

MOBILITY 2040

Killeen-Temple Metropolitan Planning Organization

Appendix I: Travel Demand Model Documentation



This page is intentionally left blank.



METROPOLITAN PLANNING ORGANIZATION

Travel Demand Model Update Model Documentation



OCTOBER, 2012

Table of Contents

Introduction.....	1
Traffic Analysis Zone Geography	1
Fort Hood.....	3
2010 Population and Households.....	3
2010 Employment	6
Outside Fort Hood	6
Fort Hood.....	8
2010 Median Income.....	9
2010 Special Generators.....	10
2010 Network.....	12
Future Year Control totals	20
Population	20
Employment	22
Local Meetings.....	23
Future Growth Distribution	23
Known and Planned Growth.....	24
Fort Hood.....	27
Anticipated Growth	28
Population Distribution	29
Special Generators.....	30
Employment Distribution	30
Final Future Growth.....	30
2040 Network.....	35
Appendix A.....	A-1

INTRODUCTION

This report summarizes the work done by CDM Smith to update the Killeen-Temple Metropolitan Planning Organization's (KTMPO) regional travel demand model. This work developed and/or updated the Traffic Analysis Zone (TAZ) structure, TAZ-level demographics, and the modeled roadway network for the years of 2010 and 2040.

The CDM Smith team would like to thank the following individuals for their support during the course of this work effort:

- Ms. Annette Shepherd, Ms. Charlotte Humpherys, Ms. Cheryl Maxwell, Mr. Jeff Stone, Mr. Anthony Notgrass, and Mr. Jeremy Wagner: Killeen-Temple Metropolitan Planning Organization (KTMPO-CTCOG)
- Ms. Janie Temple and Mr. Greg Lancaster: Texas Department of Transportation – Transportation Planning and Programming Division (TxDOT-TPP)
- Mr. Kevin Hall, Texas Transportation Institute (TTI)

In addition, a variety of individuals from the TxDOT Waco District and various city and county staff were relied upon to help identify areas of the region targeted for growth as well as to identify future planned roadway projects.

This report discusses the development of the demographics, special generator, and traffic analysis zone (TAZ) data for each of the model years is presented first, followed by the development of the roadway network for each of the model years.

TRAFFIC ANALYSIS ZONE GEOGRAPHY

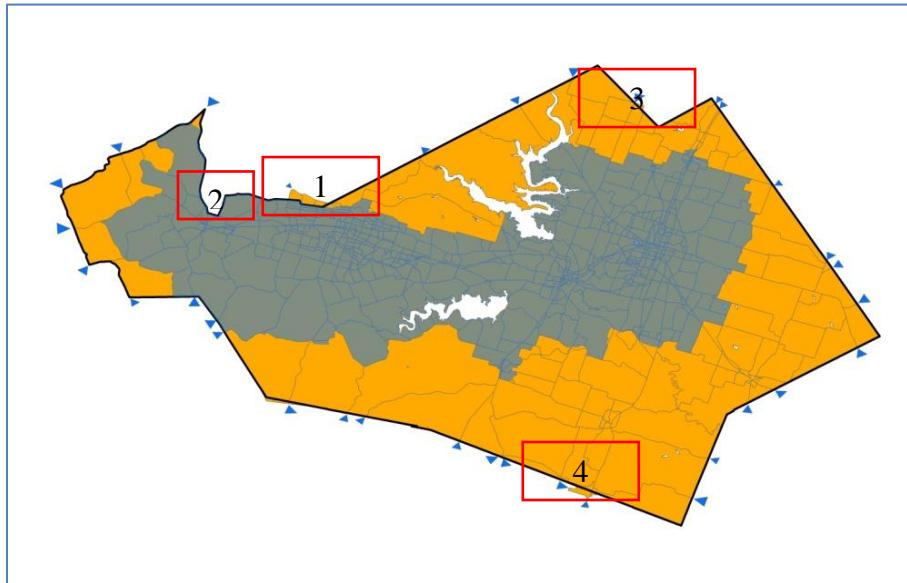
The first task was to develop TAZs that cover the recently expanded KTMPO planning area. This planning area covers all of Bell County, and small portions of Coryell and Lampasas Counties. Figure 1 shows the boundary of the old travel demand model's TAZ structure (510 internal zones and 33 external zones) on top of the newly developed TAZ structure (733 internal zones and 33 external zones). In general, TAZs were constructed from 2010 Census Blocks. However due to the incompatibility of some TAZs and Census blocks, 30 blocks had to be split among TAZs. Additional information about this issue is presented in the **Appendix A**.

For model continuity purposes, four small areas outside of the formal KTMPO planning area were included within the model coverage area. These three areas are shown in red boxes in **Figure 1** and include:

1. Small area of Fort Hood south of South Range Road to account for developed areas of Fort Hood
2. Small area in Fort Hood north of Copperas Cove Road to account for the proposed SH 9 alignment.
3. Small area in Hill County

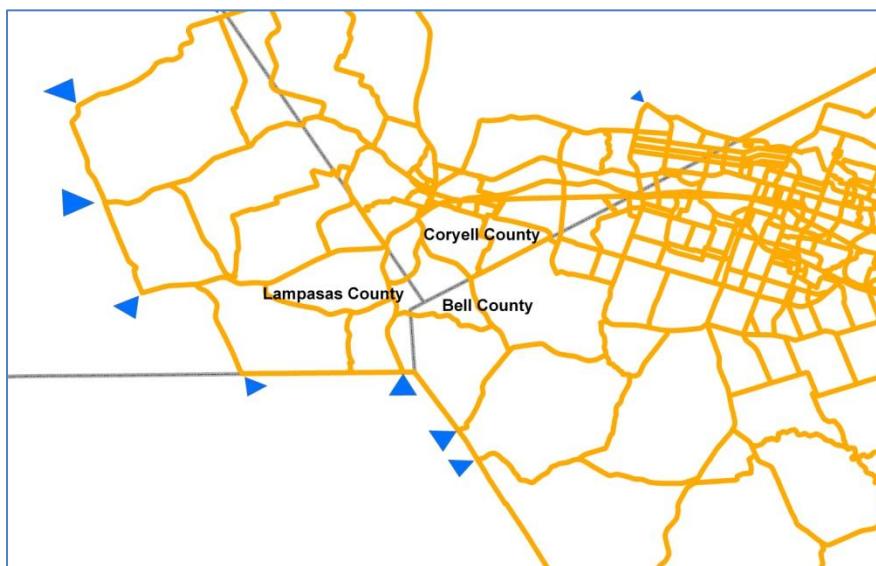
4. Small area in Williamson County to account for the entire developed areas of the City of Bartlett.

Figure 1: Old Travel Demand Model Vs. New Updated Travel Demand Model



For model continuity purposes, some TAZs span county boundaries. These locations can be seen in **Figure 2** where the gray county boundaries are not covered up by the orange TAZ boundaries. Within the TAZ boundary GIS layer, each TAZ was assigned to the county that contributes most to the TAZ population.

Figure 2: County Boundaries Compared to TAZ Boundaries



FORT HOOD

As in the 1997 model, only the main cantonment of the base is included. The extensive training ranges and gunnery ranges in Coryell County, which are primarily open areas, and the north cantonment are not included in the model TAZ structure. The general strategy in upgrading the Fort Hood TAZs has been to distinguish among the discrete land uses and to be consistent with the 2010 Census geography and with existing roadways.

Although there is some mixing, Army planning has lead to a remarkable segregation of land uses by easily-defined zones. The primary land uses are:

- Range Area: open land reserved for tank gunnery and mobility training
- Main Cantonment: core area of the base with motor pools, barracks, and administrative uses
- Warehouse & Railhead: industrial area, including facilities for loading material onto railcars
- Army Airfield: includes the Hood Army Airfield reserved for army helicopters, and the Robert Grey Army Airfield, which also serves as the regional civilian airport
- Darnall Army Medical Center: includes a series of medical and dental centers and facilities for recuperating wounded.
- Family Housing: there are thirteen distinct housing areas for military families, exclusive of the barracks and temporary housing areas.

2010 POPULATION AND HOUSEHOLDS

2010 population and household data were derived directly from the 2010 U.S. Census at the block level and shown in **Table 1**.

Table 1: 2010 Population and Households (within the KTMPO Planning Area)

County	Population	Households
Bell	310,235	114,035
Coryell	49,029	15,458
Lampasas	6,618	2,441
Total	365,882	131,934

As mentioned earlier, some TAZs span county boundaries, and there are some TAZs that extend slightly outside of the official MPO planning area. Therefore, a query of the TAZ database yields the following summary statistics, shown in **Table 2**, which show slightly higher population and household values than the official MPO planning area.

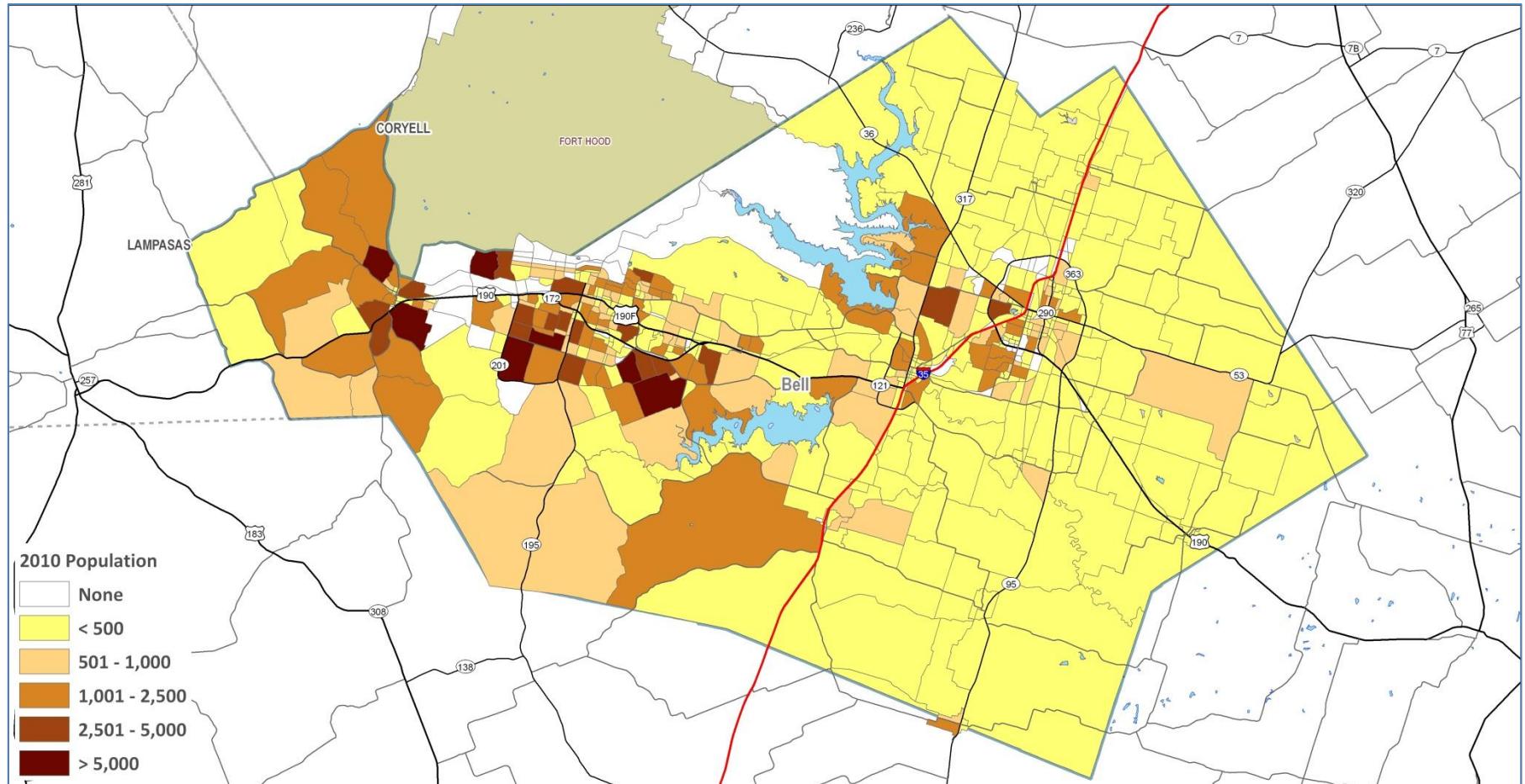
Table 2: 2010 Population and Households (within the KTMPO Modeled Area)

County*	2010 Population	2010 Households
Bell	309,901	113,905
Coryell	50,040	15,845
Lampasas	6,039	2,216
Williamson	1,919	287
Total	367,899	132,253

*: County to which TAZ is assigned (some TAZs span multiple counties)

The distribution of population by TAZ is shown in **Figure 3**.

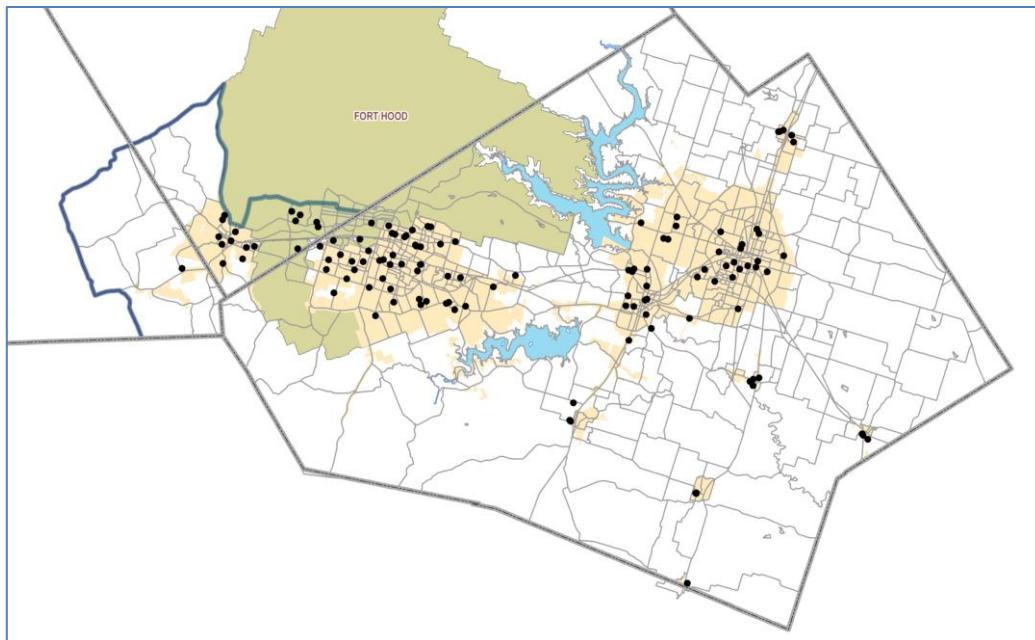
Figure 3: 2010 Population by TAZ



2010 EMPLOYMENT

For employment, a more complicated process was employed. First, education employment data was identified for each zone using data provided by KTMPO staff, and supplemented with additional research by CDM Smith. **Figure 4** below shows the location of all 125 K-12 schools in the KTMPO modeled area.

Figure 4: School Locations



Outside Fort Hood

For basic, retail, and service employment, 2010 Texas Workforce Commission (TWC) data was used, supplemented with additional research by CDM Smith.

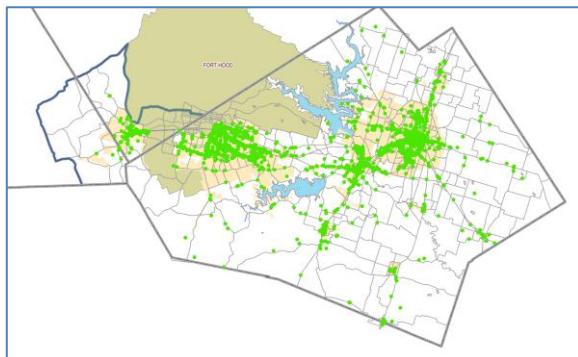
There are several challenges in using the TWC data as originally provided as shown in **Figure 5**. These challenges include:

- Many employment sites are reported as having zero employees
- Many employment sites are incorrectly located
- Many employment sites are missing spatial location information (lat/long is 0/0)
- Many employment sites report “total” employment for multiple work sites at a single “headquarters” site
- Many employment sites are simply not reported

Each zone was meticulously inspected using digital orthophotography and street-level views from Google to clean up the employment data as much as possible. Approximately 5,650 TWC employment sites were cleansed through a process which included:

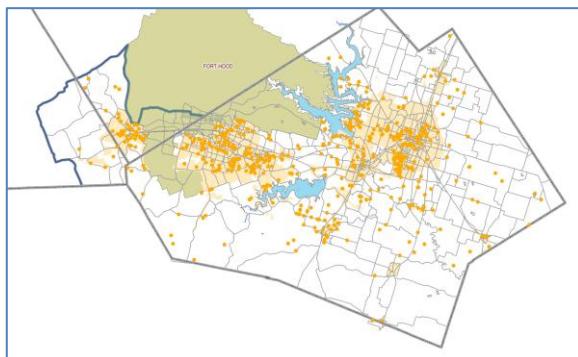
- Estimating the number of employees at sites reporting zero employees
- Moving employment sites to their correct location
- Locating employment sites that were missing spatial location information
- Modifying employment values for “headquarters” employment sites
- Identifying the location and estimating the number of employees at employment sites not reported

Figure 5: 2010 TWC Data Issues



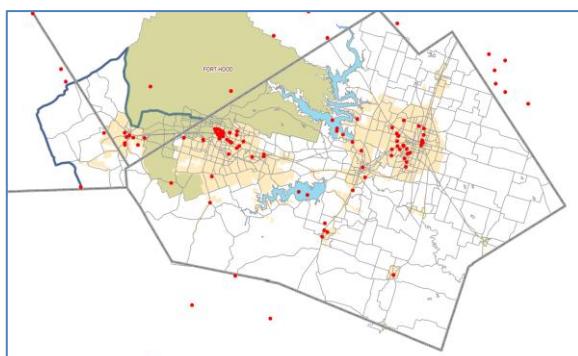
TWC data – Useable/Cleaned

- Corrected spatial location
- Resolved Headquarters issues
- Estimated employment for sites reporting 0 employees
- 3,845 sites



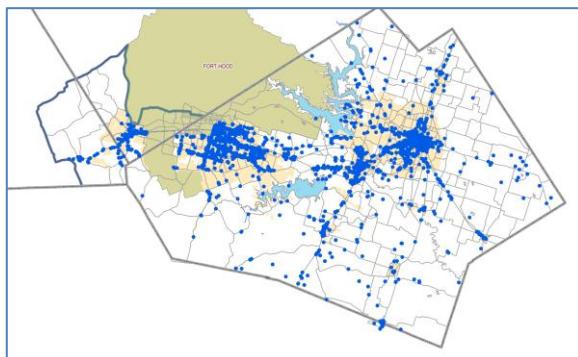
TWC data – Home Businesses

- Corrected spatial location
- Estimated employment for sites reporting 0 employees
- 575 sites



TWC data – Unusable

- Unable to identify location
- Missing location
- Incomplete data



Missing Employment Sites

- Identified location
- Determined employment type
- Estimated employment levels
- 3,126 sites (~25,200 employees)

Fort Hood

Considerations in estimating Fort Hood employment include active duty military employment, active Reserves and temporary duty military, civilian contractors working for the military, traditional civilian employment, and civilian educational employment. Texas Employment Commission data provided partial coverage of civilian employees on base. This data was supplemented by data from the Fort Hood Civilian Personnel Advisory Commission, satellite photos, and site visits. Separate employment data was obtained for Army and Air Force Exchange Service (AAFES), the commissaries, and the Killeen Independent School District. As with population, the total estimates of active duty military on base varied among the sources. The final estimate considered all sources and direct observation, and totals 48,411.

Total civilian employment on base is estimated at 20,856. This is subdivided into categories of basic, retail, service, and educational. As with population, employment data was estimated at the level of the individual building. This technique allowed the use of unit stationing data as control totals, and was supported by satellite photos and direct observation.

Basic employment is estimated at 3,748; retail at 1,236; service at 14,835; and educational at 1,037. AAFES employment of 851 was divided into retail and service components. The employment for both commissaries was given as 159. Education employment included 773 for the nine on-base schools in the Killeen Independent School District and 264 for Central Texas College.

Table 3 summarizes the 2010 employment trend for the MPO region

Table 3: 2010 Employment Totals

Category	Employment Totals				
	Bell	Coryell	Lampasas	Williamson	Total
Basic	23,767	1,640	75	39	25,521
Retail	29,932	3,283	91	96	33,402
Service	53,006	9,501	140	121	62,768
Military	13,091	13,537	0	0	26,628
Education	8,827	2,325	47	0	11,199
Total	128,623	30,286	353	256	159,518

2010 MEDIAN INCOME

Median income data for each TAZ was generated from U.S. Census median income data at the block-group level. Despite there not being a one-to-one match between block groups and TAZs, a spatial join was used to assign the median income from the block-group to the TAZ.

2010 SPECIAL GENERATORS

Building upon work performed by KTMPO staff and using the data from the 1997 model, 28 special generators were identified in the KTMPO model, as shown in **Figure 6**.

Figure 6: Special Generators

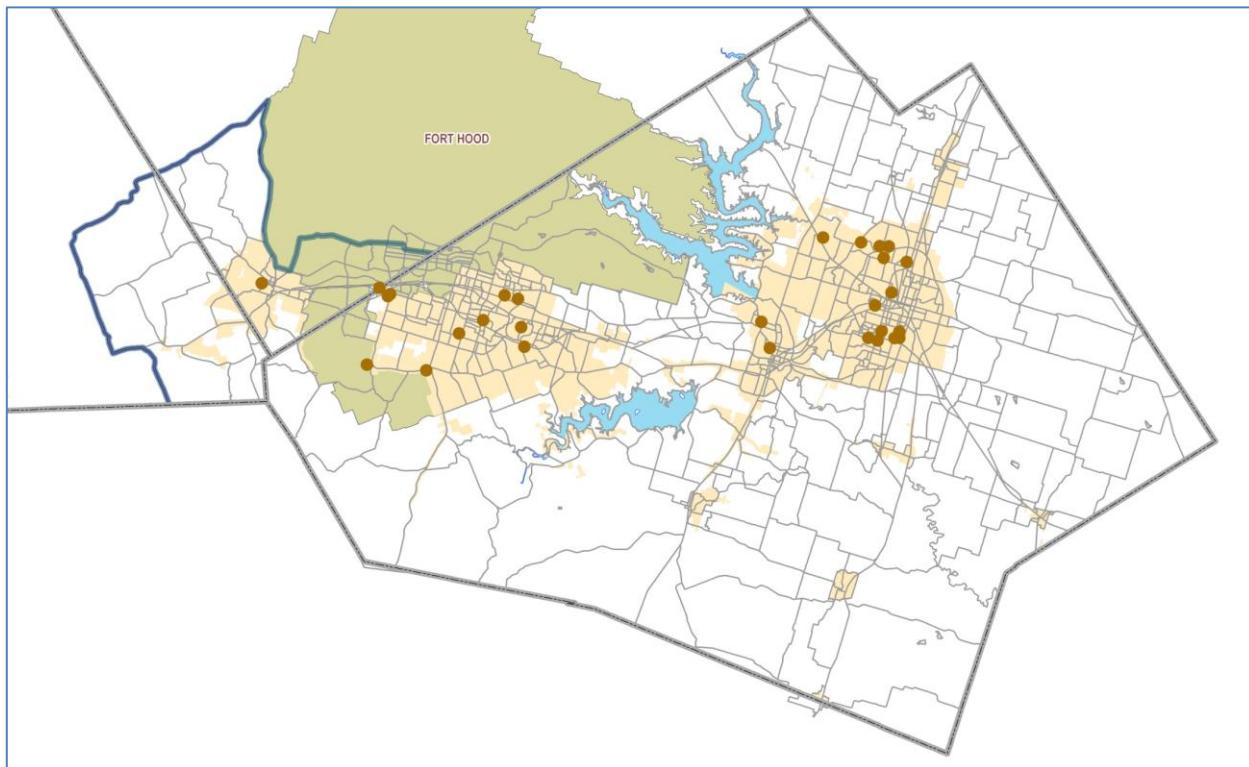


Table 4 shows the list of the special generators. The rows highlighted in yellow indicate special generators that were added to the list of those included in the 1997 model. In addition, Temple College was split into two special generators, because the campus is split by South 1st Street in Temple, which defines the boundary between two TAZs.

Table 4: Special Generators

ID	Name	Type	Units	NumUni10	NumUni40	TotEm10	TotEm40
1	Scott and White et al	Hospital	Beds	636	830	8,640	11,240
2	Veterans Health Care Clinic	Hospital	Beds	297	390	2,437	3,170
3	Wilsonart International (S)	Basic (Manuf)	Emps	393	620	393	510
4	Temple High School	High School	Students	1,938	3,100	247	400
5	McLane Southwest	Basic (Distribution)	Emps	712	930	712	930
6	Tenneco Packaging	Basic (Packaging)	Emps	715	930	715	930
7	Wilsonart International (N)	Basic (Manuf)	Emps	638	830	638	830
8	Walmart Distribution	Basic (Distribution)	Emps	669	870	669	870
9	Kings Daughters Hospital	Hospital	Emps	345	450	345	450
10	McLane Data Systems	Basic/Service	Emps	404	520	404	520
11	Belton HS	High School	Students	2,337	3,500	279	420
12	UMHB	Coll/Univ	Students	3,100	4,650	558	840
13	Temple College West of 1st	Coll/Univ	Students	4,560	5,930	406	530
14	Temple Airport	Airport	Enplanements	39	50	14	20
15	Central Texas College	Coll/Univ	Students	6,250	8,130	1,003	1,300
16	Killeen Mall	Mall	Emps	1,015	1,150	1,015	1,150
17	Metroplex Hospital	Hospital	Beds	245	320	1,081	1,410
18	AEGIS Communications Group	Service	Emps	635	830	635	830
19	Texas A&M Central Texas University	Coll/Univ	Students	2,300	0	201	0
20	Killeen High School	High School	Students	1,927	3,080	246	390
21	Killeen Ellison High School	High School	Students	2,349	3,760	299	480
22	Copperas Cove High School	High School	Students	2,090	3,760	252	450
23	Killeen Munic. Airport - Skylark Field	Airport	Enplanements	0	0	24	40
24	Seton	Hospital	Beds	83	130	0	520
25	Texas A&M New Campus 195/201	Coll/Univ	Students	0	7,500	0	600
26	Killeen Airport	Airport	Enplanements	243,861	390,200	150	240
27	Temple Mall	Mall	Emps	573	700	573	700
28	Temple College East of 1st	Coll/Univ	Students	1,140	1,480	102	130

2010 NETWORK

Two general classes of updates were performed for the KTMPO 2010 network update and included:

- The received from TxDOT was expanded to cover the full extent of the newly-defined 2010 modeling area.
- Develop the 2010 network attributes for all defined links.

The primary basis for each of these tasks was a drive out of the entire network to physically examine the existing attributes of each link. Notes from the drive out were supplemented with current and historic satellite photos, independent street maps and GIS street layers, and TxDOT schematics.

Link attributes were defined for seven standard and optional categories as shown in **Table 5**. Other fields in the network such as area type, capacity, speed, and time are the responsibility of TxDOT and are determined during the validation process; therefore, these fields were not updated in this 2010 network.

Table 5: Network Attributes

Attribute	Type	Description
Street Name	Objective	Primary street name per local usage
Posted Speed	Average	Posted speed on the majority of the link
Functional Class	Subjective	Roadway type per the standard hierarchical classification system
Facility Type	Objective Referenced	Divided, undivided, or with turn bays
Lanes	Objective	Number of through lanes
Turn Penalty	Referenced	Flag on links with assigned turn penalties
Auxiliary Lane	Objective	Flag for auxiliary lane not counted as a through lane

Attributes are described generally as objective or subjective and include:

- Street Name: Normally considered objective, but in some instances a road has multiple official and local names. Generally, the name of the higher functional class designation was used.

- Posted Speed: Network links are basically defined between intersections, and do not necessarily correspond to the boundaries defined for speed limits. Following TxDOT standards, where a link has two or more posted speed limits, the speed limit attribute is the speed that is posted for the majority of the link.
- Functional Class: TxDOT has provided guidelines and examples for designating the functional class of a road, but it remains an objective designation. For the 2010 attributes, the functional class designations from the previous network were retained and used as a guide in designating the new links in the expanded area. This helped to ensure that the functional class designations were consistent and logical throughout the network.
- Facility Type: Facility type is an objective sub classification of functional class. It references functional class then further classifies the link as divided, undivided, or with a continuous turn lane.
- Lanes: The number of lanes is generally objective, but two special instances should be noted. At intersections, only the numbers of through lanes are included (turn lanes are not counted). Also, auxiliary lanes between ramps are not counted; however, they are recorded in the separate AUX_LANES field.
- Turn Penalty: The separate turn penalty file records the link-to-link turn movements which are physically impossible. This file allows these movements to be prohibited in the model as well. This is not part of the network file, so links which have a coded turn penalty are flagged in the TURN_PENALTY field so that they are identified. This helps align any future network edits with the turn penalty file. Auxiliary Lanes: As noted, the LANES field only counts through lanes. Auxiliary lanes between ramps are flagged, but are not added to the number of lanes in the LANES field.

The 2010 network is detail coded for higher functional classed facilities as defined by TxDOT. Generally, only links with frontage roads and ramps are shown as separate road links for each direction.

It should be noted that the 2010 network was developed with a centroid and a centroid connector for each traffic analysis zone (TAZ). Edits to centroid connectors are explicitly excluded from the network development task as they are defined solely by TxDOT modelers. However, temporary centroid connectors were added to all new TAZs in order to enable network checks, verify connectivity, and to establish nodes to allow proper numbering of internal and external TAZ IDs according to the required numbering scheme. No other edits were made to centroid connectors. If any network or TAZ edit resulted in an unusual situation with a centroid connector, such as it becoming disconnected from the network, a notation was made in the COMMENTS field, but the link was not otherwise edited.

The first task, the network extension, was performed in conjunction with the development of the new TAZ boundaries. A meeting was held in April 2010 with the consultant, the MPO, TxDOT, and TTI to discuss extensions of the modeling area for network logical continuity, and to review the match between the network and the new TAZ structure. The TAZ boundaries and network were

extended slightly in Williamson County at SH 95 in the City of Bartlett, which is split by the county line. A second extension in Hill County was necessary to place Elm Creek Road fully within the TAZ system. Thirdly, the Fort Hood area was slightly expanded to accommodate its updated road network. **Figure 7** shows the original and the expanded TAZ system and identifies the newly added links. It also shows new links were added within the original TAZ area during the course of network development.

As also seen in this figure, the system of external stations was redeveloped with the expansion of the TAZ area. For the most part, existing stations were simply moved farther out along the same road to meet the new boundary line. In other instances, new links or the new configuration of existing roads taken in by the expanded area resulted in the definition of completely new external stations or the deletion of existing stations.

The second task was the development of 2010 attributes for all links. Following the standard network development procedure, attributes in the pending network were not overwritten with the new attributes. Instead, new values were placed in the various *xxx_EDIT* fields for street name, FUNCL, FTTYPE, Lanes, and DIR. Additional network fields were inserted to flag links with auxiliary lanes or turn penalties. When edits were made, the EDITS_YEAR field was completed with the year and the OK/EDIT field populated. Where necessary, an explanation of the edits was placed in the COMMENTS field. Existing links with edits for 2010 are shown in **Figure 8**.

Figure 7: New Links in the 2010 Expanded TAZ Area

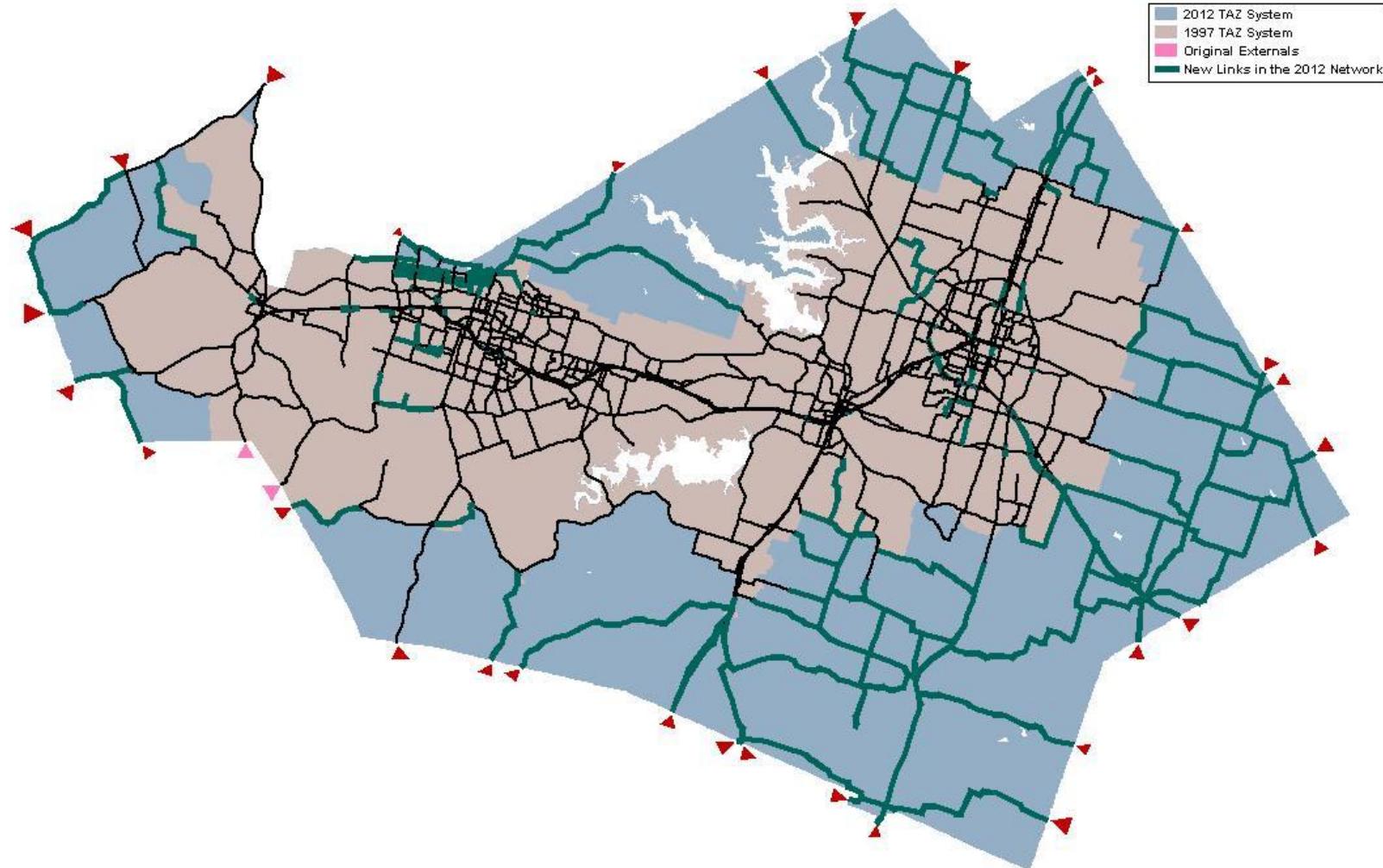
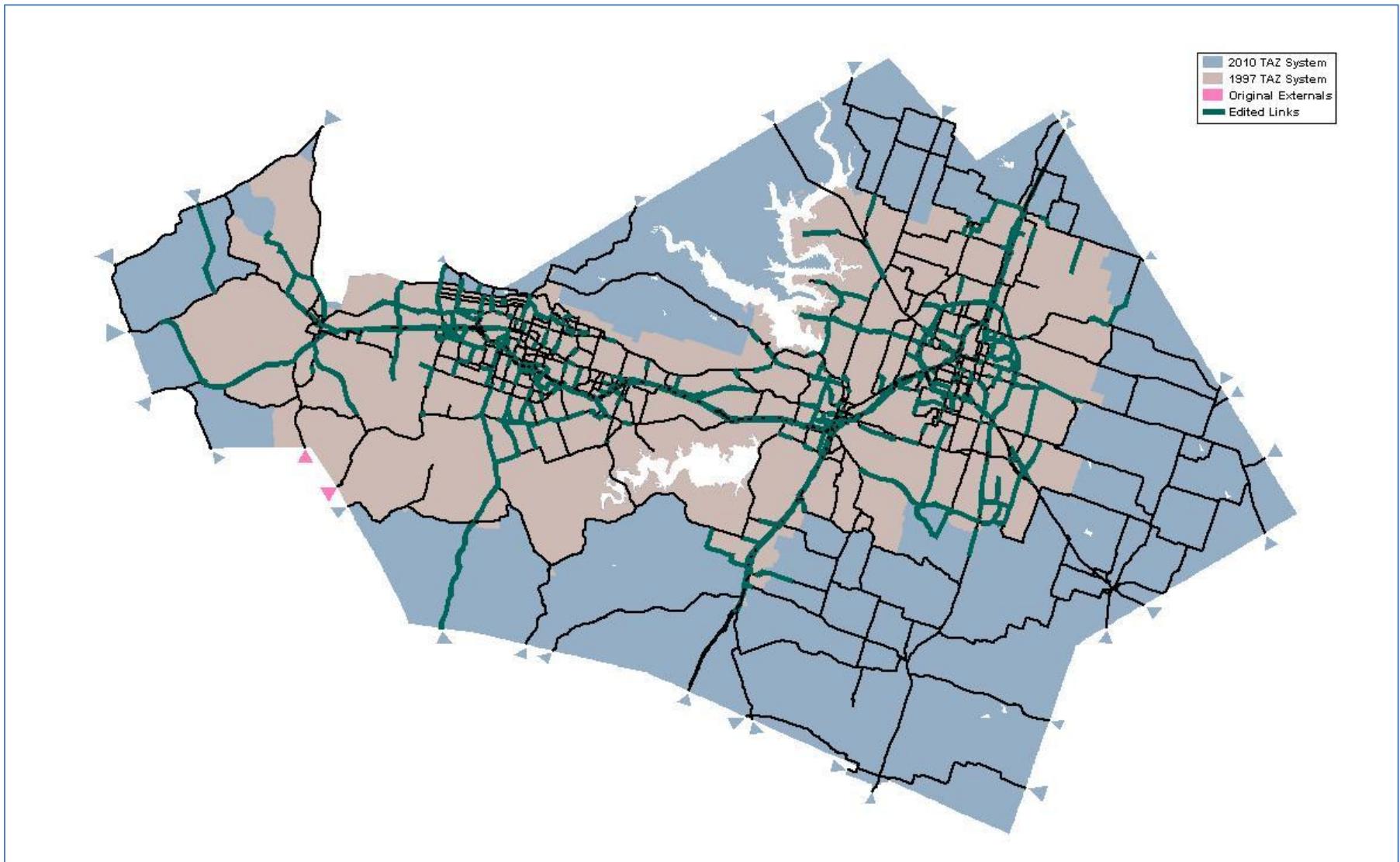


Figure 8: Edited Existing Links for 2010



Edits to existing links for 2010 fall into several categories:

- Many links had no posted speed limit;
- Some links in the 2010 pending network had no attributes ;
- A section of IH 35 frontage road was coded as one-way in the 2010 pending network, but was revealed by the network analysis to be two-way;
- Several ramps were reversed; and
- A few links in the 2010 pending network were mis-aligned or followed the wrong road. In one instance the link followed a concrete drainage ditch rather than the actual road.

Links were edited according to protocol, and a note was placed in the MPO_EDIT_DESCRIPTION field when necessary to explain the edit.

The resultant functional classes for 2010 are shown in **Figure 9**. At this scale, the frontage roads and ramps for IH 35 and US 190 are not visible.

Figure 10 shows the total number of lanes per facility for the 2010 network. The number of lanes for one-way links were added together to show the total for both directions to make this figure more succinct.

Figure 9: 2010 Functional Class

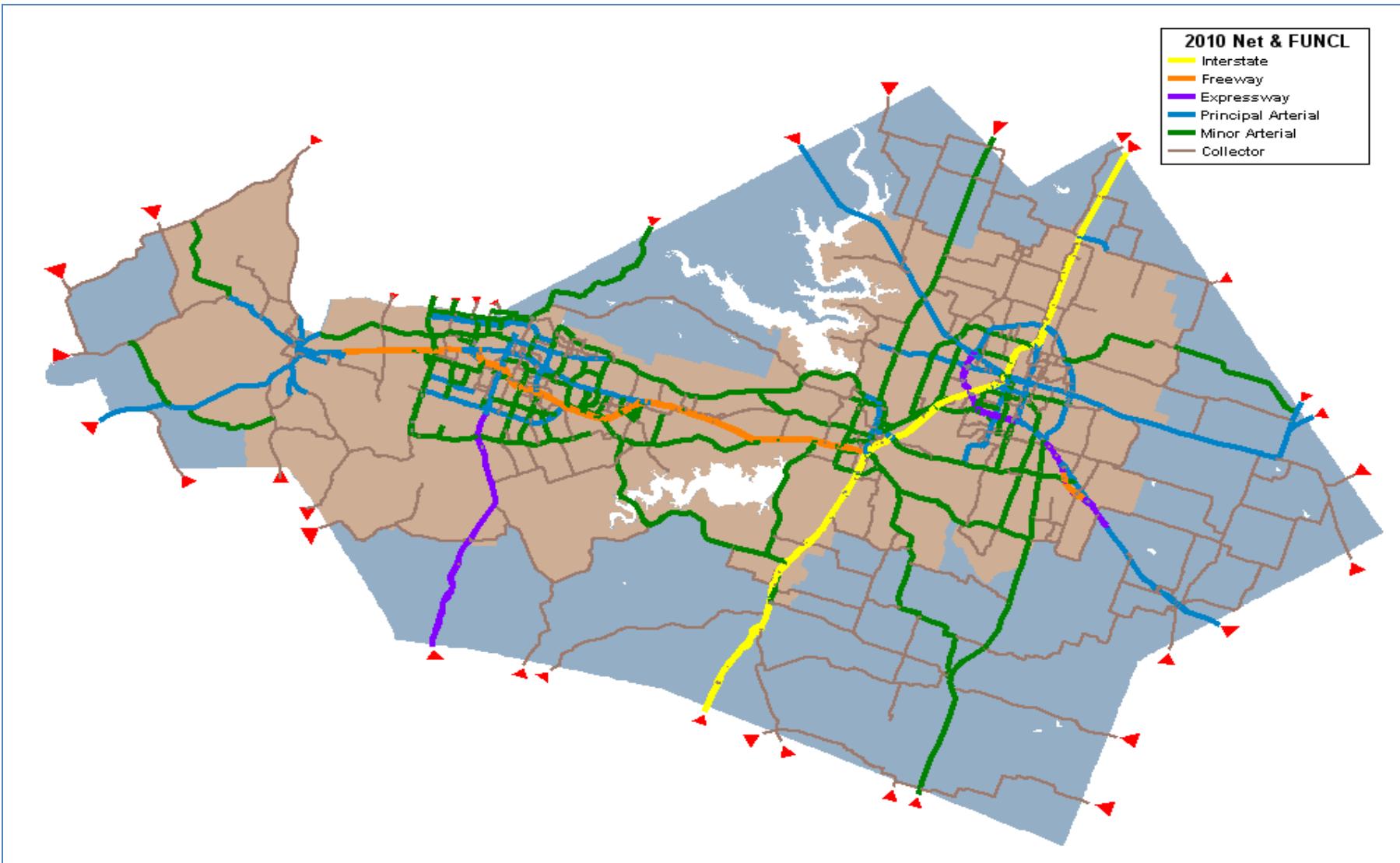
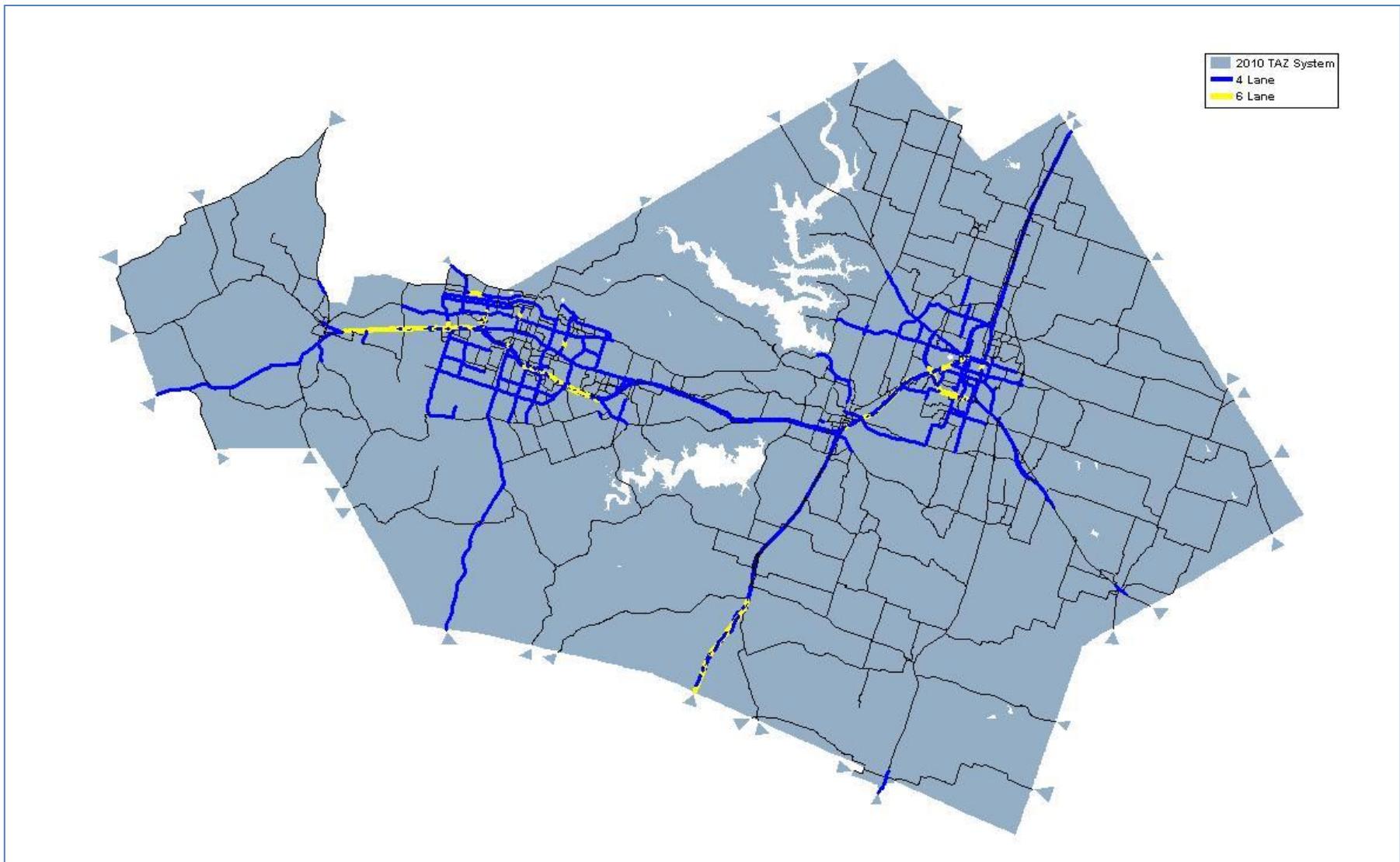


Figure 10: 2010 Total Number of Lanes



FUTURE YEAR CONTROL TOTALS

The initial step in developing demographic data for the study area was to establish future demographic “control totals”. The KTMPO has long asserted that its regional future year population projections should, to the extent practical and feasible, be based upon documented growth projections from its MPO-member jurisdictions. Accordingly, the CDM Smith team reviewed the following data sources, and met with local planners to discuss, among other things, local population projections:

- City of Belton: Comprehensive Plan Update, August 2006
- City of Copperas Cove: 2007 Comprehensive Plan Update, May 2007
- Fort Hood: Long Range Component, Real Property Master Plan, July 2010
- City of Harker Heights: Comprehensive Plan, January 2007
- City of Killeen: Comprehensive Plan, November 2010
- City of Temple: Comprehensive Plan 2008-2030, May 2008
- Coryell County: Commissioners Court Resolution, May 2012

Population

Based upon the documented growth rates described previously, the CDM Smith team developed the 2040 regional population projections shown in **Table 6** on the following page, thereby establishing the 2040 control total population for the KTMPO planning area at 575,200. **Table 7** summarizes the population and households in the KTMPO Modeled area which includes small area in Williamson County.

Table 6: Population Projections (KTMPO Planning Area)

	Population		Absolute Growth	Annual Growth rate
	2010 Census	2040 Projection		
Bell County				
Belton	18,216	36,000	17,784	2.3%
Fort Hood (Partial)	15,233	20,900	5,667	*
Harker Heights	26,700	40,500	13,800	1.4%
Killeen	127,921	200,000	72,079	1.5%
Temple	66,102	105,000	38,898	1.6%
Other Cities	17,191	24,600	7,409	1.2%
Unincorporated Areas	38,872	55,600	16,728	1.2%
Subtotal	310,235	482,600	172,365	1.5%
Coryell County				
Copperas Cove (Partial)	31,460	57,000	25,540	2.0%
Fort Hood (Partial)	14,356	21,500	7,144	*
Unincorporated Areas	3,213	4,600	1,387	1.2%
Subtotal	49,029	83,100	34,071	1.8%
Lampasas County				
Copperas Cove (Partial)	572	800	228	2.0%
Other Cities	1,089	1,600	511	1.2%
Unincorporated Areas	4,957	7,100	2,143	1.2%
Subtotal	6,618	9,500	2,882	1.2%
KTMPO Planning Area Total	365,882	575,200	209,318	1.5%

*: Fort Hood population is expected to remain at 2012 levels.

Table 7: 2040 Population and Households (within the KTMPO Modeled Area)

County*	2040 Population	2040 Households
Bell	481,723	175,828
Coryell	83,977	25,613
Lampasas	9,500	3,509
Williamson**	1,919	287
Total	577,119	205,237

*: County to which TAZ is assigned (some TAZs span multiple counties)

**: The population and households of the small area in Williamson County was assumed to remain constant between 2010 and 2040.

Employment

Employment was split into basic, retail, service, and education sectors. Based on the 2010 base data, total employment to individual employment sector ratio was calculated for each county and the future years were projected to carry forward the same ratio. **Table 7** summarizes the 2040 employment control totals by County.

Table 7: Employment Control Total

County*	Employment		Absolute Growth	Annual Growth rate
	2010	2040 Projection		
Bell	128,623	203,142	74,519	1.54%
Coryell	30,286	44,869	14,583	1.32%
Lampasas	353	525	172	1.33%
Williamson**	256	464	208	2.00%
KTMPO Model Total	159,518	249,000	89,482	1.50%

*: County to which TAZ is assigned (some TAZs span multiple counties)

**: The employment in Williamson County was assumed to grow at 2.0% per year

LOCAL MEETINGS

The consultant team met with the local representatives, shown in **Table 8**, to collect and understand information on local growth issues and trends. The following information was collected and discussed through these meetings.

- Building permits data for recent developments
- Details about final and preliminary plans submitted
- Anticipated growth areas in their jurisdiction by type of growth
- Local long-range plans (e.g., master plans, comprehensive plans)
- Recent development trends

Table 8: One on One Meeting Schedule

Date	Agency	Name	Title
Tuesday, June 05, 2012	City of Killeen	Colleen Russell	Planning Director
		George Lueck	Director of Transportation
	City of Belton	Erin Newcomer	Planning Director
		David Blackburn	City Manager
		Kim Foutz	Assistant City Manager
	City of Temple	Michael Newman	City Engineer
Wednesday, June 06, 2012	Coryell County	Judge Firth	County Judge
	Bell County	Tim Brown	County Judge
Wednesday, June 13, 2012	Fort Hood	John Burrow	Chief of Real Property Planning Division
	City of Copperas Cove	Andrea Gardner	City Manager
	City of Harker Heights	Fred Morris	Planning & Zoning Director
Wednesday, June 20, 2012	Lampasas County	Robert Vincent	County Commissioner
	City of Nolanville	Stephen Pearl	City Manager

FUTURE GROWTH DISTRIBUTION

The population, employment, household size, and median income from year 2010 were considered as the base upon which to project the future demographics for year 2040. As control totals were established for larger cities in the region like Killeen, Temple, Belton, Harker Heights, Copperas Cove and Fort Hood, the regions are separated geographically for the future growth distribution. The Future development is then was projected and distributed using a three step process.

- Identifying Known Growth between 2010 to 2012
- Identifying Growth from Planned Developments
- Distributing Anticipated Growth

Known and Planned Growth

Since 2010 is considered as the base year, it was necessary to identify all developments that were constructed after the base year. Using building permit data new construction from 2010 to 2012 were identified and included in the future year demographic projections for the City of Killeen and Temple. For the rest of region, newly constructed buildings after 2010 were identified as residential or employment centers from the orthophotography. For employment, the identified rooftops were categorized as extra small, small, medium and large centers based on the usage and building footprint. The rooftops identified as small centers were assumed 25 employees and large centers to have 50 employees. The number of employment was then distributed to each TAZ based on the number of new employment centers that TAZ has. The list of approved / proposed plats was also received from different jurisdictions and located in ArcGIS. This new construction and preliminary/final site development plans were used to develop population, household, and employment estimates by TAZ for the future year. **Table 9** summarizes the growth estimated from existing and planned developments.

Table 9: Existing and Planned Developments

County	Population	Employment
Bell County	38,287	14,191
Coryell County	26,209	612
Lampasas County	3,461	115
Total	67,957	14,918

The population and employment control total for year 2040 was attained through the distribution of these new and planned developments for City of Belton, Coryell County and Lampasas County. The **Figures 11** and **12** illustrate the results from the one-on-one meetings and platted developments.

Figure 10: Growth Areas from One-on-One Meetings

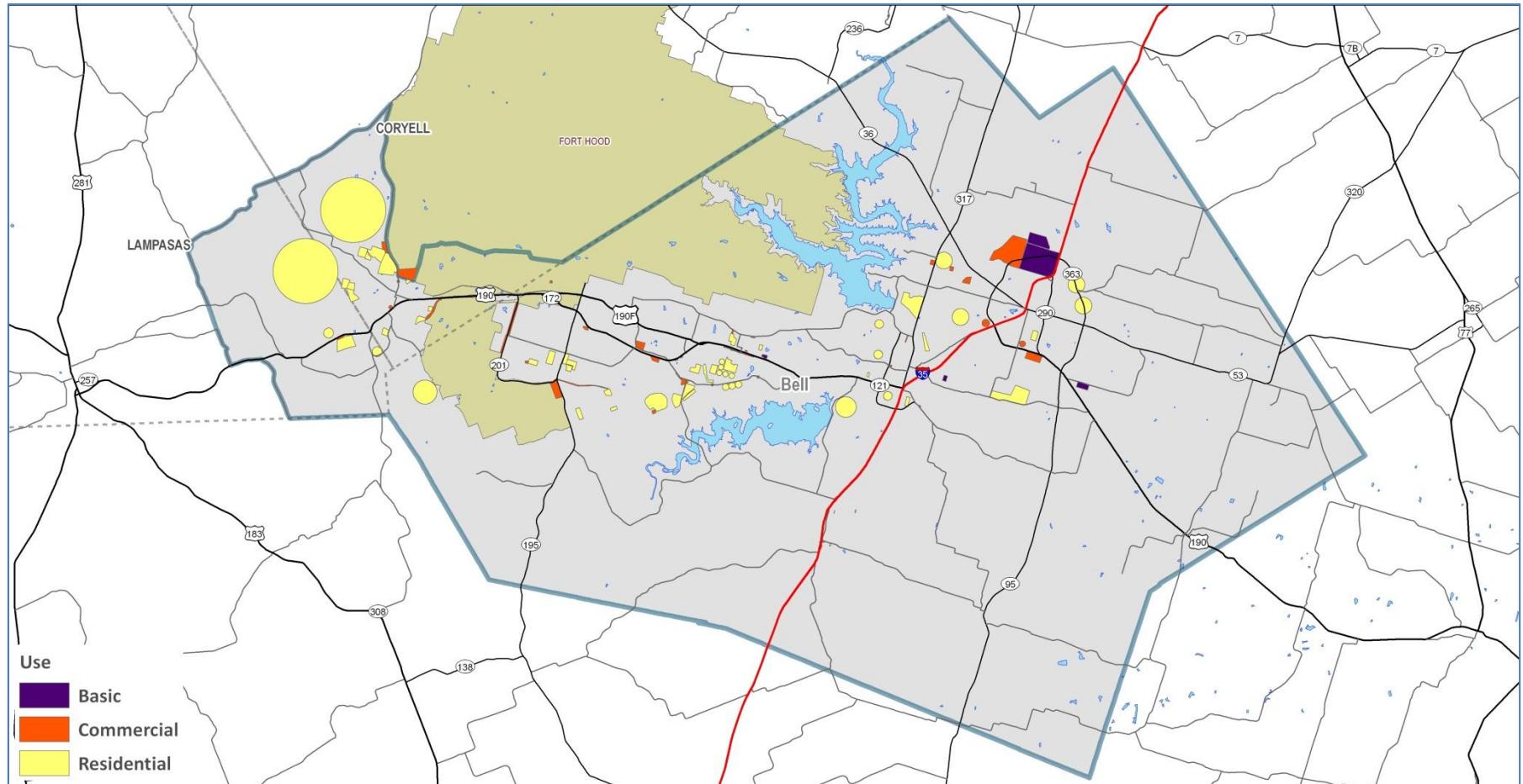
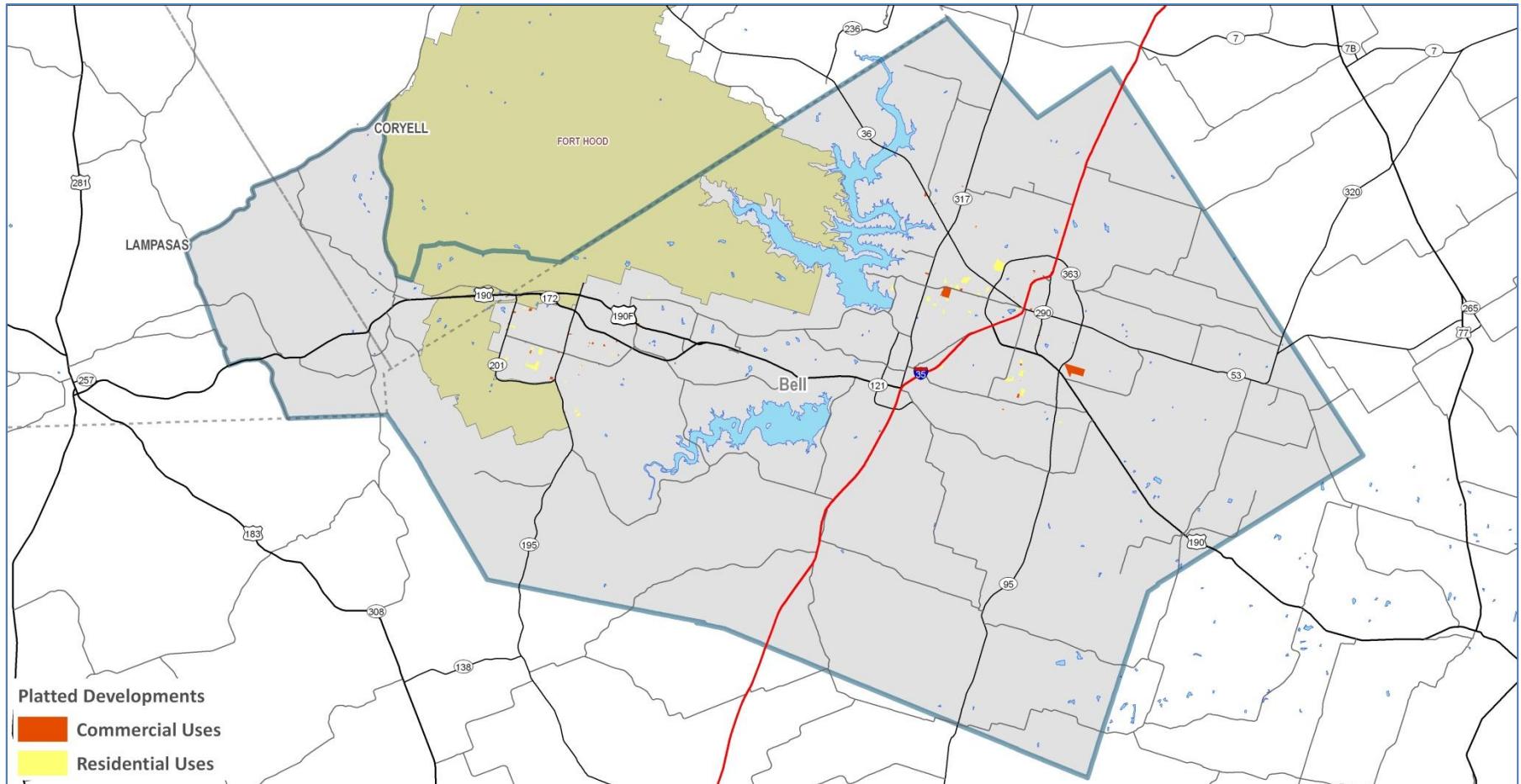


Figure 11: Planned Developments



Fort Hood

Fort Hood sources have consistently stated that they expect the base population to remain stable through the year 2040. The Base Realignment and Closure (BRAC) reports show some shifting of individual units, but overall troop strength remains unchanged in all available plans. As a result, the military and on-base population control totals remain unchanged for Fort Hood for the year 2040. There is no net difference in on-base population or households for the year 2040. However, the population has shifted within the base with the redevelopment of several areas. These areas include:

- A new 139-room Candlewood Suites Hotel will be built close to the corner of 761st Tank Battalion Ave and 37th Street. This is part of a generalized upgrade of transient and temporary duty lodging on base, which also includes the renovation of Keith Ware Hall, Poxon House, and the 5700 Block lodging. With the completion of the new hotel, it was assumed that the individual temporary structures grouped south of Battalion Ave which are currently being used for transient housing will be removed.
- Family housing in the Pershing Park and Venable Village areas, south of US 190, have been identified for removal to the current warehouse area north of US 190. The associated employment in this area has also been moved.
- Older family housing north of US 190 in the Chaffee Village, McNair Village, and Wainwright Heights areas will be renovated, but the facilities will remain in the same area. No additional expansion of the Comanche I, II, and III family housing area was identified.

There is a net zero change in military employment on base for the year 2040. However, the construction of several new Battalion and Company headquarters and operations areas, the continued development of the 69th Air Defense Artillery unit area, and the displacement of the Garrison warehousing area for relocated family housing, have all contributed to a shift of military employment throughout the base.

The most significant project for military and civilian employment is the expansion of the Darnall Army Medical Center. While, as referenced before, the new military employment for the facility is balanced by drawdowns elsewhere on base to result in a net zero change, civilian employment is expected to increase significantly. The net differences in civilian employment for 2040 include a drop in basic employment of 314 and an additional 75 retail and 2,993 service employees. The expansion of the Clear Creek PX and the new Darnall Army Medical Center account for the majority of the increased civilian employment.

It was assumed that Venable Village Elementary School would be moved to a new location north of US 190 along with all the family housing from Venable Village and Pershing Park. No other differences in educational employment were forecast for 2040.

Anticipated Growth

After distributing known development, the proposed, planned, and platted developments, the amount of population, and employment that is required to reach the previously established control totals was estimated for year 2040. To allocate where this anticipated growth will occur, a suitability analysis was performed separately for cities of Killeen, Temple, Harker Heights, and the rest of Bell County that assigns a composite “attraction” factor for each TAZ.

Attraction Factors

There are many factors that influence and drive the growth or expansion of urban areas. These can be categorized into physical, socio-economic and environmental factors. The allocation and assignment of the long term, future population and employment growth requires that assumptions be made on how and where that growth will occur. Each aspect of land has intrinsic characteristics that are in some degree either suitable or not suitable for development. Suitability analysis is a technique used to categorize locations according to a set of criteria that define an area’s suitability for development. For this analysis, in the KTMPO region a linear relationship was assumed between the development of land and its driving factors. Any change in these development factors will impact future development. The factors assumed to drive future developments are:

- Availability of Developable Land
- Accessibility (Proximity to Major Roads)
- Infrastructure (City Limits)
- Future Development Plans
- Anticipated Growth Areas

The probability of the occurrence of development is calculated based on these independent factors.

Availability of Developable Land

The first step in the process was to identify the portion of land that could be developed in each TAZ. Using aerial orthophotography and existing population and employment, vacant land in the each TAZ was identified. Next, the land which is not developable due to environmental constraints, such as river beds, water bodies, 100-year flood plains, detention ponds, pipe lines, and wetlands, was removed from the vacant land area.

Proximity to Major Roads

The distance from the boundary of the TAZ to the closest major road was measured in feet. All TxDOT in-system roads in the KTMPO region were considered “major” for this analysis. The distance from each TAZ was then normalized from 0 to 1. Normalization is a process used to transform data of different scales to a common scale for relative comparison purposes. For this project purposes the distance is transferred to a scale of 0 to 1. To transfer the distance to a comparable scale, the distance from each TAZ is divided by distance of the farthest TAZ from major road and then subtracted from 1. TAZs which have a major road located within them were

given a value of 1, and the TAZ which is farthest from any major Road is given a value of 0. The nearer the TAZ is to a major road, the greater the probability of development in that TAZ.

City Limits

It was assumed that the land within the city limits is expected to develop sooner than the land outside the city limits, due to existing infrastructure like water and sewer connections. The TAZ within the city limits are measured in a categorical measure in a binary scale (0 or 1). If the TAZ is partly or entirely within any City limits it was given a value of 1 and 0 for TAZ which are completely out of city limits.

Future Development Plans

Any TAZs with already planned development was assumed to have higher probability of attracting new development than in areas without any such plans. These future development plans in the TAZ were also measured in a binary scale (0 or 1). The TAZs with planned developments were selected and given a value of 1, while the rest of TAZs were given a value of 0.

Anticipated Growth Areas

During the one on one meeting with the local representatives, the likely growth areas by landuse in their jurisdiction were discussed. The TAZs which are marked as likely growth areas are given a value of 1 towards the attraction factor, while the rest of TAZs were given a value of 0.

Population Distribution

For each TAZ, a population attraction factor was calculated for different years to distribute the anticipated future growth. This overall factor was simply the arithmetic sum of the individual seven factors described above.

The attraction factor was then converted to a continuous scale of 0 to 1. The TAZ with a value 1 has the highest probability of attracting development, while the TAZ with value 0 has the least probability of attracting development. This attraction factor, in combination with the availability of developable land, was used as a basis to distribute the anticipated regional population growth for year 2040.

For each TAZ, the amount of new growth that the zone could accommodate was calculated based upon the availability of developable land. This calculation, in essence, attempted to quantify each TAZ's "carrying capacity" for new development. These ratios were then multiplied by the attraction factors to calculate the estimated amount of new long term growth in population. The zones which were identified to have developable land were assigned population. Lastly, because the results of this methodology did not quite exactly match the remaining population that needed to be allocated for year 2040, a final adjustment was made. To accomplish this, the ratio of population that can be attracted to a given zone to the population that can be attracted to all the zones was determined. The future population from the control total was then assigned to each of the zones based on the above calculated ratio.

Special Generators

In most cases, employment at each special generator site was expected to grow at a rate equivalent to the rate of population growth of the city in which the special generator is located.

Employment Distribution

Employment was split into basic, retail, service, and education sectors. Based on the 2010 base data, total employment to individual employment sector ratio was calculated for each county and the future years were projected to carry forward the same ratio.

Basic, Retail and Service Employment

Basic, retail and service employment sectors were assumed to grow in and around the existing employment areas. It was assumed that if a zone has basic employment, that zone was expected to grow more basic employment. So the remaining number of basic, retail, and service employment was then distributed to each TAZ based on the number of basic, retail, and service employment by sector that TAZ had in year 2010.

Education Employment

Like special generators, education employment at each school was expected to grow at a rate equivalent to the rate of population growth of the city in which the special generator is located. In instances where the location of proposed schools was known, the educational employment of the TAZ was increased by the estimated employment level supported at that school.

FINAL FUTURE GROWTH

The final step was to calculate the total growth each TAZ would experience by year 2040. The growth from planned developments and long term were added together to calculate the future growth. The **Figures 13 through 16** illustrate the future population and employment growth respectively.

Figure 13: 2010 - 2040 Population Growth

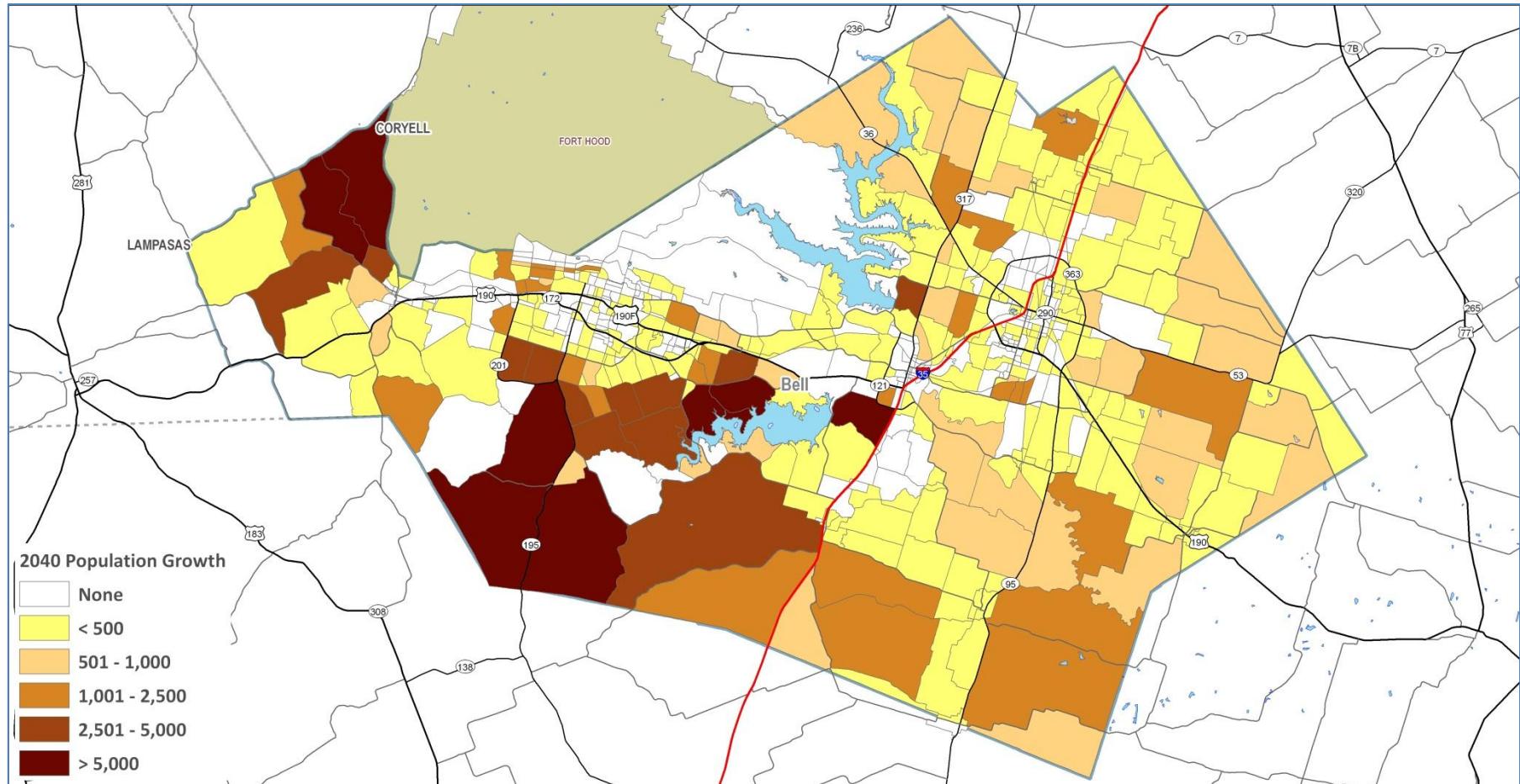


Figure 14: 2010 – 2040 Employment Growth

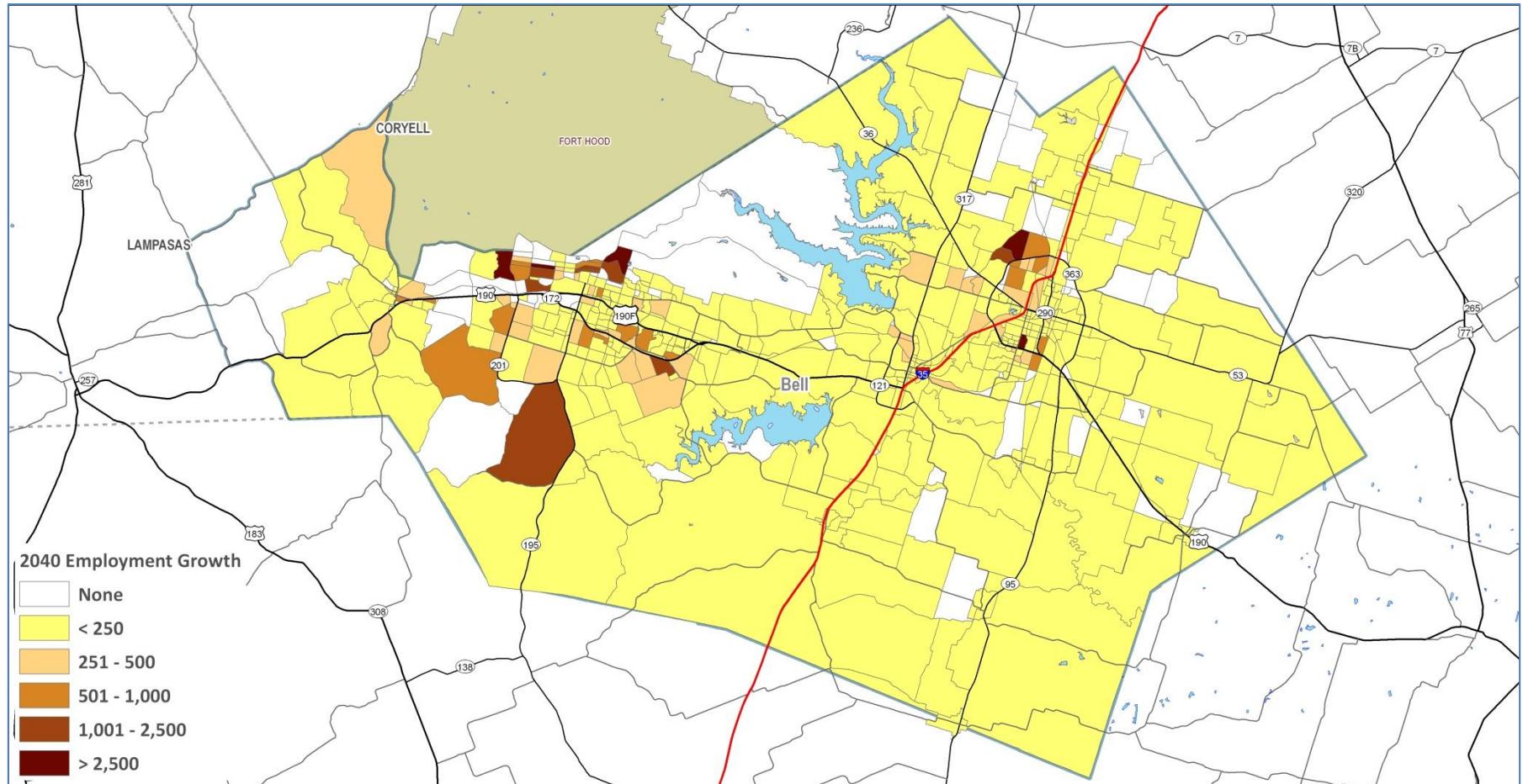


Figure 15: 2010 - 2040 Population Distribution

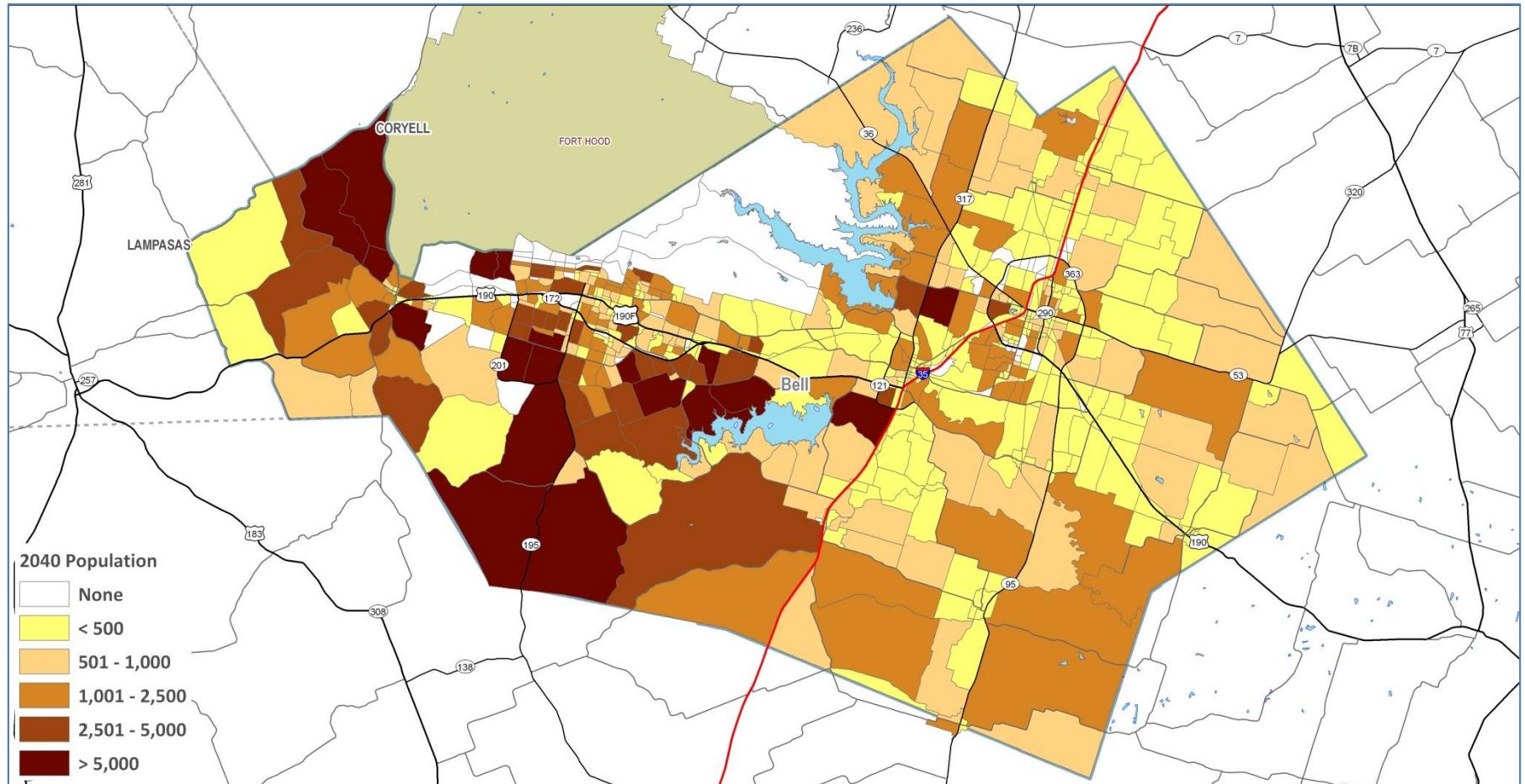
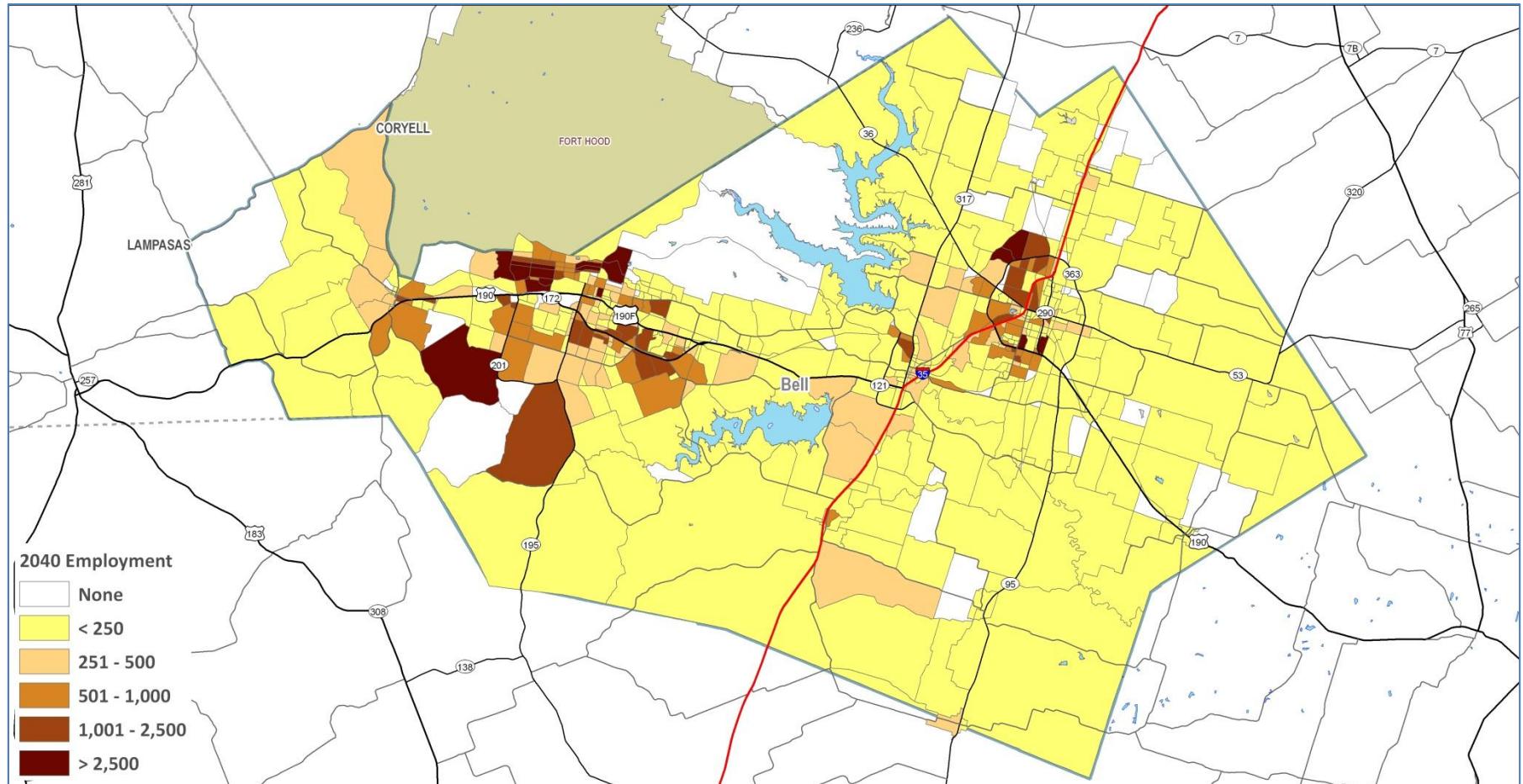


Figure 16: 2010 – 2040 Employment Distribution



2040 NETWORK

The 2040 network is built by adding projects to the final 2010 network. For 2040, there are 14 projects for various improvements to existing roads, and six projects for construction of new roads. The improvements to existing roads are listed in **Table 10**.

Table 10: Improvements to Existing Roads by 2040

Project ID	Road	Limits	Description
	IH 35	FM 2843 to FM 2484	Widen to 6 lanes
H15-01	FM 3423	BU 190 to US 190	Widen to 4 lanes w/ CTL
H15-02	FM 2410	FM 3470 to US 190	Widen to 4 lanes w/ CTL
K15-03	SH 201	Airport to SH 195	Widen to 4 lane divided, w/ overpass at SH 195
T15-06	IH 35	LP 363 N to LP 363 S	Widen to 8 lanes
T15-06	IH 35	SL 363 S to Midway	Ramp reversals and aux lanes
T15-06	IH 35	Bell/Falls C/L to SL 363	Widen to 6 lanes
T15-06m	IH 35	Loop 363 S to Midway	4 ramp reversals, 2 ramp deletions, and aux lane
T25-11	SH 317	FM 2305 to FM 439	Widen to 4 lanes w/ raised median
W25-02	SH 36	Bell/Coryell C/L to SH 317	Widen to 4-lane divided
W30-21	SL 363	IH 35 to Hopi Trail	Widen to 4 lanes divided, SH 36 & Wendland overpass
W30-23	SL 363	At Spur 290	Reconstruct Interchange
W30-27	US 190	Spur 172 to FM 2410	Widen to 6 lanes w/ FR turnarounds at FM 2410
X25-02	FM 2657	US 190 to CR 4744	Widen roadway

Different font in table - is a map going to be in this report that shows the these projects?

Significant improvement projects include widening IH 35 to six or eight lanes, the extension of the expressway section of Loop 363 to meet IH 35, and widening SH 201 to four lanes.

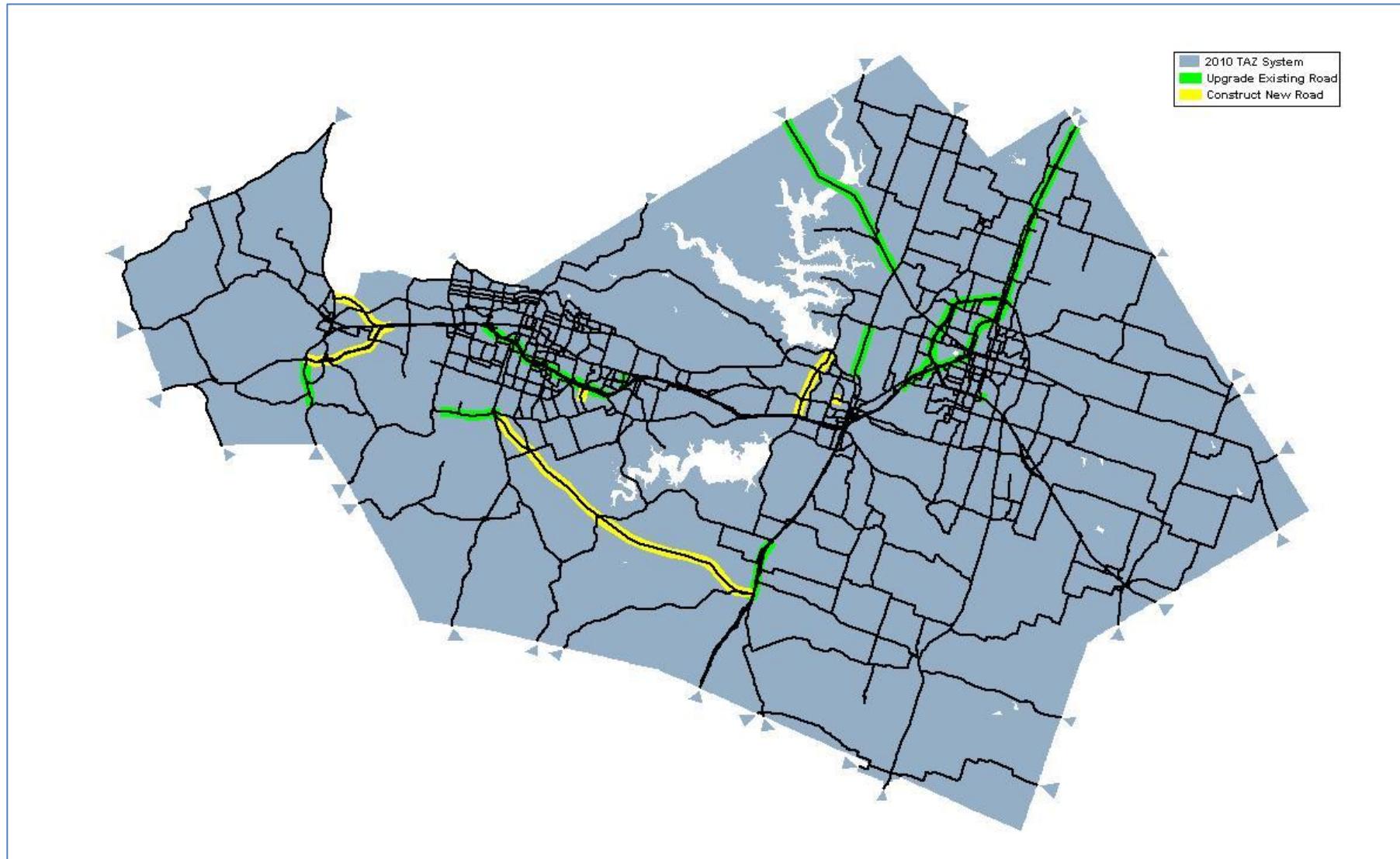
New construction projects are shown in **Table 11**. Significant projects include the US 190 Copperas Cove bypass, the extension of SH 201 to IH 35, and SH 9 north of Copperas Cove.

Table 11: New Construction Roads by 2040

Project ID	Road	Limits	Description
	SH 201	SH 195 to IH35	Construct new 4-lane divided roadway
B15-01	W 9th Ave	SL 121 to University Dr	Construct new roadway
B15-02	FM 2271	FM 439 to US 190	Construct 2-lane roadway
C15-01&	US 190	W of FM 2657 to W of Clarke Rd	Construct 4-lane divided roadway
K30-01	CS	FM 2410 to existing Rosewood	Construct 2-lane roadway w/ overpass at US 190
W35-13	SH 9	US 190 to FM 116	Construct 2 lane roadway

Figure 17 shows the 2040 network projects, with projects for existing and for new roads shown in different colors. It should be noted that the 2040 network has been prepared for reference and to establish their routing. The actual procedure for submitting the forecast year network to TxDOT is to add the projects to the final 2006 network after review, approval, and any changes made to the network during the base year validation process. This final 2006 network is not available at this time, so the 2040 network delivered at this time can be considered only as a draft deliverable. Once the final 2006 network is available from TxDOT, the projects from the draft 2040 network can be added to create the final 2040 network.

Figure 17: 2040 Network Projects



APPENDIX A

Table A-1: Splitting of Blocks by TAZ

BlockID	Pop.	Occ. HU	VacHU	TotHU	TAZ	Rooftops	Pct. Of TAZ	Pop	OccHU
480270234031071	124	41	4	45	443	4	0.111111	14	5
					446	32	0.888889	110	36
						36		124	41
480270212021005	414	182	34	216	304	200	0.925926	383	169
					319	16	0.074074	31	13
						216		414	182
480270202022064	13	6	1	7	268	1	0.5	7	3
					269	1	0.5	6	3
						2		13	6
480270232042022	28	6	0	6	697	16	0.592593	17	4
					698	11	0.407407	11	2
						27		28	6
480270218002007	184	69	1	70	135	20	0.285714	53	20
					137	50	0.714286	131	49
						70		184	69
480270216011001	226	75	7	82	242	42	0.525	119	39
					471	38	0.475	107	36
						80		226	75
480270208001010	137	48	5	53	335	29	0.568627	78	27

					336	22	0.431373	59	21
						51		137	48
480270220001073	133	59	2	61	189	20	0.357143	48	21
					190	36	0.642857	85	38
						56		133	59
480270202021110	742	274	22	296	472	34	0.128788	96	35
					489	230	0.871212	646	239
						264		742	274
480270214001055	242	83	3	86	419	2	0.022727	6	2
					518	64	0.727273	175	60
					521	22	0.25	61	21
						88		242	83
480270213012006	305	124	3	127	239	59	0.464567	142	58
					531	68	0.535433	163	66
						127		305	124
480270202021071	421	161	27	188	311	104	0.611765	258	98
					488	66	0.388235	163	63
						170		421	161
480270202023061	95	43	6	49	312	19	0.5	48	22
					708	19	0.5	47	21
						38		95	43
480270231051003	631	238	15	253	45	157	0.928994	586	221

					94	12	0.071006	45	17
					169			631	238
480270215003033	64	25	5	30	433	21	0.913043	58	23
					435	2	0.086957	6	2
					23			64	25
480270201002004	13	6	0	6	498	4	0.4	5	2
					499	6	0.6	8	4
					10			13	6
480270202012049	108	37	5	42	267	29	0.707317	76	26
					268	12	0.292683	32	11
					41			108	37
480270202021088	240	111	16	127	472	40	0.506329	122	56
					488	39	0.493671	118	55
					79			240	111
480270214001053	47	17	1	18	516	8	0.444444	21	8
					517	10	0.555556	26	9
					18			47	17
480270214002030	169	67	1	68	421	36	0.679245	114	45
					423	14	0.264151	45	18
					608	3	0.056604	10	4
					53			169	67
480270214001004	57	19	1	20	130	2	0.105263	6	2

					425	17	0.894737	51	17
					19			57	19
480270201001062	20	6	0	6	474	3	0.75	15	5
					731	1	0.25	5	1
					4			20	6
480270202022050	390	144	22	166	269	51	0.443478	173	64
					310	64	0.556522	217	80
					115			390	144
480270214002027	207	78	3	81	422	69	0.932432	193	73
					609	5	0.067568	14	5
					74			207	78
480270216015021	105	41	2	43	215	36	0.9	95	37
					216	4	0.1	10	4
					40			105	41
480270231061005	314	111	7	118	48	17	0.184783	58	21
					677	75	0.815217	256	90
					92			314	111
480270234034000	84	33	1	34	200	23	0.741935	62	24
					656	8	0.258065	22	9
					31			84	33
480270234042077	99	40	1	41	450	32	0.941176	93	38
					455	2	0.058824	6	2

							34			99	40
480990107013017	173	70	1	71	4	8	0.112676	19	8		
					12	63	0.887324	154	62		
						71			173	70	
482819503012003	144	52	8	60	59	30	0.714286	103	37		
					507	12	0.285714	41	15		
						42			144	52	