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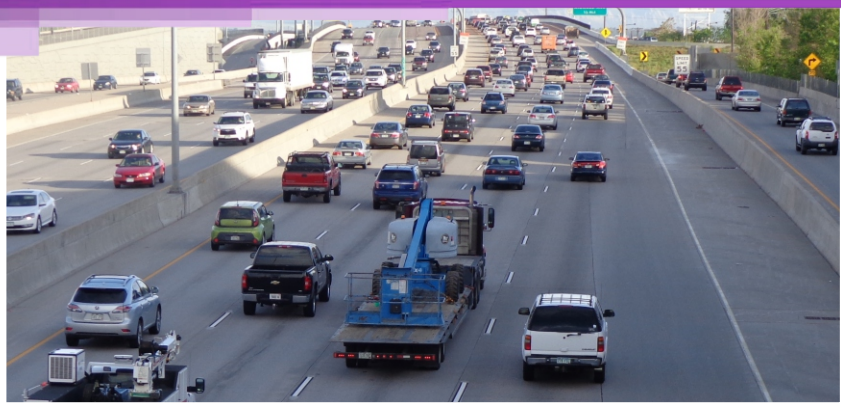


2014 Annual Report on Roadway Traffic Congestion in the Denver Region

October 2015

Visit our partner agency websites for more information:

Colorado Department of Transportation
www.coloradodot.info

Regional Transportation District
www.rtd-denver.com

Traveler Information
www.cotrip.org

Interesting Videos on Traffic Congestion

The Phantom Traffic Jam – an explanation
https://www.youtube.com/watch?v=goVjVVaLe10

Traffic Waves
https://www.youtube.com/watch?v=19S3OdK6710

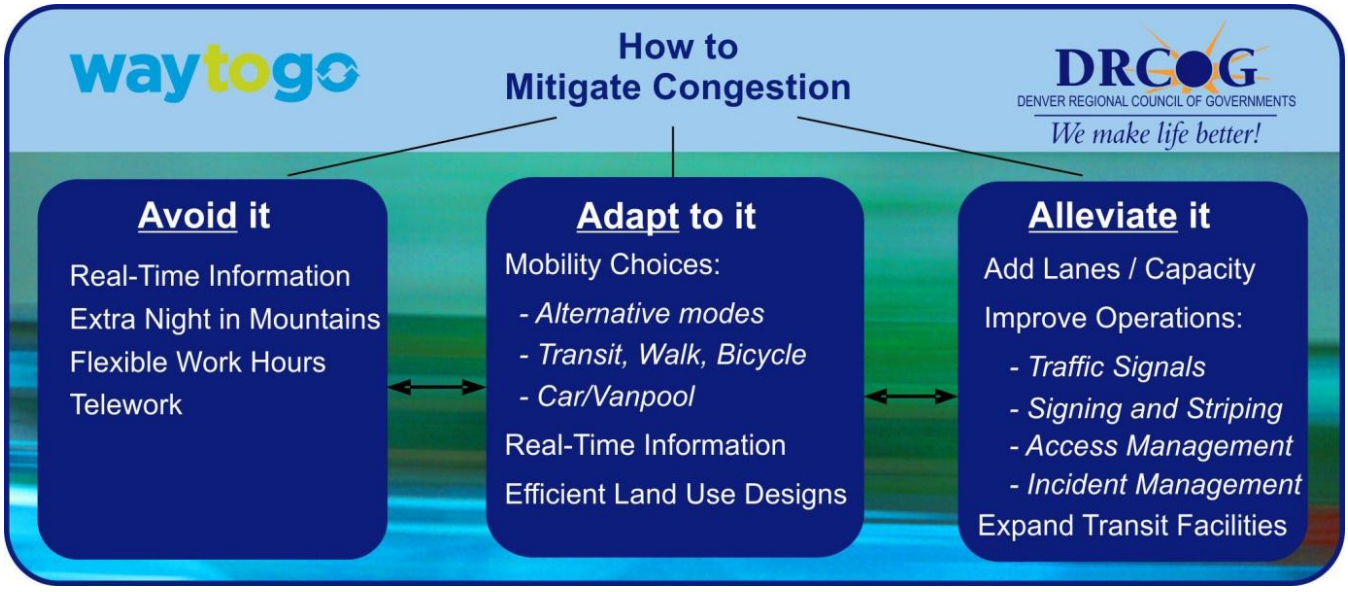
For ways to avoid or adapt to congestion via mobility options please visit:

Way to Go
http://waytogo.org

Preparation of this report has been financed in part through grants from the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration. This report and others are available at the DRCOG Congestion Mitigation webpage at: http://drcog.org//node/178.

Contact Robert Spotts, Senior Transportation/Air Quality Planner, at rspotts@drcog.org for additional information regarding DRCOG's *Congestion Mitigation Program*.

The 3-A's of Congestion Mitigation



2014 Annual Report on Roadway Traffic Congestion in the Denver Region

October 9, 2015

1. Introduction

The Denver Regional Council of Governments has prepared annual reports on traffic congestion since 2006. Since that time, several trends have emerged:

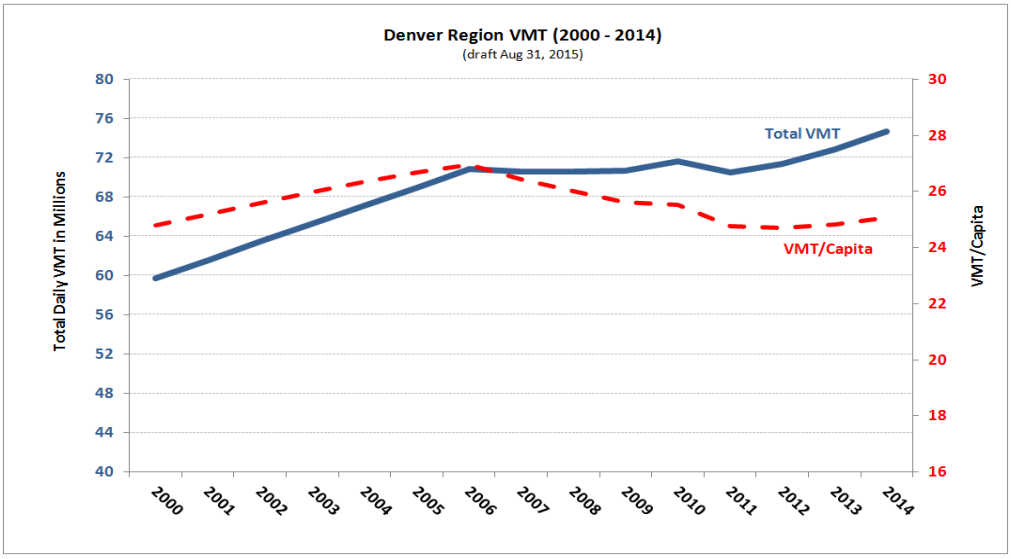
- Overall traffic has grown slightly; but at a rate less than population and employment growth.
- Miles driven per person has decreased slightly.
- Traffic congestion is a little worse across the region, though some specific locations are experiencing either much greater or even less congestion.
- More transit options are available to help people avoid driving in severe congestion and there is greater popularity and opportunities to walk, bicycle, or carpool to places.
- There is much greater access to real-time information on traffic conditions, major incidents, and travel options to avoid driving alone.

On one hand, traffic congestion can have a negative impact on attracting or retaining many types of businesses and economic activity. On the other hand, congestion can also be a sign of a strong economy. Large urban areas like the Denver region are vibrant places offering a variety of employment and recreation opportunities. Therefore some traffic congestion at some points in time is inevitable.

2. How much do we travel on a typical day? (Trends in VMT – Vehicle Miles of Travel)

People travel nearly 110 million person-miles in the Denver region every weekday. Travel occurs behind the wheel, on foot, in wheelchairs, as a passenger, on a bicycle, and in other ways. Motor vehicle drivers (cars, trucks, buses, ambulances, delivery vans, etc.) make up 75% of the miles traveled, or about 75 million VMT per day. In addition to transporting people, goods, raw materials and services, those vehicles also burn almost 4 million gallons of petroleum fuel, and cause over 170 traffic crashes per day. **Figure 1** depicts average weekday VMT for the entire Denver region over the past 14 years. The solid blue line shows that total daily VMT rose steadily through 2006, flattened out through 2011, but has increased in the past three years. Economic and population growth combined with lower fuel costs likely played a role in the recent increase. Factoring in population growth however, shows VMT per capita has actually decreased slightly since its peak in 2006.

Figure 1



3. How severe is traffic congestion?

DRCOG maintains a database to monitor traffic congestion and performance measures for the 2,400 mile "regional roadway system".

The congestion database identifies key attributes for each segment of the system. The attributes are associated with the two factors of traffic congestion: roadway capacity and traffic volume.

What factors influence traffic congestion?

A. Roadway Capacity – Or, how many motor vehicles can efficiently travel on the roadway? The vehicles of course, carry drivers, passengers, services, and goods.

The **Regional Roadway System** represents the DRCOG-designated freeways, tollways, major regional arterials, and principal arterials. These are the most heavily traveled and important connecting corridors of the region. This system handles almost 80% of the total traffic in the region.

Vehicles traveling along a road are similar to water in a pipe. Traffic signals and on-ramps are similar to valves controlling the amount of water entering a mainline pipe. If too much water tries to enter a pipe, turbulence occurs and the water backs up. A clog in the pipe is like a traffic crash that shuts down all or part of a road. The one thing a pipe doesn't have is millions of individual driver decisions that can disrupt the flow and cause a "shock-wave" of delays. For example, there is no physical reason for "rubber-necking" slowdowns–human psychology is the cause.

The following roadway attributes affecting capacity are identified in the congestion database and used in DRCOG's analysis:

- Lanes
- Traffic signals
- Driveways and curb-cuts
- Parking at the curb
- Truck activity and deliveries
- Hills (grade, slope)
- Very high pedestrian activity sites
- Sun glare at sunrise or sunset
- Frequency of crashes or incidents

Other random or seasonal conditions can also affect capacity, but are <u>not</u> inventoried for individual roadway segments. On a typical day, many non-typical events occur:

- Poor signage or worn out striping
- Tree branches blocking views
- Rainstorms, or snowfall, or power outages
- Vehicles slow down for no apparent reason
- Planned or unplanned construction
- Special events

B. Number of Vehicles (volume) – Or, how many vehicles want to use the roadway, at different times of the day? Like a water pipe, a roadway essentially has the same base capacity at all hours of the day. However, the volume of traffic (or water) at certain times of the day can overload the system. This means vehicles (plus passengers and goods) cannot reach destinations down the road in the same amount of time as when there is much less traffic.

The following traffic volume information is maintained in the database:

- Average daily traffic (ADT) – number of vehicles on a segment per day
- Distribution of traffic by hour during the day
- Daily truck and commercial vehicle traffic
- Level of bus service / ridership

Types of Congestion Measures

Traffic congestion is reflected in different ways. DRCOG calculates measures of the Regional Roadway System (see **Figure 2** and **Table 1**) for several situations:

Duration "THE ROAD IN FRONT OF MY BUSINESS WAS CONGESTED FOR **MORE THAN 5 HOURS** YESTERDAY!"

- *2014 DATA: 21% of regional roadways were severely congested for 3 or more hours per day*
- *2040 ESTIMATE: 31%*

Severity "I WAS STOPPED IN TRAFFIC FOR AT LEAST **HALF** OF MY DRIVE HOME LAST NIGHT!"

- *2014 DATA: 16% of vehicular travel occurred in congested conditions (14% of all person trips)*
- *2040 ESTIMATE: 28%*

Magnitude "THERE WERE THOUSANDS OF CARS STUCK IN TRAFFIC. WE **ALL** WASTED SO MUCH TIME!"

- *2014 Data: People were delayed a total of over 280,000 total hours per day.*
- *2040 ESTIMATE: 720,000*

Variation "I HAVE TO DRIVE MY SON TO A SOCCER GAME RIGHT DURING RUSH HOUR TODAY. IT'S GOING TO TAKE A LOT **LONGER** THAN ON SATURDAY!"

- *2014 DATA: The average rush hour trip took 22% longer than in the off-peak.*
- *2040 ESTIMATE: 36%*

Reliability "ANOTHER CRASH **SHUT DOWN THE ROAD,** AND I COULDN'T MAKE MY DELIVERY IN TIME!"

- *2014 DATA: An average of 130 reported crashes occur every day on the regional roadway system (+ ~100 other traffic disrupting incidents such as break-downs, unreported fender-benders, visual distractions, work zones, etc.).*

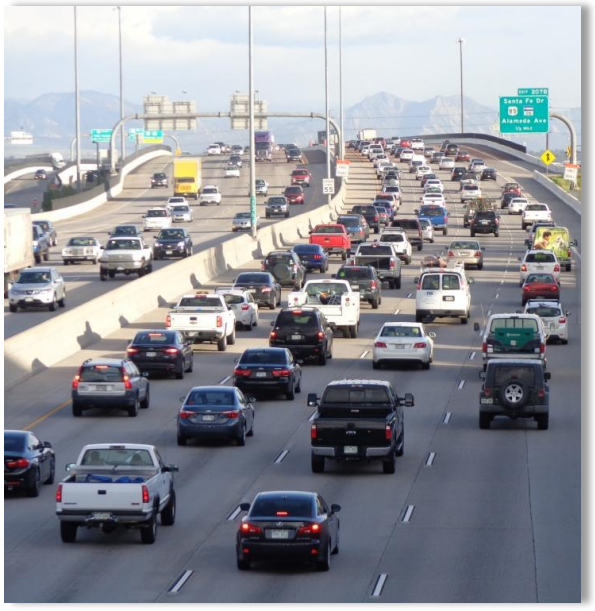


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Figure 2
Key Congested Locations in 2014 and 2040

Congested Corridors - Mobility Grade

Grade of "A" through "F" was assigned based on a combination of scores for the following measures:

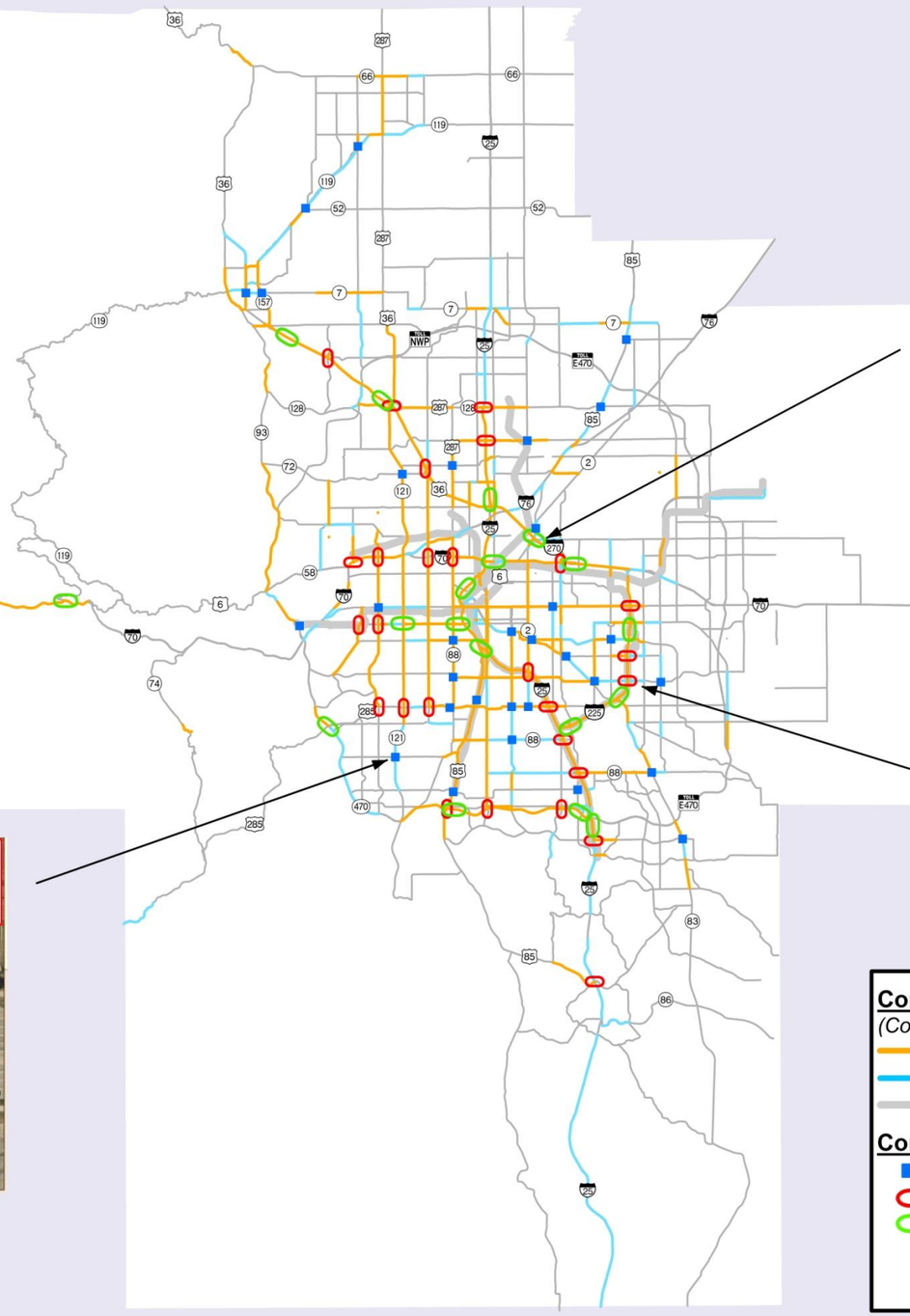
Duration - How long does the congestion last?
(number of hours per day congested)

Severity - How much of driving time is in delayed conditions?
(percent of travel time in delay in peak hour)

Magnitude - What is the total amount of delay for all travelers at that location?
(total daily delay time per mile)

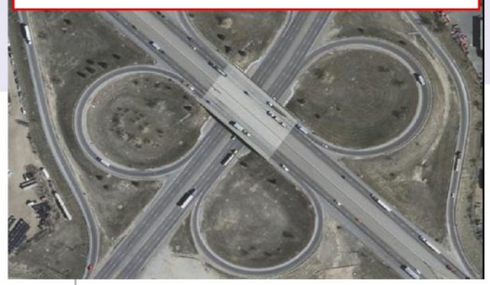
Variation - What is the variation in travel time between off-peak and rush hour?

Reliability - How often do crashes or incidents occur?
(crashes per mile per year)



Freeway Bottleneck Points

Free-flow locations where traffic often slows down or backs up because of on-ramps, hills, trucks, or sharp curves.



Arterial-Freeway Ramp Intersections

Extensive congestion occurs where arterial streets intersect with freeway ramps in a series of signalized intersections.

Arterial-Arterial Intersections

There are 3,500 signalized intersections in the region. This map shows the locations with the worst delays.

Congested Corridors in 2014 and 2040

(Congestion Mobility Grade of D or F)

- Corridor Congested in 2014
- Corridor Congested in 2040 (assuming RTP projects)
- Rail Transit

Congested Points In 2014

- Arterial / Arterial Intersections
- Arterial / Freeway Ramp Intersections
- Freeway Bottleneck Points

N

0 4 8
Miles

Projection: State Plane Colorado Central, NAD 83 (feet)

RS 9/17/2015

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Table 1 displays several measures for the designated Regional Roadway System. The 2040 estimates are based on forecasts from the DRCOG regional travel demand model. A key assumption for the model is that over 1.2 million additional people will be living in the Denver region by 2040, a 39% increase. There will be significant growth in transit, bicycle, and walking trips; outpacing the 39% population increase. These are very important travel options to encourage for people and businesses to avoid or adapt to traffic congestion. However, the increase in travel by non-SOVs will not likely be enough to offset the growth in motor vehicle travel and associated traffic congestion.

Table 1
Current and Future Congestion Measures on Denver Regional Freeways and Arterials

	2014		2040 (RTP)		% Change between 2014 and 2040
Vehicle Measures:	Average Weekday	Annual Total Estimate (1)	Average Weekday	Annual Total Estimate (1)	
Vehicle Miles of Travel	57,652,000	19,486,372,000	72,738,000	24,585,320,000	26%
Vehicle Hours of Travel	1,312,000	443,596,000	1,917,000	647,913,000	46%
Average Travel Speed (mph)	44	n.a.	38	n.a.	-14%
Vehicle Hours of Delay	209,000	70,753,000	532,000	179,725,000	154%
Travel Delay Per Driven Registered Vehicle (2)	7 minutes	41 hours	13 minutes	74 hours	80%
Travel Delay Per Household	11 minutes	60 hours	18 minutes	135 hours	124%
Person Measures:					
Person Miles of Travel	77,830,000	26,306,603,000	98,196,000	33,190,182,000	26%
Person Hours of Travel	1,772,000	598,855,000	2,588,000	874,683,000	46%
Person Hours of Delay	283,000	95,516,000	718,000	242,628,000	154%
Travel Delay Per Resident	6 minutes	32 hours	10 minutes	57 hours	78%
Other:					
Percent of Travel Time in Delayed Conditions	16%	n.a.	28%	n.a.	n.a.
Travel Time Variation (peak vs. off peak)	1.22	n.a.	1.36	n.a.	n.a.
Lane Miles of Roads Congested for 3 + Hours	1,519	n.a.	2,291	n.a.	65%
(Percent of Total Lane Miles)	21%	n.a.	31%	n.a.	n.a.
Economic Costs:					
Commercial Vehicles (3)	$1,200,000	$388,800,000	$4,200,000	$1,405,300,000	261%
Passenger Vehicles (3)	$2,300,000	$769,800,000	$5,600,000	$1,902,000,000	147%
Total Cost of Delay	$3,400,000	$1,158,700,000	$9,800,000	$3,307,300,000	185%
Transit and Other Regionwide Measures:					
Total RTD Transit Boardings	344,000	n.a.	826,000	n.a.	140%
Rail Transit Boardings	70,000	n.a.	258,000	n.a.	267%
RTD Park n Ride Parking Space Utilization (out of 32,011 spaces)	61%	n.a.	n.a.	n.a.	n.a.
Modeled Bicycle and Walking Trips	834,000	n.a.	1,244,000	n.a.	49%
Traffic Crashes (2012)	175	59,250	n.a.	n.a.	n.a.

Sources: DRCOG CMP Database, RTD Ridership Statistics, 2040 RTP

Technical Notes:

(1) Annual Total Estimate is "Average Weekday" total *338

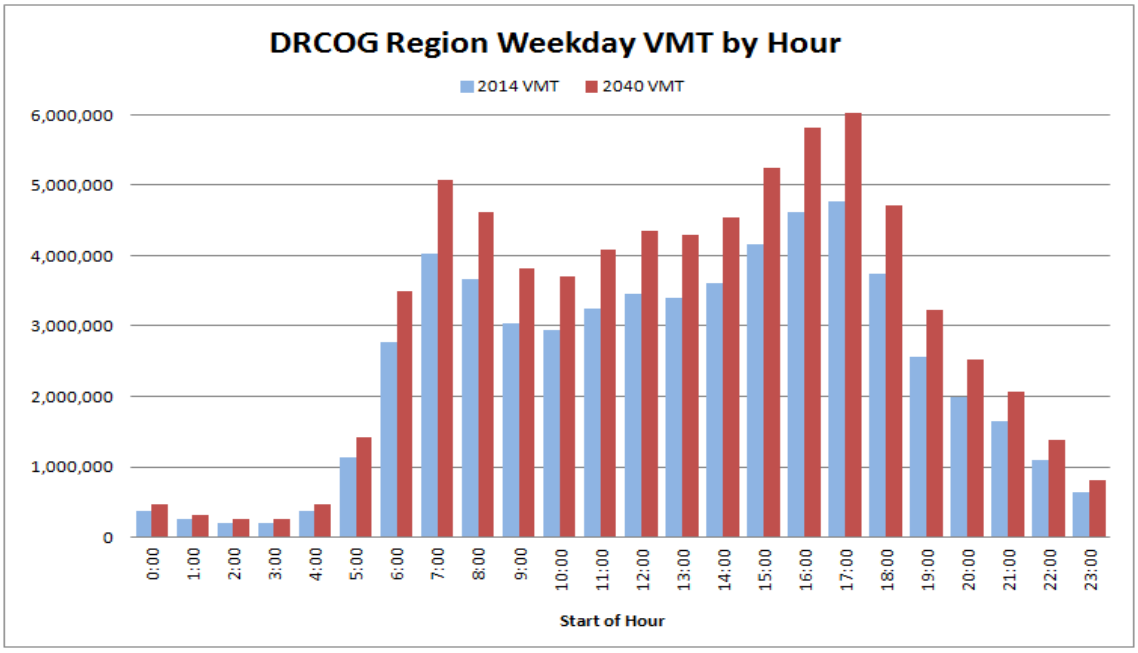
(2) Assumption of 1,713,249 driven registered vehicles in 2014 and 2,415,682 in 2040

(3) Cost calculations incorporate $12 per hour per adult in car, $48.30 per hour per light commercial vehicle operator, and $71 per hour for heavy commercial.

Time and Length of Congestion

A key aspect of traffic is the time of day people will be traveling, today and in 2040. The majority of severe traffic congestion today occurs during the weekday morning and afternoon rush hours. The rush "hour" time period is forecast to expand significantly in the future. The DRCOG model results shown in **Figure 3** forecast the period from 2:00 to 4:00 p.m. in 2040 to have as much traffic as from 4:00 to 6:00 p.m. today. Therefore, it is very important that transportation partners in the region work to reduce mid-day crashes, incidents, and their impacts. As traffic increases in mid-hours of the day, there will be less time available for traffic back-ups (queues) to clear out before the busiest rush-hours. The average clearance time to move crashed vehicles off the road and out of sight must be improved.

Figure 3



4. How does the Denver region compare to other metro areas?

Traffic congestion affects metropolitan areas across the country to varying degrees. There are many types of congestion measures used to rank metropolitan areas. DRCOG staff calculated the average of the two most common (annual hours of delay and peak hour travel time index) measures referenced in the *Urban Mobility Scorecard* prepared by the Texas Transportation Institute.

Table 2 shows the combined Denver/Aurora/Boulder "urbanized area" ranked about 19th worse in congestion in 2014. The values are not precise. A small change in a measure's value can cause a ranking to shift three to four spots. Denver's ranking did not change much between 2003 and 2014. Noticeable are the distinctly worse ranks of the Seattle and Portland areas, two key economic competitors with Denver.

Another source of comparative congestion data is produced by the company INRIX. INRIX uses a comprehensive dataset retrieved from cars, cell phones and other devices that move along the nation's roadways. Data is obtained on speeds, delays, back-ups and other variables for several million miles of roadways, every day of the year. Thus, in addition to routine travel delays, it also incorporates delays induced by crashes, incidents, construction, and bad weather. A scorecard is produced annually by INRIX with comparative results for areas around the United States. For the overall congestion index, again the Denver region ranked 19th worse in 2014. Noticeable again were Seattle, Portland, and Austin, whose congestion rank was worse than their population rank might indicate. For individual freeways reported by INRIX, the segment of I-25 from Colorado Boulevard to 84th Avenue just cracked the top 100 list of most severely congested freeways in the country in 2014.

Table 2
Comparative U.S. Metro Areas

	Metro Population Rank	Texas Transportation Institute Congestion Rank*			INRIX Congestion Index Rank**
Metro Area	***2014***	**2003**	**2011**	**2014**	**2014**
Chicago	*3*	5	10	11	11
Dallas	*4*	13	11	15	21
Austin	*35*	12	10	11	4
Seattle	*15*	16	9	5	8
Denver/Boulder	***18***	**17**	**14**	**19**	**19**
Denver UA only	*21*	*11*	*10*	*17*	
Phoenix	*12*	19	38	18	30
Portland	24	22	11	9	12
Las Vegas	*30*	25	22	24	28
Salt Lake City	48	34	57	56	55
Albuquerque	*59*	46	73	67	88
Kansas City	29	59	68	63	69
Cleveland	*31*	71	50	65	53

* Average of two Texas Transportation Institute measures of congestion: Annual Delay per commuter and Travel Time Index. *2015 Urban Mobility Scorecard*

**- INRIX 2014 Scorecard

5. Where is congestion the worst in the Denver region?

As noted on page 2, DRCOG measures five types of congestion for each segment of the regional roadway system. These calculations are then combined into one overall "mobility score" and a letter grade (A through F) is assigned to each segment. Roadway segments receiving a letter grade of D or F are considered the most highly congested and are identified in **Figure 2**. Based on the analysis, highly congested roadways accounted for 25% (1,745 lane miles) of the regional roadway system in 2014 and expected to increase to 32% (2,482 lane miles) by the year 2040. Figure 2 also identifies some of the bottlenecks that induce the most congestion in 2014. Many of these locations are obvious and are mentioned frequently on morning/afternoon traffic reports or identified on mobile traffic applications. For many locations, it should be noted a "downstream" bottleneck is actually the cause of congestion occurring on a segment.

It should also be noted the DRCOG congestion management process is not conducted with the level of precision required for a detailed engineering analysis of a specific road or intersection. DRCOG's is a regional level of analysis. Ground level site specific engineering and observational studies must be conducted (e.g., by CDOT and local governments) to determine specific causes and optional methods for addressing specific locations.

***Avoid** or **Adapt** to Congestion*

Offer flexible work-hours or teleworking; provide real-time traffic information via many methods (mobile devices, signs, webpages, alerts, etc.). Provide and encourage more practical choices of travel modes such as transit, walking, bicycling, and ridesharing, as well as more efficient mixed-use neighborhoods to live and work in.

***Alleviate** (some) Congestion*

Improve roadway and transit operations, traffic signal coordination, maintenance, provide transit facilities that bypass traffic congestion, selective addition of roadway lanes (mixed traffic, HOV, or tolled), incident management (crash prevention and clearing of crash scenes).

Since the Denver region is the growing economic engine of Colorado, traffic congestion will remain. Congestion will also affect individual people and businesses uniquely, depending for example on where you live in relation to everyday activities, family make-up (children's activities or not), or income. DRCOG's *Congestion Mitigation Toolkit* describes over 30 categories of strategies within the "3-A's" of strategies for addressing traffic congestion: **Avoid** it, **Adapt** to it, or **Alleviate** it.

6. CMP Transportation Projects Recently Completed or Underway

Several important congestion relief projects have been completed by local governments, CDOT, and RTD in the past year or are underway, as shown in **Table 3**. Transit and bicycle/pedestrian projects provide optional modes of travel for many people avoid congestion.

Table 3
Example Transportation Projects Addressing Congestion and Mobility

Interchange/Roadway Projects:	**Status**
Reconstruct Colfax Avenue @ I-225 interchange	Completed
Widen I-225 from Mississippi Avenue to Parker Road	Completed
Widen I-70 Twin Tunnels east of Idaho Springs	Completed
120th Avenue Bridge extension from US-36 to US-287/Vance Street	Underway
Extend Central Park Boulevard from 47th Avenue to 56th Avenue	Underway
Peak period shoulder managed lane: I-70 eastbound Clear Cr. Co.	Underway
Add managed lanes/BRT to US-36 from Boulder to I-25	Underway
Add managed lanes to I-25 from US-36 to 120th Avenue	Underway
Reconfigure ramps on US-6 Freeway from Federal Blvd. to I-25	Underway
Widen I-25 from Ridgegate Parkway to C-470/County Line Road	Underway

Rapid Transit Projects:	**Status**
Denver Union Station (DUS)	Completed
I-225 Corridor: (9 Mile/Parker Road to Peoria/Smith) light rail	Underway
Gold Line (Ward Road to DUS) commuter rail	Underway
Northwest Corridor (Westminster to DUS) commuter rail	Underway
East Rail Line (DUS to DIA) commuter rail	Underway
North Metro Rail Line (DUS to 124th-Eastlake) commuter rail	Underway

Bicycle/Pedestrian Projects:	**Status**
West Light Rail Golden Pedestrian & Bicycle overpass of US-6	Completed
Quebec Avenue Bicycle & Pedestrian overpass of C-470	Completed
Tollgate Creek Trail connection (north of Mississippi Avenue)	Completed
Longmont Diagonal/Airport Road underpass	Completed
US-36 Bikeway	Completed
Kipling Avenue Multi-use Path (32nd Avenue to 44th Avenue)	Underway
Pearl Parkway Multi-use Path (30th Street to Foothills Parkway)	Underway
38th/Blake Street Station area pedestrian access improvements	Underway

Quebec Avenue Overpass of C-470

I-70 Eastbound Twin Tunnels

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