6

MOBILITY AND ALTERNATIVES ANALYSIS

6.0 Mobility and Alternatives Analysis

Travel demand analysis provides a framework for the identification of transportation facilities and services that will be needed to serve existing and future travel demand. Network-based analysis is used to identify locations where future demand for transportation services is expected to approach or exceed the capacity of the existing transportation networks. This information provides a basis for developing alternative improvement projects and project sets that can be simulated and tested with respect to effectiveness in meeting regional goals including congestion reduction, regional vehicle miles of travel reduction and regional vehicle hours of travel reduction. Project-specific metrics can also be used to support prioritization of future improvements.

6.1 Forecasting Methodologies

Demand for transportation is forecasted in one of two ways. The first is to examine past growth in traffic volumes along individual corridors and apply similar "growth factors" to traffic along the corridor. The second way is to build and utilize a network demand model. Demand models estimate the additional travel demand based on the amount and location of future growth in residential population and employment for each area within the region using the capability of a network shortest path algorithm. Travel demand forecasting can be used to estimate traffic on complex networks such as all Colorado or within the PACOG region.

While a Colorado statewide traffic model is under development, it is not yet in place. Until that time, the Colorado Department of Transportation (CDOT) will continue to use a "growth factor" methodology to calculate future traffic volumes along the state highways. Each of the Metropolitan Planning Organizations (MPOs) in the state, however, uses a travel demand model which provides the most reliable forecasts for planning and project-level analysis. CDOT's 2010 observed traffic data (AADT) is used to validate PACOG's travel model. CDOT's growth factor-based forecasts, along with a variety of other metrics, are used to test the reasonableness of PACOG's model-based forecasts.

PACOG completed a comprehensive update of its travel demand forecasting model in 2014 to support the identification and analysis of the impacts of land use changes and roadway improvements on regional traffic flow. The updated model has a base year of 2010. It was calibrated using the 2010 Front Range Household Travel Survey, and was validated using 2010 traffic volume ground counts. The inputs to the model are 2010 and 2040 socioeconomic data that has been disaggregated to the traffic analysis zone (TAZ) level, as well as updated network databases for the 2010 base year and 2040 planning horizon. The 2040 planning horizon socioeconomic forecasts are consistent with county-level control totals prepared statewide by the Office of the Colorado State Demographer. Detailed information on the inputs, outputs and structure of the PACOG travel demand model can be found in the 2015 methodology report[10].

Several roadway networks were developed to support travel demand analysis for the 2040 Long Range Transportation Plan (LRTP). These networks include: the 2010 model base year network; the 2040 Vision (Preferred) Plan network; and the 2040 Fiscally Constrained Plan network.

The goal of this chapter is to present the results of PACOG's 2010 and 2040 mobility overview and alternatives analysis. This task will be achieved in this sequence:

1. Present the analysis framework.
2. Review existing and future congestion.
3. Introduce solutions for future congestion.

6.2 Roadway Analysis Approach

Roadway capacity is of critical importance when examining the growth of a region. As traffic volumes continue to increase, roadway congestion also increases, and vehicle flow

[10] Pueblo Planning Model Methodology Report, Pueblo Area Council of Governments, HDR / Parsons Brinckerhoff, March 2015.

deteriorates. When traffic volumes approach and exceed the available capacity, the road begins to fail. For this reason it is important to look at the size and configuration of the current roadways and determine if these roads need to be expanded or if a road addition is needed to accommodate existing or future traffic needs.

The capacity of a road is a function of a number of factors including the functional class or facility type of the roadway , the number of lanes, interchange functionality, adjacent land use, access and intersection spacing, road alignment and grade, operating speeds, turning movements, vehicle fleet mix, adequate shoulders, street network management, and effective maintenance and operations. In practice, the number of lanes is the primary factor in evaluating road capacity since any lane configuration has an upper volume limit regardless of how well it has been designed.

For the purpose of examining the major roadway system in the Pueblo area, the newly validated PACOG travel demand was used. Both 2010 and 2040 scenarios were created for this purpose.

6.2.1 Roadway Capacity

Roadway capacity as a per/lane per/hour value is developed using the PACOG travel demand model. There are two required inputs to the process: the link facility type and the area type in which the link segment lies.

Facility Type

There are five distinct link facility types used to estimate capacity in the PACOG network. These are shown in **Table 6.1** and described below.

Table 6.1: PACOG Link Facility Type

Facility Type	Description
1	Interstate
2	Expressway
3	Principal Arterial
4	Minor Arterial
5	Collector

- **Interstates or Freeways** – Freeways are high-capacity roadways that accommodate high speed, long-distance travel to, from and through the metro area. Access is strictly controlled, and limited to Major Arterials connected by grade-separated interchanges at a minimum spacing set by the CDOT and by the Federal Highway Administration (FHWA).
- **Expressways** – Expressways accommodate high speed, long distance travel to, from and through the surrounding area. Access to adjacent land uses is limited. Full movement intersections are at-grade and signalized or grade-separated interchanges.
- **Principal Arterials** – Principal Arterials provide a high level of mobility and favor mobility over access to adjacent land uses. They provide access between lower classification streets (minor arterials and collectors) and higher classification streets (expressways and freeways).
- **Minor Arterials** – Minor arterial streets balance the mobility of through traffic with access to adjacent land uses. Travel speeds and capacity are lower than for Principal Arterials. Separate turn lanes, especially continuous left turn lanes, may be used to permit access to land uses on both sides of the street.
- **Collectors** – These roadways collect traffic from nearby local streets. *Neighborhood collectors* remain in the neighborhood and are residential in character. *Mixed-use collectors* form the edge of neighborhoods and have a wider right-of-way to allow for future turn lanes or additional width in the future. Residential homes are typically not allowed to face mixed-use collectors. *Business collectors* serve commercial development and may be in industrial areas, mixed use neighborhoods, or regional commercial shopping areas.

Area Type

A second dimension of link capacity estimation is the area type in which the road segment lies. There are five distinct area types in the PACOG demand model: (1) Central Business District (CBD); (2) Outlying CBD; (3) Urban; (4) Suburban; and (5) Rural. The area type designation is related to density. CBD zones have a dense street grid, walkability and the ability to make short trips to satisfy non-home travel. The CBD Outlying area type maintains some of the features of CBD, though slightly dampened. Urban areas have a regular street grid, though less walkability and throughput.

The suburban and rural area types move toward dominant auto driver or passenger travel mode. The theory behind the inclusion of area type is that roadway capacities differ based on the location of the road segment. For example, a collector in a CBD will behave differently from a collector in a rural area.

The travel model link capacity is set using a lookup table that integrates both area type and functional class to set hourly lane capacity as presented in **Table 6-2**.

Table 6.2: Model Link Capacities

Area Type	Facility Type	Capacity
CBD	1	1600
	2	650
	3	500
	4	450
	5	450
CBD Outlying	1	1700
	2	700
	3	600
	4	500
	5	500
Urban	1	1900
	2	900
	3	750
	4	650
	5	650
Suburban	1	1900
	2	900
	3	750
	4	600
	5	600
Rural	1	1900
	2	800
	3	650
	4	600
	5	600

For this 2040 RTP Update, time-of-day model results were readily available; the model update included the addition of both a one hour AM and PM peak period assignment specifically to serve the LRP.. The PM peak hour volume to capacity (V/C) ratio provided a powerful analysis metric, one that is focused on a known period of congestion, the evening peak. For purposes of the travel demand analysis, the hourly V/C ratio metric was aligned with well-understood level of service (LOS) measures as shown in **Table 6.3**. Hourly lane capacity was set by roadway type and area type as noted above. Additional detail regarding lane capacity assumptions can be found in the Travel Methodology Report cited above.

Table 6.3: PM Peak Hour V/C Ratio Level of Service Equivalencies

V/C Ratio Range	Level of Service
0.00 to 0.25	A
0.25 to 0.50	B
0.50 to 0.85	C/D
0.85 to 1.00	E
Greater than 1.00	F

6.3 Existing Roadway Congestion

The updated PACOG travel demand model was used to evaluate existing levels of roadway congestion for the 2010 PM Peak Period. The highway socioeconomic data/travel demand is based on 2010 information. **Figure 6.1**, on the following page, shows that PM congestion primarily affects U.S. Highway 50 and I-25. Note that I-25 tends to become congested in both directions in downtown Pueblo. U.S. Highway 50 has a high level of use throughout, but the critical need for capacity enhancements is westbound in the PM peak in the areas west of Pueblo. A factor in congestion that affects these two facilities is the lack of alternative relief routes available in the existing roadway network.

Figure 6.1: 2010 Base Year Network – PM Peak Volume to Capacity Modeled Results

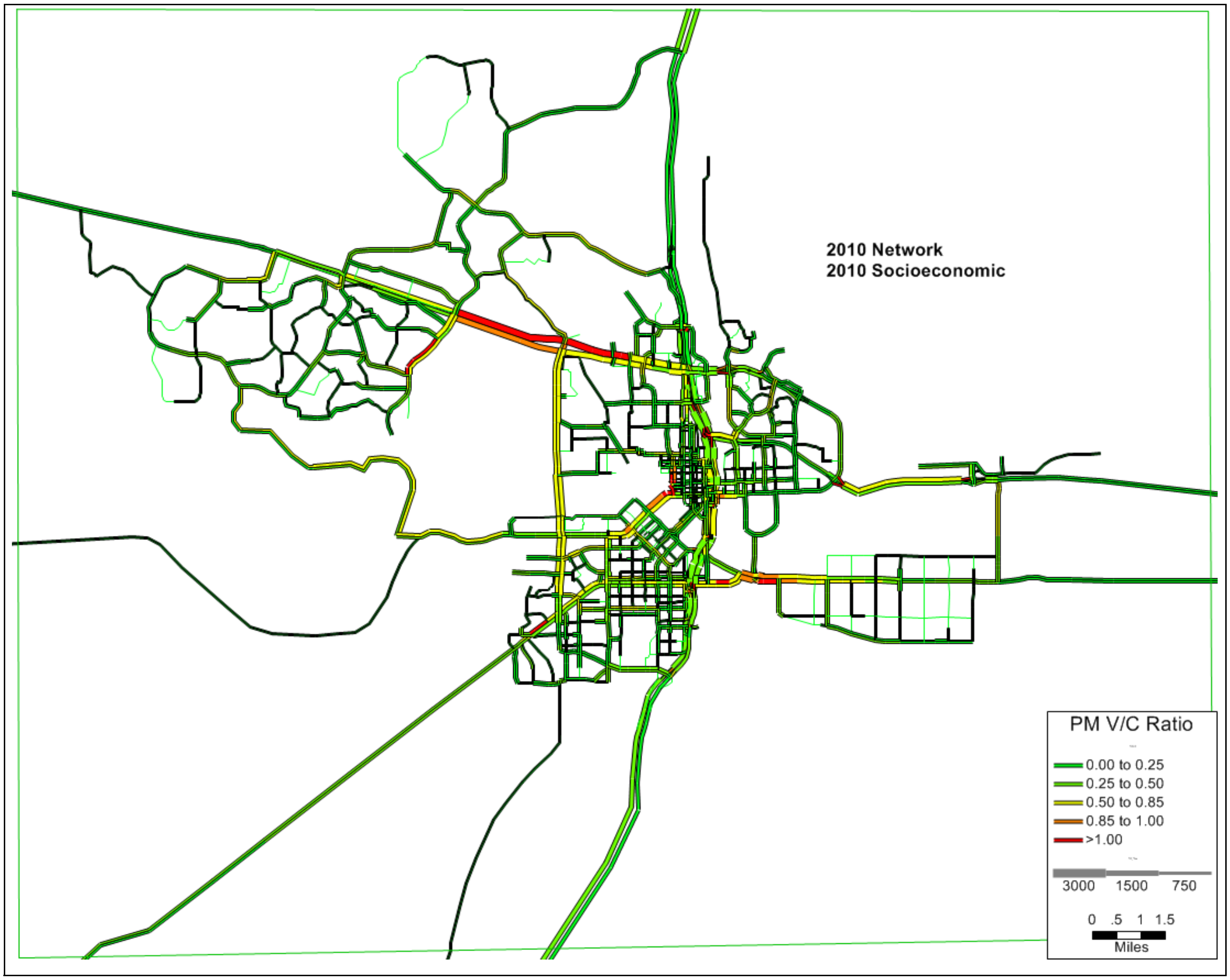
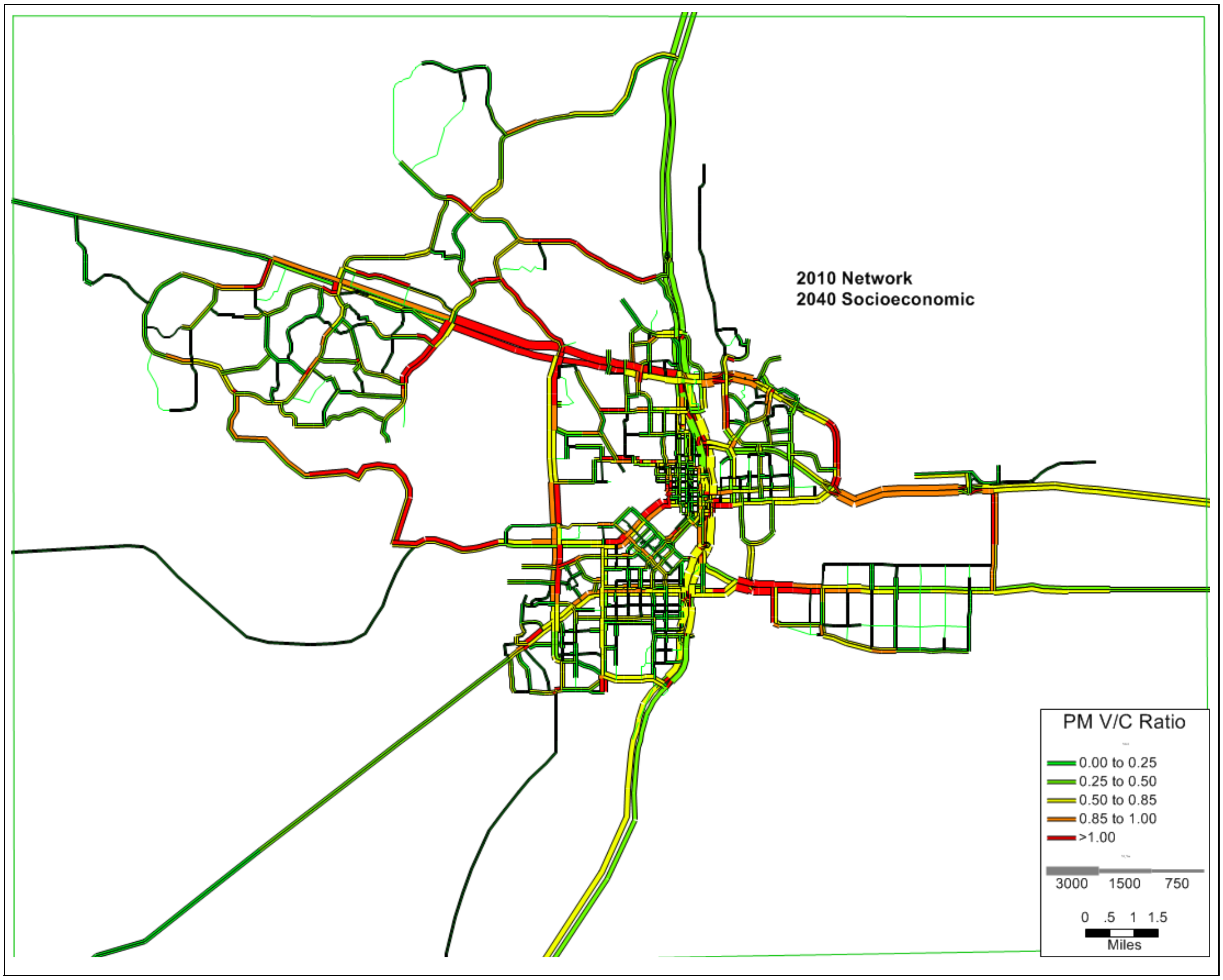


Figure 6.2: 2040 PM "No Build" Network – PM Peak Volume to Capacity Modeled Results

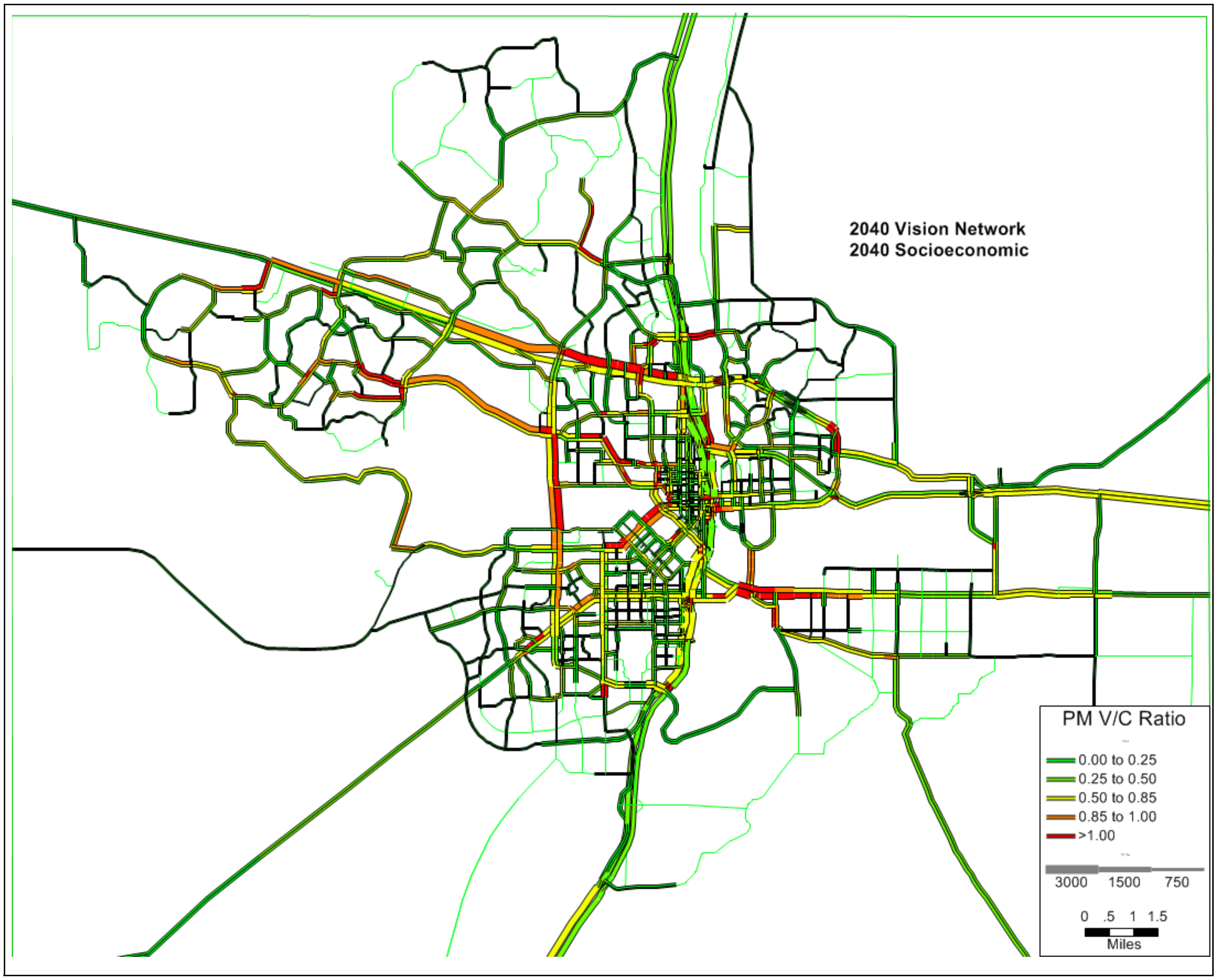


6.4 Future Roadway Congestion

6.4.1 Future "No Build" Roadway Congestion

The updated PACOG travel demand model was then used to evaluate future levels of roadway congestion for the PM Peak Period if no improvements were made to the existing transportation network. For the "No Build" condition, the 2010 network was modeled with 2040 socioeconomic data/travel demand. The model results, shown in **Figure 6.2,** above, highlight significantly worsened congestion that continues to affect U.S. Highway 50 and I-25, and has spread to other facilities. Again, a factor in congestion that affects these two key facilities is the lack of alternative relief routes available in the existing roadway network.

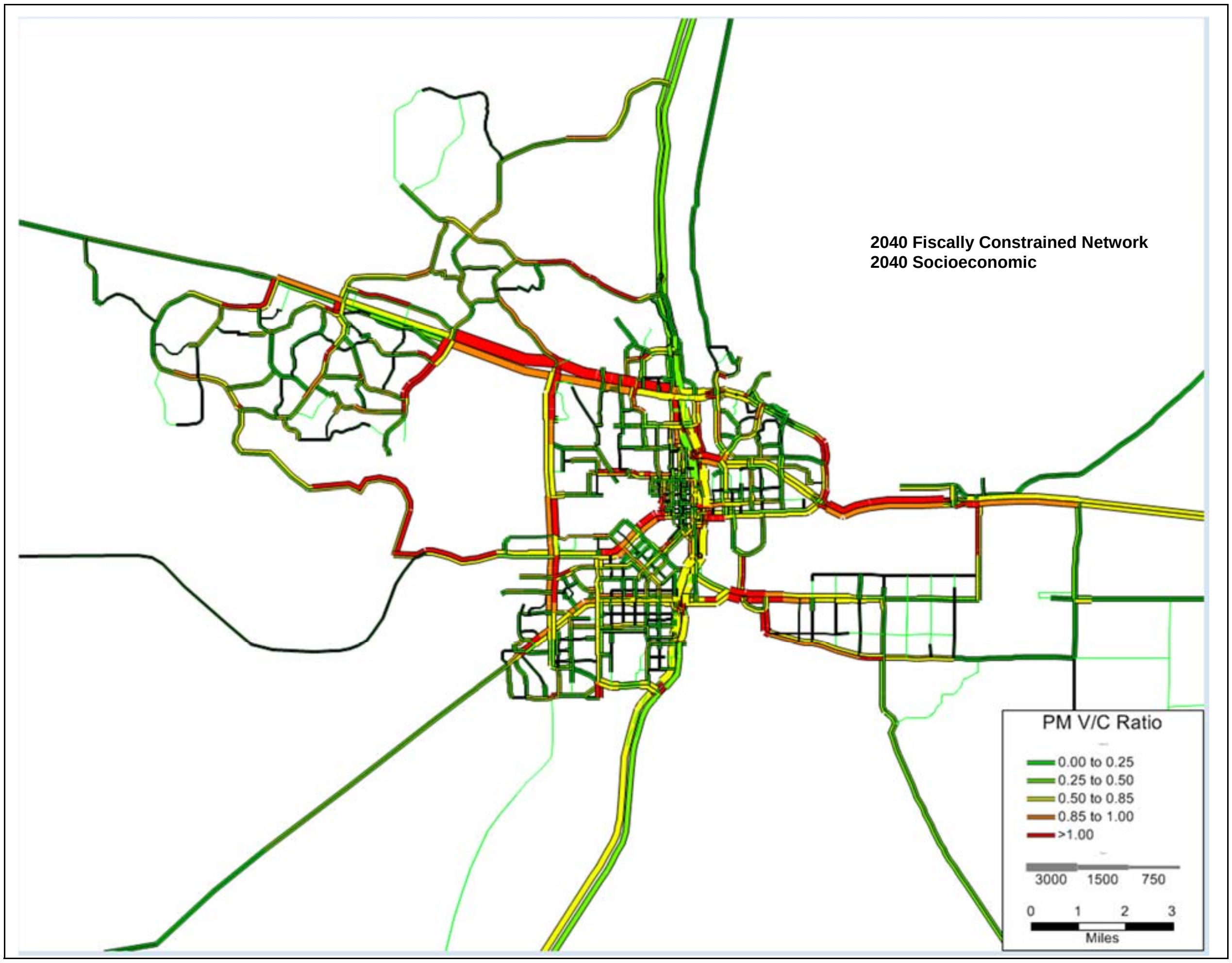
Figure 6.3: 2040 Vision Plan – PM Peak Volume to Capacity Modeled Results



6.4.2 Future Vision (Preferred) Plan Roadway Congestion

Supported by analysis of existing and future "no build" travel demand and roadway congestion, and consistent with adopted land use and development plans, PACOG developed a 2040 Vision Plan highway network. Network development was also supported by facilitated stakeholder outreach and public consultation sessions. The Vision Plan network was then evaluated using the PACOG travel demand model in the PM Peak Period. Model results for the Vision Plan network and 2040 socioeconomic data/travel demand are shown in **Figure 6.3** above. The 2040 Vision Plan improvements would provide significant improvement over the 2040 "No Build" scenario, but would not fully keep pace with forecast growth in travel demand, although selected facilities, such as U.S. Highway 50 and I-25 would be improved over existing conditions even with increased 2040 travel demand.

Figure 6.4: 2040 Fiscally Constrained Plan – PM Peak Volume to Capacity Modeled Results



6.4.3 Future Fiscally Constrained Plan Roadway Congestion

The cost for implementation of the full set of 2040 Vision Plan improvement projects exceeds anticipated available revenues by a significant margin. Thus a fiscally constrained 2040 project network was needed. The Fiscally Constrained Plan network was developed with a focus on high priority needs and available resources. Model results for the 2040 Fiscally Constrained Plan network and 2040 socioeconomic data/travel demand are shown in **Figure 6.4** above. Although the model results show more congestion that is shown for the 2040 Vision Plan network, the margin is small and benefit of the improvements is great when compared to the more costly Vision Plan scenario

6.4.4 Future Congestion Summary of Findings

The PACOG travel demand model provides a visual representation of four scenarios: 2010 Existing Conditions, 2040 No Build, 2040 Vision Plan and 2040 Fiscally Constrained. These four scenarios behave in a cohesive and consistent manner with respect to the socioeconomic inputs and the chosen networks. The 2010 scenario shows congestion in the locations and direction observed by local planners, engineers and citizens. The set of three 2040 scenarios extend this logic by first (No-Build) showing a progression of congestion in the future if no action is taken; then showing the impact of both visionary and fiscally constrained highway build solutions. The following was noted:

- In the PM peak, there is more congestion in the Fiscally Constrained Plan network than in the Vision Plan network. Examples of this difference include U.S. Highway 50 West and East and SH 45.
- Congestion on I-25 in the PM peak is similar between the two networks.
- The northeast part of the MPO region profits from the addition of the Vision Plan network facilities. Examples include: less congestion on Dillon Road and on the east-west roads serving I-25.
- Outer circumferential routes in both the Fiscally Constrained Plan network and the Vision Plan network are utilized, but do not become congested.

While visual analysis is valuable, it is best supported by a metric that tabulates both congested and uncongested vehicle miles over the PACOG region network. One useful metric is the Vehicle Miles Traveled (VMT), which includes both auto and trucks. Both VMT and congested VMT can be tabulated from a traffic assignment. Congested VMT is defined as all road segments operating at V/C greater than .85.

In **Table 6.4**, a VMT comparison is done for the PM Peak period. Both networks return about 500,000 VMT during the PM period. However, the 2040 Vision network, because it features more network detail (added roadways), results in fewer miles traveled in the region. The Vision network also delivers a higher percentage of uncongested VMT (21%) than does the fiscally constrained scenario (25%).

Table 6.4: Comparison of 2040 Fiscally Constrained and Vision Plan Congestion

Type of VMT	2040 Fiscally Constrained Plan		2040 Vision Plan	
	VMT	% of Total	VMT	% of Total
Congested VMT	123,960	25%	104,134	21%
Uncongested VMT	381,720	75%	397,896	79%
Total	505,680	100%	502,030	100%

6.5 Addressing Roadway Congestion

Reducing or minimizing future congestion is one of the most significant goals to consider in planning the transportation system. Based on the review of current and future forecasts of congestion, one feature is significant. Areas with limited connectivity have greater levels of congestion than do areas with multiple access points. This will be a significant factor in planning for the future development of the areas around I-25 and U.S. Highway 50. Traditionally, increases in the capacity of existing facilities, or the development of alternate or parallel facilities reduce areas of congestion. However, local agencies can also implement measures to reduce the demand for transportation services. PACOG is mindful of Travel Demand Management (TDM) strategies including the development of incentives for using alternate modes of travel such as carpooling, public transportation, traveling off-peak, or telecommuting.

6.6 Roadway Alternatives

This section presents the funded highway projects with descriptions of their locations and extent. The projects emerged from years of planning and engineering review and are keyed to the congestion locations shown in the **Figures 6-2** through **6-4**. The solutions will be presented by facility name.

6.6.1 Interstate-25

The purpose of investment in I-25 is to improve safety for north-south travel and to improve local and regional mobility within and through the Pueblo County to meet existing and future travel demands. Much of I-25 through Pueblo was built between 1949 and 1959 as U.S. 85/87 before the creation of the Interstate Highway System in 1956. As a result of its age and outdated design standards, this segment of I-25 still contains structural and operational deficiencies. Today, these deficiencies are evident through high accident rates, areas of reduced speed, traffic congestion, and poor traffic operations.

Among the CDOT funded 10-year Capital Improvements Program (CIP) projects are:

1. I-25 through Pueblo from Ilex Street to City Center Drive.
2. I-25 Corridor Access and Hazmat Study from Ilex Street to 29th Street.
3. I-25 Intelligent Transportation System (ITS): Install traffic cameras from MP 109 to MP 114.8.
4. I-25 North from 13th Street to the U.S. Highway 50B Interchange.
5. I-25 Eastside Frontage Road from the Dillon Interchange to the Eden Interchange.

I-25 is also slated to receive funding which is not yet present in the 10-year CIP for improvements from City Center (1st Street) to 13th Street; from 13th Street to U.S. Highway 50B; and from U.S. Highway 50B to north of 29th Street.

6.6.2 U.S. Highway 50

U.S. Highway 50 is the only existing route between I-25 and the major business and population centers west of the Interstate. Investment in this highway would provide connectivity east-west as well as eliminate periods of congestion in the AM and PM peaks. 10-year CIP projects that are CDOT funded are:

1. U.S. Highway 50A West (EB) from Wills Boulevard to McCulloch Boulevard: Add the third lane and trail facilities; improve pedestrian crossings at signalized intersections.
2. U.S. Highway 50A West (WB) from Wills Boulevard to McCulloch Boulevard: Complete the EA from Wills Boulevard to McCulloch Boulevard; add the third lane from Wills Boulevard to the hill just west of Pueblo Boulevard; realign to be parallel to the EB alignment; construct a new bridge; rebuild the signal at U.S. Highway 50/Pueblo Boulevard to accommodate the new WB alignment and traffic flow and improve pedestrian crossings at signalized intersection.
3. U.S. Highway 50C from 4th St. to Baxter Rd from Aspen Road to 21st Lane (MP 0.0 to 7.4).

4. U.S. Highway 50 from Bonforte Blvd. to Hudson Ave.
5. U.S. Highway 50B (MP 332.1 and 333.9): Construct continuous left lane where U.S. Highway 50C and U.S. Highway 50B meet.
6. U.S. Highway 50 Access Management Plan from Interstate 25 to Fortino Boulevard.

U.S. Highway 50 is also slated to receive funding which is not yet present in the 10-year CIP for surface and drainage improvements.

6.6.3 State Highway 96

Traffic along SH96 is expected to increase as population centers continue to grow west of SH45 and south of the Arkansas River. This vital link to downtown Pueblo will require both safety and capacity improvements. 10-year CIP projects that are CDOT funded on SH 96 are:

1. SH 96A at Abriendo Avenue - Intersection improvements (signal update, ADA Ramps and pedestrian crossing improvements).
2. SH 96A at Chester Avenue - Add a left-turn lane and replace the signal.
3. SH 96 at Acero Avenue.
4. SH 96 at Bradford Avenue.
5. SH 96A West of Pueblo - shoulder widening, bridge rail replacement, bike lane and other safety improvements.

6.6.4 State Highway 45

Traffic along SH45 is also expected to increase as population centers continue to grow west of SH45 and south of the Arkansas River. This vital north-south partial circumferential will require both safety and capacity improvements. 10-year CIP projects that are CDOT funded on SH 45 are:

1. SH 45 at Hollywood Dr. and SH 45 at Lehigh Avenue - Signal Replacement and Pedestrian Crossing Improvements.
2. SH 45 from City Park to E. Spaulding Avenue (MP 4.9 to 8.7).
3. SH 45 North Extension Study from U.S. Highway 50A to I-25 at Exit 108.

6.6.5 State Highway 47

Traffic along SH47 is expected to increase as population centers continue to grow east and north of SH47 and east of Fountain Creek. Colorado State University - Pueblo also lies adjacent to this road facility. This vital link connects Pueblo West via U.S. Highway 50 to the Airport Industrial Park (AIP) and portions of eastern Pueblo County. If large-scale development is built in the northeast quadrant of Pueblo County, major freeway/expressway corridors, as well as supporting arterials and collectors, will be required to accommodate future traffic growth. A 10-year CIP projects that is CDOT-funded on SH 47 is: SH 47 Junction I-25/ U.S. Highway 50to East of Troy (MP 0.035 to 0.29). Other highway projects of note are the SH 78 raised median between Bandera Parkway and Surfwood Lane and the addition of a Dillon Drive segment.

6.6.6 Summary of Roadway Alternatives

Addressing existing and future congestion in the Pueblo Area has required a careful assessment of facility needs with available revenue, driven by the local planning and engineering knowledge gathered over decades in the region. Congestion on I-25 and U.S. Highway 50, both on the ground and as mirrored in the PACOG 2010 and 2040 travel demand model scenario results, has driven the projects screened and selected for this LRTP.