of Cole Road south of Northview Street was deleted from the base year. Cole Road is a major north-south route near the regional shopping mall. Figure 17 and Figure 18 are maps of the area where a network link was deleted. Figure 44 in Appendix D is a map highlighting all four TAZs used for the dynamic validation. The model responded appropriately to the removal of a link by diverting trips to other parallel facilities.

Figure 17

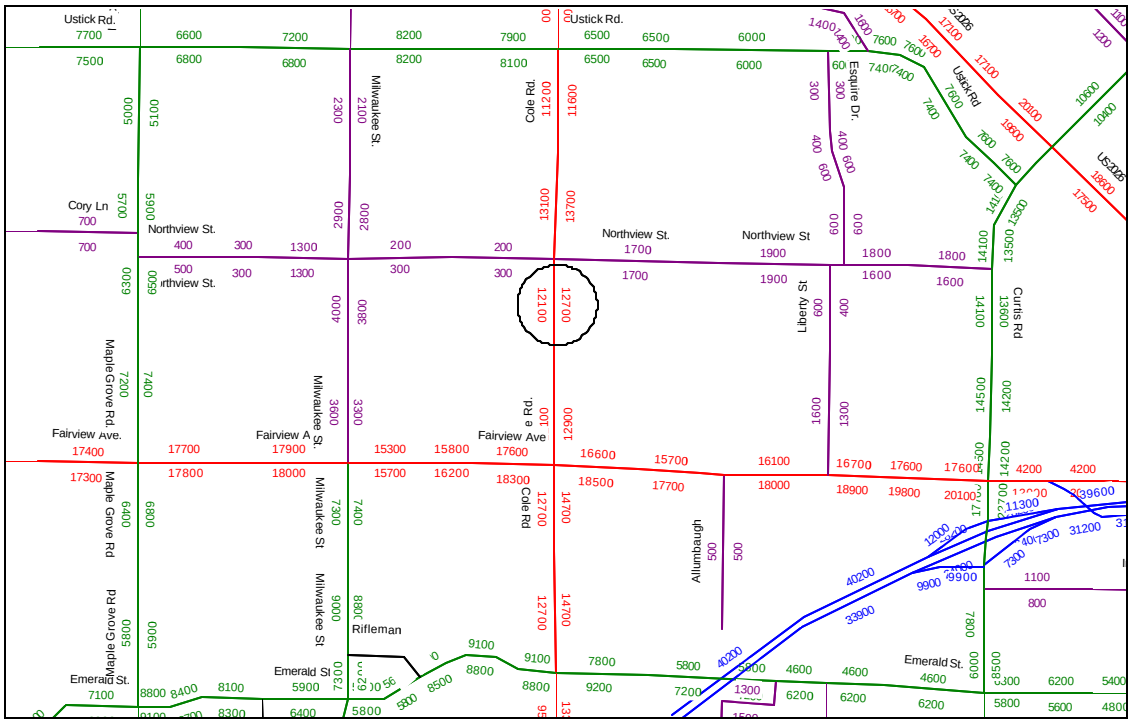
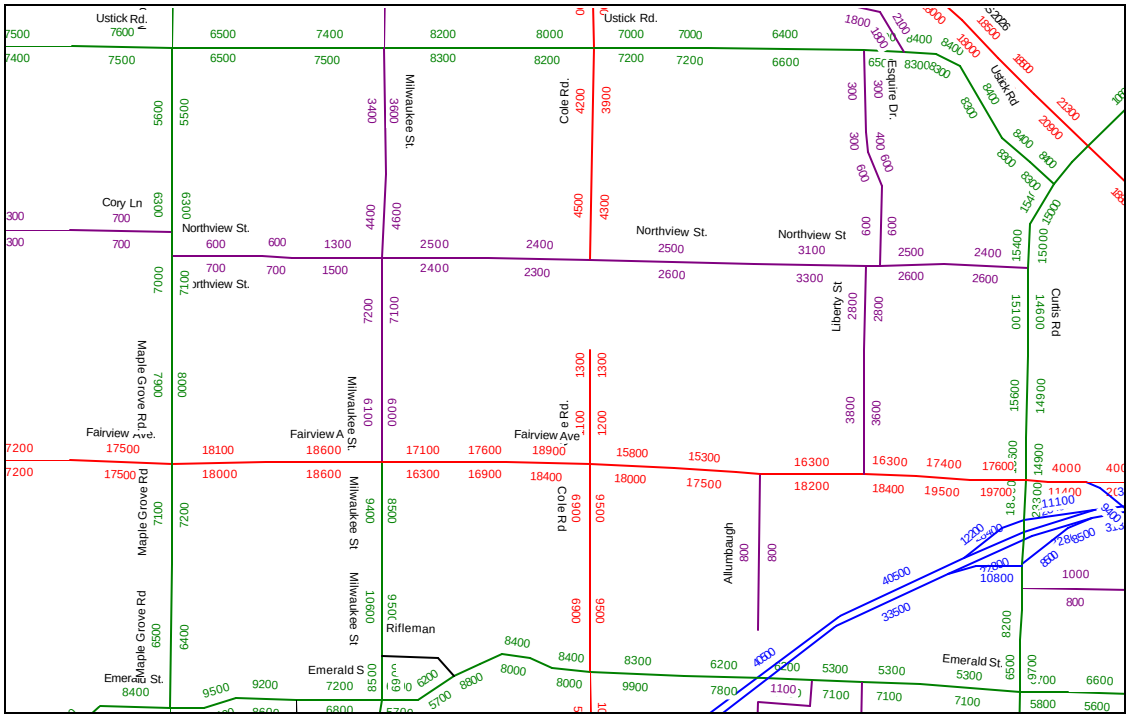


Figure 18



VALIDATION CONCLUSIONS

Based upon how each model performed under both the static and dynamic validation tests, COMPASS staff requested TMAC's acceptance of these models. The 24-hour model was accepted on June 29, 2004 and the peak hour model was accepted on October 12, 2004.

ON-GOING AND NEXT STEPS

Although both the 24-hour and peak hour models were completed and accepted in 2004, refinements have continued. The most important refinement is the addition of a mode choice step.

RECENT IMPROVEMENTS

COMPASS began developing a new regional long-range transportation plan, *Communities in Motion*, for an area including the two-county area. To improve this planning process it was essential that the model included a mode choice step and an effective way to evaluate the impact of different land uses.

Communities in Motion workshops held in October 2004 resulted in several different growth scenarios. In order to compare the impacts of these different scenarios on the transportation system, COMPASS used the 4D process developed by Fehr & Peers. This 4D process (land use density, diversity (land use mix); pedestrian design and access to regional destinations) enables four-step modeling to account for the effects of the first three of these 4Ds. The 2002 model's trip distribution module was sufficient for capturing the effects of the fourth D - distribution of regional destinations. The process essentially modifies trip generation rates to reflect the impact of localized changes in the 3D variables. By using the 3D adjustments, a change in vehicle trips generated by a regional or sub-regional alternative land use can be measured in terms of a change in each of the 3D variables.

The mode choice step was completed in May 2005 using a nested logit model structure. Due to time and data constraints the structure and coefficients of the mode choice step would be adapted from an "analogue" region. After reviewing mode choice models used in three areas, it was determined that the Wasatch Front Regional Council (WFRC, the MPO for the Salt Lake City region), model was most applicable. The WFRC model contained a fully tested 4-step travel model and its region was most comparable to the COMPASS region both geographically and demographically.

COMPASS used its new 4-step model in the development and the air quality conformity demonstration for *Communities in Motion.* On May 2, 2006, COMPASS staff requested TMAC to accept the 4-step model to replace the 3-step model. COMPASS staff anticipates the long-range transportation plan will be final and adopted by the COMPASS Board in July 2006.

In February 2006, a "feedback loop" was tested in the 2030 model to evaluate how congested speeds effect mode split and assignment. The Method of Statistical Averaging (MSA) methodology used was proposed by Dr. David Boyce. This feature is not part of the official model. Documentation regarding the "feedback loop" can be obtained directly from COMPASS staff.

NEXT UPDATE

- Household Travel Survey anticipated in 2009/2010
- TAZ splits in high growth areas and along primary transit routes
- Household type categories
- Appropriate network refinement
- Research a better sources of employment data
- Incorporate travel time data into the next calibration/validation effort. Data collection began in Spring 2003 as part of the Congestion Management System.
- Improve external station data and develop a truck trip table using data from Truck Freight Travel study planned for FY 2007