CHAPTER SIX – TRI-CITIES AREA TRAFFIC MODEL

INTRODUCTION

A regional travel demand model consists of a computerized transportation network that is coupled with existing land use data to replicate movement on the transportation system. The models inputs are then adjusted to future year forecasts to allow planners and engineer's evaluation of expected performance of the system, as well as consider impacts of alternate land use scenarios or mode choice behaviors and their impacts to the transportation system. As such, a travel demand model provides a valuable tool of support in the development of local and regional plans.

The Benton-Franklin Council of Governments (BFCG) first constructed a travel demand model using TModel software in 1994. This model was the basis for subsequent updates made during 1997 and 2001. In June of 2004, a committee of local representatives selected Caliper Corporation's *TransCAD* as the region's new travel demand modeling platform followed by conversion to that platform during 2005-06. In anticipation of the 2011 Regional Transportation Plan, efforts began in 2010 to update the 2005 model effort to a 2010 base year with updated forecasts closely matching the twenty-year timeframe of this plan.

The 2010 Tri-Cities Travel Demand Model is representative of vehicular traffic characteristics during a typical PM peak hour weekday during 2010. The model area includes the entire Tri-City metropolitan area, including cities of Richland, West Richland, Kennewick, Pasco, as well as surrounding unincorporated areas on the metropolitan fringe. The fringe areas are expected to become urban in nature within the timeframe of this plan, and are included to allow evaluation of area facilities. These areas include: Finley, Badger Road, Red Mountain vicinity, portions of Franklin County north of the Pasco UGA, and Burbank area in Walla Walla County. In addition, the model areas includes the entire Hanford Nuclear Reservation due to its' significant employment levels and the associated impact on local traffic patterns. In all, the model area encompasses over 650 square miles of territory.

MODEL ASSUMPTIONS

Outside factors at the local, regional, and global levels can have dramatic impact upon the choices travelers make. For the BFCG model, it was necessary to make some general assumptions regarding growth and other factors that have impacts upon travel behavior. These assumptions should be reviewed for their accuracy and adjusted, if needed, in subsequent model efforts.

Economy: It was assumed that no major economic fluctuations would occur at the global, national, or regional levels. Current regional economic trends were assumed to continue.

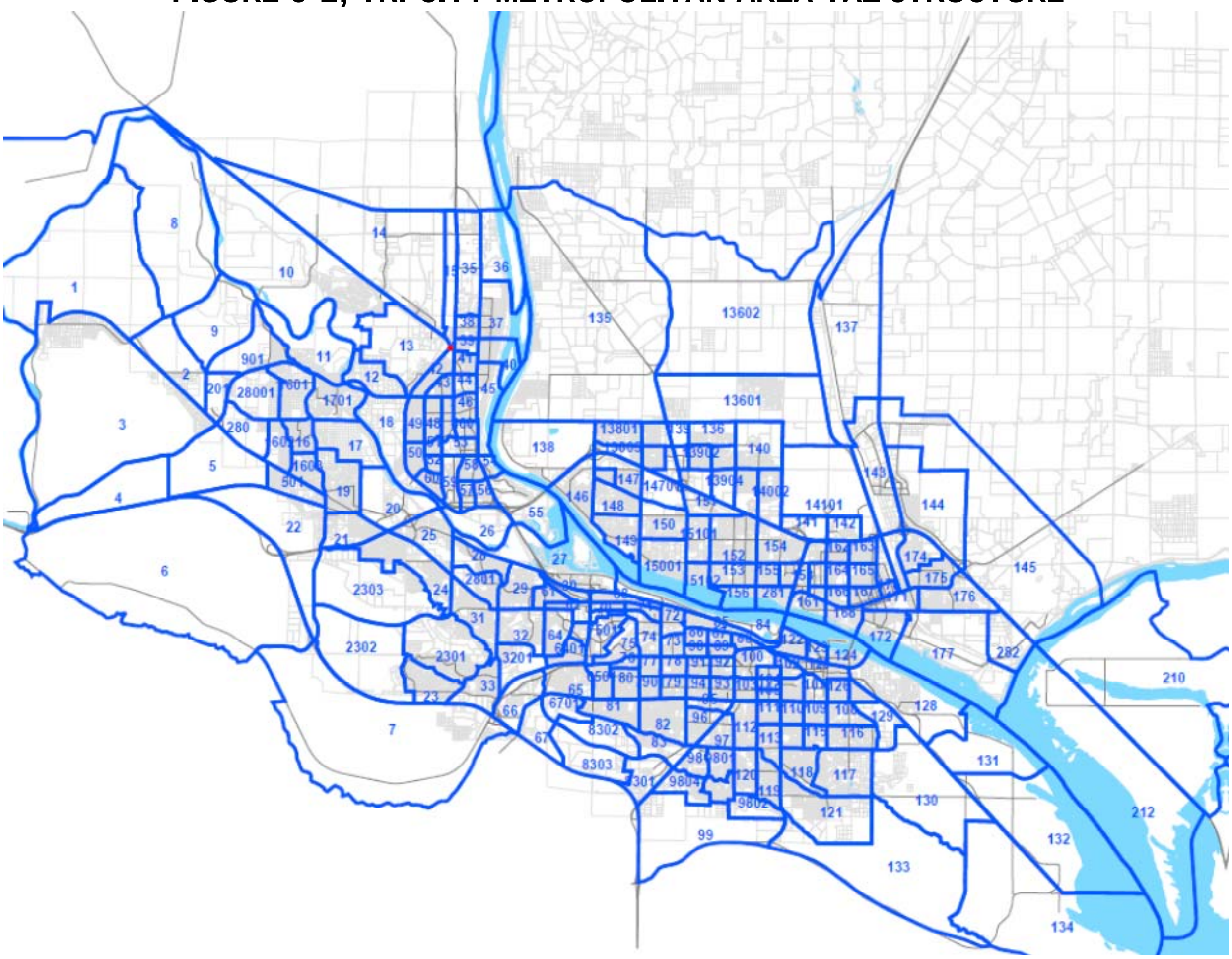
Growth: The region has seen significant population growth in recent years. It was assumed the area would continue to grow at a pace between "medium" and "high" GMA forecast levels.

Mode Split: The modal split shows what types of transportation people use when traveling. Currently, the modal split in the Tri-Cities is 76% drive-alone, 16% carpool or vanpool (HOV), with smaller percentages to other modes (transit, bike, and walk)[i]. These rates were assumed to remain steady in future model scenarios.

TRI-CITIES POPULATION AND EMPLOYMENT FORECASTS

In a travel demand model, the "trips" seen upon the transportation network are estimated by associating different production and attraction rates to an assortment of land uses. For example, a retail use would attract and produce more trips than a similar sized residential development. The model area is broken into smaller geographic units, called Transportation Analysis Zones (TAZs), which allows the model to estimate trips produced and trips attracted to each TAZ and the routes between. The BFCG Travel Demand Model area is split into 229 TAZs, which can be seen in Figure 6-1 below. In general, TAZs are more defined in areas of greater development with larger TAZs found in areas with less development, or upon the model fringe. To the northwest of the area shown in the graphic, is the Hanford Nuclear Reservation (TAZ 34) - over 360 square miles in area and exceeding the remainder of the model area in size.

FIGURE 6-1, TRI-CITY METROPOLITAN AREA TAZ STRUCTURE



Area planners were asked to provide housing and employment information for every TAZ, beginning with the base-year (2010) and later providing forecasts for 2020 and 2030. It was agreed a population growth rate between OFM's M*edium* and H*igh series GMA Projections* would be used with growth distributed between jurisdictions proportionately. Employment forecasts – both with regard to levels and locations - were individual to each participating jurisdiction. Forecasts were consistent with available lands, local zoning, and comprehensive plans. BFCG staff worked with officials from Mission Support Alliance (Hanford) and Pacific Northwest National Labs for individual forecasts specific to these large area employers. The compiled data represent the latest available estimates for population, land use, employment levels and economic activity in the area. The thirteen land use categories used in the model are shown in Table 6-1 below, while a complete table showing the forecasted land-use quantities by TAZ and scenario year can be found in Appendix E.

TABLE 6-1, LAND USE CATEGORIES

LU1	Single-family Dwelling Units	Dwelling Units
LU2	Multi-family Dwelling Units	Dwelling Units
LU3	Industrial/Manufacturing	Employees
LU4	Retail	Employees
LU5	FIRESG (Finance, Insurance, Real Estate, Service, Government)	Employees
LU6	Regional Mall	Employees
LU7	Airport	Employees
LU8	Schools (High Schools, Colleges, Trade)	Students
LU9	Hanford: Onsite	Employees
LU10	Pacific Northwest National Labs & Hanford “Inner”	Employees
LU11	Offices	Employees
LU12	Hotel/Motel	Rooms
LU13	Assisted Living/Nursing Facilities	Rooms

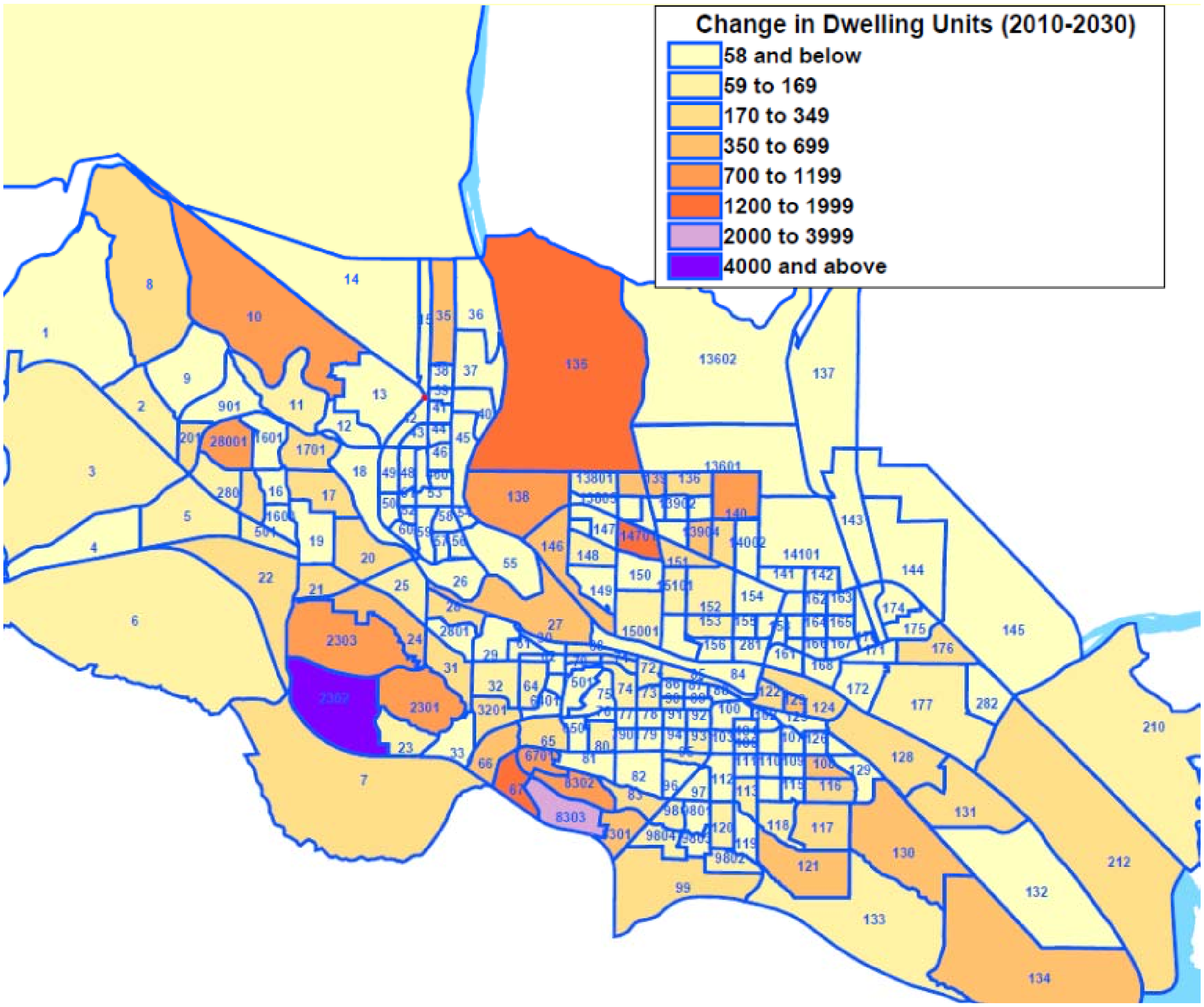
A summary of population forecasts are shown in table 6-2, by individual jurisdiction and the complete model area. Population totals are anticipated to increase by over forty-eight thousand individuals in the next decade, and nearly one-hundred thousand by the year 2030. The levels projected would result in a 22.7 % increase in population by 2020, and a 45% increase by 2030 – similar to rates realized in the previous decade for the area.

TABLE 6-2, POPULATION FORECASTS BY AGENCY AND YEAR

Year	*Richland*	*Kennewick*	*West Richland*	*Benton Co*	*Pasco*	*Franklin Co*	*Walla Walla Co*	*Model Area*
2010	48,708	68,661	11,673	18,244	61,578	1,694	3,419	*213,977*
2020	61,261	82,502	14,292	24,967	73,828	1,574	4,119	*262,542*
2030	74,183	95,601	17,179	29,205	87,752	1,816	4,768	*310,504*

The distribution of new population into the model area is best portrayed by showing where new dwelling units are anticipated. By the year 2030, model data reflect an increase in over twenty-eight thousand single-family units and an additional 7,300 multi-family units to be built. Figure 6-2 portrays the expected increase and location of where new dwelling units are expected over the twenty-year period.

FIGURE 6-2, PROJECTED GROWTH IN DWELLING UNITS, BY TAZ

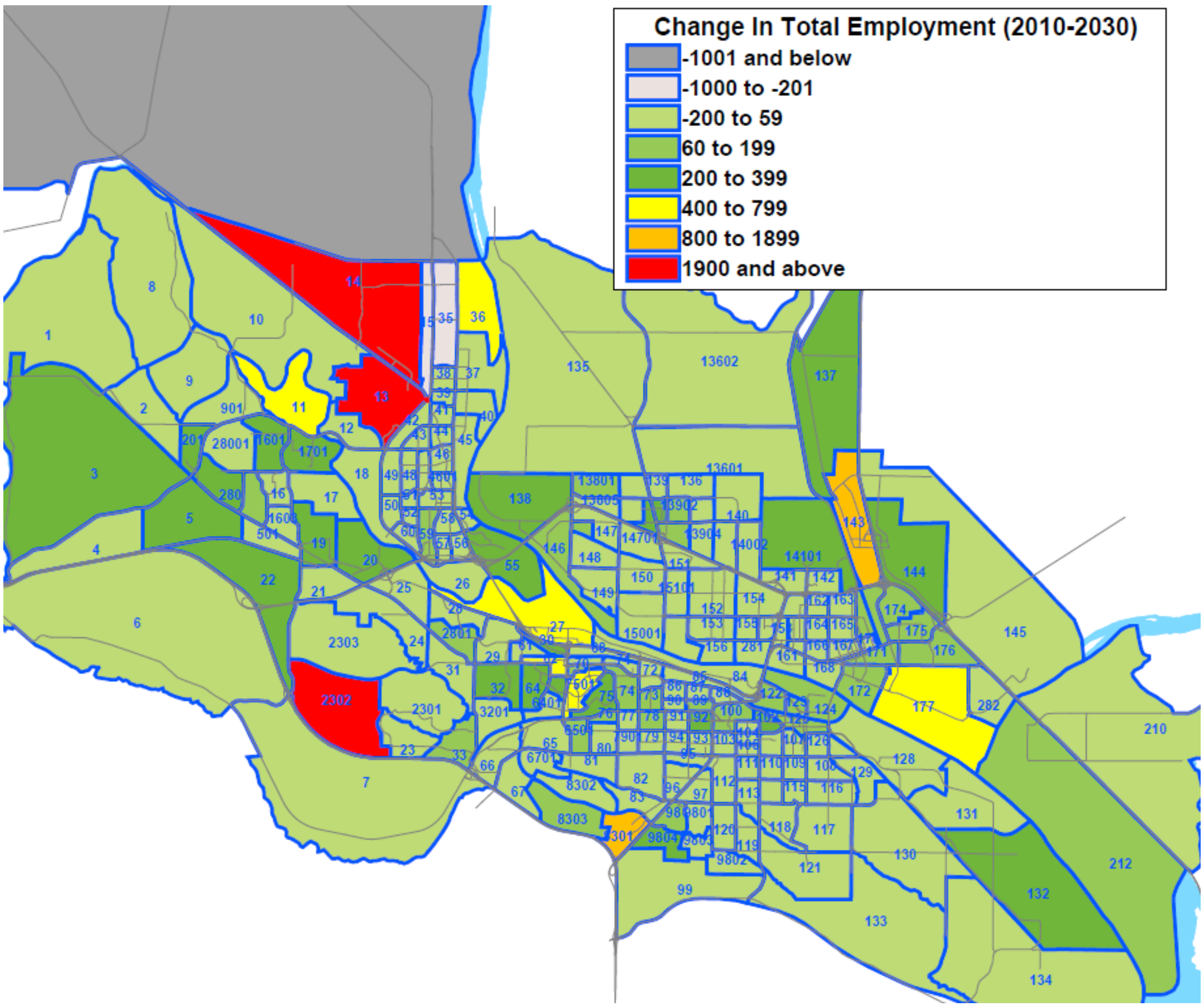


Employment forecasts indicate moderate growth expected in most TAZs, with the greatest concentrations of new employers to be located in the following areas: Horn Rapids "triangle", Richland Airport vicinity, Badger Mountain sub-area, Southridge sub-area (adjacent to SR 395), and the Pasco Processing facility adjacent SR 395.

Over half of the projected increase in employment is attributed to retail sector growth, followed by industrial/manufacturing jobs and then jobs within the service sector. Area high schools, trade schools, and colleges are expected to see enrollment increase by nearly eight thousand (36% increase) by the year 2030 – primarily in existing campus locations. A few TAZs are expected to see decreases in total employment, due to their heavy percentage of

Hanford-related employment. In 2010, nearly eighteen thousand employees worked for contractors or their subcontractors upon Hanford Site related jobs. As the Hanford nuclear clean-up mission progresses, officials with Mission Support Alliance (Hanford) have indicated a reduction of approximately 3700 jobs could be expected by the year 2020, and a total of 6700 jobs would be cut by 2030. In total, the model area is expected to see an overall increase of approximately eighteen thousand jobs by the year 2030. The projected change in total employment, by TAZ, can be seen in figure 6-3.

FIGURE 6-3, PROJECTED CHANGE IN EMPLOYMENT, BY TAZ



MODEL DEVELOPMENT

As mentioned earlier in the chapter, trips between TAZs are approximated by applying varying production and attraction rates to the different land use category values in a process called Trip Generation. “Origin” and “Destination” trips are then totaled by TAZ, determining the number of total trips entering and leaving each TAZ. Travel between TAZs is completed on a roadway network built to match existing conditions.

The model network consists of all roadways classified as collector or above on the functional class system, with select local roadways added at to allow sufficient connectivity in the model network. Roadways are built into the model as a series of links, matching their actual alignment and given characteristics as to their speed, number of lanes, capacity, and classification. Due to the large number of links contained in the model, it is not reasonable to complete individual link capacity analyses. As in most regional models, a global link capacity system was adopted, with capacities adjusting based upon the classification, number of lanes, and presence of turn lanes. Additionally, actual traffic count data is entered, by direction, for links throughout the model area. In the 2010 BFCG model, nearly 1200 individual counts were used to calibrate the model flows against 2010 traffic volumes.

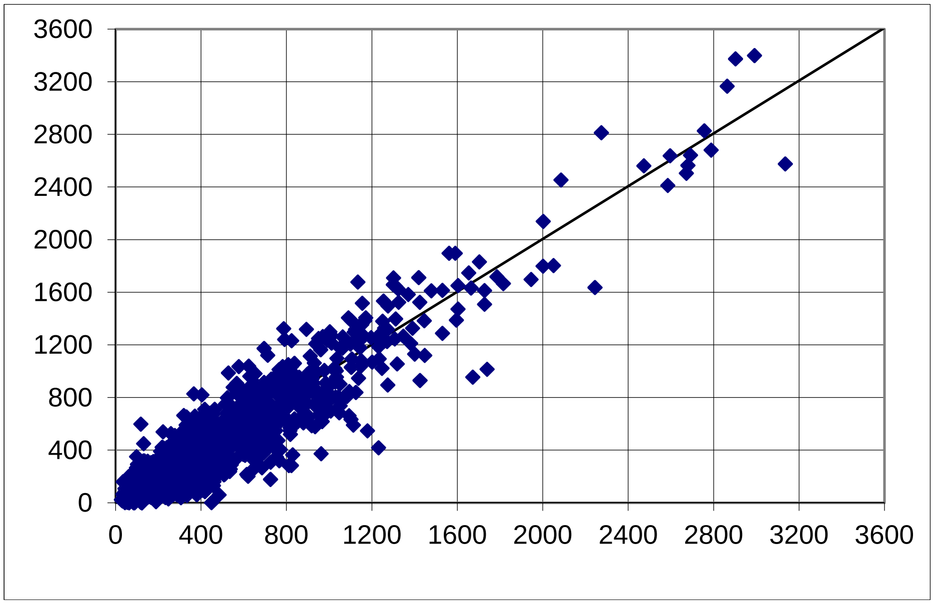
The beginning and end points of each link are called nodes. A node can be an intersection, a zone centroid, or an intermediate point between intersections. A zone centroid is simply the point from which the total trips calculated during trip generation will travel. From the zone centroid, trips are loaded out onto the road network by a series of connectors, designed to match access from local streets not in the model network. By loading the trips at multiple locations, the model is able to replicate a more realistic assignment. Nodes are coded to reflect the operating characteristics of that node – whether it be a stop sign, a traffic signal, or other control device. As with link capacities, a global intersection delay system is applied where traffic controls devices are present. Delays vary dependent upon the classification of roadway approaching, as well as the turning direction. For example, a stop sign on a minor roadway would expect more delay than upon the major arterial. Or, a left turn movement would expect more of a delay than a right turn.

With these elements in place, the simulation runs of the model began. Traffic will flow through the model to its destination using the path of least resistance or, put another way, roadways with higher speed and greater capacity will be used until they become congested. At the point of congestion, alternate routes are found. Ideally, the model outputs would exactly match all of the traffic counts across the network. In actuality, only a close approximation of the traffic patterns and volumes is realistic. Efforts are made to ensure roadways of higher classification are modeled more accurately. A series of simulation runs (calibration) are made with examination of the results between each run. Entered data, rates, or assumptions are all reviewed and adjustments made until the model produces volumes that approximate actual traffic volumes within an acceptable level of error. The acceptable level of error for calibrated model data has been recommended in National Cooperative Highway Research Program Report No. 255 entitled *Highway Traffic Data for Urbanized Area Project Planning and Design* (NCHRP 255).

CALIBRATION RESULTS

The results of the calibration process are detailed by a number of statistical measures and observations. R^2, the correlation coefficient, measures how well model volumes correlate with traffic count observations at the same locations. Figure 6-4, on the following page, shows actual 2010 traffic counts on the X-axis and assigned model volumes on the Y-axis. The diagonal 'goal' line shows where an assignment volume would equal the ground count, or an R^2 equal to 1.00. The R^2 of the 2010 BFCG model is 0.89. The recommended standard is 0.88 or above as described in FHWA, "Calibration and Adjustment of System Planning Models", 1990.

FIGURE 6-4, CORRELATION COEFFICIENT (R-SQUARED)



Model	Target
0.89	0.88

The %RMSE (Root Mean Square Error) essentially measures the amount of scatter about the observed traffic count values by the model produced volumes. NCHRP Report 365 recommends a %RMSE of between 30% and 50%. Experienced modelers, who correspond through the Transportation Model Improvement Project (TMIP), sponsored by the US Department of Transportation recommend a value of 40% or less. The 2010 BFCG model has a %RMSE of 32.3% for all links, with %RMSE measures of 14.6%, 31.8%, and 33.0% for Freeways & Expressways, Principal Arterials & Ramps, and Minor Arterials respectively. Only the collector classification was below the suggested %RMSE range, measuring 53.3%. The higher error associated with the collector classification is due to the large number of counts entered and the lower volumes generally seen upon collector roadways. This model exceeds the recommended standard and improves upon the previous model.

During calibration, observations were made ensuring the average trip length by trip type was comparable to other areas of similar size. Node delay values were adjusted to achieve desired movements at key area intersections. In addition, screen lines were established at key model locations, such as rivers and major dividing corridors, to ensure major travel patterns were being replicated by model flows.

The FHWA "Calibration and Adjustment of System Planning Models" (1990) document recommends maximum average deviations (differences between link volume counts and model volumes) for groups of links by functional classification. Table 6-3 presents the percent errors by functional class as well as corresponding results from the 2005 model effort.

TABLE 6-3, PERCENT ERROR BY FUNCTIONAL CLASS (MODEL WIDE)

Classification	Max. % Deviation*	2010 % Deviation	2005 % Deviation	Validation
Freeway/Expressways	Less than +/- 7%	0%	-1%/-4%	PASS
Principal/Ramps	Less than +/- 10%	-2%	2%/-12%	PASS
Minor	Less than +/- 15%	-5%	-5%	PASS
Collector	Less than +/- 25%	7%	-10%	PASS

This updated model represents improvements in all measures and meets or exceeds all of the recommended statistical measures, while implementing key improvements to link capacities and node delays. The model represents the Tri-Cities traffic flow patterns well and can be a useful tool in the analysis of future projects and traffic volumes. As with any forecast model, it is important to confirm the validity of model assumptions when looking at future year forecasts. It is also important to evaluate the base-year (calibration) results as they relate to actual volumes. If model results vary beyond acceptable error in a specific location, it is likely future forecasts would mirror those trends at that same local. The strength of a Regional Travel Demand Model is in its' evaluation of corridor-based volumes and regional trends, not necessarily specific movements upon any one link or intersection. In these instances, a more appropriate "micro-level" tool such as highway capacity software, Synchro, or other package would be better suited for this type of evaluation.

---

[i] 2008 ACS, US Census Bureau