



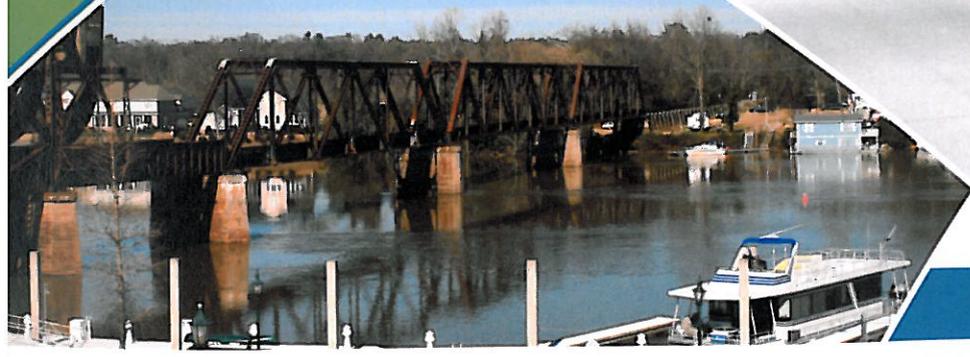
ARTS 2035

Long Range Transportation Plan

FINAL REPORT

Appendix B – Travel Demand Model for the ARTS MPO

September 2010



The Travel Demand Model for the Augusta MPO

Prepared for
Georgia Department of
Transportation
By



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1.0 Introduction

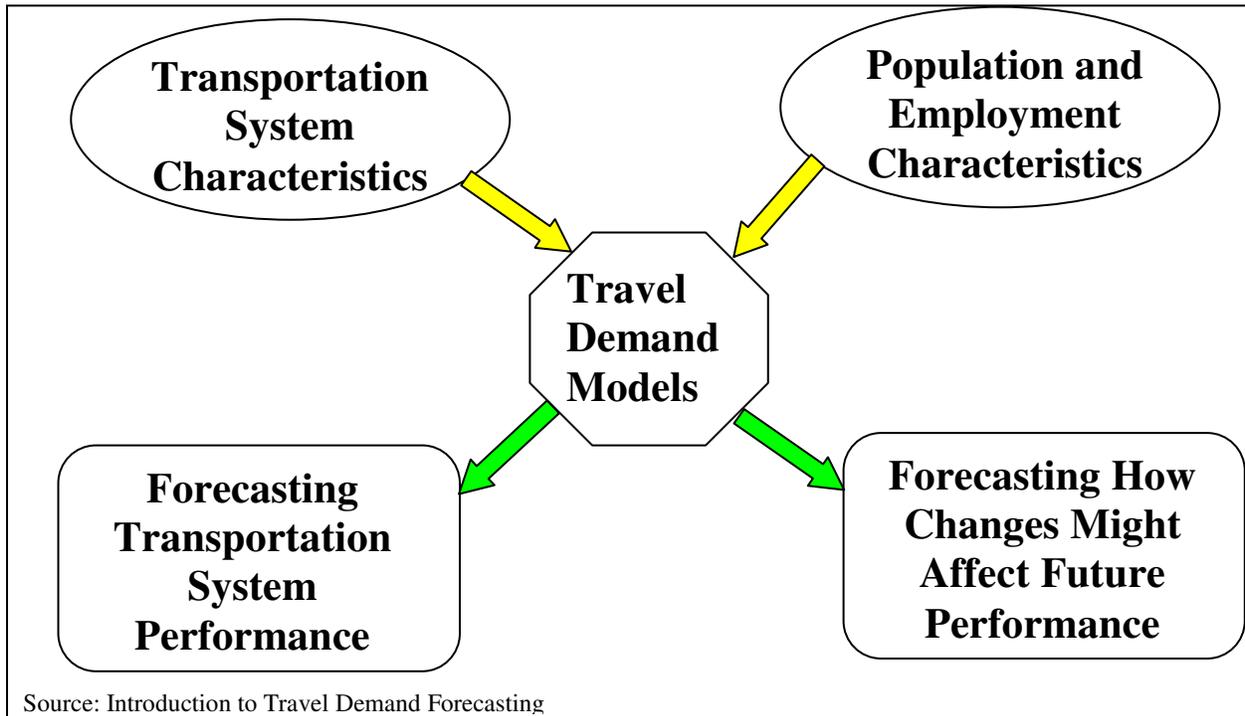
Transportation system studies are done periodically by the Georgia Department of Transportation, Augusta Regional Transportation Study (ARTS) and Augusta Transit to determine what types of transportation improvements or investments would best serve the public. Georgia DOT and ARTS are primarily responsible for technical studies pertaining to the roadway system while the Augusta Transit conducts studies of transit service.

The travel demand model is used to evaluate the performance of the roadway system in and around Augusta by the Georgia Department of Transportation and ARTS. The ARTS model is a traditional urban area analysis tool that is used to identify where major improvements should be made to its principal thoroughfare system. Since there is usually more than one strategy proposed to address future congestion and safety concerns, the model is frequently used to study which combination of improvements provides the most end-user benefits. The output from the travel demand model is used to estimate mobile source emissions and perform the conformity analysis.

There are two key inputs to the travel demand modeling process, socio-economic data and the transportation system. Socio-economic data such as population, household and employment by type represents land use. Future year projections of socioeconomic data were based on a 2006 inventory of existing land uses including vacant land, as well as region wide forecasts of population, households and employment. Future year forecasts also considered planned major transportation improvements. Allocation of expected growth is then done using known development patterns and proposals as the basis, taking into consideration planned infrastructure improvements (new highways, sewer extensions, etc.). It is in this area of travel model development that land use and community planning are connected to the transportation planning process. Figure 1.1-1 shows the interaction between travel demand models and transportation system characteristics and population and employment characteristics

The other key element of the travel model is referred to as the highway network. The highway network is a computer file containing links and nodes that represent roadway segments and intersections. Each link record in the file contains information describing these items: free-flow travel speed, distance, number of lanes, area type (density of population and employment); facility type (similar to functional classification) and capacity. Node records simply contain positional, two dimensional x and y coordinates to enable the network file to be displayed pictorially.

**Figure 1.1-1
Travel Demand Models**



Georgia DOT is responsible for the development, maintenance and application of the ARTS travel model. GDOT has updated various components of the ARTS travel model to ensure that the model is state-of-the-practice and includes technical procedures that would be needed in developing the 2035 LRTP. A detailed description of the ARTS' travel model is presented in Section 2. It includes explanations for how trips are estimated, how person trips are converted to vehicle trips, what attributes comprise the highway network and how trips are assigned onto the highway network. Each of the modeling steps involved in developing an urban travel model is described. These steps are as follows: Trip Generation; Trip Distribution; Mode Split; and Traffic Assignment.

2.0 Model Update

Several significant changes were made to the Augusta area travel model. These changes are based on the original 2002 model and listed below.

- Updated the HPMS functional classification code to 2000 HPMS in the network
- Updated screenlines and cutlines
- Updated and validated the base year highway network and expanded it to include all Aiken County in South Carolina

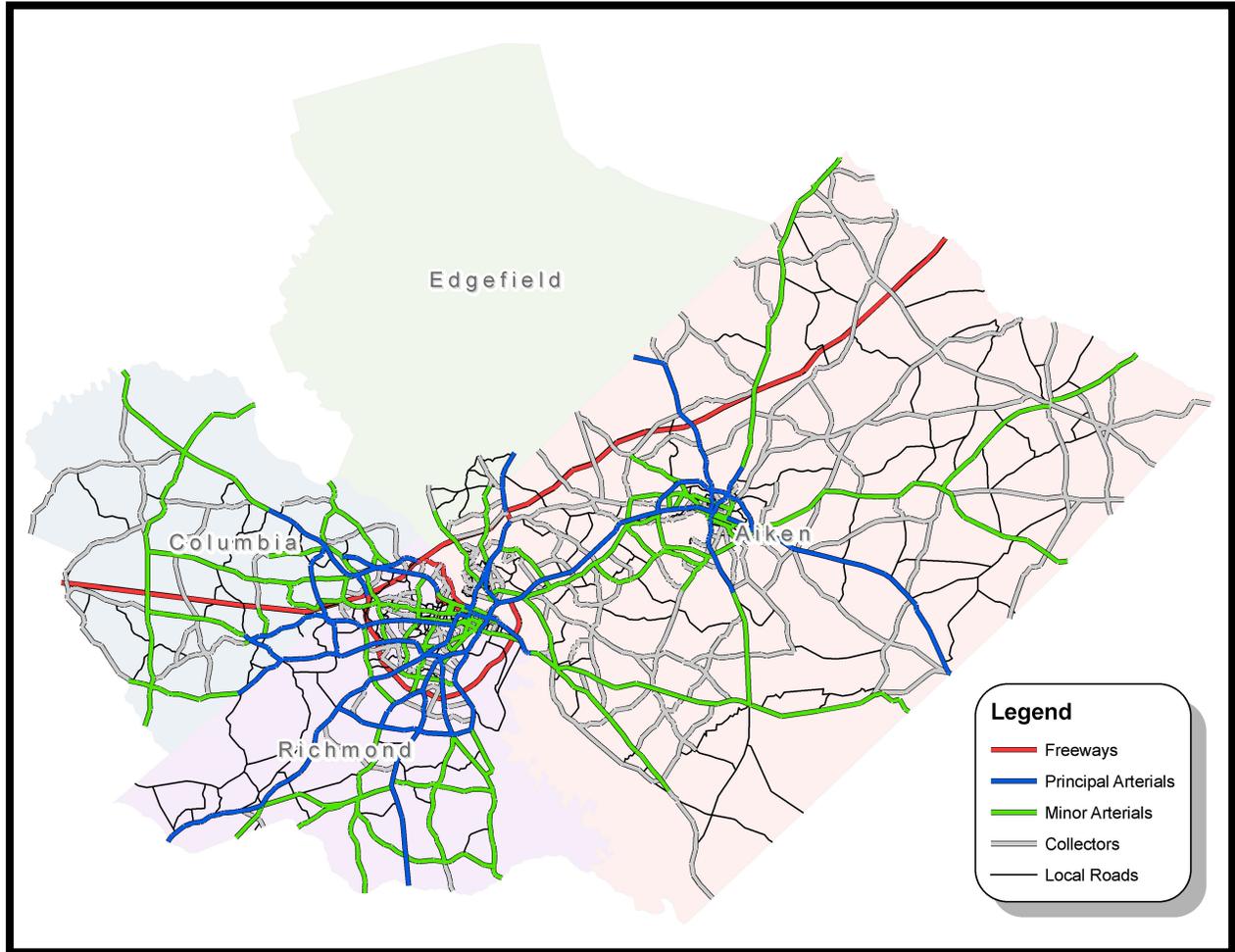
- Updated trip generation model and incorporated Augusta transit mode split process
- Updated trip distribution model
- Updated the traffic assignment procedure (24-Hour daily)
- Updated additional zones and expanded external stations
- Updated external trip model
- Added the delta matrix post-process procedure to refine the final traffic assignment

The general structure of the Augusta model is standard, in comparison with other travel demand models used in urban areas that are similar in size to Augusta. Descriptions of each principal model element are presented in the subsequent parts of this section.

2.1 Highway Network Coding

The base year model network was updated to reflect 2006 existing conditions. The 2006 highway network was closely examined and revised to reflect base year conditions. Projects that had been built in-between the current base year and previous one were included. The purpose of the highway network is to provide accurate routing paths based on the minimum time to travel from one traffic analysis zone to another. In effect, the highway network file is a simulation tool replicating the thoroughfare system in Augusta MPO area. A graphical representation of the model highway network by facility type is presented in Figure 2.1-1.

Figure 2.1-1
ARTS 2006 Highway Network



Facility Type and Area Type. Individually and in combination these two link attributes provide the framework for organizing the network into sub-groups so that free-flow speeds and capacities can be assigned. In combination with the distance and number of lanes, these attributes constitute the base layer of highway network data needed to update and apply the travel model. The facility type and area type definitions used in the ARTS highway network and modeling process are shown in the table below.

**Table 2.1-1
Facility and Area Types**

Code	Facility Type	Code	Area Type
1	Interstate	1	High Density Urban
2	Freeway	2	High Density Urban Commercial
3	Expressway	3	Urban Residential
4	Parkway	4	Suburban Commercial
6	Freeway to Freeway Ramp	5	Suburban Residential
7	Freeway Entrance Ramp	6	Exurban
8	Freeway Exit Ramp	7	Rural
11	Principal Arterial – Class I		
12	Principal Arterial – Class II		
13	Minor Arterial – Class I		
14	Minor Arterial – Class II		
15	One Way Arterial		
21	Major Collector		
22	Minor Collector		
23	One Way Collector		
30	Local Road		
32	Centroid Connector		

Capacity. Link capacities for the model network are obtained from a lookup table of per-lane hourly capacities based on facility type and area type. The final link capacity is calculated by multiplying the hourly capacity per lane by the number of lanes. The following table displays the hourly capacities per lane:

**Table 2.1-2
Hourly Capacities**

Facility Type	Area Type						
	1	2	3	4	5	6	7
Interstate	1900	1950	2000	2050	2100	2060	2020
Freeway	1600	1660	1730	1790	1850	1820	1780
Expressway	1300	1380	1450	1530	1600	1570	1540
Parkway	1170	1240	1310	1370	1440	1410	1380
Freeway to Freeway Ramp	1400	1530	1650	1780	1900	1860	1820
Freeway Entrance Ramp	900	1030	1150	1280	1400	1370	1340
Freeway Exit Ramp	800	810	810	820	820	810	790

Facility Type	Area Type						
	1	2	3	4	5	6	7
Principal Arterial – Class I	1000	1030	1050	1080	1100	1080	1060
Principal Arterial – Class II	900	900	900	900	900	880	860
Minor Arterial – Class I	800	810	810	820	820	810	790
Minor Arterial – Class II	630	630	640	640	640	630	610
One Way Arterial	760	760	770	770	770	760	740
Major Collector	520	530	540	550	560	550	540
Minor Collector	380	390	390	400	400	390	380
One Way Collector	460	470	470	480	480	470	460
Local Road	340	350	360	370	380	370	360
Centroid Connector	0	0	0	0	0	0	0

Speeds. Link speeds in the model network are derived from a speed lookup table based on facility type and area type. Assumed free-flow speed are approximately 5 mph faster than typical speed limits for the various roadway classes and area types, taking into consideration control for delay (i.e. traffic signals) if applicable. Peak and off-peak free-flow speeds were evaluated using observed speeds obtained from a travel time study conducted in the Augusta area. Based on the initial study of the speeds, a revised speed table was developed. An analysis of the Augusta data determined that Augusta’s characteristics and data results are appropriate for use in all GDOT MPO models since the travel dynamics for these urban areas are similar. Final free-flow calibrated speeds are shown in the matrix below.

**Table 2.1-3
Free Flow Speeds**

Facility Type	Area Type						
	1	2	3	4	5	6	7
Interstate	55	60	60	60	60	70	70
Freeway	50	55	55	55	55	60	60
Expressway	50	50	50	50	55	55	55
Parkway	45	50	50	50	50	55	55
Freeway to Freeway Ramp	55	55	55	55	55	55	55
Freeway Entrance Ramp	45	50	50	50	50	55	55
Freeway Exit Ramp	22	23	30	31	34	40	48
Principal Arterial – Class I	25	28	33	34	37	47	52
Principal Arterial – Class II	23	26	31	32	35	45	49
Minor Arterial – Class I	22	23	30	31	34	40	47
Minor Arterial – Class II	21	22	27	30	32	38	45
One Way Arterial	23	26	30	32	35	42	48
Major Collector	17	18	21	27	29	34	42
Minor Collector	14	15	18	24	26	30	40
One Way Collector	17	18	21	27	29	34	42
Local Road	14	14	17	18	22	28	35
Centroid Connector	14	14	17	18	22	28	35

Network Link Attributes. All input network link attributes are included in the following table. While most of them are not directly involved in the model process, they provide assistance in link attributes summary for post model result processing and for model calibration and validation.

**Table 2.1-4
Input Network Link Attributes**

Attribute Name	Description
Distance	Roadway Link Length in miles
County	County FIPS Code
Roadname	Roadway Name
Ftype	Facility Type
Lanes	Number of Lanes
Lanesam	Number of Lanes in AM Peak Direction
Lanespm	Number of Lanes in PM Peak Direction
HPMS1990	HPMS Functional Classification Code, 1990 Census Geography
HPMS2000	HPMS Functional Classification Code, 2000 Census Geography
Cstation	Traffic Count Station Number
Tcount02	2002 AADT - Two Way
Tcount06	2006 AADT - Two Way (from GDOT QA/QC Database)
Count02	2002 AADT - One Way
Count06	2006 AADT - One Way
Screenline	Screenline ID
Cutline	Cutline ID
*UAB1990	Urbanized Area Code, 1990 Census Geography
GDOT_PI	GDOT Project Identification Number
Local_PI	Local Project Identification Number
Open_date	Model Year Open to Traffic – Construction Completed
*Tollpc	Passenger car toll charge
*Tolltk	Truck toll charge
*Use	Truck prohibition identifier

* Optional attribute reserved for tolling model analysis

Network Nodes Attributes. The network node contains four attributes designated to identify the accessibility of a node. Only the centroid nodes of the network are attached with these attributes which use non-zero to indicate the availability of transit. The level of the accessibility is shown in the following table.

**Table 2.1-5
Input Network Node Attributes**

Attribute Name	Description
Transit	1 - Centroid within 0.25 miles of transit access
	2 - Centroid within 0.50 miles of transit access
	3 - Centroid within 1.00 miles of transit access

2.2 Trip Generation

Trip generation is the first step in the traditional four-step modeling process. It estimates the number of trips that will begin and end in each individual traffic analysis zone (TAZ). These are referred to as “trip ends”. Trip ends generated by households are referred to as productions. Trip ends calculated from employment or school enrollment figures are referred to as attractions. This process is accomplished by establishing relationships between trips and socioeconomic variables. The process estimates the number of trip ends, or productions and attractions, for each traffic zone by various trip purposes. Trip generation does not determine the origin and destination of each trip, only the total trips generated by each TAZ's socioeconomic characteristics.

In 1997, GDOT contracted with a consulting firm to assist in developing a new standardized trip generation process for the state's urbanized areas outside of Atlanta. The Trip Generation Update Project included a household travel survey and external travel survey in the Augusta metropolitan area. Household travel behavior by household size and income group is homogeneous from one urban area to another if transportation choices and land-use patterns are similar. The Augusta survey information was used to formulate and recommend a trip generation process that is considered transferable to the State's other urbanized areas.

The new trip generation process includes trip production and trip attraction sub-models. For all trips that have origins and destinations inside the ARTS region, excluding trucks, the trip production sub-model applies trip rates through a cross-classification of household size (1,2,3,4+) and automobiles available (0,1,2,3+). Aggregate household data for each traffic analysis zone is disaggregated into sixteen cross-classified cells using a household stratification model. The household stratification model is also a product of the Trip Generation Update Project. This model breaks out the total number of ARTS households into cross-classification cells using zonal income, Augusta area specific data from the Census Transportation Planning Package (CTPP), and data from the Augusta household survey. The trip production sub-model applies regression equations for other trip purposes. The trip attraction sub-model applies regression equations for all trip purposes.

Typically, there are three types of trips that travel demand models include: (1) Internal-Internal (I-I) trips whose origin and destination are inside the study area boundary; (2) Internal-External (I-E) trips that have exactly one trip end inside the study area; and (3) External-External (E-E)

trips that have both trip ends outside of the study area. I-I trips follow the production and attraction logic of trip formulation. They are commonly grouped into trip purposes so their characteristics can be reproduced by the chain of sub-models in the four-step process. I-E and E-E trips are developed separately using a different methodology that is heavily dependent on traffic counts observed on the principal roads leading into and out of the region.

2.2.1 Trip Purposes

Seven trip purposes were included in the trip generation process. These purposes are summarized below:

1. **Home Based Work (HBW):** All travel made for the purpose of work and which begins or ends at the traveler's home.
2. **Home Based Other (HBO):** Any trip made with one end at the home except those for the purpose of work or shopping.
3. **Home Based Shopping (HBS):** Trips made for the purpose of shopping and which begins or ends at the traveler's home.
4. **Non Home Based (NHB):** Any trip that neither begins nor ends at home.
5. **Internal-Internal Truck (IIT):** Internal trips made by commercial vehicles.
6. **Internal-External Passenger Car (IEPC):** Internal trips beginning or ending outside the modeled area, excluding trucks.
7. **Internal-External Truck (IET):** Internal truck trips beginning or ending outside the modeled area.

2.2.2 Socioeconomic Data

The ARTS provided 2006 Base Year socioeconomic data for the model. For each of the 1,001 traffic analysis zones (TAZ's) in the model area, the following socioeconomic variables were collected for use in the trip generation model:

Population: The total number of individuals that are residing in each traffic zone.

Retail Employment: Number of employees working for retail businesses in a given traffic analysis zone where the business is located.

Industrial Employment: Number of employees working for industrial based businesses in a given traffic analysis zone where the business is located

Service Employment: Number of employees working for service based businesses in a given traffic analysis zone where the business is located.

Wholesale and Warehouse Employment: Number of employees working for Wholesale and warehouse based businesses in a given traffic analysis zone where the business is located.

Total Employment: The total number of employed persons in those traffic zones with employment.

Income: Average household income in TAZ in 2000 dollars (per 2000 Census).

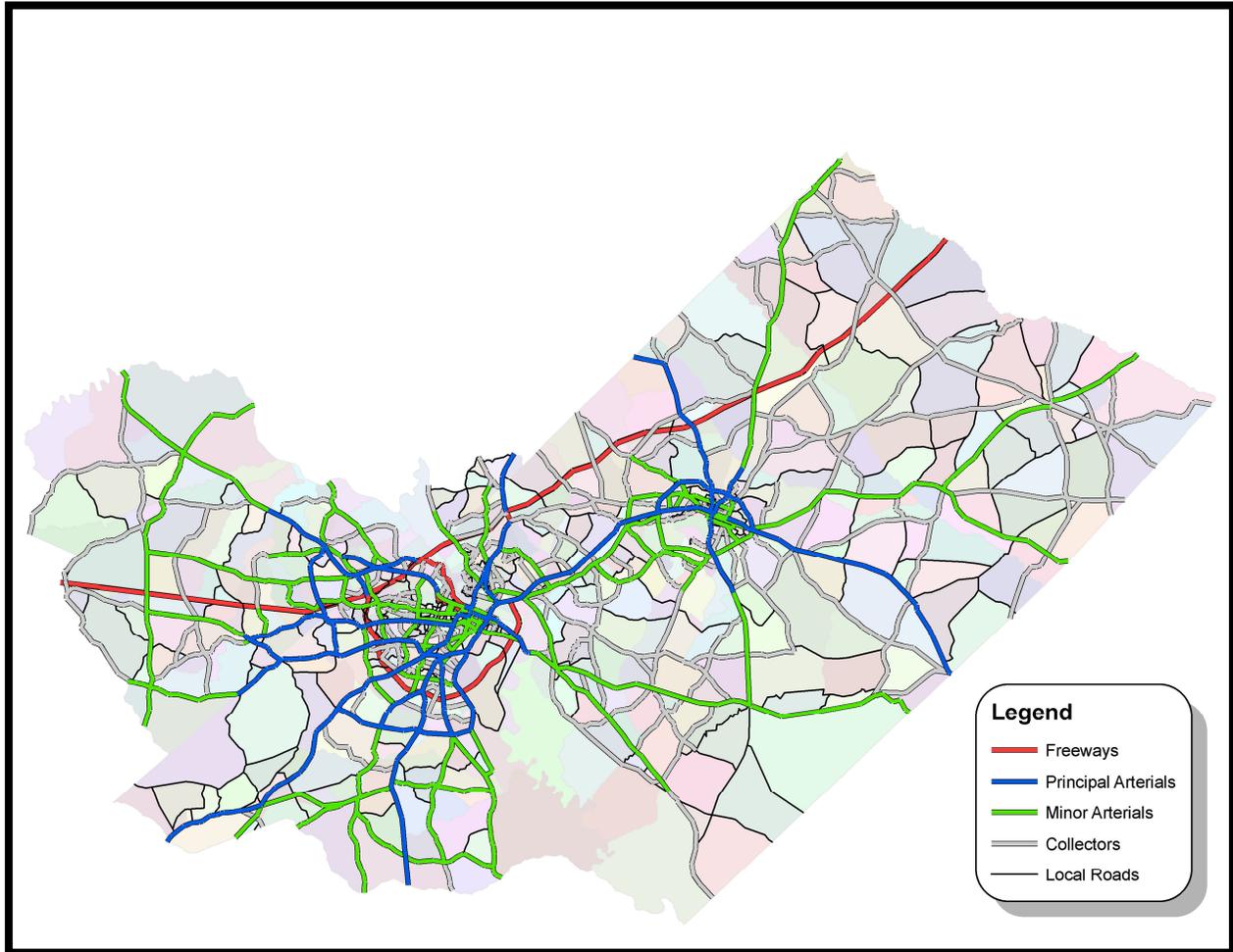
Total Households: Total number of occupied households in a given traffic analysis zone.

School Enrollment: The total number of enrolled students in zones with educational facilities.

Acres: Area of TAZ in acres.

Appendix A contains the zonal level socioeconomic data used in the travel demand model for 2006. An illustrative picture of the zone boundary map is presented in Figure 2.2.2-1. There are 1,001 internal zones in the ARTS model with 33 additional zones called external stations. Zone numbers are consecutive within each county but are non-consecutive between counties. Gap zone numbers are reserved in each MPO county for future zone expansion. The external station zones represent the key facilities where travel in and out of the ARTS region occurs such as I-20 316, US-78 and US-25.

Figure 2.2.2-1
Map of Traffic Analysis Zones



2.2.3 Household Stratification Model

The household stratification model subdivides the total number of households by TAZ into sixteen household strata defined by household size and the number of automobiles available. Stratification is done using zonal income, Augusta area specific data from the Census Transportation Planning Package (CTPP), and data from the Augusta household survey. The model distributes the total households in a TAZ to each cross-classification cell by calculating a relative¹ probability that a household will be a particular size with a particular number of automobiles. The relative probability is calculated with the following equation:

$$P(i,j) = S * I * CF, \text{ where}$$

¹ The term relative probability is used because the value is not technically a statistical probability.

- P(i,j) = Relative probability that a household will be size i and own j autos
- S = Household size factor from CTPP lookup table
- I = Income factor from CTPP lookup table
- CF = Composite household factor from Augusta household survey lookup table.

An estimate of the number of households in a particular cross-classification cell is then calculated by multiplying the total number of households in the TAZ by the corresponding relative probability. The final number of households in each cross-classification cell is calculated by applying an adjustment factor to each calculated value. The adjustment factor is applied to insure that the sum of the resulting disaggregated households equals the original aggregate number of households. This process is represented mathematically with the following equations:

$$HH_{ij}(\text{est.}) = HH * P(i,j), \text{ where}$$

- HH_{ij}(est.) = Estimated number of households of size i that own j autos
- HH = Total number of households in the TAZ

$$HH_{ij} = HH_{ij}(\text{est.}) * F, \text{ where}$$

- HH_{ij} = Final number of households² of size i that own j autos
- F = $HH / \sum HH_{ij}(\text{est.})$, control total adjustment factor.

The three lookup tables used in the household stratification model are shown on the following pages.

**Table 2.2.3-1
2000 Household Size CTPP Distribution**

Computed			HOUSEHOLD SIZES			
Persons/HH			HOUSEHOLD SIZES			
Ranges			1	2	3	4+
0.0	to	1.0	1.0000	0.0000	0.0000	0.0000
1.0	to	1.2	0.7812	0.2056	0.0133	0.0000
1.2	to	1.4	0.6898	0.2568	0.0331	0.0203
1.4	to	1.6	0.5752	0.3128	0.0687	0.0433
1.6	to	1.8	0.4839	0.3511	0.1021	0.0630
1.8	to	2.0	0.4141	0.3537	0.1279	0.1043
2.0	to	2.2	0.3487	0.3563	0.1464	0.1486
2.2	to	2.4	0.2872	0.3471	0.1689	0.1968
2.4	to	2.6	0.2389	0.3274	0.1879	0.2458
2.6	to	2.8	0.1939	0.3140	0.1985	0.2935

2 Not rounded to an integer value to eliminate problems with round off errors.

Computed			HOUSEHOLD SIZES			
Persons/HH			1	2	3	4+
Ranges						
2.8	to	3.0	0.1553	0.2947	0.2076	0.3424
3.0	to	3.2	0.1253	0.2749	0.2074	0.3924
3.2	to	3.4	0.1152	0.2489	0.1996	0.4363
3.6	to	3.8	0.1119	0.2116	0.1932	0.4832
3.8	to	4.0	0.1038	0.2042	0.1688	0.5232
4.0	to	4.2	0.1028	0.2032	0.1608	0.5332

**Table 2.2.3-2
2000 CTPP Household Income Distributions**

TAZ-Level Median HH Income		Income Group 1 < \$20,000	Income Group 2 \$20,000 - \$39,999	Income Group 3 \$40,000 - \$59,999	Income Group 4 > \$60,000
\$0	\$2,499	0.8835	0.1165	0.0000	0.0000
\$2,500	\$4,999	0.8549	0.1168	0.0232	0.0050
\$5,000	\$7,499	0.8300	0.1318	0.0300	0.0081
\$7,500	\$9,999	0.7585	0.1468	0.0427	0.0521
\$10,000	\$12,499	0.6933	0.1826	0.0718	0.0523
\$12,500	\$14,999	0.6311	0.2131	0.0802	0.0756
\$15,000	\$17,499	0.5771	0.2465	0.0894	0.0870
\$17,500	\$19,999	0.5031	0.2938	0.1046	0.0985
\$20,000	\$22,499	0.4326	0.3321	0.1257	0.1096
\$22,500	\$24,999	0.3927	0.3387	0.1449	0.1236
\$25,000	\$27,499	0.3316	0.3581	0.1702	0.1401
\$27,500	\$29,999	0.3071	0.3488	0.1824	0.1617
\$30,000	\$32,499	0.2734	0.3395	0.1945	0.1926
\$32,500	\$34,999	0.2399	0.3356	0.2152	0.2093
\$35,000	\$37,499	0.2108	0.3322	0.2254	0.2316
\$37,500	\$39,999	0.1825	0.3143	0.2418	0.2615
\$40,000	\$42,499	0.1655	0.2840	0.2612	0.2893
\$42,500	\$44,999	0.1501	0.2688	0.2676	0.3134
\$45,000	\$47,499	0.1391	0.2550	0.2663	0.3396
\$47,500	\$49,999	0.1207	0.2387	0.2649	0.3758
\$50,000	\$52,499	0.1188	0.2142	0.2569	0.4101
\$52,500	\$54,999	0.1016	0.2012	0.2566	0.4407
\$55,000	\$57,499	0.0945	0.1894	0.2480	0.4682
\$57,500	\$59,999	0.0901	0.1853	0.2256	0.4990
\$60,000	\$62,499	0.0844	0.1684	0.2102	0.5371
\$62,500	\$64,999	0.0766	0.1598	0.2025	0.5612
\$65,000	\$67,499	0.0688	0.1510	0.1948	0.5854

TAZ-Level Median HH Income		Income Group 1	Income Group 2	Income Group 3	Income Group 4
		< \$20,000	\$20,000 - \$39,999	\$40,000 - \$59,999	> \$60,000
\$67,500	\$69,999	0.0653	0.1416	0.1926	0.6004
\$70,000	\$72,499	0.0601	0.1271	0.1833	0.6295
\$72,500	\$74,999	0.0535	0.1218	0.1698	0.6549
\$75,000	\$77,499	0.0512	0.1087	0.1636	0.6765
\$77,500	\$79,999	0.0485	0.1042	0.1551	0.6922
\$80,000	\$82,499	0.0446	0.0991	0.1465	0.7099
\$82,500	\$84,999	0.0405	0.0939	0.1455	0.7202
\$85,000	\$87,499	0.0364	0.0889	0.1359	0.7387
\$87,500	\$89,999	0.0350	0.0839	0.1238	0.7573

**Table 2.2.3-3
Size/Income//Auto Ownership Distribution**

Income Group	Persons Per Household	Autos Available			
		0	1	2	3+
1	1	0.3063	0.6689	0.0248	0.0000
	2	0.0978	0.6578	0.2222	0.0222
	3	0.0733	0.6909	0.1628	0.0730
	4	0.1000	0.5694	0.1765	0.1541
2	1	0.2548	0.4776	0.2259	0.0417
	2	0.0400	0.2140	0.6320	0.1140
	3	0.1111	0.1256	0.6033	0.1600
	4	0.0900	0.1080	0.5942	0.2078
3	1	0.1833	0.6056	0.1578	0.0533
	2	0.0274	0.1677	0.6343	0.1707
	3	0.0900	0.1050	0.5033	0.3017
	4	0.0600	0.0438	0.3862	0.5100
4	1	0.0577	0.6654	0.2000	0.0769
	2	0.0694	0.1044	0.5322	0.2939
	3	0.0200	0.0581	0.5098	0.4121
	4	0.0189	0.0405	0.5405	0.4000

2.2.4 Trip Production

The routine for computing trip productions uses cross-classified data from the household stratification model and applies trip rates to calculate Home Based Work, Home Based Other, Home Based Shopping, and Non Home Based Productions. Trip rates for each purpose are shown below.

Table 2.2.4-1

Household Size	0 Autos	1 Auto	2 Autos	3+ Autos
Home Based Work				
1	0.285	0.751	0.733	0.909
2	0.750	1.165	1.305	1.422
3	1.556	1.780	1.625	1.983
4+	1.000	1.727	2.109	2.387
Home Based Other				
1	0.694	1.190	1.300	1.818
2	1.350	1.835	2.360	2.688
3	4.444	4.195	4.048	3.600
4+	5.833	6.523	8.122	7.312
Home Based Shopping				
1	0.367	0.411	0.200	0.636
2	0.558	0.882	0.675	0.688
3	0.222	0.585	0.490	0.733
4+	0.417	1.023	0.769	1.151
Non-Home Based				
1	0.245	1.081	1.033	1.364
2	0.500	1.518	1.939	2.016
3	0.889	2.976	2.154	2.667
4+	1.333	2.886	3.184	3.720

Trip end productions for other purposes are calculated using the following regression equations:

I-I Truck Productions = 0.388*hh + 1.206*retail + 1.362*(manuf + whole) + 0.514*service

I-E Passenger Car Productions = 0.331*Households + 0.724*Total Employment

I-E Truck Productions = 0.078*Retail Employment + 2.149*Wholesale Employment + 0.228*Manufacturing Employment

2.2.5 Trip Attraction Sub-model

The trip attraction routine to compute the estimated number of trips attracted to each TAZ uses the following regression equations:

Home Based Work Attractions = 1.196*Total Employment

Home Based Other Attractions = 0.5077*Population + 0.967*Total Employment + 1.5258*School Enrollment

Home Based Shopping Attractions = 2.655*Retail Employment
Non-Home Based Attractions = 0.293(Population) + 2.82108*(Retail Employment + Wholesale Employment) + 0.6984*Service Employment
Internal Truck Attractions = Internal Truck Productions
Internal-External Attractions = Based on counts and EE% (internal zones=0)
Internal-External Truck Attractions = Based on counts, EE%, and Truck% (internal zones=0)

The trip rates were subsequently refined system-wide on case by case basis during the model calibration process. The adjustments were considered necessary for special trip generators such as Fort Gordon military base where trip making behaviors are entirely different from those of civilians. Trip rates were also refined for area types where higher trip rates usually associated to dense urbanized areas.

The total number of Internal-External (I-E) trips for each external station is calculated by subtracting the estimated number of External-External trips (based on an assumed percentage) from the station’s daily traffic volumes. Then the total I-E trips are separated into I-E truck trips and other I-E trips based on an assumed truck percentage at each external station. The following table displays the percentages that are used to calculate I-E and E-E Attractions at each external station for truck and passenger cars.

**Table 2.2.5-1
 Proportion of External-Internal Trips by External Station**

2006 Model Station	2000 Model Station	Road Name	2006 Volume	Percent		Trucks		PC's	
				Trucks	PC's	E-E	I-E	E-E	I-E
1614	1313	US 221/GA 150	1,450	9%	91%	1.8%	7.0%	18.2%	73.0%
1615	1314	GA 28	3,800	15%	85%	0.2%	14.5%	3.2%	82.1%
1616	1315	SC 230	6,500	7%	93%	1.0%	5.8%	7.2%	86.0%
1617	1316	Sweetwater Rd (S-34)	5,500	7%	93%	0.0%	6.8%	0.0%	93.2%
1618	1317	US 25	10,400	17%	83%	2.2%	14.4%	5.8%	77.6%
1619	n/a	Rainbow Falls Rd.	1,750	3%	97%	0.4%	2.6%	6.8%	90.2%
1620	1318	Bettis Academy Rd.	1,850	7%	93%	0.4%	6.4%	3.5%	89.7%
1621	1319	SC 19	4,500	17%	83%	2.3%	14.3%	6.4%	77.0%
1622	1320	SC 191	2,000	7%	93%	0.4%	6.4%	3.5%	89.7%
1623	n/a	US-1	2,700	5%	95%	0.3%	4.7%	2.9%	92.2%
1624	n/a	SC-391	2,000	3%	97%	0.2%	2.8%	2.9%	94.1%
1625	n/a	I-20	27,600	23%	77%	9.2%	13.8%	19.3%	57.8%
1626	n/a	SC-113	1,350	3%	97%	0.2%	2.8%	2.9%	94.1%
1627	n/a	SC-302	1,950	5%	95%	0.4%	4.7%	2.9%	92.2%
1628	n/a	SC-389	2,800	3%	97%	0.2%	2.8%	2.9%	94.1%
1629	n/a	SC-39	1,250	3%	97%	0.2%	2.8%	2.9%	94.1%
1630	n/a	SC-4	950	4%	96%	0.2%	3.8%	2.9%	93.1%
1631	n/a	US-78	5,600	17%	83%	2.4%	14.6%	6.6%	76.4%
1632	n/a	US-278	2,400	10%	90%	0.6%	9.4%	2.7%	87.3%
1633	n/a	SC-125	3,000	3%	97%	0.2%	2.8%	2.9%	94.1%

2006 Model Station	2000 Model Station	Road Name	2006 Volume	Trucks				PC's	
				Percent Trucks	Percent PC's	Percent E-E	Percent I-E	Percent E-E	Percent I-E
Number	Number	Road Name	Volume	Trucks	PC's	E-E	I-E	E-E	I-E
1601	1300	GA 56	10,640	10%	90%	1.6%	8.5%	4.5%	85.4%
1602	1301	Waynesboro Rd./CR 1516	1,880	10%	90%	1.6%	8.5%	4.5%	85.4%
1603	1302	US 25	7,600	10%	90%	1.6%	8.5%	4.5%	85.4%
1604	1303	Storey Mill Rd.	950	10%	90%	1.6%	8.5%	4.5%	85.4%
1605	1304	Keysville Rd.	1,400	10%	90%	1.6%	8.5%	4.5%	85.4%
1606	1305	GA 88	1,440	10%	90%	1.6%	8.5%	4.5%	85.4%
1607	1306	US 1	6,990	13%	88%	3.1%	9.4%	4.4%	83.1%
1608	1307	US 221/GA47	2,000	9%	91%	1.0%	7.8%	0.9%	90.3%
1609	1308	US 278/US 78/GA 10	4,980	9%	91%	1.0%	7.8%	0.9%	90.3%
1610	1309	Wrightsboro Rd./GA 223	2,470	9%	91%	1.0%	7.8%	0.9%	90.3%
1611	1310	I-20	32,730	22%	78%	9.0%	13.4%	19.4%	58.2%
1612	1311	Gross Place Rd.	1,250	9%	91%	1.0%	7.8%	0.9%	90.3%

2.2.6 External-External Trips

Two external-external (E-E) trip tables were estimated for the 2006 calibration. One for passenger cars and one for trucks. The external-external trip tables were developed based on the 2002 E-E trip model and were expanded to the new model coverage area. A matrix summarizing the distance in miles between all external stations was developed using the 2006 network with illogical movements eliminated. This distance matrix serves as a “seed” to develop the final E-E trip tables. The theory behind using distance between external stations to help predict external-external trips is that the greater the distance between external stations, the more likely there will be external-external trips between these external stations. For example, typically, the distance between two external stations on either end of an interstate facility would be longer and, likewise, the number of trips that will travel between the two external stations on either end of the interstate would be higher. The final 2006 external trip tables were estimated by applying the FRATAR procedure on the “seed” matrix to match the estimated E-E trips at each external station. Because E-E traffic volumes on collectors and local streets are relatively low, it is assumed these movements were negligible.

2.2.7 Special Trip Generators

Special trip purposes are used for zones or activity centers having trip rates that are not represented well by the standard trip generation process. In order to realistically reflect travel pattern exhibited by Fort Gordon, a separate trip rate for military base was used based on the ITE Trip Generation Handbook. Total trip productions and attractions were estimated and allocated by the trip purpose for the base.

2.2.8 Balancing Productions and Attractions

A TP+ script was developed for the trip generation process. Using 2006 socioeconomic data, the script calculates and balances the productions and attractions, writes the productions and attractions to a file, builds the E-E trip table, calculates Fratar factors, and applies the Fratar model to adjust the E-E table so that traffic volumes at external stations closely match traffic counts.

For trip purposes in the ARTS model, production and attraction trip ends are computed separately. As such, the sum of productions across all zones does not necessarily equal the sum of attractions. In reality though, each trip has two trip ends; one is a production/origin and one is an attraction/destination. In theory, it makes sense to equalize the sum of productions with the attractions across all zones which, in effect, “balances” the two types of trip ends. This balancing or reconciliation is performed in the trip generation script. The script uses the process listed below.

Balancing Productions and Attractions

1. Productions and Attractions are calculated for all internal TAZs by purpose.
2. Zonal attractions for each trip purpose are proportionally adjusted so the total attractions equal the total productions by purpose (i.e. attractions balanced to productions) for all internal zones.
3. Special generator productions and attractions are added/subtracted.
4. Non-home based productions are set equal to non-home based attractions (NHB trip productions were generated in the “home” zone, but by definition, NHB trips do not begin or end at the home. Therefore, the assumption is that the attraction variables are a better indicator of total trips than home based characteristics).
5. Attractions are balanced to productions for all internal zones (except NHB).
6. Internal-External Attractions (including trucks) are calculated for external stations.
7. I-E productions (including trucks) are balanced to the calculated attractions (assumes that since I-E attractions are based on traffic counts or external station projections, they provide the best controls).
8. The I-E productions and attractions are appended to the I-I trip end file to produce the final productions and attractions.

2.3 Trip Distribution

Trips are calculated for persons, by trip purpose, from the production and attraction trip ends. The trip distribution step uses the gravity model process, which is commonly used for this purpose in urban models. The estimated number of trips between any two origin-destination zones will, in general, be proportional to the number of trip ends (mass) and inversely proportional to the travel time. The gravity model computes trips such that the resulting distribution matches an observed distribution of trips by travel time for each of the trip purposes.

Minimum time paths for the network were calculated using the TP+ Hwyload function. These times include all turn prohibitory and turn penalties. The minimum times were then adjusted to include the intrazonal times and terminal times. Intrazonal times, the average time it takes to make a trip inside a particular TAZ, were created by the TP+ Matrix function using half of the average travel time to the nearest four TAZ's. Terminal times were assigned based on the employment density of the origin and destination TAZ's. At the trip origin, terminal time generally refers to the walk from one's residence to their car. At the destination end, it generally represents the time it takes to go from one's car to their destination. The following table summarizes the terminal time criteria:

**Table 2.3-1
Terminal Time Criteria**

Zone	Employment Density				
	(Total Employees per Acre)				
	0-4.00	3.01-15.00	15.01-50.00	25.01-75.00	>75.00
Origin	1.0 minute	1.0 minute	2.0 minutes	2.0 minutes	2.0 minutes
Destination	1.0 minute	1.5 minutes	2.0 minutes	2.5 minutes	3.0 minutes

Average trip travel times are displayed in the following table. These are typical trip travel times, found in urban areas the size of Augusta. Home Based Work trips have the longest trip travel time at 19.9 minutes while Non Home Based trips have the shortest travel time at 12.5 minutes. The comparison of the model results with the target values is shown in Appendix B.

**Table 2.3-2
Average Trip Travel Times**

Trip Purpose	Average Trip Travel Time (Time)
Home Based Work	19.9
Home Based Other	12.9
Home Based Shopping	15.7
Non Home Based	12.5
Trucks	16.2

Gravity model input consists of a set of travel time impedance factors (friction factors), in addition to the production trip ends, attraction trip ends and minimum time skim. These parameters force the gravity model to produce sets of trips by trip purpose, whose distributions approximate an observed travel time distribution.

2.4 Mode Split

The mode split process determines what mode of travel will be used to make the trips between zones. A trip-end model split was used to determine the number of transit trips. Trip-end models are based on socio-economic characteristics within traffic zones (i.e., income, auto-ownership, etc.), rather than service characteristics between zones. Trip-end models can serve as a reasonable tool for estimating changes in regional transit ridership levels in response to changes in regional transit investments and policies.

Since trip-end models are based on zonal attributes, the implied assumption is that transit ridership consists primarily of “captive” riders who must use transit, and a fixed share of those who choose to use transit over other available modes. A trip-end modeling approach has been developed that can be used to test the effectiveness of system-wide transit improvements. The general approach is as follows:

1. Transit trip rates are calibrated to replicate base year transit ridership totals. Transit trip rates are stratified by auto ownership level (0 autos; 1 auto; 2 autos; 3+ autos)³.
2. Each Traffic Analysis Zone (TAZ) is coded with attributes that designate whether a zone is within three transit service area buffers (0.25-mile, 0.5-mile and 1-mile).
3. Transit service area attributes are used to estimate the percentage of households in each zone that have access to transit.
4. Transit trips are estimated by applying transit trip rates to households that are within the transit service area.
5. Highway person trip tables are estimated by subtracting transit trips from the total person trip tables estimated in the trip generation model.

Future regional-level transit policies can be tested, including transit service area expansion, fare adjustments and headway⁴ changes. Trip rates can also be factored to test the effects of attracting more choice riders. Base year operating costs and revenues are used to estimate the costs of the regional transit policies.

Augusta has a transit system serving the area; the Augusta Transit. After the transit trips are calculated and subtracted, the remaining person trips are converted to vehicle trips for the internal trip purposes (HBW, HBO, HBS, and NHB). Average auto occupancy rates by purpose from various sources such as the Census Journey-to-Work data and other national travel surveys were used to estimate the Augusta average auto occupancy rate. The other trip tables, internal truck and I-E and E-E passenger car and truck trips were calculated in terms of vehicle trips at their inception. Conversion to vehicle trip table enables comparison to vehicle counts and capacity analyses.

The following trip table factors or vehicle occupancy rates were used in the ARTS model:

³ Initial trip rates were calculated from the 1997 Augusta Household Travel Survey, and are scaled proportionally to produce observed trip totals.

⁴ Using typical fare and headway elasticities.

**Table 2.4-1
ARTS Vehicle Occupancy Rates**

Trip Purpose	Occupancy Rate
Home Based Work	1.11
Home Based Other	1.67
Home Based Shopping	1.44
Non Home Based	1.66
Internal Trucks	No adjustment – already vehicle trips
Internal-External	No adjustment – already vehicle trips
Internal-External Trucks	No adjustment – already vehicle trips

2.5 Traffic Assignment

The last step in the modeling sequence is the assignment or simulation of the trip tables to logical routes in the highway network. Trip assignment for the ARTS model was accomplished using the equilibrium assignment technique. The traffic assignment algorithm is iterative, running through successive applications until equilibrium occurs. Equilibrium occurs when no trip can be made by an alternate path without increasing the total travel time of all trips in the network. The equilibrium assignment is an iterative process that reflects travel demand assigned to minimum time paths as well as the effects of congestion. In each assignment iteration, traffic volumes are loaded onto network links and travel times are adjusted in response to the volume to capacity relationships. Final assigned volumes are derived by summing a percentage of the loadings from each iteration. The percentages reflect congested conditions that usually influence motorists' path selection for a portion of the day, not the entire day.

During the model run, additional network link attributes are attached to the input network to store assignment results as well as values used in the traffic assignment. These additional attributes provide volumes, travel time, speed, and so on for each link, and can be used to summarize network-wide link statistics. A list of these attributes is shown in Table 2.5-1.

**Table 2.5-1
Output Network Attributes**

ARTS Travel Demand Model – Output Network Attributes	
Attribute Name	Description
Taz	Nearest Taz ID
Atype	Area Type
Hcap	Hourly Capacity (Vehicles per Hour)
Hcapam	AM Peak Hourly Capacity (Vehicles per Hour)
Hcappm	PM Peak Hourly Capacity (Vehicles per Hour)
Capacity	Daily Capacity (Vehicles per Day)

ARTS Travel Demand Model – Output Network Attributes	
Attribute Name	Description
Speed	Freeflow Speed in Mile per Hour (Miles per Hour)
Time_ff	Free Flow Travel Time (Minutes)
Time_op	Off-peak Travel Time (Minutes)
Linkclass	Link Classification Used in Assignment
V_1	Daily Volume (One-way)
Time_1	Congested Link Travel Time
Vc_1	Daily Volume over Capacity Ratio
Cspd_1	Congested Speed (Miles per Hour)
Vht_1	Vehicle Hour of Travel
Vt_1	Daily Volume (Two-way)
V_pc	Daily Volume (One-way passenger)
V_tk	Daily Volume (One-way truck)
Vmt_1	Total Daily Vehicle Mile of Travel
Vhd_1	Total Daily Vehicle Hours of Delay
Count	Base Year Traffic Count (One-way)
Vcnt	Daily Volume over Base Year Count Ratio

2.5.1 Model Calibration

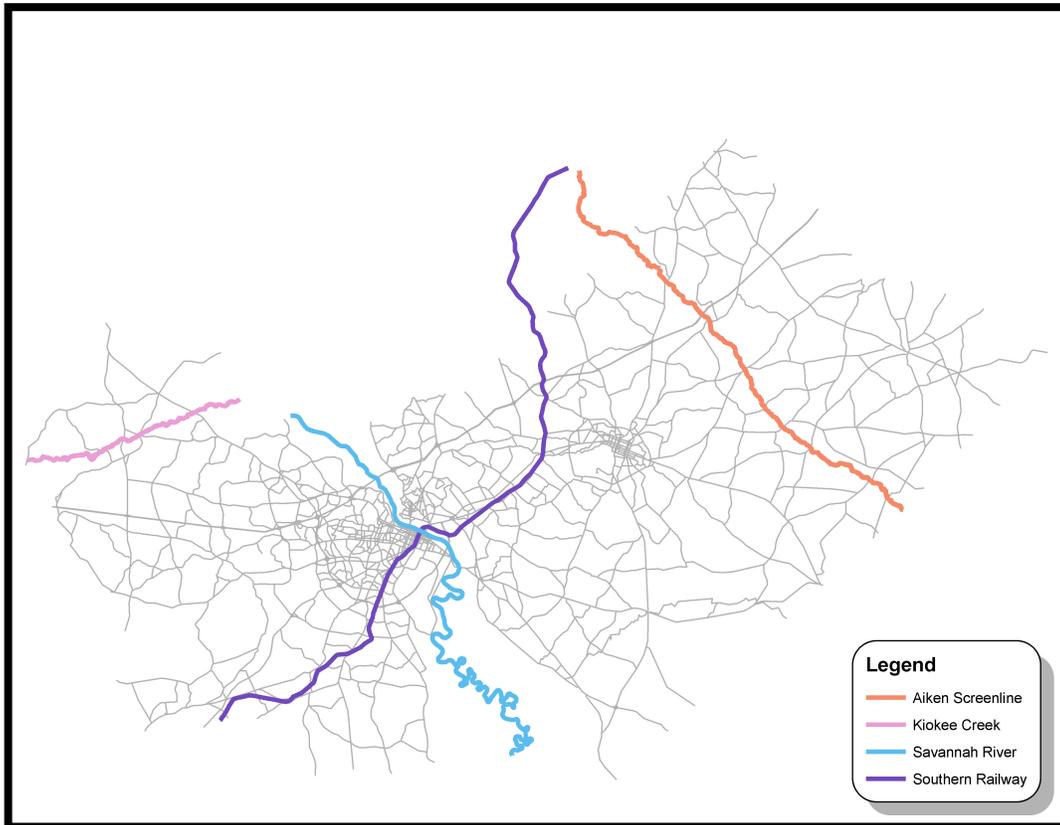
Georgia DOT requires refinements to various model parameters until the base year (2006) model sufficiently replicates observed 2006-level travel patterns. The base year model was checked for accuracy by determining the percent error of assigned volumes compared to ground counts and by checking the reasonableness of the model's Vehicle-Miles Traveled (VMT) statistics. Also, the model was tested along screenlines and cutlines to indicate if there were any broad areas and corridors where trips appeared to be consistently overestimated or underestimated. Results from each of these tests are presented in the following tables and figures.

Georgia DOT requires multiple validation checks to each of the major steps in the travel demand modeling process. Output modeled volumes are validated against traffic counts at several levels – regional, corridors (screenlines & cutlines) and link-by-link. Regional evaluations include VMT, Root Mean Squared Error (RMSE) and R-Squared calculations for volume-count matching. Corridor evaluations are primarily screenline and cutline comparisons. Nationally recognized maximum desirable deviation standards are applied to analyze model performance at the link level. These include FHWA's "*Calibration & Adjustment of System Planning Models*", 1990 and the NCHRP Report 365: "*Travel Estimation Techniques for Urban Planning*", 1998.

One of many steps in the validation process involves screenlines. Screenlines are defined by features such as railroads, creeks, and rivers. Since all roadways are not reflected in the travel demand model, these types of features serve to funnel traffic into corridors so that all trips can be analyzed where crossing of these features is possible. Cutlines are imaginary lines drawn

perpendicular to roadways to assist with analyzing traffic flow between geographic areas, such as north to south, east to west, etc. Figure 2.5.1-1 and 2.5.1-2 depict the locations of screenlines and cutlines used for the validation process. Where each screenline or cutline crosses a roadway can be identified by following the color coded links across the ARTS area.

**Figure 2.5.1-1
Screenline Locations**



**Figure 2.5.1-2
Cutline Locations**

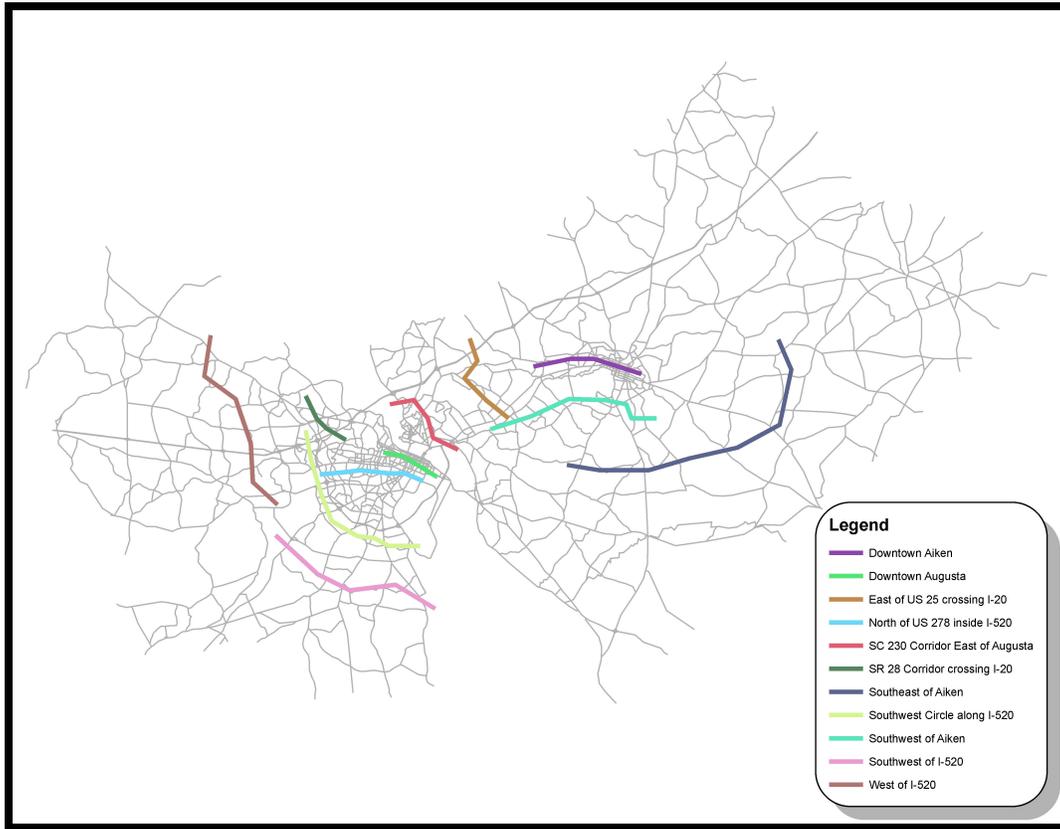


Table 2.5.1-1 and 2.5.1-2 list the results of the screenline and cutline analysis. All of the model volumes for the screenlines and cutlines are well within the acceptable range of error when compared to the observed traffic volumes.

**Table 2.5.1-1
Summary of the Screenlines**

Screenlines	Target	ARTS 2006 Model
	Range / Value	
All Counts	+/- 16 %	-1%
1 Savannah River	+/- 26 %	-5%
2 Southern Railway	+/- 19 %	-2%
3 Kiokee Creek	+/- 58 %	14%
4 Aiken Screenline	+/- 38 %	14%

**Table 2.5.1-2
Summary of the Cutlines**

Cutlines	Target	ARTS 2006 Model
	Range / Value	
All Counts	+/- 10 %	-1%
1 West of I-520	+/- 25 %	0%
2 SR 28 Corridor crossing I-20	+/- 23 %	2%
3 Southwest of I-520	+/- 30 %	1%
4 Southwest Circle along I-520	+/- 18 %	-3%
5 North of US 278 inside I-520	+/- 22 %	1%
6 Downtown Augusta	+/- 28 %	-3%
7 SC 230 Corridor East of Augusta	+/- 29 %	2%
8 East of US 25 crossing I-20	+/- 30 %	5%
9 Southwest of Aiken	+/- 31 %	-14%
10 Downtown Aiken	+/- 37 %	-16%
11 Southeast of Aiken	+/- 38 %	-3%

Table 2.5.1-3 and 2.5.1-4 list the results of the comparison between the ARTS model assigned volumes and the observed volumes for each link within each screenline and cutline. In most cases, the largest differences between the model and observed counts occur on the less traveled facilities.

**Table 2.5.1-3
Screenline Results**

Screenline 1: Savannah River					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
I - 20 W	25,617	26,245	0.98	-2.39%	25.12%
I - 20 E	25,166	26,245	0.96	-4.11%	25.12%
US 1 CONN	5,131	7,000	0.73	-26.70%	44.70%
SR 4	26,295	26,810	0.98	-1.92%	24.89%
Total	82,210	86,300	0.95	-4.74%	26.24%

Screenline 2: Southern Railway					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
Tobacco Rd	8,660	7,460	1.16	16.08%	43.48%
Peach Orchard Rd	20,895	20,750	1.01	0.70%	27.83%
SR 10	21,637	22,800	0.95	-5.10%	26.71%
S - 81	5,320	5,700	0.93	-6.66%	48.89%
SR 105	1,436	650	2.21	120.96%	126.02%
SR 191	3,570	1,950	1.83	83.08%	78.05%
S- 145	4,500	3,800	1.18	18.41%	58.35%
SC 421	10,539	9,800	1.08	7.54%	38.60%
S- 33	8,208	10,000	0.82	-17.92%	38.26%
S-67	3,775	3,600	1.05	4.87%	59.74%
I-20 WB	14,928	14,000	1.07	6.63%	33.04%
I-20 EB	15,011	14,000	1.07	7.22%	33.04%
Patterson Bridge Road	2,918	2,700	1.08	8.09%	67.73%
S-254	3,976	6,500	0.61	-38.84%	46.17%
CS 1321	14,079	12,000	1.17	17.33%	35.34%
CS 1304	7,249	7,200	1.01	0.68%	44.16%
SR 28	7,875	7,500	1.05	5.00%	43.38%
CS 1307	898	3,850	0.23	-76.68%	58.02%
CR 349	1,467	490	2.99	199.47%	142.55%
SR 56	11,431	13,640	0.84	-16.19%	33.42%
Lumkin Rd	6,982	9,300	0.75	-24.93%	39.49%
WINDSOR SPRING RD	4,139	6,680	0.62	-38.04%	45.62%
LOUISVILLE RD	1,943	3,690	0.53	-47.34%	59.10%
CR 274	3,843	4,180	0.92	-8.06%	55.97%
I-520 E	22,085	19,800	1.12	11.54%	28.40%
Total	207,364	212,040	0.98	-2.21%	18.63%
Screenline 3: Kiokee Creek					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
WASHINGTON RD	7,227	7,250	1.00	-0.31%	44.02%
Ray Owens Rd	3,619	2,080	1.74	73.97%	75.89%
Cobham Rd	1,243	1,250	0.99	-0.53%	94.76%
Total	12,089	10,580	1.14	14.27%	58.39%

Screenline 4: Aiken Screenline					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
I-20 WB	13,799	14,150	0.98	-2.48%	32.89%
I-20 EB	13,799	14,150	0.98	-2.48%	32.89%
State Park Rd	1,088	425	2.56	155.90%	151.68%
SR 49	3,297	1,250	2.64	163.79%	94.76%
SC 4	5,819	3,300	1.76	76.34%	62.05%
Veterans Rd	485	425	1.14	14.21%	151.68%
Total	38,288	33,700	1.14	13.61%	37.55%

**Table 2.5.1-4
Cutline Results**

Cutline 1: West of I-520					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
COLUMBIA RD	9,619	9,040	1.06	6.41%	39.98%
HEREFORD FARM RD	7,562	10,630	0.71	-28.86%	37.26%
OLD BELAIR RD	3,907	4,200	0.93	-6.97%	55.86%
WRIGHTSBORO RD	9,777	9,240	1.06	5.81%	39.60%
I-20 EB	26,438	26,500	1.00	-0.24%	25.01%
I-20 WB	26,912	26,500	1.02	1.55%	25.01%
Old Washington Rd	1,546	1,520	1.02	1.73%	87.01%
US 78	14,720	13,000	1.13	13.23%	34.13%
Total	100,482	100,630	1.00	-0.15%	24.75%
Cutline 2: SR 28 Corridor crossing I-20					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
I-20 WB	30,664	31,005	0.99	-1.10%	23.36%
I-20 EB	30,557	31,005	0.99	-1.45%	23.36%
CR 649	13,584	13,000	1.04	4.49%	34.13%
WASHINGTON RD	33,505	33,380	1.00	0.38%	22.62%
OLD PETERSBURG RD	11,473	8,900	1.29	28.91%	40.26%
Total	119,783	117,290	1.02	2.13%	23.35%

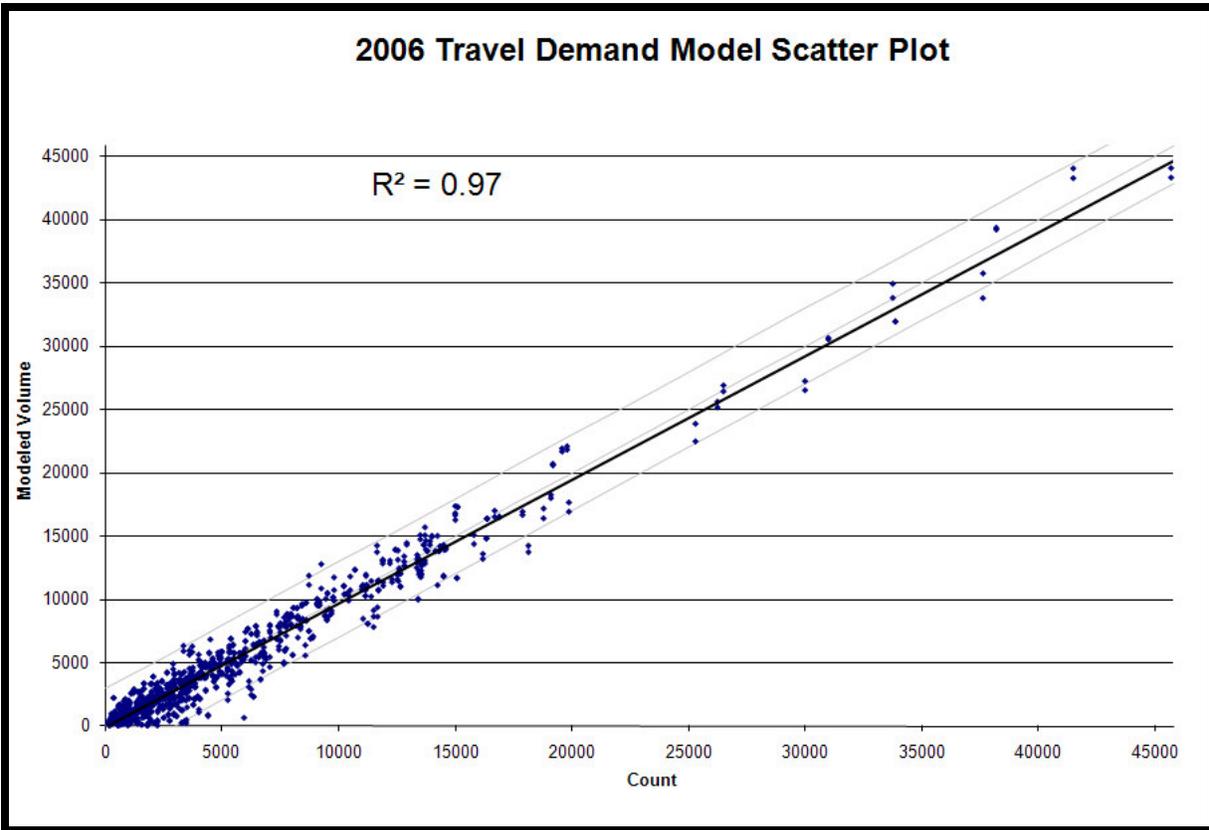
Cutline 3: Southwest of I-520					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
CR 1516	8,076	5,920	1.36	36.42%	48.09%
PEACH ORCHARD RD	15,959	15,900	1.00	0.37%	31.26%
Windsor Spring Rd	9,091	9,070	1.00	0.23%	39.93%
SR 4	14,950	17,450	0.86	-14.33%	30.01%
SAVANNAH RD	15,715	14,840	1.06	5.90%	32.21%
Total	63,791	63,180	1.01	0.97%	29.55%
Cutline 4: Southwest Circle along I-520					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
Winsor Spring Rd	21,424	23,420	0.91	-8.52%	26.40%
DEANS BRIDGE RD	29,601	32,670	0.91	-9.39%	22.83%
SR 10	28,545	27,480	1.04	3.87%	24.62%
56 Spur	12,760	10,940	1.17	16.63%	36.79%
I-20 WB	33,813	37,630	0.90	-10.14%	21.47%
I-20 EB	35,773	37,630	0.95	-4.93%	21.47%
Wheeler Rd	28,410	29,000	0.98	-2.03%	24.05%
Dixon Airline Rd	271	460	0.59	-41.04%	146.53%
US 25	32,900	30,000	1.10	9.67%	23.70%
Total	223,497	229,230	0.97	-2.50%	18.08%
Cutline 5: North of US 278 inside I-520					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
CR 146	399	920	0.43	-56.59%	108.31%
N Leg Rd	8,647	8,280	1.04	4.43%	41.54%
SR 10	25,283	27,070	0.93	-6.60%	24.78%
Damascus Rd	3,817	4,360	0.88	-12.45%	54.95%
Twiggs St	6,738	5,640	1.19	19.47%	49.12%
Olive Rd	5,766	4,740	1.22	21.64%	52.99%
Highland Ave	12,505	12,800	0.98	-2.30%	34.36%
I-520 NB	39,242	38,200	1.03	2.73%	21.33%
I-520 SB	39,381	38,200	1.03	3.09%	21.33%
Total	141,779	140,210	1.01	1.12%	21.81%

Cutline 6: Downtown Augusta					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
CR 475	7,765	6,780	1.15	14.53%	45.33%
CR 1499	28,855	27,830	1.04	3.68%	24.49%
7 th St	1,869	3,300	0.57	-43.35%	62.05%
8 th St	6	3,600	0.00	-99.82%	59.74%
9 th ST	2,707	3,700	0.73	-26.84%	59.03%
11 th St	60	1,930	0.03	-96.89%	78.40%
12 th St	2,723	2,750	0.99	-0.97%	67.19%
SR 4	17,610	15,570	1.13	13.11%	31.54%
Ford Ave	5,869	4,390	1.34	33.68%	54.79%
Total	67,465	69,850	0.97	-3.41%	28.44%
Cutline 7: SC 230 Corridor East of Augusta					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
SC 230	17,026	15,700	1.08	8.44%	31.43%
S- 45	8,192	8,200	1.00	-0.10%	41.72%
SC 125	10,305	12,500	0.82	-17.56%	34.71%
S- 45	2,343	2,800	0.84	-16.32%	66.66%
S- 68	1,103	1,350	0.82	-18.28%	91.63%
S-901	4,336	4,450	0.97	-2.57%	54.47%
US 1	24,637	21,400	1.15	15.12%	27.46%
Total	67,941	66,400	1.02	2.32%	29.00%
Cutline 8: East of US 25 crossing I-20					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
S-67	2,479	1,700	1.46	45.85%	82.86%
US 1	21,765	22,300	0.98	-2.40%	26.97%
S- 254	4,033	5,500	0.73	-26.67%	49.66%
I-20 WB	17,264	15,100	1.14	14.33%	31.97%
I-20 EB	17,304	15,100	1.15	14.60%	31.97%
Total	62,846	59,700	1.05	5.27%	30.20%

Cutline 9: Southwest of Aiken					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
SC 118	13,768	17,600	0.78	-21.77%	29.90%
S- 81	4,922	4,600	1.07	6.99%	53.68%
S- 79	3,227	4,900	0.66	-34.15%	52.22%
S- 66	1,970	2,000	0.98	-1.51%	77.19%
S- 936	7,284	13,300	0.55	-45.23%	33.79%
S- 440	3,601	3,600	1.00	0.04%	59.74%
TWO NOTCH RD	4,187	2,900	1.44	44.37%	65.65%
S- 202	1,551	1,600	0.97	-3.08%	85.08%
S-67	971	1,000	0.97	-2.87%	104.44%
Piney Heights Rd	5,313	2,800	1.90	89.76%	66.66%
Total	46,793	54,300	0.86	-13.82%	31.31%
Cutline 10: Downtown Aiken					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
SC 118	5,555	8,600	0.65	-35.40%	40.86%
GREGG AVE	2,798	2,700	1.04	3.64%	67.73%
BEAUFORT ST	6,381	6,800	0.94	-6.16%	45.27%
SC 191	5,378	4,800	1.12	12.05%	52.70%
S- 105	3,702	3,300	1.12	12.19%	62.05%
S-2131	3,007	4,700	0.64	-36.03%	53.18%
LAURENS ST	648	2,600	0.25	-75.09%	68.85%
EDISTO AVE	1,236	1,200	1.03	3.04%	96.46%
Williamsburg St	1,657	1,500	1.10	10.48%	87.51%
Total	30,363	36,200	0.84	-16.12%	36.54%
Cutline 11: Southeast of Aiken					
	2006	2006	Volume	Percent	Maximum
	Assign	Traffic	/Count	Deviation	Desirable
Road Name	Volume	Count	Ratio	From Base	Deviation
SC 19	13,210	13,200	1.00	0.08%	33.90%
Silver Bluff Rd	4,523	5,400	0.84	-16.24%	50.06%
S-79	1,235	2,700	0.46	-54.25%	67.73%
SC 113	844	1,450	0.58	-41.81%	88.82%
US 78	6,216	6,800	0.91	-8.59%	45.27%
SC 4	5,819	3,300	1.76	76.34%	62.05%
Total	31,847	32,850	0.97	-3.05%	37.92%

Another way of viewing link validation is through the use of a scatter plot that depicts the relationship between traffic counts and modeled volumes. The following graphic depicts this relationship for the ARTS 2006 network. The graphic indicates that the majority of modeled volumes are consistent with the traffic counts. It should be noted that it is normal to have outliers, both high and low. The R^2 value of 0.97 indicates the model successfully replicates base year travel characteristics.

Figure 2.5.1-3



The modeled traffic volumes summarized by facility type are shown in Table 2.5.1-5. The HPMS VMT is based on the Georgia Department of Transportation's Office of Transportation Data "445 Report" as well as on the data from South Carolina Department of Transportation. The HPMS VMT numbers represent the average annual daily VMT for the year 2006 for all of Columbia, Richmond, and Aiken County and parts of Edgefield County. The HPMS VMTs for Edgefield County were prorated based on its roadway mileage by functional classifications.

The highway network and trip table are considered to provide a good representation of travel conditions on the existing system if the total percent error region-wide for the VMT is less than +/-5 percent. For the ARTS model, the total percent error region-wide is less than about 3% excluding the local streets. Calculating the percent error by facility type indicates whether the model is loading trips in a reasonable manner. The ARTS model is performing very well

estimating traffic volumes for all of the facility types except for local roads. This is not surprising or alarming since most of the local roads in an urban area are usually not included in a regional travel demand model. These volumes are provided below just for informational purposes only.

**Table 2.5.1-5
2006 Travel Demand Model Maximum Desired Deviation Chart**

Facility Type	VMT		Between Model and HPMS	
	Model	HPMS	Difference	Percent
Freeway	3,198,961	3,253,512	-54,551	-2%
Principal Arterials	3,268,883	3,431,132	-162,248	-5%
Minor Arterials	2,742,847	2,792,557	-49,710	-2%
Collectors	1,293,232	1,383,142	-89,910	-7%
Total excluding Local Roads	10,503,923	10,860,342	-356,419	-3%
Local	466,839	274,767	192,071	70%
Total including Local Roads	10,970,762	11,135,110	-164,348	-1%

Comparing the deviation of assigned link volumes with the maximum desirable deviation is also a method for validation and calibration check. The higher the link traffic count, the smaller the maximum desired deviation allowed on that link. Generally, models should be able to replicate traffic volumes on higher facilities more accurately than those on lower facilities. Higher facilities have higher usage and often are focuses of transportation policy making. Therefore, how well the model assigns trips on these facilities is another indicator for how well the model is validated and calibrated and how useful the model would be. Figure 2.5.1-4 shows the comparison of the maximum desired deviation curve and the model assigned volumes. Figure 2.5.1-5 illustrates trip-loaded network. The model performed very well system-wide with almost all major facilities within the maximum desired deviation allowed.

Figure 2.5.1-4

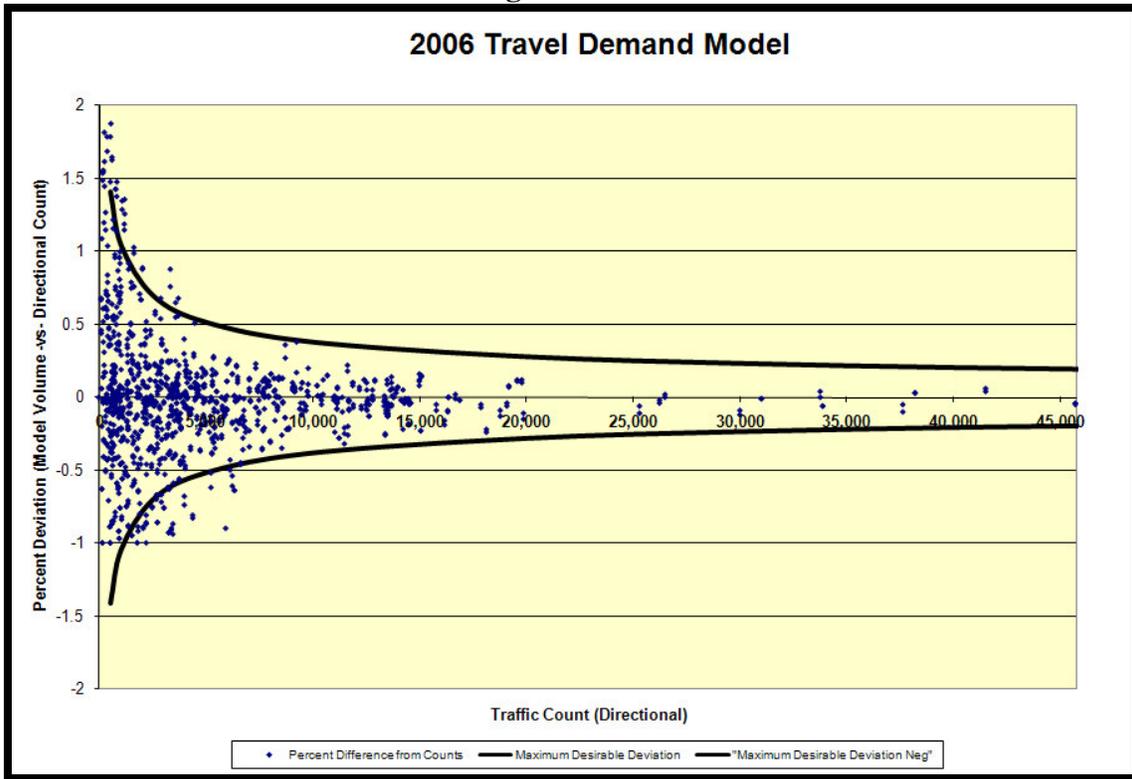
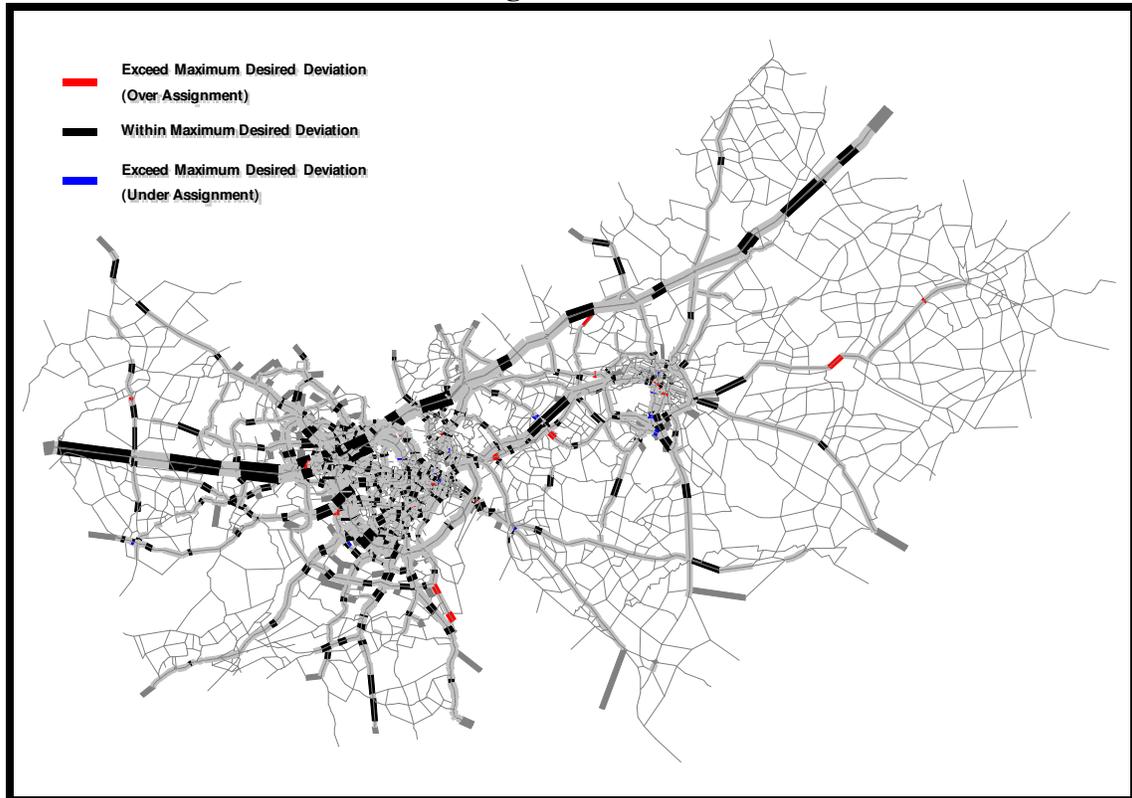


Figure 2.5.1-5



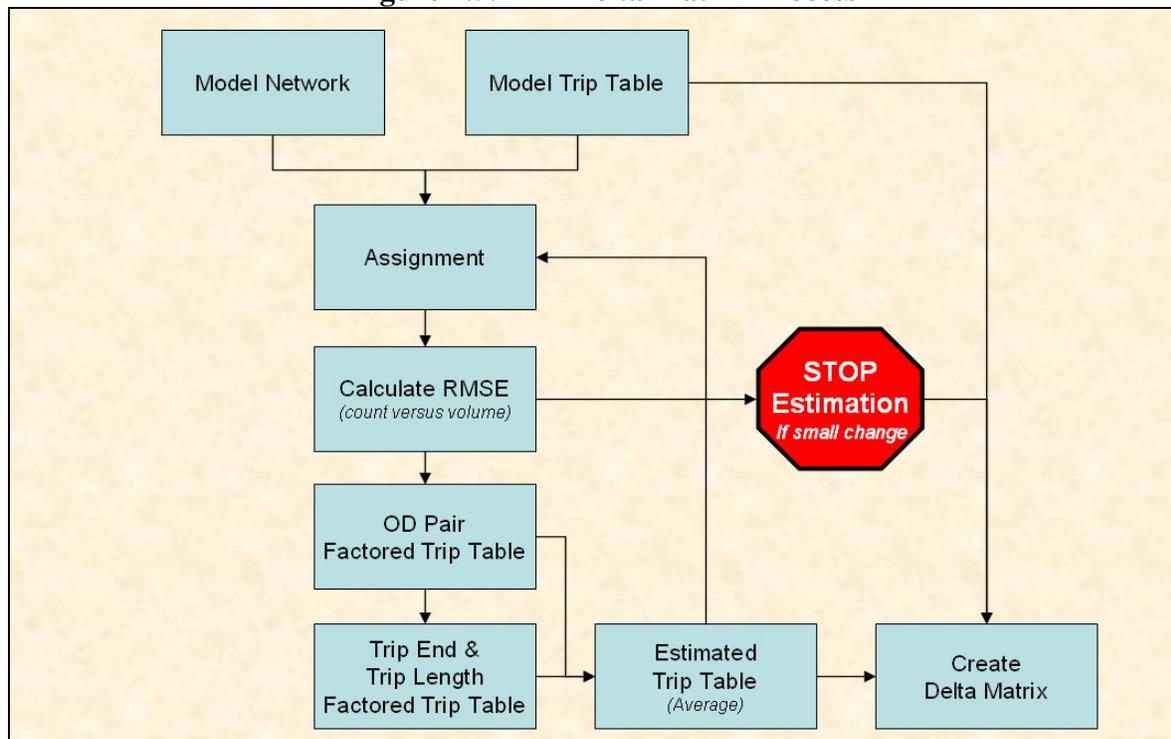
2.5.2 Delta Matrix Process

Due to the many variables involved, estimated traffic volumes from travel demand models will inevitably differ from observed traffic counts. As a result, it is usually necessary to post-process modeled volumes for use in traffic studies. National Cooperative Highway Research Program (NCHRP) Report 255 outlines a widely used methodology for post-processing model results, but like many approaches to refining travel demand models, the procedures are intended for specific projects or corridors and are not easily applied to an entire region.

Matrix estimation techniques to post-process travel demand model volumes for an entire region have been developed for the GDOT MPO areas. This region level post-processing is done by developing a delta matrix, which is a trip table that is combined with the normal travel demand model trip table to produce traffic assignments that closely replicate observed traffic counts.

Figure 2.5.2-1 outlines how a delta matrix is developed. The delta matrix process uses the travel demand model trip table as a seed for a matrix estimation process. The matrix estimation process attempts to closely replicate observed traffic counts, while also controlling the trip ends and trip lengths possessed by the seed matrix. This is accomplished by iteratively assigning a trip table, adjusting the trip table to match traffic counts, then applying a tri-proportional fitting process to match trip ends and trip lengths. Once a trip table is produced that sufficiently matches the traffic counts, a delta matrix is produced by subtracting the initial seed trip table from the estimated trip table.

Figure 2.5.2-1 – Delta Matrix Process



Conceptually the resulting delta matrix represents the localized factors that the regional travel demand modeling process does not reproduce well. Future travel demands are post-processed by applying the same local corrections that are represented in the delta matrix without adjustment since similar localized issues cannot be identified for future conditions. Therefore, the delta matrix is simply added to future trip tables before assigning the trips.

Appendix A: Socio-Economic Variables By Zone for 2006

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
1	37	61	0	55	410	0	0	465	109	158,104
2	0	0	0	0	0	0	0	0	19	0
3	0	0	0	0	0	0	0	0	12	0
4	0	0	0	79	54	0	0	133	12	0
5	4	15	0	16	168	0	0	184	7	17,024
6	25	29	0	62	231	0	0	293	14	23,906
7	0	0	0	60	447	0	0	507	8	0
8	0	0	0	20	802	0	0	822	8	0
9	0	0	0	15	560	0	0	575	7	0
10	0	0	0	12	140	0	0	152	10	0
11	0	0	0	9	45	0	0	54	9	0
12	14	36	0	50	117	8	5	180	16	16,080
13	25	25	0	61	80	0	12	153	9	21,101
14	14	18	0	78	46	0	0	124	21	29,110
15	0	0	0	42	302	8	0	352	13	0
16	154	154	0	36	259	0	0	295	12	6,515
17	0	0	0	8	140	0	0	148	10	0
18	15	44	0	39	66	28	2	135	16	11,388
19	10	10	0	4	112	4	0	120	12	19,297
20	0	0	0	10	36	0	0	46	6	0
21	175	196	0	0	158	0	0	158	13	16,744
22	20	34	0	0	42	0	0	42	8	11,531
23	239	239	0	5	50	0	0	55	7	8,261
24	0	0	0	0	79	0	0	79	6	0
25	0	0	0	0	657	0	0	657	10	0
26	4	25	0	0	38	0	0	38	7	11,388
27	0	0	0	0	0	0	0	0	53	0
28	82	135	0	0	72	0	0	72	15	28,343
29	68	127	0	0	0	0	0	0	10	28,343
30	21	35	0	0	0	0	0	0	6	28,343
31	65	107	0	0	66	0	0	66	18	20,712
32	150	298	0	1	12	0	0	13	23	24,404
33	45	83	0	7	2	3	0	12	13	21,631
34	20	20	0	0	135	0	0	135	11	32,207
35	90	141	0	0	0	0	0	0	14	12,522
36	54	86	0	16	0	0	0	16	8	7,946
37	0	0	0	0	30	7	0	37	20	0
38	38	117	441	0	85	13	0	98	32	9,441
39	8	25	0	0	139	0	0	139	19	9,441
40	43	508	0	0	190	0	0	190	39	25,164
41	102	243	0	5	0	0	0	5	22	15,700
42	65	207	0	3	0	0	0	3	13	8,479
43	3	11	0	0	2	0	20	22	28	43,305
44	0	0	0	15	166	25	60	266	44	0
45	25	29	0	0	200	0	57	257	80	5,444

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
46	134	346	0	7	4	0	0	11	135	22,418
47	0	0	0	16	0	11	0	27	20	0
48	1	1	0	10	60	22	10	102	39	16,359
49	0	0	0	0	200	0	0	200	25	0
50	0	0	0	0	49	0	0	49	24	0
51	191	364	0	5	183	0	0	188	51	12,323
52	62	230	0	35	154	0	0	189	29	16,359
53	124	291	0	20	80	0	33	133	52	10,649
54	14	24	0	41	31	0	27	99	36	26,160
55	51	139	0	0	12	3	0	15	33	26,160
56	48	72	0	50	40	10	15	115	52	126,928
57	0	0	0	0	0	0	0	0	2	0
58	0	0	0	20	65	28	45	158	7	0
59	0	0	0	20	58	0	27	105	6	0
60	0	0	398	0	0	0	0	0	2	82,422
61	13	21	0	20	30	0	15	65	9	12,323
62	0	0	0	0	120	0	25	145	7	0
63	0	0	0	25	384	0	35	444	39	0
64	145	283	0	25	537	43	0	605	31	26,508
65	244	247	1,450	0	217	0	0	217	77	7,027
66	0	0	0	1	31	0	0	32	8	0
67	0	0	0	20	141	0	10	171	30	0
68	0	0	0	118	7,490	9	0	7,617	98	0
69	0	0	0	0	3,500	0	0	3,500	45	0
70	0	0	0	20	259	0	0	279	14	0
71	354	905	0	0	260	0	0	260	52	7,155
72	271	644	0	30	223	0	0	253	115	14,016
73	227	535	0	1	184	0	0	185	61	11,194
74	124	272	0	0	7	0	0	7	50	14,247
75	382	1,012	0	3	144	65	33	245	220	9,897
76	598	1,594	0	0	62	5	0	67	85	20,752
77	63	160	0	0	21	0	8	29	19	19,577
78	165	409	0	12	51	0	0	63	85	11,123
79	76	158	0	4	5	0	0	9	19	11,123
80	162	352	0	0	0	0	0	0	75	12,822
81	213	620	0	8	196	0	23	227	60	16,062
82	4	8	0	5	0	26	49	80	81	20,786
83	0	0	0	0	0	0	0	0	57	0
84	16	26	0	11	42	350	24	427	64	82,422
85	30	94	0	5	0	0	0	5	30	5,714
86	29	63	0	5	20	0	0	25	12	16,093
87	26	62	0	42	425	0	10	477	77	16,093
88	168	461	0	68	168	0	9	245	49	24,136
89	178	430	0	5	13	0	0	18	43	19,181
90	218	586	0	191	245	0	0	436	93	16,795
91	19	40	0	69	13	0	0	82	8	24,136

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
92	14	36	0	69	12	0	0	81	8	24,136
93	208	362	0	23	138	0	0	161	38	44,508
94	201	389	0	0	243	0	0	243	82	39,034
95	88	147	1,091	43	45	0	0	88	48	27,339
96	150	343	0	107	505	0	0	612	88	20,754
97	149	664	0	154	557	2	0	713	78	13,048
98	25	499	0	43	281	0	0	324	37	18,645
99	157	281	0	37	72	5	0	114	44	24,009
100	250	573	0	44	11	0	4	59	56	22,351
101	35	83	0	0	40	0	0	40	18	41,089
102	55	172	0	0	15	0	0	15	26	36,470
103	420	953	0	25	206	620	84	935	308	22,172
104	203	421	0	0	3	0	0	3	135	27,503
105	18	42	0	109	130	90	177	506	130	26,101
106	269	440	0	0	12	0	0	12	135	26,010
107	765	2,302	427	99	193	35	25	352	409	29,294
108	310	664	0	9	379	70	35	493	170	13,290
109	104	254	0	20	29	0	5	54	43	16,827
110	179	444	0	162	131	51	85	429	119	24,042
111	40	60	0	214	88	0	0	302	115	32,606
112	64	138	0	107	204	4	0	315	77	14,039
113	339	921	287	140	255	0	40	435	134	17,821
114	0	0	0	60	35	0	0	95	5	0
115	163	323	444	27	180	0	0	207	149	29,647
116	40	158	0	533	707	9	0	1,249	135	23,040
117	275	707	0	25	155	0	0	180	199	25,630
118	475	1,220	0	10	62	0	0	72	148	14,542
119	102	239	0	0	0	0	0	0	52	16,670
120	116	291	0	2	60	0	19	81	76	16,670
121	52	105	0	0	0	0	0	0	27	16,670
122	64	137	0	0	0	0	0	0	34	16,670
123	25	60	0	0	12	0	0	12	29	11,393
124	0	0	508	9	13	0	9	31	24	0
125	63	199	0	0	62	615	39	716	116	24,768
126	74	139	352	12	65	0	15	92	77	22,445
127	24	52	125	13	184	30	22	249	88	35,042
128	55	142	0	5	6	0	0	11	52	12,329
129	656	1,339	0	40	82	0	17	139	168	26,462
130	100	225	583	0	8	0	0	8	46	28,367
131	103	293	0	10	29	0	0	39	51	17,218
132	271	698	0	9	8	0	0	17	180	10,922
133	181	403	0	14	29	0	0	43	189	10,922
134	0	0	0	0	0	0	0	0	108	0
135	170	402	0	55	280	0	0	335	174	86,435
136	472	930	0	4	140	0	0	144	511	66,932
137	114	186	0	0	0	0	0	0	48	45,947

Traffic Zone	Household	Population	Enrollment		Employment				Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
138	109	133	0	12	35	0	0	47	26	6,365
139	26	30	0	0	0	0	0	0	40	70,287
140	244	541	0	39	47	0	0	86	72	62,420
141	292	555	530	10	2	0	0	12	115	34,599
142	207	458	0	0	12	0	0	12	105	35,250
143	75	149	0	0	0	0	0	0	51	35,250
144	306	481	0	0	84	0	0	84	51	25,183
145	125	329	0	0	0	0	0	0	56	78,639
146	155	310	0	0	0	0	0	0	50	63,911
147	29	79	0	32	21	0	0	53	13	63,911
148	83	182	0	0	559	0	0	559	127	71,303
149	142	242	0	4	25	0	8	37	53	39,782
150	140	363	0	0	45	0	0	45	73	33,988
151	149	236	0	5	81	0	0	86	58	58,841
152	40	88	0	12	60	0	0	72	66	46,644
153	0	0	0	213	332	0	0	545	33	0
154	59	129	0	7	40	0	0	47	17	32,083
155	204	392	654	20	112	0	0	132	49	32,083
156	125	314	0	0	37	0	0	37	42	36,578
157	65	102	0	2	26	0	0	28	19	31,557
158	185	326	0	15	26	0	0	41	78	24,500
159	110	395	0	0	1,023	0	0	1,023	158	42,384
160	157	262	0	0	110	0	0	110	60	31,631
161	242	544	470	8	1,405	0	0	1,413	110	31,631
162	181	370	0	0	0	0	0	0	52	31,631
163	634	1,696	0	10	121	10	0	141	214	28,595
164	103	246	0	11	200	8	38	257	118	24,783
165	106	273	0	0	86	0	0	86	80	40,002
166	49	133	0	0	0	0	0	0	75	133,042
167	291	743	0	0	8	0	0	8	161	82,614
168	116	260	609	0	86	0	0	86	148	38,236
169	95	253	0	0	2	0	0	2	83	118,195
170	488	1,051	0	0	4	0	0	4	260	59,797
171	78	126	0	0	0	0	0	0	26	59,797
172	763	1,655	719	54	80	0	0	134	149	33,199
173	292	643	0	0	305	0	0	305	351	27,957
174	73	169	0	0	0	0	0	0	46	77,691
175	101	216	0	0	0	0	0	0	51	77,691
176	882	2,012	0	122	204	0	0	326	370	25,809
177	0	0	0	26	48	13	16	103	362	0
178	273	577	0	4	0	0	0	4	359	30,282
179	321	801	0	0	25	0	15	40	233	32,518
180	589	1,445	0	104	286	0	31	421	463	36,528
181	165	418	694	12	3	0	0	15	114	31,757
182	118	310	635	19	123	0	0	142	69	31,757
183	694	1,843	0	82	128	0	0	210	310	33,542

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
184	235	538	1,490	27	69	0	0	96	123	28,738
185	536	1,307	481	107	445	0	0	552	549	28,603
186	254	628	0	0	0	0	0	0	149	24,699
187	289	799	0	36	134	0	0	170	112	24,699
188	766	1,834	0	39	220	0	17	276	303	26,016
189	176	436	0	10	8	0	0	18	132	26,875
190	304	725	0	51	81	0	0	132	218	26,875
191	439	1,031	0	37	93	5	0	135	208	28,730
192	425	859	0	150	326	0	0	476	296	28,425
193	231	777	0	16	198	0	0	214	123	28,451
194	215	554	825	14	54	0	14	82	155	30,619
195	0	0	0	0	3	0	0	3	11	0
196	0	0	0	18	275	0	0	293	95	0
197	665	1,602	0	85	424	16	20	545	295	32,555
198	265	792	0	25	75	0	0	100	219	39,790
199	550	1,323	0	29	65	0	12	106	386	31,397
200	0	0	0	0	45	0	0	45	35	0
201	0	0	0	0	5	0	0	5	77	0
202	379	954	0	10	58	0	0	68	199	30,872
203	4	25	608	4	157	69	37	267	323	20,931
204	120	551	1,496	5	681	0	0	686	262	41,542
205	461	1,440	0	15	212	79	25	331	266	35,365
206	0	749	0	0	105	0	0	105	268	0
207	0	0	0	0	20	678	62	760	353	0
208	4	12	0	0	0	0	0	0	52	28,369
209	5	11	0	0	0	0	0	0	46	28,369
210	502	1,194	0	0	122	0	0	122	516	33,033
211	985	2,109	0	60	73	0	0	133	370	35,668
212	85	181	0	0	0	0	0	0	85	35,668
213	0	0	0	0	0	0	0	0	408	0
214	179	432	0	0	0	0	0	0	128	35,668
215	0	0	0	0	0	0	0	0	75	0
216	0	0	0	0	0	0	0	0	268	0
217	0	0	0	0	270	0	0	270	188	0
218	934	2,142	0	225	315	0	8	548	488	45,472
219	1,413	2,340	0	327	670	0	20	1,017	334	34,084
220	494	988	0	229	539	0	0	768	420	47,175
221	134	248	0	0	135	0	0	135	123	36,586
222	631	1,229	0	0	12	0	0	12	245	36,586
223	10	15	0	0	0	0	0	0	88	76,889
224	96	223	0	40	95	0	0	135	94	101,801
225	668	1,653	0	32	60	0	0	92	465	101,801
226	619	1,402	1,388	0	45	0	0	45	269	56,565
227	68	194	0	0	20	0	0	20	52	47,175
228	56	170	0	0	18	0	0	18	53	68,246
229	275	626	0	0	196	0	0	196	124	41,767

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
230	213	602	0	16	124	0	0	140	196	133,042
231	233	444	1,174	0	0	0	0	0	85	33,199
232	50	131	0	0	0	0	0	0	63	118,195
233	165	417	0	102	36	4	28	170	101	51,442
234	0	0	0	6	0	0	0	6	17	51,442
235	0	0	0	263	436	0	25	724	71	36,849
236	214	372	0	12	34	0	0	46	26	36,849
237	430	1,184	0	25	106	0	0	131	239	41,977
238	519	1,215	0	0	124	0	0	124	255	60,155
239	690	1,761	0	73	255	0	0	328	326	49,944
240	172	305	0	115	390	0	0	505	235	51,083
241	10	23	0	69	212	0	12	293	66	47,552
242	0	0	0	0	12	0	0	12	27	0
243	276	694	0	30	2	0	0	32	166	70,261
244	774	1,373	0	155	636	0	0	791	293	32,917
245	698	1,088	0	5	401	55	88	549	248	45,834
246	255	855	0	10	109	65	45	229	1,218	42,209
247	10	26	0	0	0	6	0	6	42	39,784
248	14	29	0	0	114	635	165	914	204	39,784
249	909	1,626	487	30	2,545	0	25	2,600	423	38,688
250	0	0	2,034	0	5	0	0	5	70	0
251	181	408	0	13	69	0	0	82	484	28,729
252	292	771	0	15	259	0	0	274	364	25,534
253	426	830	0	45	120	0	0	165	476	35,666
254	126	190	0	26	428	0	8	462	71	35,666
255	0	0	0	12	40	0	0	52	28	0
256	15	54	0	20	93	62	44	219	77	47,926
257	10	14	0	0	34	28	78	140	164	47,926
258	903	2,451	0	16	85	0	0	101	1,448	47,926
259	717	2,040	0	22	60	0	25	107	656	36,901
260	161	354	0	0	6	0	0	6	94	24,210
261	438	1,226	0	0	8	0	0	8	1,168	32,435
262	0	0	0	0	0	0	0	0	188	0
263	174	433	0	5	0	0	0	5	1,822	31,168
264	7	1,112	0	0	125	0	0	125	140	31,168
265	1,536	4,439	0	25	203	0	20	248	1,508	28,888
266	0	0	0	10	0	0	0	10	12	0
267	26	35	0	0	0	0	0	0	78	25,597
268	3	19	0	7	130	50	0	187	140	25,597
269	20	54	0	21	44	45	65	175	159	17,559
270	204	488	0	16	21	0	0	37	327	26,803
271	4	30	0	4	4	0	0	8	148	8,577
272	9	9	0	5	24	0	0	29	116	30,017
273	140	243	0	41	170	17	43	271	99	37,209
274	0	0	0	26	138	300	47	511	74	0
275	126	214	0	28	215	10	25	278	208	21,389

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
276	172	457	250	32	118	8	49	207	112	26,273
277	73	152	0	44	59	0	8	111	67	26,273
278	473	1,007	0	37	85	23	0	145	265	28,839
279	97	260	0	0	0	0	0	0	270	50,375
280	262	911	0	210	527	0	20	757	471	50,375
281	1,549	4,599	0	38	166	0	0	204	1,440	34,376
282	356	1,110	0	64	189	0	0	253	236	33,832
283	239	758	0	0	0	0	0	0	134	33,832
284	133	407	0	15	5	0	0	20	86	33,832
285	70	147	0	0	0	0	0	0	45	48,908
286	0	0	0	0	35	0	0	35	9	0
287	901	2,390	0	24	238	0	0	262	566	38,231
288	405	1,107	0	35	85	0	0	120	282	34,009
289	210	570	0	70	21	0	0	91	129	39,761
290	29	79	0	0	0	0	0	0	196	36,739
291	651	2,010	0	20	32	0	0	52	707	36,739
292	2,035	6,048	0	88	361	0	0	449	2,189	38,885
293	326	950	0	0	7	0	0	7	1,288	30,193
294	3,371	10,628	486	130	226	0	0	356	4,131	34,322
295	1,623	5,247	0	74	169	11	0	254	1,743	44,098
296	1,043	3,210	0	44	143	3	0	190	1,303	32,103
297	963	3,018	0	18	0	0	0	18	885	35,206
298	100	275	0	0	0	0	0	0	176	35,206
299	890	7,755	0	25	16,578	0	0	16,603	1,483	30,670
300	0	0	0	0	0	0	0	0	2,599	0
301	0	0	403	0	0	0	0	0	3,759	0
302	0	0	0	0	0	0	0	0	13,013	0
303	0	0	0	0	0	0	0	0	2,357	0
304	0	0	0	0	0	0	0	0	10,662	0
305	0	0	0	0	0	0	0	0	2,655	0
306	0	0	0	0	0	0	0	0	1,415	0
307	0	0	0	0	0	0	0	0	3,395	0
308	0	0	0	0	0	0	0	0	413	0
309	0	0	0	0	0	0	0	0	2,640	0
310	8	16	0	0	0	0	0	0	186	30,670
311	80	197	0	0	0	0	0	0	4,639	42,040
312	38	100	0	6	18	0	0	24	244	42,040
313	34	107	0	0	0	0	0	0	225	42,040
314	56	177		0	0	0	0	0	749	42,040
315	107	305		0	0	0	0	0	1,103	34,036
316	90	256		0	0	0	0	0	358	42,040
317	10	28		7	11	0	0	18	224	42,040
318	50	151		8	8	0	0	16	846	42,040
319	404	1,167		8	20	35	0	63	4,448	34,036
320	8	24		0	0	0	0	0	89	42,040
321	32	94		0	0	0	0	0	157	42,040

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
322	29	90		0	0	0	0	0	451	42,040
323	26	62		10	14	0	0	24	998	34,036
324	34	95		0	12	58	0	70	1,186	34,036
325	51	134		0	20	0	0	20	285	34,036
326	11	27		0	0	0	0	0	118	36,364
327	166	394		0	142	0	0	142	165	36,364
328	106	329		5	15	0	0	20	359	36,364
329	110	322		0	30	0	0	30	1,937	42,040
330	68	227		0	0	0	0	0	577	42,040
331	85	216		10	10	0	0	20	242	34,036
332	264	756		8	18	0	7	33	1,544	35,201
333	522	1,461		6	37	5	8	56	6,680	43,530
334	126	305		18	163	0	12	193	1,808	34,036
335	347	1,030		0	142	10	0	152	2,877	43,530
336	170	509		0	0	0	0	0	5,371	43,530
337	15	53		13	5	0	0	18	204	37,058
338	528	1,440		0	6	122	31	159	778	37,058
339	1	3		0	3	4	29	36	152	58,280
340	22	54		0	40	0	0	40	659	58,280
341	192	902		33	1,257	0	0	1,290	410	40,939
342	393	1,192		38	119	390	63	610	1,798	40,939
343	337	936		17	48	3	32	100	973	45,763
344	341	962		78	268	357	30	733	1,050	33,067
345	2	10		5	20	720	57	802	554	33,067
346	8	26		17	48	0	28	93	555	45,763
347	0	0		0	0	1,854	41	1,895	502	0
348	189	618		0	0	0	0	0	1,217	42,190
349	48	94		6	0	0	0	6	467	42,190
350	360	1,046		2	15	0	0	17	1,540	42,190
351	148	367		0	0	0	0	0	138	42,190
352	910	2,615		10	140	0	0	150	1,909	42,190
353	119	303		6	10	0	0	16	3,150	44,128
354	57	184		0	12	0	0	12	665	42,190
355	523	1,476		5	0	0	0	5	2,266	42,190
356	142	361		0	0	0	0	0	991	42,190
357	562	1,598		24	0	0	12	36	18,410	46,065
358	400	1,177		0	62	0	0	62	4,528	46,065
359	111	282		0	0	0	0	0	2,289	46,065
360	260	771		5	0	0	0	5	1,896	46,065
361	135	382		0	0	0	0	0	2,738	35,472
362	281	818		6	0	0	0	6	3,403	37,067
363	150	283		0	0	0	0	0	41	34,799
364	0	0		929	694	0	15	1,638	81	0
365	57	81		205	512	0	0	717	94	35,590
366	530	1,214		0	559	0	0	559	305	51,363
367	165	312		250	105	0	0	355	65	27,915

Traffic Zone	Household	Population	Enrollment		Employment				Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
368	325	859		185	199	0	0	384	258	40,779
369	90	286		1,361	638	0	0	1,999	145	32,392
370	0	0		53	45	0	38	136	34	0
371	325	804		65	100	22	0	187	163	36,556
372	255	432		15	78	0	30	123	65	29,218
373	0	0		0	0	28	8	36	217	0
374	11	22		0	129	43	17	189	205	17,984
375	150	447		0	49	73	0	122	141	19,918
376	24	52		0	64	68	0	132	150	10,171
377	0	0		0	0	0	0	0	74	0
378	11	30		0	18	0	0	18	49	4,811
379	0	0		0	34	138	0	172	164	0
380	0	0		0	50	80	0	130	53	0
381	144	400		19	165	275	59	518	239	4,383
382	0	0		0	17	0	0	17	163	0
383	12	35		0	38	5	0	43	1,597	9,273
384	0	0		5	112	487	77	681	759	0
385	0	0		0	0	0	0	0	1,082	0
386	0	0		10	95	176	48	329	563	0
387	80	176		0	0	0	0	0	25	28,241
388	264	694		0	0	0	0	0	57	16,396
389	252	778		0	65	0	0	65	29	20,886
390	282	744		0	0	0	0	0	72	20,886
391	29	95		8	10	0	0	18	20	20,886
392	325	874		8	107	0	0	115	154	20,886
393	16	62		0	0	0	0	0	50	24,454
394	378	1,207		15	30	10	0	55	394	23,419
395	30	59		0	20	31	44	95	247	34,368
396	0	0		10	30	0	0	40	43	0
397	0	0		0	51	1,413	30	1,494	929	0
398	0	0		0	0	0	0	0	1,954	0
399	0	0		0	52	0	0	52	3,960	0
400	0	0		4	402	676	0	1,082	3,751	0
401	0	0		0	0	0	0	0	86	0
402	0	0		0	0	0	0	0	202	0
403	0	0		0	0	1,600	155	1,755	233	0
404	0	0		0	0	1,520	48	1,568	275	0
500	303	844		0	23	0	0	23	801	97,222
501	1,358	3,776		110	190	0	0	300	953	95,717
502	811	2,253		0	109	0	0	109	1,025	117,844
503	658	1,828		7	156	0	0	163	2,829	68,549
504	1,098	3,052		6	334	0	0	340	1,970	73,524
505	67	186		0	76	0	0	76	599	92,789
506	44	122		0	0	0	0	0	328	60,813
507	509	1,414		54	354	348	112	868	595	82,202
508	58	161		7	93	0	0	100	107	33,210

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
509	6	18		1	10	0	0	11	22	33,210
510	8	22		3	7	0	0	10	6	89,207
511	782	2,173		250	664	41	0	955	1,470	89,207
512	410	1,138		4	12	0	0	16	1,406	87,782
513	1,206	3,352		6	0	0	0	6	2,174	81,008
514	412	1,145		0	299	0	0	299	2,800	110,649
515	1,105	3,071		0	117	372	0	489	1,259	82,777
516	699	1,942		10	405	303	6	724	423	52,097
517	698	1,941		6	12	0	0	18	627	69,782
518	786	2,185		29	497	0	0	526	356	52,096
519	968	2,690		68	572	0	0	640	636	52,098
520	191	531		148	602	5	0	755	243	26,902
521	180	502		243	622	29	0	894	161	21,616
522	20	55		363	1,569	184	19	2,135	170	26,895
523	806	2,241		188	327	14	0	529	633	46,707
524	142	396		33	58	2	0	93	60	46,707
525	541	1,503		41	445	647	0	1,133	404	40,682
526	8	22		28	110	0	0	138	63	17,461
527	25	69		8	49	0	0	57	97	29,020
528	58	161		18	114	0	0	132	217	29,020
529	955	2,654		156	449	0	47	652	306	44,616
530	2,140	5,949		145	520	17	5	687	1,542	66,085
531	283	786		46	265	32	39	382	207	28,120
532	34	95		18	100	0	0	118	31	67,659
533	392	1,089		202	1,151	0	0	1,353	434	67,659
534	33	92		36	114	0	0	150	140	40,690
535	1,566	4,353		241	1,104	0	0	1,345	1,121	49,432
536	32	89		5	23	0	0	28	23	49,432
537	385	1,071		10	253	0	0	263	330	46,468
538	863	2,400		48	207	0	0	255	713	69,662
539	651	1,810		13	43	0	0	56	766	67,325
540	1,088	3,026		157	694	0	14	865	1,659	45,456
541	460	1,278		3	14	0	0	17	875	56,447
542	320	889		2	9	0	0	11	935	66,840
543	147	410		0	19	0	0	19	61	57,067
544	8	22		0	1	0	0	1	1,162	57,067
545	196	546		0	7	0	10	17	1,026	76,014
546	250	695		0	7	0	11	18	1,335	67,568
547	1,023	2,844		94	164	8	4	270	581	54,480
548	1,250	3,476		115	200	10	5	330	957	54,480
549	347	965		43	150	0	0	193	101	48,657
550	319	887		43	34	0	0	77	1,505	61,210
551	220	612		0	6	0	0	6	1,416	37,993
552	390	1,084		0	0	0	0	0	2,578	76,144
553	251	698		5	33	0	0	38	1,172	66,467
554	324	902		4	22	11	0	37	2,646	51,355

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
555	0	0		0	0	0	0	0	281	0
556	81	225		0	1	0	0	1	2,060	44,439
557	121	338		0	2	0	0	2	8,354	44,439
558	200	556		14	70	0	0	84	15,265	48,247
559	46	129		0	0	0	0	0	807	44,439
560	36	100		0	0	0	0	0	2,740	44,439
561	21	57		0	0	0	0	0	2,564	44,439
562	13	37		0	0	0	0	0	2,872	36,141
563	38	105		1	0	0	0	1	2,608	48,247
564	152	421		3	0	0	0	3	1,510	48,247
565	181	504		9	92	0	0	101	9,217	53,868
566	222	617		10	112	0	0	122	7,240	53,868
567	60	167		0	0	0	0	0	6,060	47,680
568	230	640		1	105	0	0	106	6,389	47,680
569	16	46		0	0	0	0	0	315	47,867
570	20	57		0	0	0	0	0	850	47,867
571	32	89		0	20	0	0	20	81	49,216
572	99	274		0	45	0	0	45	738	47,680
573	49	136		0	0	0	0	0	4,336	47,680
574	6	17		0	4	0	0	4	70	47,997
575	115	318		5	67	0	0	72	8,593	47,997
576	181	504		0	111	0	0	111	5,313	49,216
577	112	312		0	0	0	0	0	3,293	49,972
578	282	783		30	120	17	28	195	3,098	49,972
579	122	340		0	34	0	0	34	2,335	49,972
580	46	128		0	0	0	0	0	1,253	49,972
581	598	1,662		0	0	0	0	0	1,109	60,894
582	3	9		0	30	0	0	30	612	60,894
583	145	402		0	11	0	0	11	673	39,367
584	615	1,709		32	30	58	13	133	1,454	41,802
585	54	150		27	130	269	44	470	1,122	25,153
586	269	749		153	176	309	19	657	1,010	39,288
587	161	449		80	245	20	46	391	224	39,416
588	349	970		0	4	0	0	4	681	65,843
589	692	1,923		13	142	207	0	362	1,706	48,441
590	411	1,142		56	196	0	0	252	174	24,531
591	56	157		29	14	0	0	43	478	43,635
592	665	1,848		7	76	0	0	83	4,103	47,267
593	573	1,594		17	134	0	0	151	884	33,957
594	417	1,159		14	953	0	0	967	476	30,059
595	42	116		0	0	0	0	0	1,302	45,414
596	155	431		0	0	0	0	0	1,679	45,414
597	109	303		0	0	0	0	0	1,009	42,802
598	36	101		0	0	0	0	0	683	45,414
599	137	382		19	94	0	0	113	1,917	45,414
600	286	794		0	0	0	0	0	3,161	45,414

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
601	68	188		0	0	0	0	0	1,062	45,414
602	55	154		0	0	0	0	0	194	45,414
603	252	700		8	36	4	0	48	1,095	35,598
604	308	856		10	44	4	0	58	2,945	35,598
605	383	1,064		11	40	0	0	51	7,305	42,007
606	320	890		26	76	19	0	121	1,618	31,874
607	351	976		22	132	0	17	171	801	41,341
608	190	529		0	0	0	0	0	1,528	45,414
609	140	390		9	53	0	7	69	7,258	41,341
610	105	293		6	40	0	5	51	1,621	41,341
611	7	18		0	0	0	0	0	569	41,341
612	13	36		0	0	0	0	0	550	41,341
613	13	36		0	0	0	0	0	817	41,341
614	105	293		6	40	0	5	51	893	41,341
700	19	45		13	72	0	0	85	541	66,484
701	430	1,010		2	54	0	0	56	702	66,484
702	229	538		0	108	0	0	108	253	58,968
703	293	689		1	60	0	0	61	216	49,360
704	241	566		0	192	0	0	192	244	42,258
705	122	287		0	55	0	0	55	80	52,535
706	89	209		4	54	0	0	58	56	39,730
707	148	348		0	47	0	0	47	66	39,730
708	95	223		1	2	0	0	3	42	39,730
709	31	73		0	22	0	0	22	18	39,730
710	29	68		0	0	0	0	0	12	39,730
711	96	226		0	37	0	0	37	45	39,730
712	52	122		0	0	0	0	0	35	42,258
713	14	33		0	10	0	0	10	6	42,258
714	14	33		0	7	0	0	7	6	42,258
715	18	42		0	0	0	0	0	8	42,258
716	6	14		0	0	0	0	0	6	42,258
717	20	47		0	164	0	0	164	13	30,469
718	74	174		0	49	0	0	49	29	30,469
719	158	371		0	10	0	0	10	82	42,258
720	37	87		0	74	0	0	74	16	42,258
721	21	49		34	196	0	0	230	19	42,258
722	160	376		63	0	0	0	63	58	30,469
723	399	938		281	53	0	0	334	217	30,469
724	43	101		1	7	0	0	9	51	30,469
725	265	623		25	132	0	0	157	100	42,258
726	46	108		0	551	0	0	551	42	19,757
727	184	432		5	29	0	0	34	334	42,258
728	221	519		4	1,029	0	0	1,033	486	19,757
729	3	7		0	0	0	0	0	58	19,757
730	0	0		0	0	0	0	0	140	68,621
731	293	689		0	22	0	0	22	1,255	68,621

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
732	93	219		0	0	0	0	0	261	68,621
733	225	529		52	561	10	0	623	775	68,621
734	622	1,462		5	32	0	0	37	472	68,621
735	9	21		97	86	24	49	256	1,577	46,250
736	160	389		5	0	0	2	7	2,893	46,250
737	79	197		4	0	0	0	4	1,256	46,250
738	15	35		12	0	0	0	12	167	75,982
739	19	45		0	10	0	0	10	434	75,982
740	10	24		0	63	0	0	63	215	75,982
741	58	136		1	0	0	0	1	138	75,982
742	119	280		2	136	0	0	138	165	75,982
743	27	63		0	0	0	0	0	43	32,112
744	170	400		0	0	0	0	0	107	75,982
745	18	42		0	52	0	0	52	35	75,982
746	208	489		1	0	0	0	1	117	75,982
747	559	1,314		1	29	0	0	30	472	51,737
748	122	287		48	186	0	0	235	241	32,112
749	46	108		25	15	0	0	40	23	54,769
750	219	515		0	17	0	0	17	130	39,609
751	468	1,100		30	662	0	0	692	311	39,609
752	23	54		0	194	0	0	194	31	28,516
753	171	402		242	345	0	0	587	92	28,516
754	13	31		6	12	0	0	18	11	28,516
755	2	5		37	7	0	0	44	9	28,516
756	48	113		0	56	0	0	56	23	28,516
757	19	45		1	299	0	0	300	33	28,516
758	43	101		0	314	0	0	314	28	28,516
759	4	9		1	74	0	0	74	13	28,516
760	301	707		36	74	0	0	110	108	22,026
761	297	698		6	2	0	0	9	282	36,492
762	6	14		0	0	0	0	0	213	26,668
763	0	0		0	0	0	0	0	0	22,026
764	159	374		340	12	0	0	352	153	28,516
765	209	491		43	115	0	3	161	72	28,516
766	190	446		0	58	12	0	70	213	36,492
767	0	0		0	12	0	11	23	65	37,500
768	8	19		81	0	0	0	81	27	28,516
769	163	383		8	186	0	0	194	111	37,500
770	2	5		0	169	0	0	169	226	37,500
771	0	0		0	0	0	0	0	25	37,500
772	87	204		0	25	0	0	25	512	40,745
773	20	42		2	25	0	0	26	48	40,745
774	69	162		0	48	0	0	48	430	40,745
775	10	17		2	12	2	0	16	21	40,745
776	0	0		17	71	0	0	88	241	30,184
777	1	2		0	0	0	0	0	43	40,745

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
778	6	14		42	512	5	2	560	853	30,184
779	12	28		17	2	0	0	19	902	35,203
780	8	19		0	0	0	0	0	897	35,203
781	8	19		0	10	0	0	10	656	56,750
782	63	148		0	25	0	0	25	544	56,750
783	0	0		0	22	0	0	22	523	56,750
784	4	9		0	29	0	7	36	160	56,750
785	1	2		0	12	0	0	12	923	56,750
786	0	0		2	17	0	0	19	1,269	56,750
787	12	25		1	2	0	0	4	58	56,750
788	45	113		2	0	0	0	2	1,266	56,750
789	30	75		0	0	0	0	0	228	56,750
790	3	7		0	0	0	0	0	114	32,720
791	2	5		0	47	0	0	47	48	37,500
792	27	68		1	0	0	0	1	50	32,750
793	0	0		0	0	0	0	0	23	29,464
794	0	0		1	10	0	0	11	343	29,464
795	0	0		0	10	0	0	10	448	43,594
796	1	2		0	100	0	0	100	594	43,594
797	3	7		50	0	2	0	52	172	32,720
798	1	2		8	123	0	0	130	302	32,720
799	66	164		0	7	0	2	10	395	32,750
800	335	670		184	12	0	0	196	300	29,464
801	167	387		37	22	0	0	59	189	43,594
802	74	166		0	2	0	0	2	279	43,594
803	42	125		25	20	0	0	44	30	22,266
804	0	0		0	42	0	0	42	208	22,266
805	202	425		0	0	0	0	0	146	22,266
806	113	237		21	38	0	0	59	86	22,266
807	15	35		16	5	0	0	21	77	22,266
808	22	47		0	7	0	0	7	244	22,266
809	41	93		1	56	0	0	57	90	22,266
810	64	167		0	0	0	0	0	157	22,266
811	0	0		0	0	0	0	0	106	22,266
812	50	128		0	0	0	0	0	41	22,266
813	56	140		0	0	0	0	0	573	22,250
814	30	76		0	2	0	0	2	83	22,250
815	30	76		14	0	0	0	14	421	48,375
816	33	82		11	12	0	0	24	469	48,375
817	19	47		0	0	0	0	0	254	48,375
818	32	80		2	106	9	0	117	338	48,375
819	39	97		0	12	0	0	12	1,016	48,375
820	54	136		7	5	0	0	12	638	48,375
821	67	153		30	5	0	0	35	385	48,375
822	295	639		17	45	29	0	92	402	27,159
823	494	1,056		19	32	154	2	207	625	24,313

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
824	16	35		0	44	0	0	44	1,087	27,159
825	40	96		0	0	0	0	0	362	65,179
826	39	97		0	5	2	0	6	1,314	65,179
827	175	433		129	300	2	114	544	2,136	65,179
828	44	112		8	44	0	0	52	915	35,395
829	54	136		0	0	15	0	15	118	35,395
830	79	183		47	15	0	0	62	60	35,395
831	84	158		41	113	0	0	154	72	24,053
832	63	159		50	42	0	0	91	242	24,053
833	273	576		9	7	0	0	16	1,212	24,839
834	375	749		0	0	0	0	0	375	24,839
835	307	788		39	20	2	1	61	527	28,357
836	499	1,107		38	35	0	3	76	725	34,087
837	396	872		17	36	11	0	64	1,366	34,087
838	436	842		1	22	0	1	24	557	24,053
839	208	509		0	0	0	0	0	444	31,875
840	0	0		0	12	0	0	12	643	34,087
841	398	959		9	0	0	7	16	676	31,349
842	43	108		45	10	152	0	207	1,930	31,349
843	37	91		0	0	0	0	0	589	31,349
844	50	97		8	45	770	1	824	2,725	31,349
845	309	712		19	2	0	2	24	750	28,750
846	227	439		23	49	180	0	252	395	28,750
847	527	1,146		24	43	0	1	68	889	16,968
848	13	22		5	117	3	0	125	72	16,968
849	7	18		0	0	0	5	5	50	49,042
850	224	537		0	85	0	0	85	149	49,042
851	190	479		171	168	4	8	351	282	37,566
852	586	1,100		5	43	0	0	48	357	37,566
853	34	67		0	0	0	0	0	33	37,566
854	59	147		0	0	0	0	0	101	49,042
855	68	169		0	50	0	0	50	162	49,042
856	152	319		15	244	0	0	259	141	37,566
857	7	16		148	68	3	0	219	22	42,500
858	113	280		2	30	0	0	32	216	42,500
859	4	10		0	75	0	0	75	23	42,500
860	19	25		0	60	0	0	60	20	42,500
861	0	0		0	55	0	0	55	18	42,500
862	7	15		80	106	0	2	188	26	42,500
863	7	15		17	101	16	0	134	23	42,500
864	6	10		31	583	21	10	645	17	42,500
865	0	0		119	483	2	0	604	17	42,500
866	21	40		0	99	0	0	99	18	42,500
867	38	106		0	0	0	0	0	21	42,500
868	12	30		0	33	0	0	33	11	42,500
869	0	0		0	90	0	0	90	6	42,500

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
870	7	14		0	29	0	0	29	8	42,500
871	0	0		0	18	0	0	18	9	42,500
872	4	10		10	69	0	0	79	16	42,500
873	1	2		2	45	0	4	51	8	42,500
874	28	72		0	0	0	0	0	27	42,500
875	110	283		0	4	0	3	7	1,190	76,720
876	139	320		0	38	0	0	38	1,151	76,720
877	180	450		0	0	0	0	0	720	76,720
878	545	895		0	175	0	0	175	244	76,720
879	644	1,352		62	79	0	0	141	423	76,720
880	75	142		309	281	0	0	590	81	45,690
881	100	241		4	110	0	0	114	1,406	53,750
882	915	1,982		35	180	0	2	217	743	57,083
883	188	532		0	9	0	0	9	526	53,750
884	529	1,340		0	5	0	0	5	856	53,750
885	193	470		72	334	8	4	418	253	87,761
886	276	691		0	5	0	0	5	517	87,761
887	81	180		5	46	2	2	55	82	26,429
888	383	968		0	60	3	4	67	407	26,429
889	114	275		15	33	45	43	136	65	14,792
890	34	70		0	0	0	0	0	19	14,792
891	205	410		13	261	0	0	274	96	14,792
892	56	142		12	8	0	0	20	31	14,792
893	3	8		0	17	0	0	17	4	37,566
894	0	0		0	209	0	0	209	12	14,792
895	58	176		0	0	0	0	0	38	14,792
896	18	41		0	0	0	0	0	23	14,792
897	233	675		0	0	0	0	0	86	26,429
898	146	554		0	32	0	0	32	87	9,606
899	15	39		0	148	0	0	148	167	9,606
900	0	0		5	12	0	0	17	32	9,606
901	220	546		94	220	4	0	318	196	23,152
902	48	62		0	0	0	0	0	46	9,606
903	27	76		5	0	0	0	5	26	9,606
904	0	0		6	119	0	0	125	21	23,152
905	6	12		0	2	0	0	2	6	23,152
906	14	14		0	0	0	0	0	10	23,152
907	62	174		0	2	0	0	2	41	23,152
908	41	94		0	17	0	0	17	22	14,792
909	34	71		0	0	0	0	0	18	20,043
910	9	14		0	0	0	0	0	9	20,043
911	35	60		0	12	0	0	12	15	20,043
912	58	131		2	7	0	0	9	40	18,045
913	13	36		0	0	1	0	1	7	16,046
914	2	5		0	0	0	0	0	14	16,046
915	127	184		2	328	0	6	336	45	14,792

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
916	45	90		0	18	0	0	18	35	20,043
917	20	40		0	48	0	0	48	16	20,043
918	129	180		0	5	0	0	5	31	20,043
919	75	186		0	78	0	0	78	73	18,045
920	29	72		0	0	0	0	0	15	16,046
921	4	12		0	33	0	0	33	30	16,046
922	20	40		3	2	0	0	5	16	20,043
923	95	190		9	4	0	0	13	40	16,046
924	0	0		0	37	0	8	45	7	16,046
925	0	0		13	5	0	0	18	15	16,046
926	69	132		9	59	0	0	68	42	16,046
927	0	0		7	11	0	5	23	8	16,046
928	0	0		0	18	0	8	26	17	16,046
929	69	115		0	2	0	0	2	37	16,046
930	0	0		2	2	0	7	11	7	16,046
931	12	30		0	9	0	6	15	14	16,046
932	48	91		0	0	0	0	0	42	42,969
933	13	22		0	0	0	0	0	9	48,971
934	23	48		0	2	0	0	2	16	48,971
935	101	186		0	0	0	0	0	40	42,538
936	202	551		7	35	0	10	52	180	42,538
937	11	27		5	8	90	0	103	136	42,538
938	1	3		0	8	0	0	8	41	42,538
939	136	223		0	8	0	0	8	98	42,969
940	7	12		2	16	0	0	18	12	48,971
941	10	15		0	10	0	0	10	117	48,971
942	152	380		0	0	0	0	0	85	48,971
943	57	160		0	5	0	0	5	122	42,538
944	13	30		0	8	0	0	8	143	42,538
945	163	342		0	0	0	0	0	242	42,969
946	319	548		263	76	0	0	339	244	42,969
947	583	1,457		20	108	35	0	163	431	48,971
948	423	1,067		12	12	0	0	24	193	48,971
949	714	1,785		288	1,724	63	23	2,098	1,109	36,385
950	599	1,504		96	193	63	40	392	1,168	65,244
951	623	1,547		4	114	24	17	159	3,370	46,131
952	49	123		3	6	3	0	12	1,019	46,131
953	785	1,951		10	74	0	0	84	2,292	65,244
954	80	157		628	861	14	45	1,548	225	51,953
955	893	2,238		261	571	2	1	835	340	51,953
956	913	2,258		83	616	25	20	744	2,916	77,078
957	770	1,940		10	170	0	0	180	1,517	77,078
958	2	5		0	4	0	0	4	300	77,078
959	116	288		5	8	0	4	17	1,517	77,078
960	159	457		0	0	0	0	0	834	49,137
961	202	501		0	0	0	0	0	1,017	49,137

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
962	114	265		0	17	0	0	17	2,117	49,137
963	139	453		15	0	0	0	15	2,751	49,137
964	31	80		0	0	0	0	0	2,021	49,137
965	171	422		28	42	6	3	79	2,092	49,137
966	328	566		0	81	0	0	81	3,925	50,500
967	370	912		2	32	0	0	34	9,389	50,500
968	60	121		6	0	0	4	9	2,217	32,475
969	181	448		17	61	0	0	78	3,684	50,500
970	0	0		0	0	0	0	0	410	49,137
971	51	140		28	0	0	0	28	1,571	49,137
972	211	474		16	20	0	0	36	3,650	49,137
973	414	950		12	38	0	0	50	7,555	49,137
974	43	121		24	75	0	0	99	846	49,137
975	0	0		0	0	0	0	0	2,349	49,137
976	20	62		18	44	0	0	62	778	42,538
977	19	59		13	61	0	0	74	2,504	42,538
978	23	69		15	61	0	0	76	2,355	42,538
979	26	67		0	0	0	0	0	588	36,523
980	14	31		54	5	276	0	334	330	36,523
981	23	46		5	0	211	132	348	621	36,523
982	0	0		0	20	0	0	20	255	36,523
983	91	200		0	0	0	0	0	2,132	36,523
984	167	418		8	2	0	0	10	1,567	36,523
985	168	386		0	0	62	0	62	2,323	36,523
986	222	502		21	12	3	0	37	3,307	36,523
987	92	261		10	3	0	0	13	1,645	36,523
988	147	330		6	0	0	2	7	2,183	36,523
989	41	57		0	0	0	0	0	24	36,523
990	104	263		6	15	0	0	20	135	36,523
991	151	284		0	17	0	0	17	130	45,586
992	39	79		33	12	0	0	45	165	45,586
993	75	190		0	0	0	0	0	147	36,523
994	13	33		21	25	0	0	46	832	36,523
995	77	194		0	0	0	0	0	771	45,586
996	176	449		1	0	0	0	1	2,858	36,523
997	183	461		2	5	0	0	7	3,518	36,523
998	432	1,208		0	0	11	0	11	12,687	37,461
999	169	418		47	110	1,648	2	1,808	1,517	45,586
1000	173	411		1	49	0	0	50	1,765	37,461
1001	13	33		2	44	0	0	46	840	45,586
1002	187	460		5	2	0	0	7	1,864	37,461
1003	80	201		0	22	0	0	22	935	45,586
1004	64	130		0	0	0	0	0	1,476	45,586
1005	68	171		53	102	0	0	155	1,532	36,523
1006	20	50		24	34	0	0	58	2,673	36,523
1007	340	866		25	0	0	1	26	6,260	36,523

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
1008	353	888		23	29	0	0	52	8,973	36,523
1009	85	214		0	0	0	0	0	650	42,969
1010	19	55		3	0	0	0	3	486	42,969
1011	128	323		8	0	0	0	8	3,974	42,969
1012	73	184		0	0	0	0	0	306	42,969
1013	845	2,516		11	56	193	0	260	19,328	42,969
1014	13	33		9	0	31	0	40	1,198	42,969
1015	190	507		7	29	108	0	144	6,900	36,523
1016	130	327		18	0	97	0	115	4,330	36,523
1017	344	907		17	12	285	1	315	8,646	36,523
1018	305	858		16	0	157	0	173	9,147	36,523
1019	1,123	3,378		59	20	636	0	714	24,088	36,523
1020	113	284		3	0	0	0	3	2,968	36,523
1021	40	93		2	11	1	3	17	330	35,603
1022	57	142		0	0	0	0	0	1,362	35,603
1023	129	354		0	0	0	0	0	3,363	36,535
1024	62	155		0	0	0	18	18	1,478	36,535
1025	158	399		0	0	0	0	0	4,915	36,535
1026	230	526		20	2	0	1	24	3,570	36,535
1027	110	260		6	7	8	0	21	1,205	36,535
1028	317	800		36	56	0	0	92	4,171	36,535
1029	32	64		0	0	0	0	0	3,124	36,535
1030	28	58		2	0	0	0	2	608	32,632
1031	9	22		6	5	0	0	11	409	32,632
1032	55	132		0	0	0	0	0	602	32,632
1033	57	112		11	0	5	0	16	1,387	32,632
1034	48	121		0	0	0	0	0	347	36,535
1035	10	28		2	3	0	10	15	393	36,535
1036	8	20		1	19	0	0	20	1,091	36,535
1037	90	190		2	0	0	0	2	824	32,632
1038	61	128		0	1	0	0	1	710	24,063
1039	61	153		19	4	0	0	23	2,667	35,603
1040	161	403		12	1	0	3	16	1,603	32,632
1041	175	439		7	2	0	1	11	3,234	32,632
1042	66	170		13	44	203	7	267	1,038	24,063
1043	444	1,043		1	0	200	5	206	2,028	24,063
1044	75	180		2	5	30	0	37	853	24,063
1045	26	65		4	12	0	4	20	485	35,603
1046	0	0		0	2	0	0	2	41	35,603
1047	86	216		2	29	0	2	34	511	35,603
1048	708	1,803		5	550	0	0	555	284	35,603
1049	0	0		0	0	0	0	0	12	35,603
1050	500	850		20	2,020	0	0	2,040	339	35,603
1051	24	60		30	5	0	28	63	279	35,603
1052	110	242		0	65	0	0	65	564	36,532
1053	104	279		2	169	0	0	171	398	31,436

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
1054	365	932		0	0	0	0	0	110	31,436
1055	197	498		11	0	20	0	31	98	31,436
1056	0	0		30	5	0	0	35	30	31,436
1057	30	75		27	13	3	54	97	232	32,500
1058	0	0		0	2	15	0	17	345	32,500
1059	1	2		0	0	0	0	0	57	32,500
1060	57	142		0	8	0	0	8	50	32,500
1061	0	0		0	0	0	0	0	45	32,500
1062	0	0		12	9	0	0	21	14	32,500
1063	0	0		0	2	0	6	8	14	28,173
1064	23	54		8	0	0	0	8	296	32,500
1065	118	215		0	5	0	3	8	1,200	32,500
1066	205	483		5	0	0	0	5	1,106	31,436
1067	130	362		27	2	0	0	29	931	36,532
1068	254	650		0	0	0	0	0	3,481	28,173
1069	78	214		15	45	1,053	2	1,115	2,727	28,173
1070	254	650		0	0	0	0	0	4,217	28,173
1071	78	171		9	12	0	0	21	1,172	28,173
1072	211	473		0	0	0	0	0	3,673	28,173
1073	341	866		9	10	0	0	19	8,273	28,173
1074	170	371		0	0	0	0	0	4,372	28,173
1075	176	444		36	12	0	0	48	5,236	28,173
1076	114	313		0	0	0	0	0	4,404	28,173
1077	80	201		26	7	0	0	33	2,226	28,173
1078	118	304		0	0	0	0	0	3,767	39,519
1079	259	679		27	15	0	0	42	5,706	39,519
1080	332	864		0	0	0	0	0	6,286	39,519
1081	179	459		25	12	2	0	39	5,091	36,532
1082	190	489		10	0	0	0	10	1,297	36,532
1083	183	507		0	0	0	0	0	4,073	36,532
1084	178	448		0	0	0	0	0	2,135	36,532
1085	105	270		0	0	0	0	0	5,572	36,532
1086	109	275		9	5	6	0	19	5,820	36,532
1087	65	164		0	0	0	0	0	1,452	36,532
1088	14	39		7	0	0	0	7	1,178	28,173
1089	115	293		0	0	0	0	0	1,900	28,173
1090	67	178		0	0	0	0	0	980	28,173
1091	172	507		14	15	6	0	34	2,130	31,436
1092	44	127		0	0	0	0	0	1,983	31,436
1093	117	334		0	0	0	0	0	2,769	31,436
1094	118	316		14	12	9	0	35	1,966	31,436
1095	219	565		0	0	0	0	0	4,513	31,436
1096	86	230		0	0	0	0	0	839	31,436
1097	55	151		16	15	0	0	30	3,231	39,519
1098	220	583		0	0	0	0	0	4,565	39,519
1099	126	338		0	0	0	0	0	2,479	39,519

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
1100	349	676		0	78	0	0	78	2,017	39,519
1101	176	442		0	0	0	0	0	1,471	39,519
1102	113	287		0	5	0	0	5	2,578	39,519
1103	180	499		5	0	0	0	5	2,993	45,690
1104	258	656		0	12	0	0	12	4,279	45,690
1105	57	157		0	0	0	0	0	493	45,690
1106	578	1,479		10	20	0	0	29	10,054	45,690
1107	57	157		0	0	0	0	0	1,612	45,690
1108	354	1,106		0	0	0	0	0	9,086	28,173
1109	160	403		10	12	0	0	23	5,154	28,173
1110	82	207		11	0	0	0	11	2,542	28,173
1111	39	97		0	0	0	0	0	1,251	28,173
1112	87	220		10	0	0	0	10	138	28,173
1113	69	175		0	0	0	0	0	89	28,173
1114	18	46		18	15	0	0	33	1,102	28,173
1115	96	241		0	21	0	0	21	1,852	35,603
1116	259	653		0	0	0	0	0	1,476	35,603
1117	109	274		0	0	0	0	0	3,775	35,603
1118	199	500		2	12	0	0	14	6,297	35,603
1119	83	218		7	12	0	0	19	3,513	35,603
1120	120	302		0	0	0	0	0	5,457	35,603
1121	124	389		2	5	0	0	7	2,355	45,690
1122	215	541		0	0	0	0	0	4,973	45,690
1123	104	263		2	7	0	0	9	4,889	45,690
1124	150	377		10	37	0	0	47	1,616	45,690
1125	199	502		18	7	0	0	25	6,239	45,690
1126	317	754		0	0	0	0	0	7,796	28,173
1127	312	787		0	0	0	0	0	7,646	28,173
1128	276	733		10	29	0	0	40	7,577	28,173
1129	86	227		0	0	0	0	0	1,581	28,173
1130	374	1,028		13	29	0	0	43	9,206	28,173
1131	87	246		0	0	0	0	0	2,684	45,690
1132	326	863		0	0	0	0	0	7,252	45,690
1133	158	421		10	15	0	0	25	4,198	45,690
1134	329	841		11	15	0	0	26	6,804	45,690
1135	20	50		0	0	0	0	0	2,653	45,690
1136	39	97		10	15	0	0	25	2,980	28,173
1137	323	814		11	7	0	0	19	5,230	45,690
1138	46	116		0	0	0	0	0	3,115	45,690
1139	48	121		0	0	0	0	0	2,648	28,173
1140	70	178		18	10	0	0	28	3,098	32,500
1141	133	334		0	102	0	0	102	1,384	32,500
1142	215	558		0	0	0	0	0	732	32,500
1143	210	555		0	0	0	0	0	3,048	32,500
1144	228	576		13	7	0	0	21	4,223	35,603
1145	178	448		0	0	0	0	0	3,902	35,603

Traffic Zone	Household	Population	Enrollment	Employment					Acres	Income
			School	Retail	Service	Manufacture	Wholesale	Total		
1146	73	184		17	5	0	0	22	731	35,603
1147	18	46		0	0	0	0	0	1,344	35,603
1148	39	97		28	12	0	0	40	1,225	35,603
1149	124	313		0	0	0	0	0	1,657	35,603
1150	210	545		22	39	0	0	61	3,723	32,500
1151	222	583		0	0	0	0	0	4,688	32,500
1152	103	278		0	0	0	0	0	2,781	32,500
1153	65	190		8	0	0	0	8	1,516	32,500
1154	173	452		0	0	0	0	0	2,954	32,500
1155	151	402		4	12	0	0	16	3,077	35,603
1156	96	277		0	0	0	0	0	4,875	35,603
1157	246	633		0	7	0	0	7	5,552	35,603
1158	301	772		0	0	0	0	0	6,269	35,603
1159	75	219		0	0	0	0	0	814	35,603
1160	73	184		0	12	0	0	12	148	35,603
1161	85	214		0	0	0	0	0	95	45,690
1162	429	1,080		60	29	0	0	90	10,676	45,690
1163	228	606		0	0	0	0	0	6,258	28,173
1164	177	456		9	10	0	0	19	4,745	28,173
1165	44	127		8	20	0	0	28	306	28,173
1166	91	228		0	0	0	0	0	2,515	28,173
1167	214	465		5	7	0	0	12	4,998	28,173
1168	76	191		42	34	0	0	77	3,041	35,603
1300	0	0		3	24	0	0	27	4,475	53,698
1301	0	0		0	0	0	0	0	265	54,485
1302	0	0		0	0	0	0	0	31	54,485
1303	41	96		8	0	0	0	8	1,682	54,485
1304	268	702		0	1	15	0	16	1,175	54,485
1305	228	594		11	106	3	0	120	857	54,485
1306	6	14		0	4	0	0	4	249	54,485
1307	0	0		0	0	0	0	0	65	54,485
1308	13	33		0	24	0	0	24	778	54,485
1310	0	0		0	0	0	0	0	400	54,485
1311	206	485		12	14	85	0	111	1,166	54,485
1312	157	347		0	0	0	0	0	82	32,663
1313	175	438		0	0	0	0	0	658	32,663
Total	179,471	465,496	21,539	22,843	115,347	24,732	4,435	167,359	1,109,987	35,517

Appendix B: Travel Demand Model Validation Sample Report

Travel Demand Model Validation Report		
Calibration Measure	Target Range / Value	2006 Model
Socio-Economic Data		
Persons / Household	2 - 4	2.6
Workers / Household	1 - 3	0.9
Trip Generation		
Person Trips Per Household	8.5 - 9.2	7.6
Person Trips Per Person	3 - 4	2.9
HBW Trips / Employee	< 2	1.5
Shopping Trips / Retail Employment	-	5.1
P/A Ratio Before Balancing (HBW)	0.9 - 1.1	1.1
P/A Ratio Before Balancing (HBO)	0.9 - 1.1	1.1
P/A Ratio Before Balancing (HBSshop)	0.9 - 1.1	1.0
P/A Ratio Before Balancing (NHB)	0.9 - 1.1	1.1
Trip Distribution		
Average Trip Length (HBW)	19.8 - 21.8	19.9
Average Trip Length (HBO)	16.7 - 18.5	12.9
Average Trip Length (HBSshop)	14.7 - 16.3	15.7
Average Trip Length (NHB)	14.6 - 16.2	12.5
Average Trip Length (Truck)	N/A	16.2
% Intrazonal Trips	< 10%	2.5%
Trip Assignment		
VMT-Freeway	3,253,512	3,198,961
VMT-Arterials	6,223,688	6,011,730
VMT-Collectors	1,383,142	1,293,232
VMT-Total	10,860,342	10,503,923
VMT / Household	60.5	58.5
VMT / Person	23.3	22.6
Screenlines		
All Counts	+/- 16 %	-1%
Savannah River	+/- 26 %	-5%
Southern Railway	+/- 19 %	-2%
Kiokee Creek	+/- 58 %	14%
Aiken Screenline	+/- 38 %	14%

Travel Demand Model Validation Report		
Calibration Measure	Target Range / Value	2006 Model
<u>Cutlines</u>		
All Counts	+/- 10 %	-1%
N/S West of I-520	+/- 25 %	0%
N/S SR 28 Corridor crossing I-20	+/- 23 %	2%
N/S Southwest of I-520	+/- 30 %	1%
N/S Southwest Circle along I-520	+/- 18 %	-3%
E/W North of US 278 inside I-520	+/- 22 %	1%
E/W Downtown Augusta	+/- 28 %	-3%
N/S SC 230 Corridor East of Augusta	+/- 29 %	2%
N/S East of US 25 crossing I-20	+/- 30 %	5%
E/W Southwest of Aiken	+/- 31 %	-14%
E/W Downtown Aiken	+/- 37 %	-16%
E/W Southeast of Aiken	+/- 38 %	-3%
RMSE = Root Mean Squared Error (Vol)	< 51%	21%
% RMSE (0-5K)	< 76%	41%
% RMSE (5K-10K)	< 44%	19%
% RMSE (10K-15K)	< 35%	10%
% RMSE (15K-20K)	< 30%	12%
% RMSE (20K-30K)	< 25%	8%
% RMSE (>30K)	< 22%	5%