NC Capital Area Metropolitan Planning Organization

Status of the System Report 2012-2013

North Carolina Capital Area
Metropolitan Planning Organization

Status of the System Report - 2012

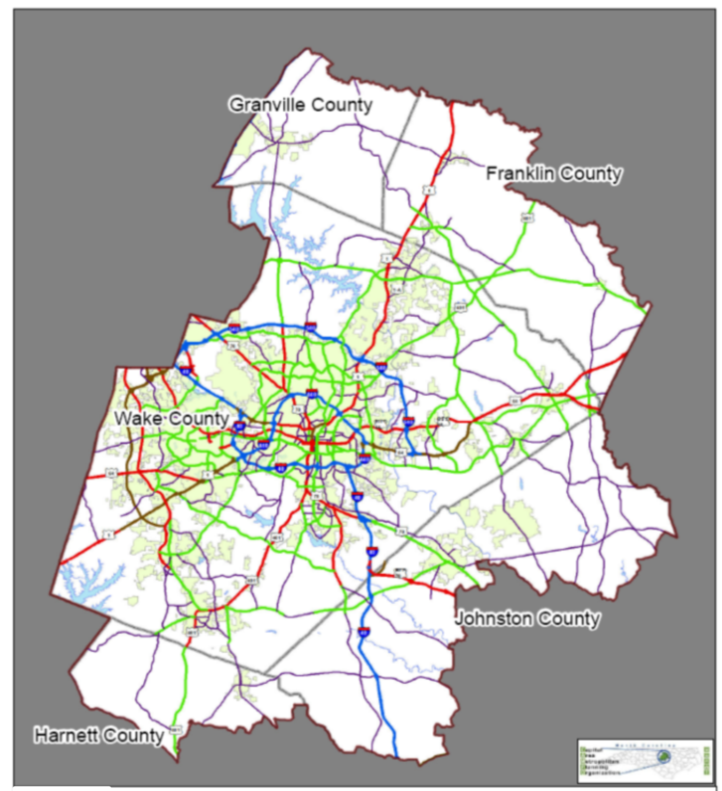
STATUS OF THE SYSTEM EXECUTIVE SUMMARY

This is the inaugural Status of the System (SOS) Report for the North Carolina Capital Area Metropolitan Planning Organization (CAMPO). It provides a useful benchmark for various measures of transportation system performance. This report provides a regional perspective on trends and travel conditions, and the performance of initiatives implemented to address those trends. In general, the following major elements can be identified from this report:

- Explanation of the Status of the System Report and the purpose of the Congestion Management Process Annual Update;
- Comparisons of performance measures for Vehicle Miles Traveled, Vehicle Hours Traveled, and Speed for CAMPO's major roadways by county between 2005 and 2010;
- Defining Congestion, Duration of Congestion, and Delay
- Highlighting the INRIX National Traffic Scorecard for the Raleigh area, identifying the congested and bottleneck segments along I-40, and explaining how travel times and speeds have been improved in the noted I-40 segments using congestion mitigation measures;
- Introducing congestion management strategies that include Traffic Incident Management along I-40 and the CMP Toolbox that contains alternative solutions to capacity expansion.

The Capital Area MPO's Congestion Management Process (CMP) is addressing congestion through various methods. The CMP has developed a 'Toolbox" (Referenced as Appendix "A" of this Report) which outlines traffic congestion mitigation strategies for member agencies to consider when developing future projects or minor improvements. An initiative to collaborate with NCDOT, the Durham-Chapel Hill-Carrboro MPO and local emergency response agencies to develop and implement region-wide standards for response to and quick clearance of traffic incidents to minimize impacts to traffic and maximize traffic and responder safety is underway. Another of the congestion mitigation methods is the updated Triangle Regional Intelligent Transportation System (ITS) Strategic Deployment Plan (which has incorporated a Ramp-Metering Feasibility Study for major freeways traversing the region).

Conclusions presented in this Report show that capacity improvements and low-cost pavement marking revisions at noted bottlenecks on Interstate 40 have improved mobility and reduced the negative impacts of traffic congestion brought about by increases in Vehicle Miles Traveled of 17% and 5% in Wake and Johnston Counties respectively, and a 20% increase in Vehicle Hours of Travel in Wake County. Overall, the improvements implemented at noted bottlenecks on I-40 have resulted in an approximately $3.0 million annual cost savings for users of the freeway.



Capital Area MPO Highway Network

INTRODUCTION

The NC Capital Area MPO is required by federal law to develop and implement a Congestion Management Process (CMP) as part of routine transportation planning efforts. The MPO finalized its CMP toolkit and adopted its CMP on June 16, 2010. This Status of the System (SOS) Report, a product of the CMP provides an overview of the system for which the MPO provides long-range planning, and will:

- Outline high congestion sections of roadway, bottlenecks, etc.,
- Identify solutions implemented to address the congested areas,
- Provide an evaluation of projects/programs that have been implemented in those areas.

WHAT IS A CMP?

A Congestion Management Process (CMP) is a management system and process used by an MPO to improve traffic operations and safety by using strategies that: (1) reduce travel demand or (2) allow the implementation of operational improvements.

A CMP usually identifies low-cost improvements with short timeframes (5-10 years), where traditional projects (lane additions etc.) can cost significantly more and have longer implementation timeframes.

The public benefits from having a functional CMP in place since it can improve travel conditions through the use of short-term, low-cost improvements.

OUR APPROACH

A major element of the SOS report is identification of the top ranked (most severely congested) highway segments. This ranking is based on a technical, measurable evaluation of key mobility factors. This ranking system is used as the foundation for the MPO's Congestion Management Process (CMP).

The CMP focuses on operational strategies to improve mobility conditions and safety in congested corridors. The following sample of mobility performance measures illustrate some of the data used to provide guidance at the MPO on prioritizing projects:

Travel Time Index (TTI)

Defined as a measure of conditions that indicates how much longer travel times are during congestion compared to periods of light traffic.

Example:
A TTI of 1.60 means that for a trip that usually takes 10 minutes in light traffic, a traveler should budget an additional 6 minutes on average.

Average Daily Traffic (ADT)

Is a measure of the total volume of vehicle traffic of a highway or road for a year divided by 365 days. ADT is a useful and simple measurement of how busy the road is.

Example:
A roadway sees a total volume of 7 million cars in a year. 7,000,000/365 = 19,178 ADT. This means that the Average daily traffic on this section of roadway is 19,178 cars per day.

The CMP Annual Update Process

To effectively reduce congestion, the MPO is evaluating an annual update process. As shown on the previous chart, the process includes three phases:

identifying congested corridors,
screening the corridors to identify potential strategies, and
identifying/implementing potential projects.

Phase 1:

Congested Corridor Network Identification

Congested Roadway and Intersection Identification:

Annual monitoring efforts are used to review the level of service on the roadway network to identify recurring congestion. Roadways that are congested today, or forecasted to be congested in five years, are considered for review through the CMP screening process in Phase 2.

High Frequency Corridor/Intersection Identification:

Crash data management systems are used to identify corridors or intersections with a high frequency of crashes that result in nonrecurring congestion. Safety improvements not only reduce the potential harm to persons in our communities but also can reduce congestion.

Phase 2:

CMP and Safety Strategy Screening

Once congested corridors are selected for review, they are screened to identify mitigation strategies appropriate to reduce congestion or improve safety to reduce crashes.

Congestion Mitigation Process Strategy Matrix:

Used to address recurring congestion, and should be used in a workshop setting to quickly review a corridor.

Safety Mitigation Strategy Matrix:

Used to address non-recurring congestion and is applied based on a review of crash data.

Phase 3:

Project Identification and Implementation

Congestion/safety mitigation strategies that are identified as having the greatest potential benefit are then evaluated in greater detail based on committee/technical recommendations.

Analysis of potential projects is undertaken to identify specific improvements, implementation issues, and costs. “Programs” such as demand-reducing programs or policy changes are evaluated to identify recommended action items. Recommendations are made for the projects or programs to be implemented.

This may result in a near-immediate refocusing of existing resources, programming improvements in the local agency capital improvement programs, or using funds controlled by the MPO, and finally may be identified as candidate projects for implementation in future Metropolitan Transportation Plans (MTPs).

SYSTEM TRENDS AND CONDITIONS

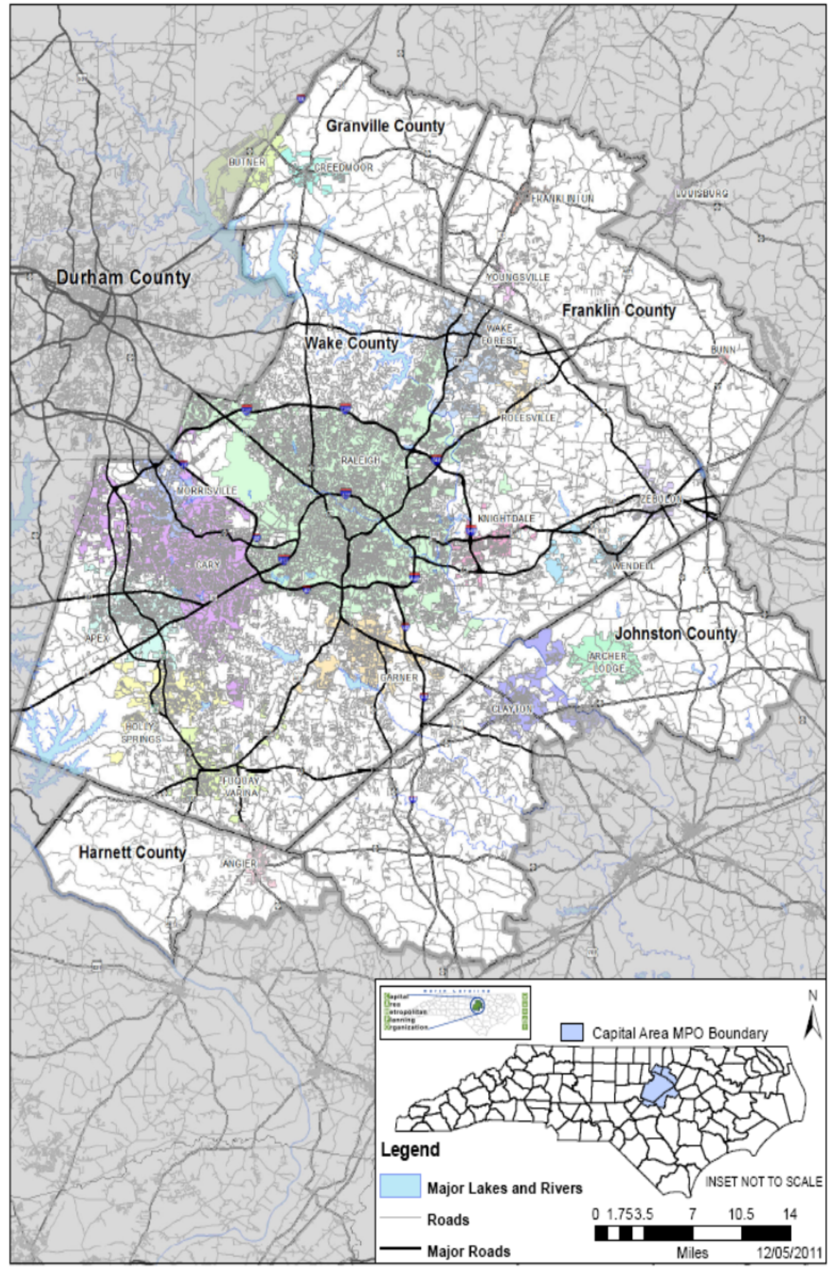
The North Carolina Capital Area MPO now represents a geographic region containing over 1 million people with the City of Raleigh being the largest jurisdiction. The MPO boundaries include the entirety of Wake County and portions of Franklin, Granville, Harnett, and Johnston counties, all of which border Wake County. This portion of the Status of the System Report references transportation system performance measures during the years 2005 and 2010 for the MPO planning area.

The following system performance measures were monitored to identify mobility conditions and trends in the MPO planning area:

- Vehicle miles of travel (VMT)
- Vehicle hours of travel (VHT), and
- Speed
- Duration of Congestion

The 2010 INRIX national scorecard for the Raleigh area was used to highlight known congested locations, and the efforts made to improve those locations. Since this report focuses on conditions in 2010, tasks that are currently underway such as the Ramp Metering Feasibility Study, Incident Management, and Transportation Demand Management programs will not be addressed in detail at this time. The aforementioned tasks will be recorded in the next Status of the System Report.

The primary data sources for the Status of the System Report are the Triangle Regional Travel Demand Model and INRIX data through an agreement with the North Carolina Department of Transportation (NCDOT). The information is updated annually with traffic data compiled by NCDOT, the MPO, and local governments.



Vehicle Miles of Travel (VMT)

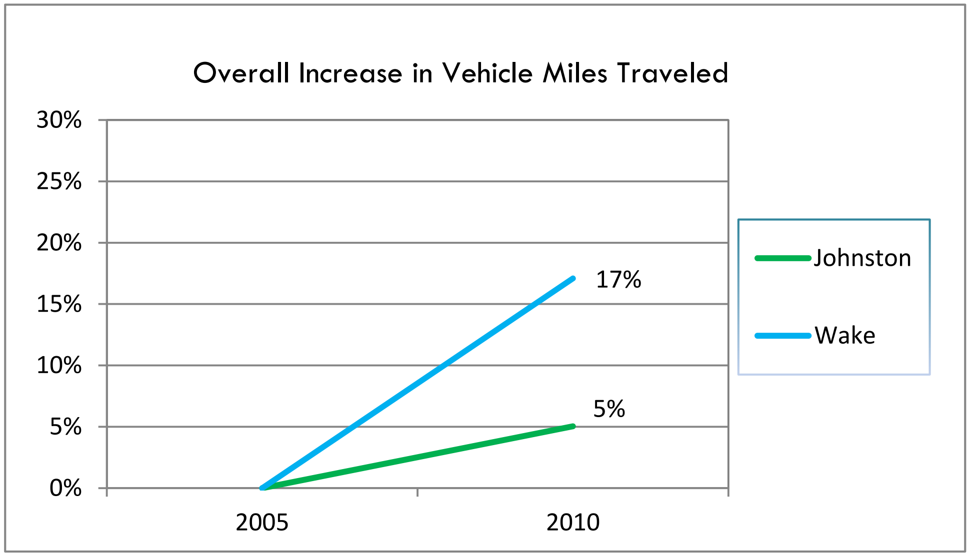
Vehicle Miles of Travel is a measure of the estimated number of miles driven on the roadway network during an average day. For an urbanized area, VMT is a good measure for estimating travel habits. For a given segment in the MPO area, VMT is measured by multiplying the average annual daily traffic (AADT) volume for the roadway segment by the length of the segment.

i.e. [Volume of segment x length of segment = VMT

40,000 cars per day x 1 mile segment]
= 40,000 vehicle miles of travel

The following charts and tables compare the average daily VMT for interstates, freeways and arterials in the MPO area for the years 2005 and 2010. The tables display VMT by roadway classification and by county within the MPO area.

Total VMT increased in Johnston, and Wake counties from 2005 to 2010.



Both Wake County and Johnston County experienced increases in total vehicle miles traveled between 2005 and 2010. This is due to general population and vehicular growth and available employment opportunities in the two counties as compared to the neighboring counties of Franklin, Granville, and Harnett.

Table One. Vehicle Miles of Travel

Johnston County	2005	2010	Percentage Change
Interstate	2,326,850	2,225,469	-4.36%
Freeway	0	0	0.00%
Principal Arterial	747,068	1,040,862	39.33%
Minor Arterial	446,693	431,684	-3.36%
Total	3,520,610	3,698,015	5.04%

Johnston County's vehicle miles traveled overall increased by 5%. Interstate travel decreased by 4% and Minor Arterial travel decreased by 3%. Principal Arterials however saw an increase of 39%.

Table Two. Vehicle Miles of Travel

Wake County	2005	2010	Percentage Change
Interstate	5,499,816	6,695,253	21.74%
Freeway	1,623,896	1,771,346	9.08%
Principal Arterial	4,473,404	5,154,928	15.24%
Minor Arterial	4,723,008	5,487,723	16.19%
Total	16,320,124	19,109,250	17.09%

In Wake County, an increase of 17% was seen in the overall vehicle miles traveled. Roadways experienced increases between 9% and nearly 22%. These increases are due to continued growth in population and the subsequent vehicle fleet that is using the roadways to travel to home and employment destinations.

Table Three. Vehicle Miles of Travel

Franklin County	2005	2010	Percentage Change
Interstate	0	0	0.00%
Freeway	0	0	0.00%
Principal Arterial	358,446	347,637	-3.02%
Minor Arterial	380,410	382,728	+0.61%
Total	738,856	730,365	-1.15%

Total VMT decreased in Franklin, Granville, and Harnett counties from 2005-2010. Using 2005 as our start, the chart below shows the change in VMT in these counties.

Franklin County had the lowest overall decrease in VMT. The minor arterial road classification received an increase of less than one percent. The data indicates that drivers are making more short trips within their nearby communities instead of longer commuter trips.

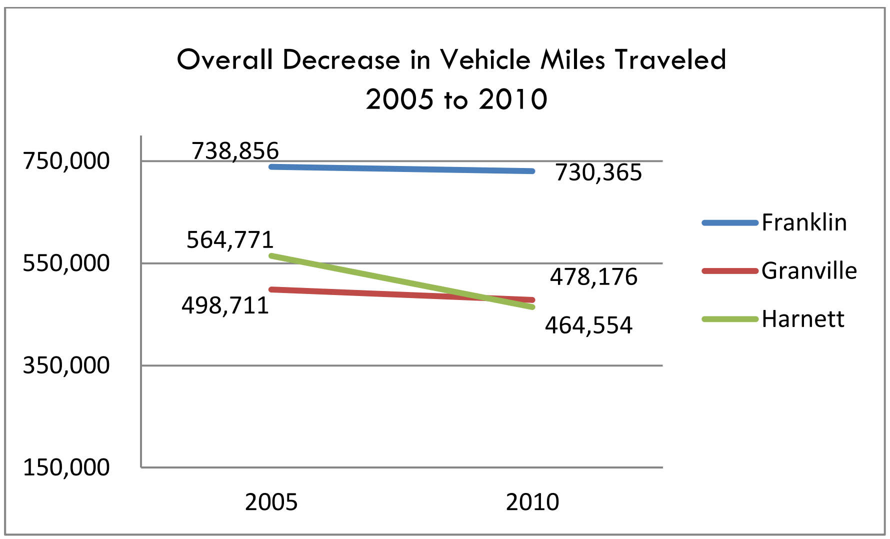


Table Four. Vehicle Miles of Travel

Granville County	2005	2010	Percentage Change
Interstate	6,687	6,468	-3%
Freeway/Expressway	0	0	0%
Principal Arterial	157	125	-21%
Minor Arterial	554	443	-20%
TOTALS	7,398	7,036	-5%

Granville County saw a decrease in vehicle miles traveled on all of its roadways. Interstate 85 saw a decrease of 3% and arterials saw decreases in excess of 20%. The decreases can be attributed to the economic downturn in Granville County, which in turn has affected travel to and from employment and home destinations.

Table Five. Vehicle Miles of Travel

Harnett County	2005	2010	Percentage Change
Interstate	0	0	0%
Freeway/Expressway	0	0	0%
Principal Arterial	4,181	3,147	-25%
Minor Arterial	7,150	5,930	-17%
TOTALS	11,331	9,077	-20%

In Harnett County, there are no interstate or freeway facilities within the MPO planning area. Arterials however saw decreases of 17%-25%. The decreases can be attributed to the economic downturn and limited employment opportunities in Harnett County, which in turn has affected travel to and from employment and home destinations.

Vehicle Hours of Travel (VHT)

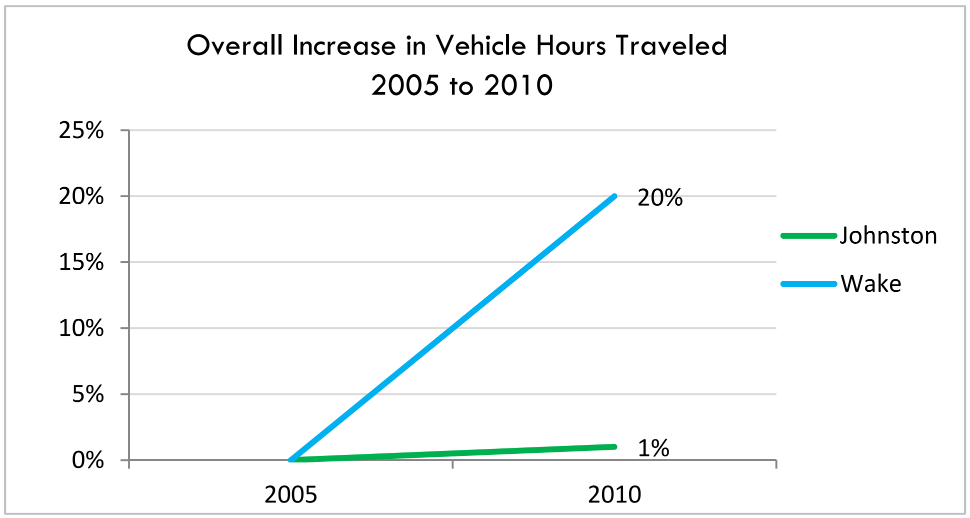
Vehicle hours of travel (VHT) is a measure of the number of hours vehicles have driven on a given roadway segment during an average day. VHT is calculated by dividing the segment VMT by the average vehicle speed.

i.e.

VHT = VMT (volume x length) / average speed

using the VMT calculated above:
40,000 vehicle miles of travel / 50 mph (average speed)
= 800 vehicle hours of travel

The following charts and tables compare the average daily VHT for interstates, freeways, and arterials in the MPO area for the years 2005 and 2010. The table display VHT by roadway classification and by county within the MPO area.



Total VHT increased in both Johnston and Wake counties.

The increase in VHT in Wake County shows a directed correlation between population and vehicular growth and hours traveled. The growth was consistent along all roadway classifications.

Table One. Vehicle Hours of Travel

Wake County	2005	2010	Percentage Change
Interstate	86,292	108,994	26%
Freeway	27,556	30,580	11%
Principal Arterial	96,605	115,318	19%
Minor Arterial	113,841	135,361	19%
Total	324,295	390,253	20%

The chart below identifies both increases and decreases along Johnston County's facilities between 2005 and 2010. There was a significant decrease in VHT along the interstate system in Johnston County. This could be attributed to the opening of the US 70 Bypass in 2008 as well as the economic slowdown of the past few years. The US 70 Bypass is classified as a "Principal Arterial", and as a result, the "Principal Arterial" classification received a 12% increase during that time period.

Table Two. Vehicle Hours of Travel

Johnston County	2005	2010	Percentage Change
Interstate	32,961	31,472	-5%
Freeway	0	0	0%
Principal Arterial	17,507	19,633	12%
Minor Arterial	8,960	8,855	-1%
Total	59,428	59,960	1%

VHT decreased in Franklin, Granville, and Harnett counties between 2005 and 2010.

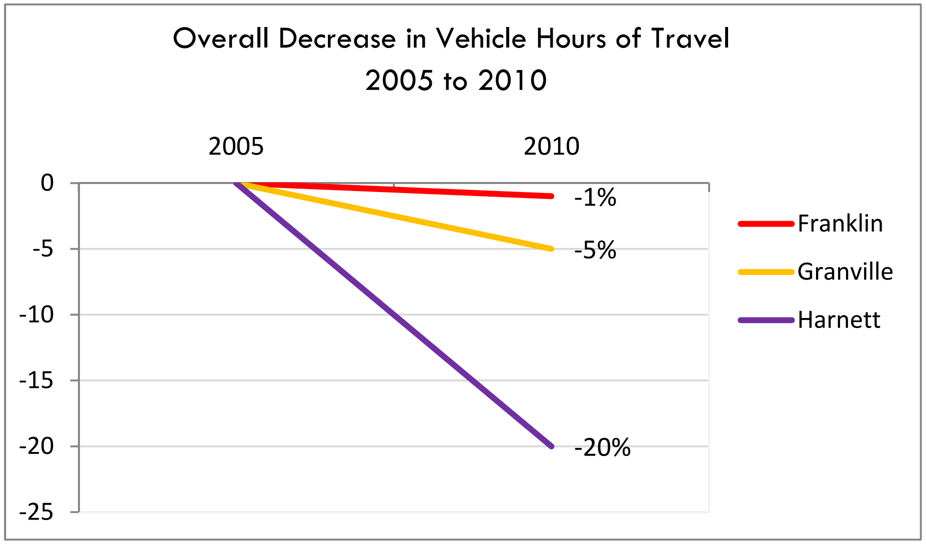


Table Three. Vehicle Hours of Travel - Franklin County

Franklin County	2005	2010	Percentage Change
Interstate	0	0	0
Freeway	0	0	0
Principal Arterial	6,393	6,199	-3%
Minor Arterial	7,251	7,304	1%
Total	13,644	13,503	-1%

The chart above for Franklin County, as well as the following charts for Granville and Harnett Counties shows a decrease in VHT. This is consistent with the decrease in VMT addressed in the earlier section.

Economic development opportunities (and activities) in these counties as compared to Wake and Johnston Counties has been very limited. As a result, the vehicle fleet activity of those counties has decreased along the highway systems.

When comparing VMT and VHT for the minor arterial classification in Franklin, the data indicates that people are driving slightly more miles and spending more time on roads within the general Franklin County community.

Table Four. Vehicle Hours of Travel – Granville County

Granville County	2005	2010	Percentage Change
Interstate	6,687	6,468	-3%
Freeway	0	0	0%
Principal Arterial	157	125	-20%
Minor Arterial	554	443	-20%
Total	7,398	7,036	-5%

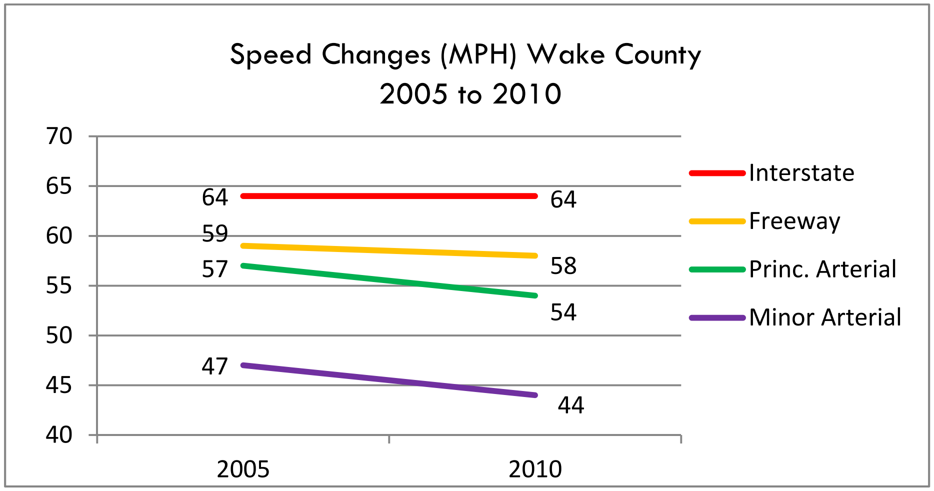
Table Five. Vehicle Hours of Travel – Harnett County

Harnett County	2005	2010	Percentage Change
Interstate	0	0	0%
Freeway/ Expressway	0	0	0%
Principal Arterial	4,181	3,147	-25%
Minor Arterial	7,150	5,930	-17%
TOTALS	11,331	9,077	-20%

Speeds

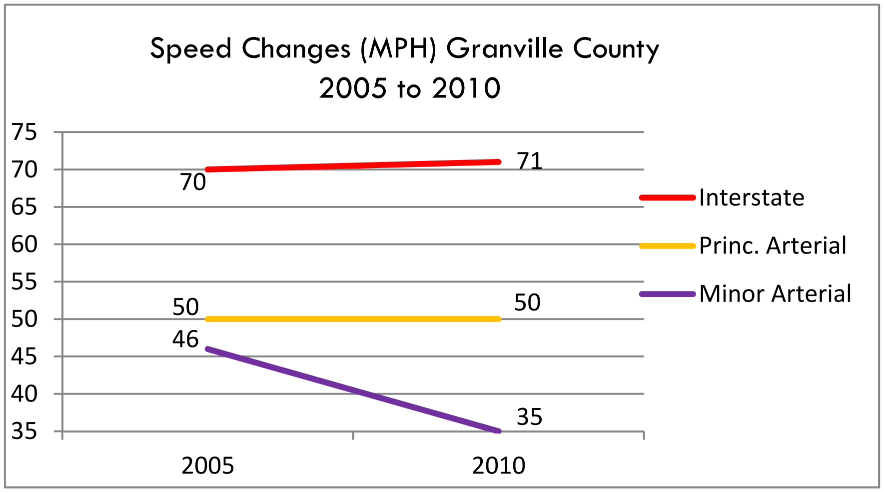
Wake County

Speeds along interstate facilities in Wake County experienced no changes between 2005 and 2010; which is significant given the vehicle miles traveled increased. However, freeways, principal and minor arterial roads in Wake County experienced decreased speeds between 2005 and 2010. This could be due to increased congestion along the highway system in part as a result of increased population and additional vehicles on the roadways.



Granville County

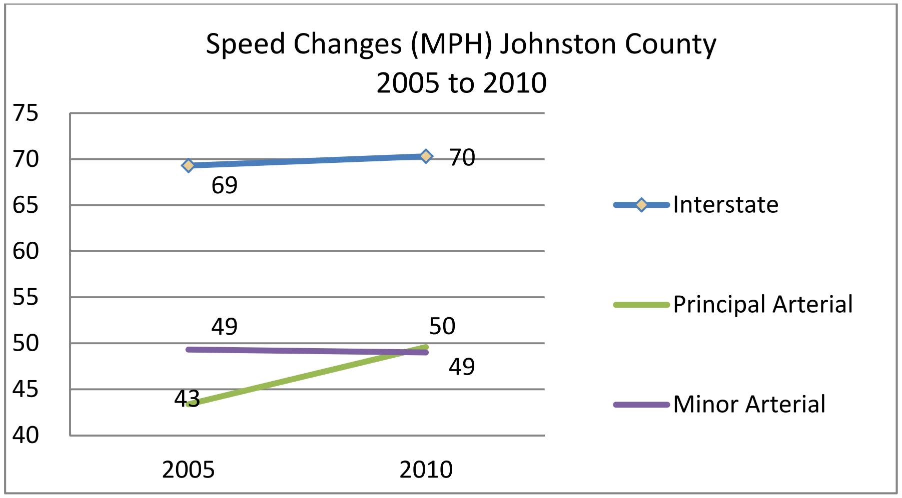
Speeds along minor arterial roadways in Granville County decreased between 2005 and 2010; which also coincides with the decrease in the vehicle miles and vehicle hours traveled along such roads. As mentioned earlier, economic conditions in Granville County have negatively impacted travel patterns and behavior. Changes in the county's economic fortune will impact traffic and travel conditions and will be carefully monitored.



Johnston County

Speeds along interstates and principal arterial roads in Johnston County increased between 2005 and 2010 as compared with the neighboring MPO counties. The US 70 (Clayton Bypass) which is classified as an arterial but functions as a freeway through Johnston County, opened in 2010. Speeds along minor arterial facilities remained constant through this period.

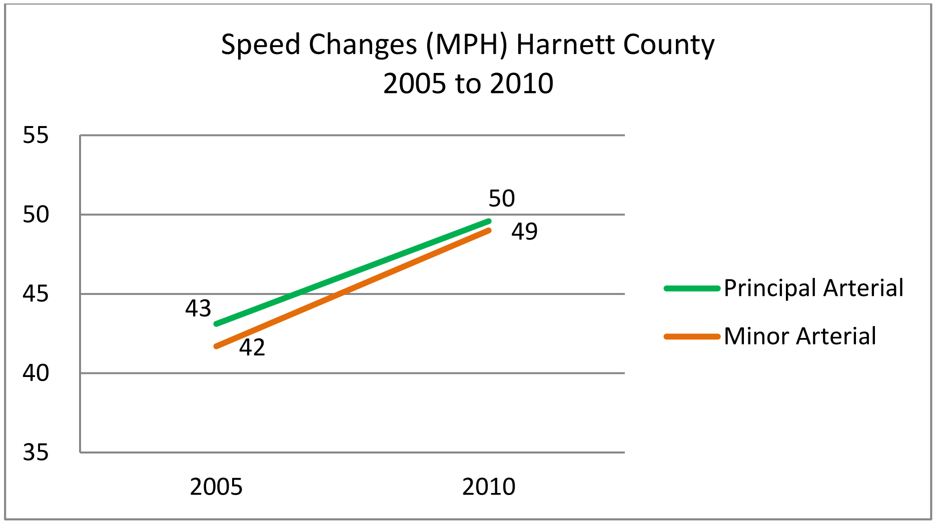
In spite of the national economic downturn, Johnston County has maintained a relatively healthy job market, with moderate growth due to "spillover" development from Wake County. The opening of the Clayton Bypass in 2010 has benefitted travelers through Johnston County whose destinations may either be to downtown Raleigh, Research Triangle Park, or the southern and eastern coastal communities of North Carolina.



Harnett County

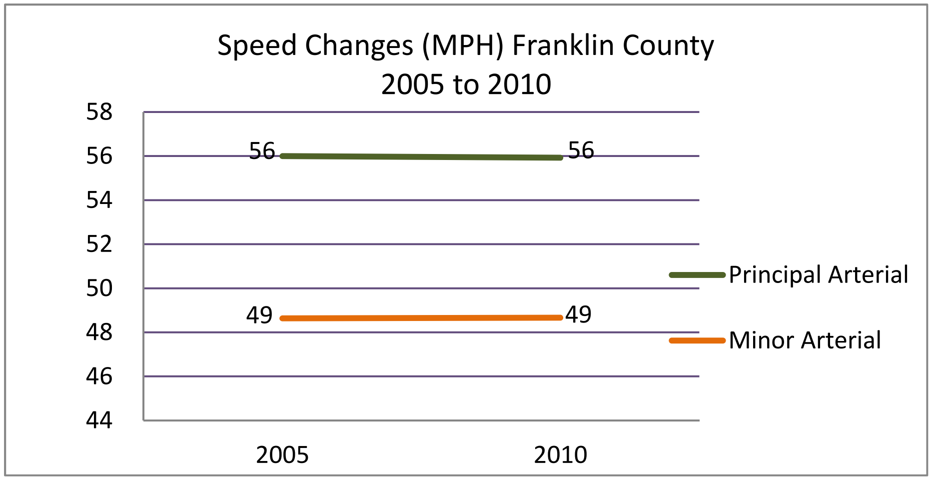
While vehicle miles traveled and vehicle hours traveled decreased in Harnett County, speeds increased on both principal and minor arterial roads. Harnett County lies between the major employment centers of Raleigh, Research Triangle Park, and Fort Bragg.

Highways such as NC 42, NC 55, NC 210, and US 401 remain two-lane facilities through northwestern Harnett County. Minimal development has occurred along these highways at this point in time however, future development will increase delay on the existing highway system.



Franklin County

There were no changes in speeds along Franklin County roads between 2005 and 2010. Although the county has experienced moderate growth there have been no significant transportation facility improvements that coincide with that growth. As US 1 and US 401 are either widened, or converted to superstreets or freeways, speeds are expected to slightly increase on these and other roads traversing Franklin County.



Congested Roadways

For the purpose of this report, an arterial or freeway is considered congested if:

> the travel time index is measured to be 1.15 or higher (smaller than 1.15 is uncongested, between 1.15 and 1.30 is lightly congested, between 1.30 and 2.00 is moderately congested, and greater than 2.00 is severely congested).

For example, the Texas Transportation Institute's 2011 Congested Corridors Report lists eastbound I-40 between Airport Boulevard (Exit 284) and Chapel Hill Road (Exit 290) having a travel time index of 1.57. (See http://mobility.tamu.edu/files/2011/11/NC-ccr.pdf)

Duration of Congestion

Duration of congestion for a roadway segment is a measure of the severity of the congestion. The duration of congestion is calculated by:

> Identifying all 15-minutes periods during an average day for which traffic volumes exceed capacity.

The following table lists the interstate/freeway and arterial segments that average more than one hour of congestion per day. The segments were identified based location along with traffic direction, functional classification, average duration, and average maximum length (of the congested area)

Location	Functional Classification	Average Duration	Average Length (Miles)
I-40 at US 70 (Exit 306) Eastbound	Interstate	1h 06 min	2.86
US 1 (Southbound) at US 401	Principal Arterial	1h 42 min	1.29
US 70 (Westbound) at Morehead Drive (Crabtree Valley Area)	Principal Arterial	1h 30 min	1.29
US 1 (Northbound) at Burlington Mills Road	Principal Arterial	1h 12 min	3.08
US 70 (Eastbound) at I-440/US 1	Principal Arterial	1h 8 min	1.06
NC 98 (Westbound) at NC 96	Minor Arterial	1h 31 min	0.07
NC 96 (Northbound) at NC 98	Minor Arterial	1h 11 min	0.07
NC 96 (Southbound) at NC 98	Minor Arterial	1h 02 min	0.07

Segments with One or More Hours of Congestion on an Average Day

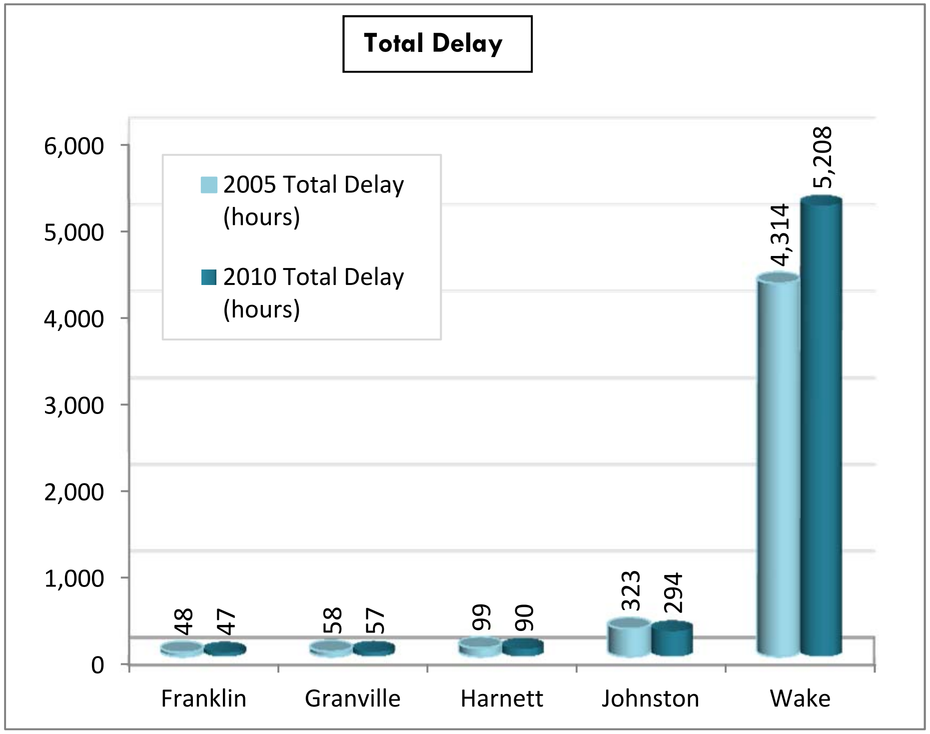
Delay

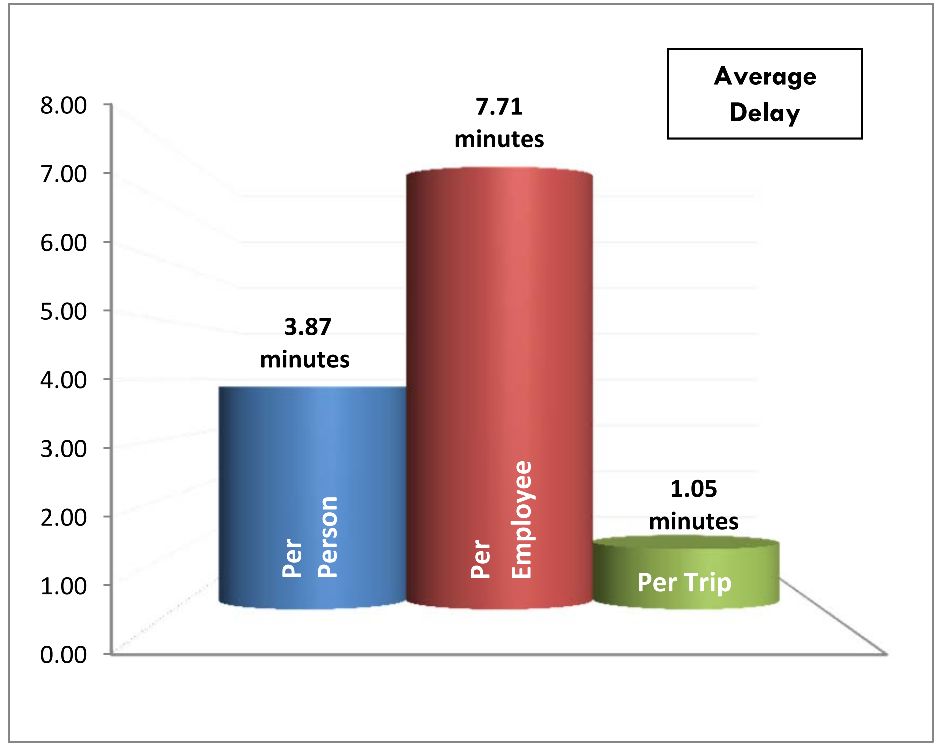
Delay is defined as, 'the difference in travel time between peak and off-peak periods'.

The Charts on page 12, using information from the Triangle Regional Model, illustrate two methods of viewing delay

Total Delay
The delay per vehicle x number of vehicles
And
Delay per commuter experienced on a per person, per employee, and per trip basis.

DELAY IN THE CAPITAL AREA MPO PLANNING AREA - 2010





This Graph compares the <u>total delay</u> (in hours per year) experienced by the drivers living in each county between 2005 and 2010. Wake County has, by far, the highest amount of delay in both 2005 and 2010.

As this shows, between 2005 and 2010, delay in Franklin, Granville, Harnett and Johnston Counties *decreased* slightly. Delay in Wake County however, increased.

The Chart above displays daily delay in the Year 2010 using three distinct categories as noted on Page 11. Using variables such as "Delay Hours", the total population, the total employees, and the calculated total number of trips in 2010 the delay for each category can be computed.

The total delay hours in CAMPO has been calculated at 68,378. The total population of the CAMPO region is estimated to be 1,060,192. The total employment population is estimated to be 532,365. The total number of trips that were driven within CAMPO is estimated to be 3,909,398.

The chart illustrates an average for delay within the Capital Area MPO and <u>not</u> specific delays experienced by typical commuters to regional employment centers such as downtown Raleigh, North Carolina State University, and Research Triangle Park

INRIX, one of the world's leading traffic data providers, published their National Traffic Scorecard Annual Report in 2010 that analyzed and compared the status of traffic congestion throughout the United States. This report has become a trusted benchmark for understanding congestion and the impact in metropolitan areas. The 2010 National Traffic Scorecard Annual Report on the following page shows that the Raleigh area was number 52 out of 100 nationally in traffic congestion.

Subsequent reports completed by INRIX in 2011 and 2012 respectively show that the Raleigh area has climbed the congestion ladder to ranks 41 and 37.

These rankings validate the 2010 Scorecard Report's Executive Summary which states, "Drawing on five years of trend data, this 2010 National Traffic Scorecard Annual Report documents that after three years of relatively modest traffic congestion, America is now back on the road to gridlock with a vengeance. The data shows congestion is on its way back, even with only modest urban area job growth".

- We're back on the road to gridlock…
  but not for everyone, everywhere
- Congestion is acting like a magnet
  attracting more congestion
- Freight mobility is a national issue, and
  an increasingly important issue
- If we want to "win the future,"
  we need to address congested corridors
- Operating the system is the biggest force multiplier available
  to impact full network performance

"Drawing on five years of trend data, this 2010 National Traffic Scorecard Annual Report documents that after three years of relatively modest traffic congestion, America is now back on the road to gridlock with a vengeance. The data shows congestion is on its way back, even with only modest urban area job growth"

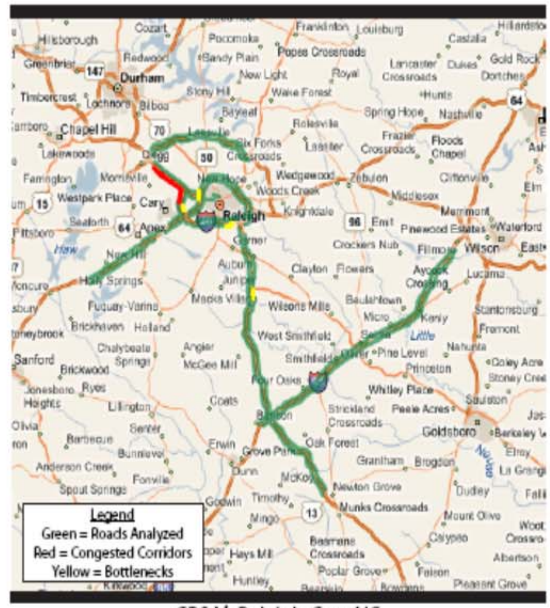
INRIX 2010 National Traffic Scorecard, Executive Summary

#52 Raleigh Metropolitan Area

National Congestion Rank: #52

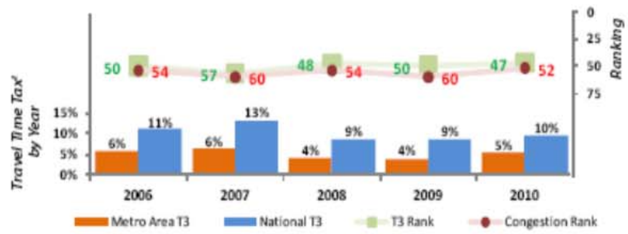
—3% of Peak Period[2] Congestion of Nation's Worst Metro Area (L.A.)

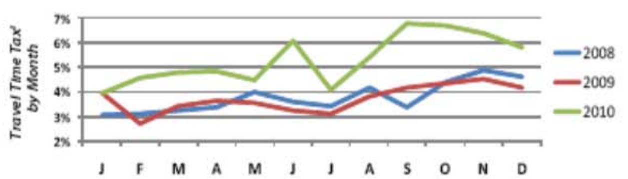
Population Rank: #49 (1,126,000)



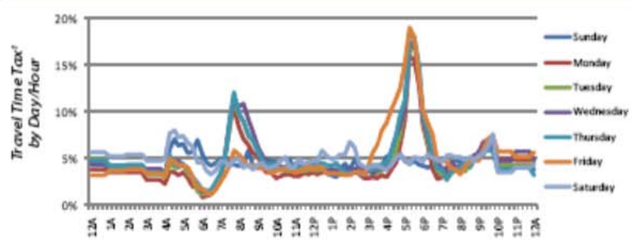
CBSA[4]: Raleigh-Cary NC

Trends
for Peak Period[2] Congestion in Metro Area





Patterns
for 2010 Congestion in Metro Area



What Was the Worst Time? Friday, 5:15-5:30 PM [19% Travel Time Tax[1]]

Impact
of Employment Changes

	Total Employment 2006	Total Employment 2010	Change Total	Change %	Travel Time Tax[1] 2006	Travel Time Tax[1] 2010	Change Total	Change %
Metro Area	496 K	500 K	4 K	0.8%	5.6%	5.3%	-0.3%	-5.0%
Top 100 Metros	93.3 M	87.9 M	-5.4 M	-5.8%	11.1%	9.7%	-1.4%	-12.7%
National	136.9 M	130.7 M	-6.2 M	-4.5%	N/A			

Congested Corridors and Bottlenecks
across Metro Area in 2010

Congested Corridors[5] (1 Total in Metro Area)

Regional Rank	National Rank	Road/Direction	From	To	Length (miles)	Uncongested Travel Time (min)	Peak Period[2] (AM/PM)	Peak Period[2] Travel Time (min)	Peak Period[2] Tax[1](%)	Worst Hour (Day & Hour)	Worst Hour Travel Time (min)	Worst Hour Tax[1](%)
1	219	I-40 EB	AIRPORT BLVD/EX 284	NC-54/EX 290	6.9	6	PM	12	81%	F, 4-5pm	17	174%

Bottlenecks (9 Total in Metro Area)

Regional Rank	National Rank 2010	National Rank 2009	Road/Direction	Segment/Interchange	County	State	Length (miles)	Hours of Congestion[3]	Average Speed when Congested[3] (mph)
1	2041	2749	I-40 EB	HARRISON AVE/EXIT 287	Wake	NC	2.31	12	25.9
2	2139	2682	I-40 EB	RALEIGH CHAPEL HILL EXPY/EXIT 289	Wake	NC	2.09	12	27.0
3	2954	3233	I-40 WB	CARY TOWNE BLVD/FARM GATE RD/EXIT 291	Wake	NC	1.00	8	27.3
4	3165	3413	I-40 EB	AVIATION PKWY/EXIT 285	Wake	NC	1.28	6	24.3
5	3213	3192	I-40 EB	NC-54/EXIT 290	Wake	NC	1.26	7	27.8
6	3443	3201	I-440 WB	WADE AVE/EXIT 4	Wake	NC	0.93	5	22.1
7	3472	4061	I-440 WB	NC-54/HILLSBOROUGH ST/EXIT 3	Wake	NC	0.29	6	26.8
8	3517	4579	I-40 EB	ROCK QUARRY RD/EXIT 300	Wake	NC	1.14	5	24.5
9	3612	#N/A	I-40 WB	JOHNSTON/WAKE COUNTY LINE (GARNER) (SOUTH)	Johnston	NC	1.23	5	26.9

Notes:

1 - **Travel Time Tax** is the percentage of extra travel time (vs. "free flow") a random trip takes in the specific region and time period analyzed. A 10% tax means 10% additional trip time due to congestion.
2 - **Peak hours** are Monday to Friday, 6 to 10 AM and 3 to 7 PM.
3 - **"Hours of Congestion"** is defined as times of the week when a road segment's average hourly speed is half or less than its uncongested speed.
4 - **CBSA** stands for "Core Based Statistical Area," the official term for a functional region based around an urban center of at least 10,000 people, based on standards published by the U.S. Government's Office of Management and Budget (OMB).
5 - **Corridors** are composed of multiple contiguous bottlenecks totaling at least 3 miles in length.

Additional information on the methodologies used in this report are available at http://scorecard.inrix.com.

Congested Highway Bottlenecks

A traffic bottleneck is a disruption of vehicular traffic on a street, road or highway. As opposed to a traffic jam (a condition on road networks that occurs as use increases), a bottleneck is typically a result of a specific physical condition, insufficient roadway capacity, traffic signal timing, or design considerations such as lane widths, traffic merges, or alignments. They are also caused by temporary situations, such as construction and maintenance.

The Nine highway 'bottlenecks' identified the Raleigh area:

Regional Rank	National Rank 2010	National Rank 2009	Road / Direction	Segment / Interchange	County	Length (miles)	Hours of Congestion	Posted Speed	Average Speed when Congested	Speed Change
1	**2041**	**2749**	**I-40 EB**	**Exit 287 - Harrison Ave**	**Wake**	**2.31**	**12**	**65**	**25.90**	**-39.10**
2	2139	2682	I-40 EB	Exit 289 - Raleigh Chapel Hill Expressway	Wake	2.09	12	65	27.00	-38.00
3	2954	3233	I-40 WB	Exit 291 - Cary Towne Blvd/Farm Gate	Wake	1.00	8	65	27.30	-37.70
4	3165	3413	I-40 EB	Exit 285 - Aviation Parkway	Wake	1.28	6	65	24.30	-40.70
5	3213	3192	I-40 EB	Exit 290 - NC 54	Wake	1.26	7	65	27.80	-37.20
6	3443	3201	I-440 EB	Exit 4 - Wade Avenue	Wake	0.93	5	60	22.10	-37.90
7	3472	4061	I-440 WB	Exit 3 - NC 54 / Hillsborough Street	Wake	0.29	6	60	26.80	-33.20
8	3517	4579	I-40 EB	Exit 300 - Rock Quarry Rd	Wake	1.14	5	65	24.50	-40.50
9	3612	N/A	I-40 WB	Johnston/Wake Co. Line - Garner South	Johnston	1.23	5	65	26.90	-38.10

The I-40/Harrison Avenue segment was identified in 2010 as the most congested bottleneck in the Raleigh area; with average speeds nearly ***40 mph below*** the posted speed limit for nearly half of the day.

I-40 in the Raleigh area is home to 7 of these 9 bottlenecks. Interstate 40 is the region's "Main Street" for travel, commuting, and commerce. Congestion occurring at the bottlenecks along I-40 not only impacts the region's economic activity, but also has a negative impact on safety.

I-440, Raleigh's 'Beltline', is home to the remaining 2 bottlenecks.

NCDOT Congestion Mitigation Measures Implemented Along I-40

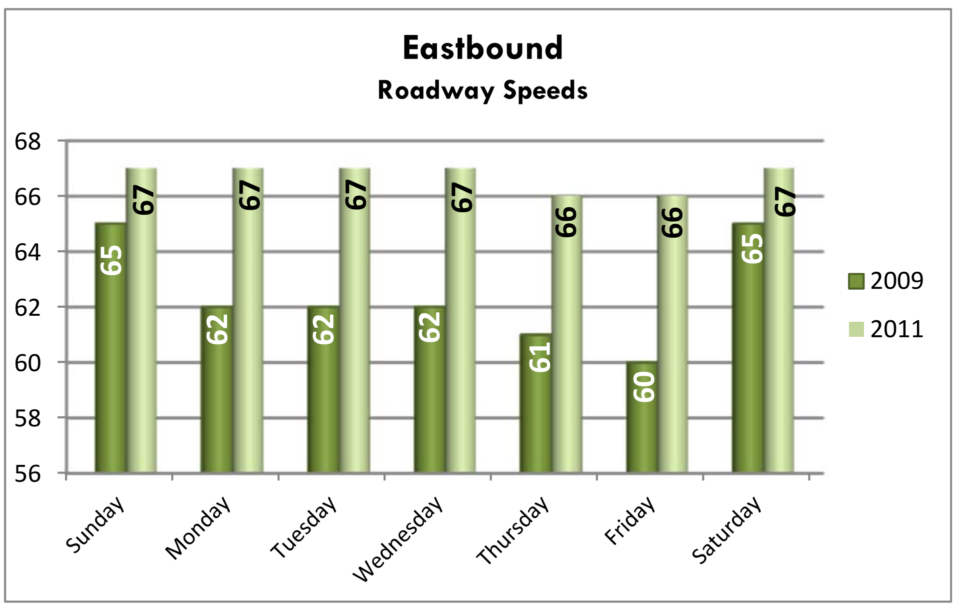
Most of the nine bottlenecks shown in the 2010 Scorecard have been addressed by NCDOT. One of NCDOT's Interstate 40 projects improved the bottlenecks that were ranked 1, 2, 3, and 5. The project addressing these bottlenecks improved I-40 between Harrison Avenue (Exit 287) and US-1/US-64 (Exit 293). The project (designated as I-4744) was a capacity-expansion of I-40. The roadway in this section was expanded from four lanes to six lanes and was completed June 30, 2011.

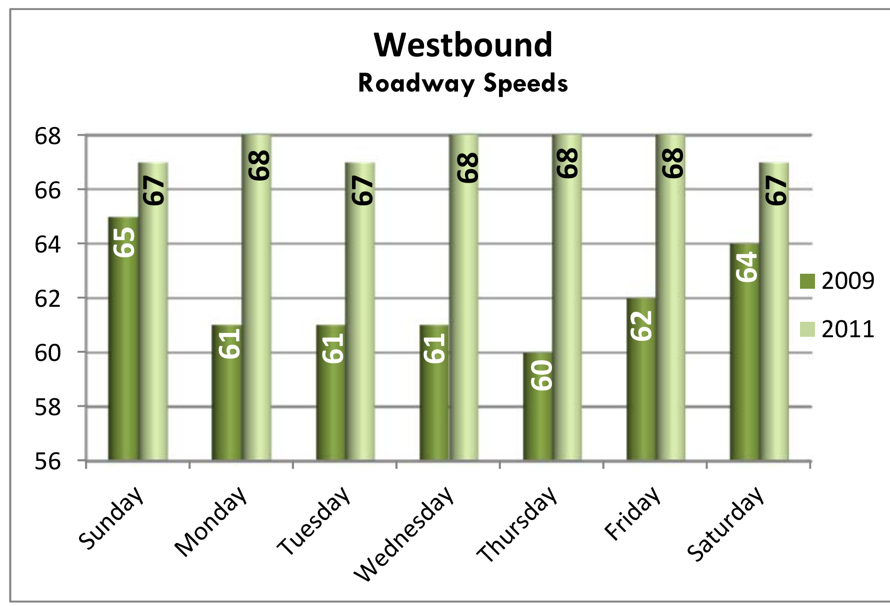
Bottlenecks 1,2,3 &5

The following graphics compare the ***average speed*** along I-40 prior to the construction of Project I-4744 in 2009 with the average speed along I-40 following the completion of Project I-4744 (June 30, 2011). The average speed through this segment of I-40 ***has increased*** by as much as 8 mph during the workweek; and 3 mph during the weekend. The increase in speed has improved travel times, and is directly related to a reduction in congestion.

I-4744 - Average Roadway Speed

Pre and Post Construction

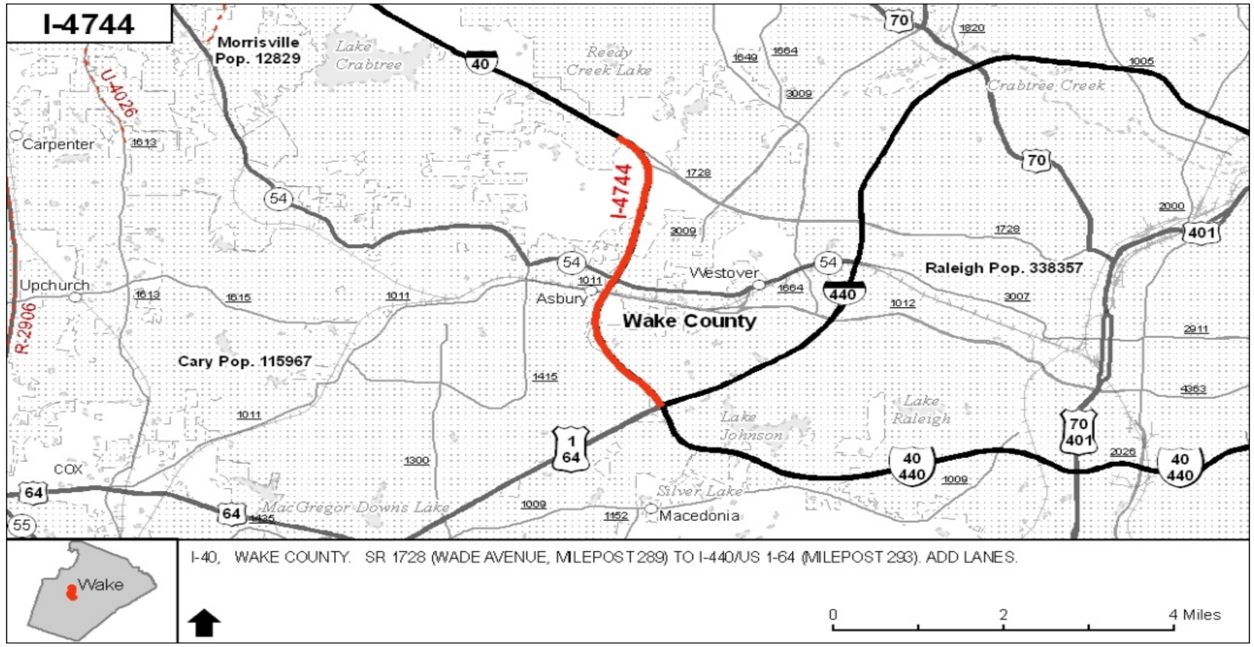


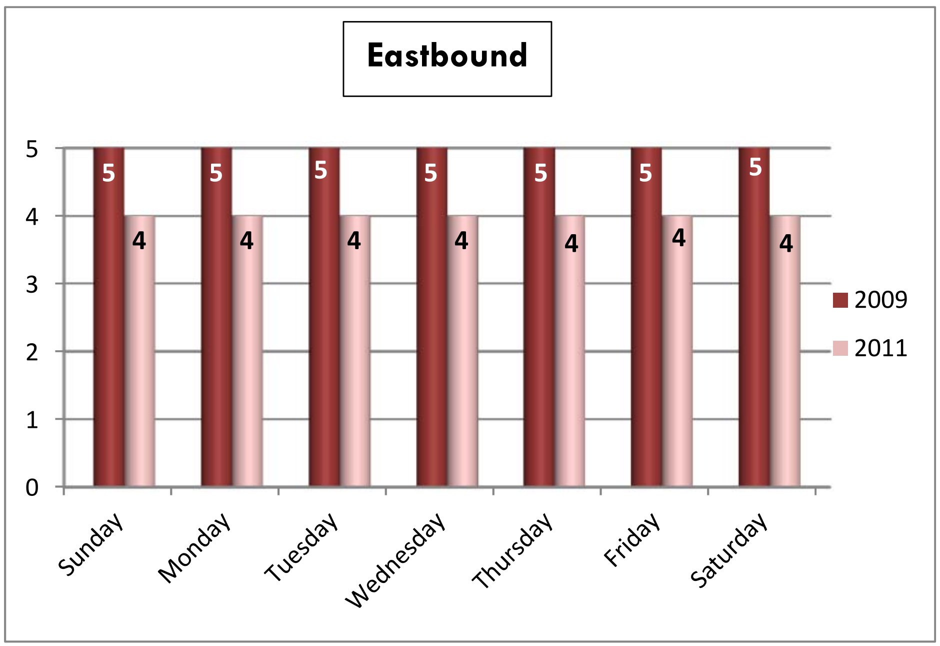


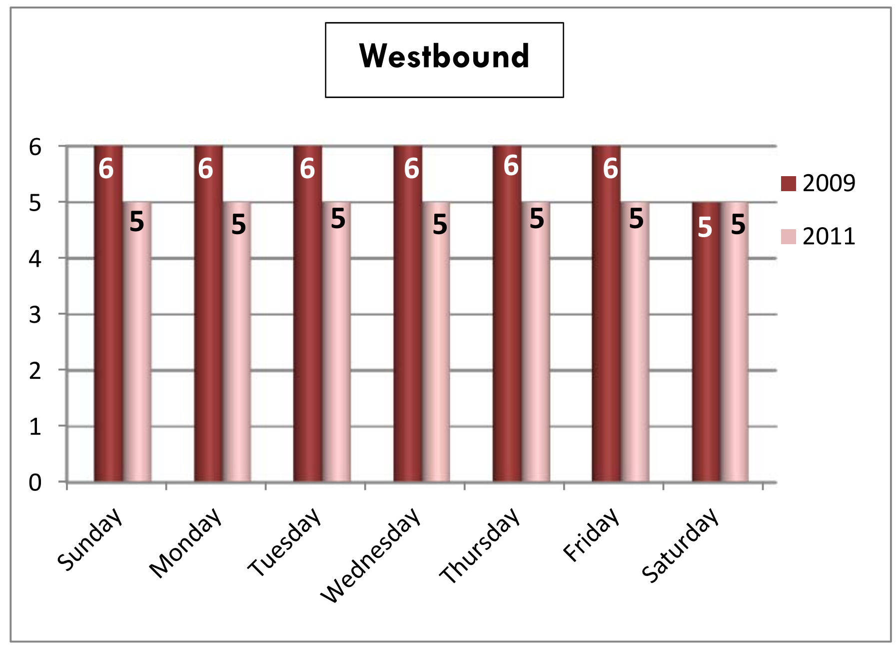
Travel Time

The following charts compare the ***travel time*** along I-40 within the project limits of I-4744 in 2009 with the travel time following completion of the project (June 30, 2011).

Due to the increase in speed (shown on page 16), **travel time** through this segment of I-40 has ***been reduced*** in both directions during the weekdays.



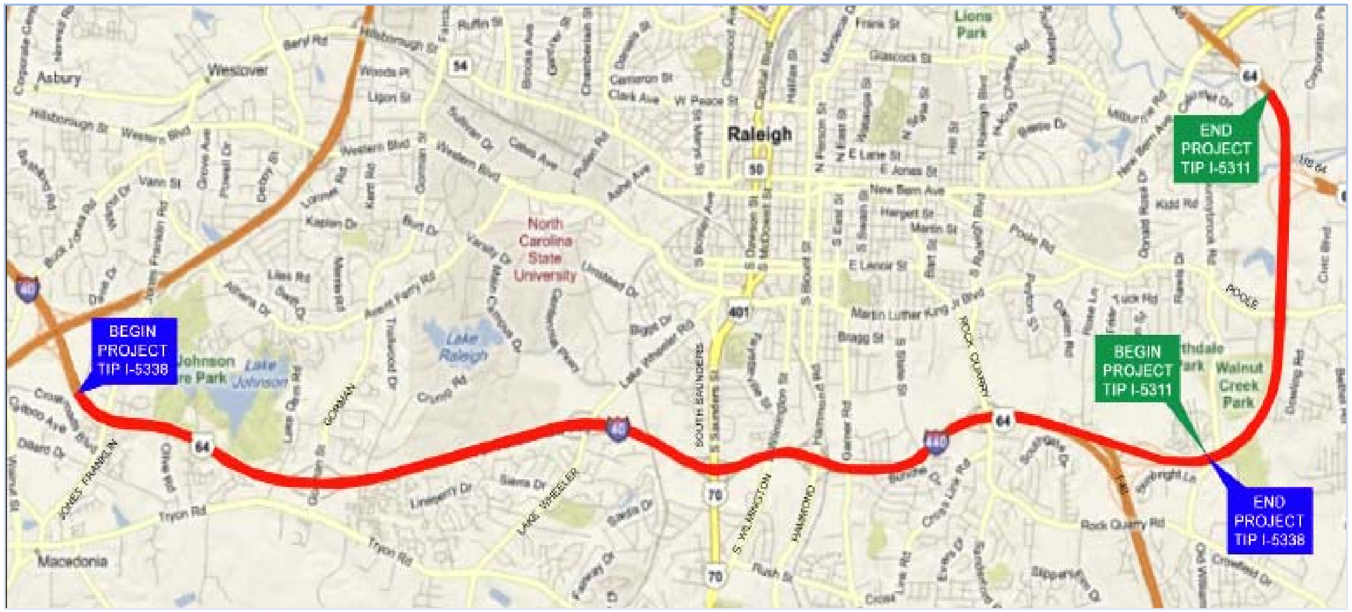




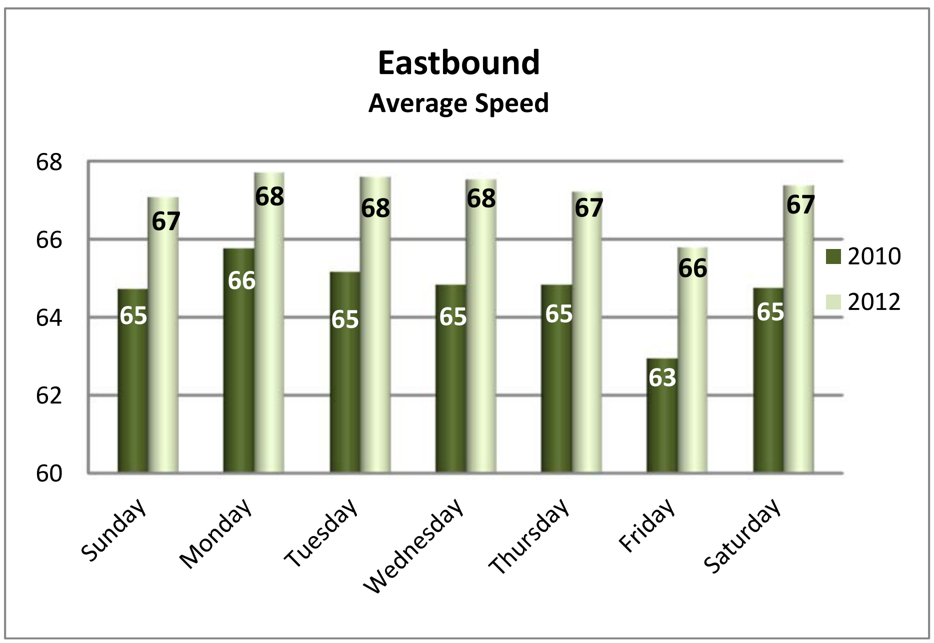
Bottleneck 8 - Average Speed

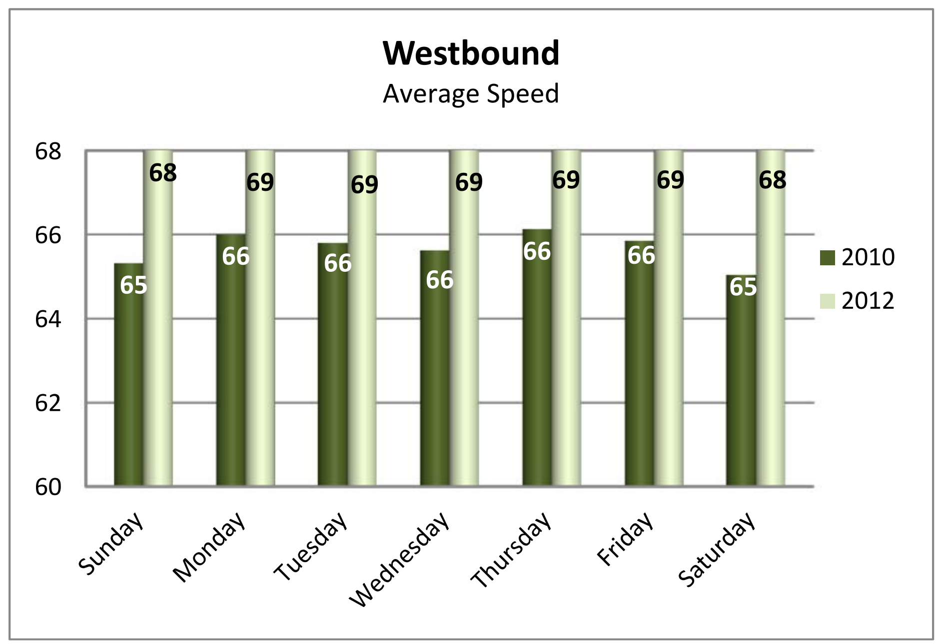
The I-40 bottleneck ranked number 8 (Rock Quarry Road vicinity) will be within the limits of Project I-5338/I-5311; expected to be let early in 2013.

A future project that will have significant impact on this bottleneck will be Project I-5111 - widening I-40 from I-440 in Wake County to NC 42 in Johnston County – scheduled for construction after 2017.



I-5338/I-5311

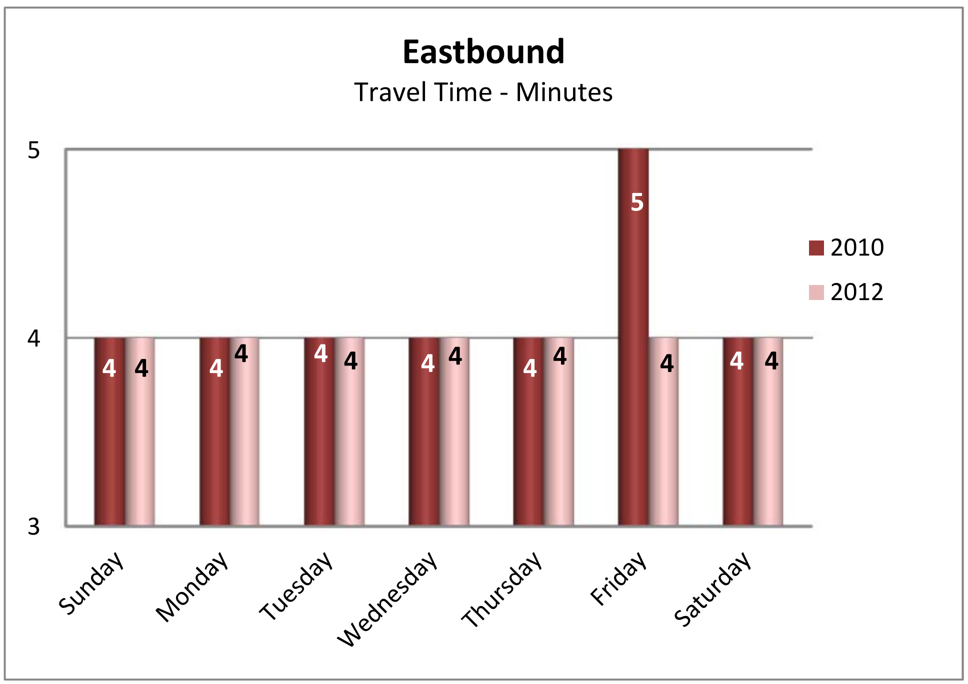


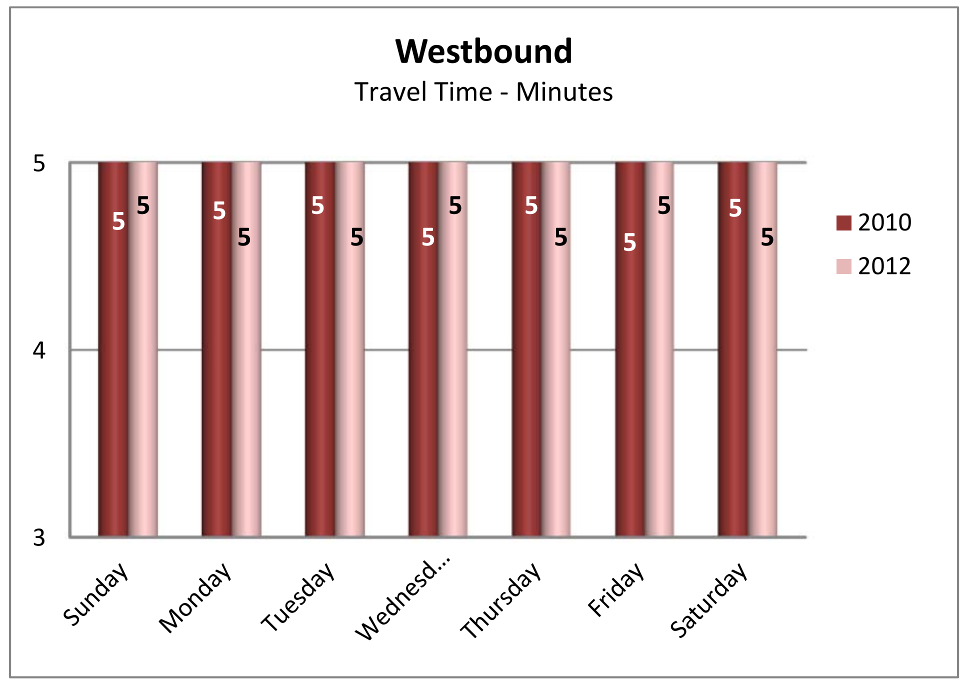


Bottleneck 8 - Travel Time

The charts below show ***travel time*** comparisons for the segment of I-40 in the vicinity of Rock Quarry Road for years 2010 and 2012.

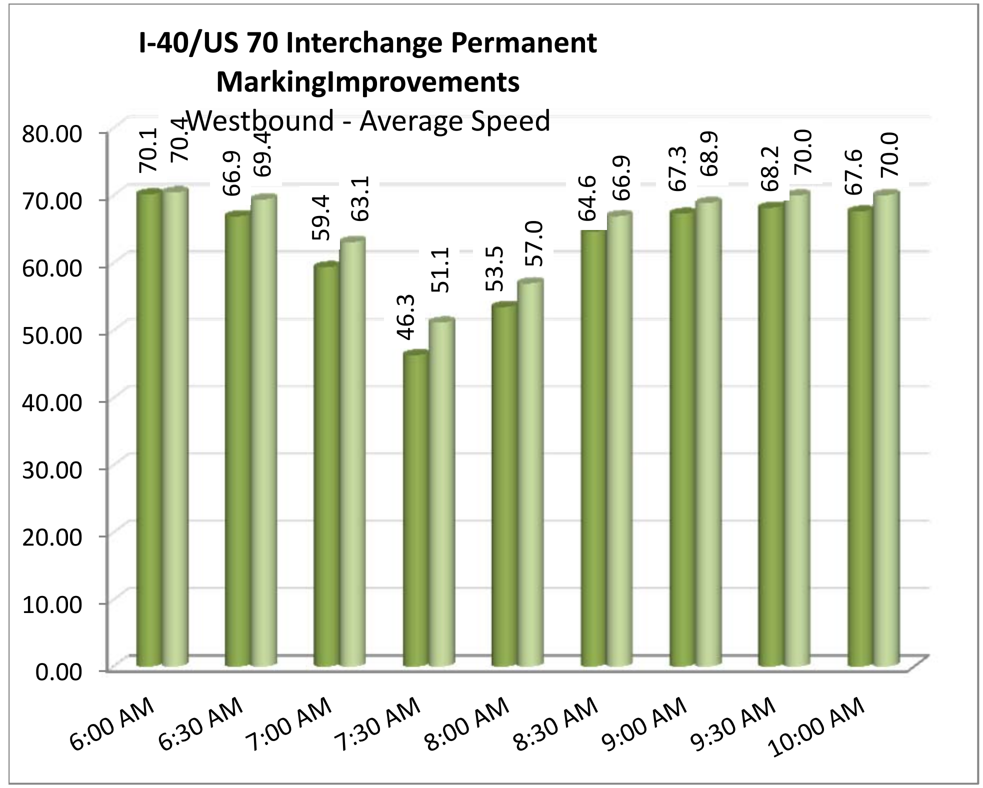
The travel time has generally ***remained the same*** in both the westbound and eastbound lanes; particularly during the weekdays. The outlier in travel time for the eastbound segment for Fridays could be due to pavement rehabilitation work and signage improvements performed on that segment of I-40 in 2010. The pavement rehabilitation work and signage improvements were completed in 2010.





Bottleneck 9- Average Speed

Bottleneck 9 in the vicinity of the I-40/US 70 Bypass interchange near the Wake/Johnston County line. Congestion in this segment, made worse by aggressive drivers, led NCDOT to revise the pavement markings for westbound lanes through the I-40/US 70 interchange. This was done to improve traffic operational issues created by multiple merge locations along this section of the roadway. The permanent markings were the result of a two-year study of the interchange traffic traveling in the westbound direction during the AM peak hour. The graphic shows that average speeds have increased between 6:30 and 10:00 am following the pavement marking revisions.

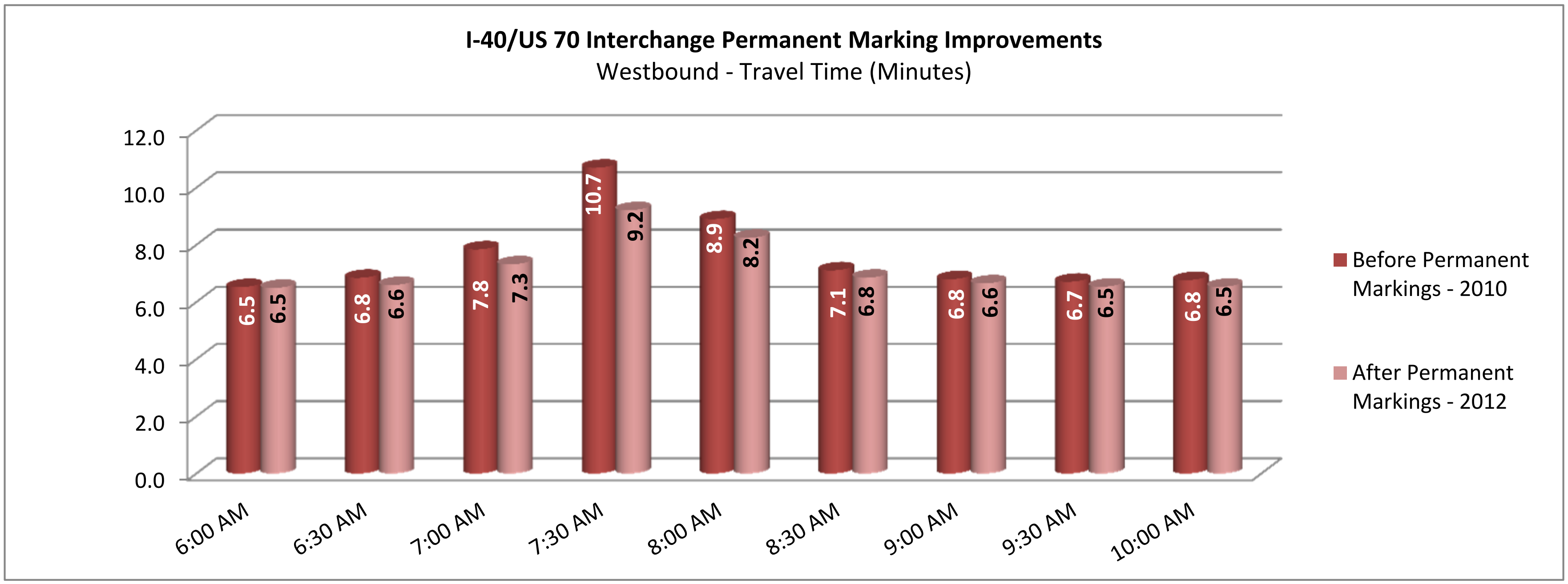


Before Permanent Markings – 2010
After Permanent Markings - 2012

Bottleneck 9 - Travel Time

As a result of the increase in speed (shown on page 20), **travel time** through this segment of I-40 has ***been reduced*** in the Westbound direction during the weekdays.

The most noticeable reduction in travel time occurs at 7:30 am. The travel time has not only been reduced by one minute, the reduction occurs during the most congested time-period for the interchange. This low-cost solution has proven to be effective as an interim 'quick-fix' at this congested location until funding is available for long-term improvements.



CONGESTION MANAGEMENT STRATEGIES

This Section outlines strategies for reducing traffic congestion within the Capital Area MPO. As part of the Congestion Management Process (CMP), federal regulations require metropolitan planning organizations in transportation management areas to identify potential strategies to reduce congestion, and thereby can help the MPO reduce emissions from mobile sources and meet the National Clean Air Act Standards. The three bullet items below address the significance of air quality for this MPO:

- Wake, Granville, and Johnston counties are designated as air quality maintenance areas under the eight-hour ozone standard as of December 26, 2007.
- Wake County was redesignated as a maintenance area for carbon monoxide on September 18, 1995.
- The MPO's 2035 Long Range Transportation Plan and the 2012-2018 Transportation Improvement Plan conform to the State Implementation Plan.

This means that while the use of federal funds for the expansion of the transportation system's capacity to move single occupancy vehicles is not precluded, congestion management strategies are encouraged. In response, the MPO has developed a CMP toolbox (Appendix A), as well as an initiative to improve traffic incident management, and participates in other planning activities with NCDOT.

TRAFFIC INCIDENT MANAGEMENT

The impact of congestion on the Nation's highways is well documented. In the 2009 Urban Mobility Report published by the Texas Transportation Institute, data calculated in 2007 reported that based on wasted time—4.2 billion hours—and fuel—2.8 billion wasted gallons, congestion cost about $87.2 billion combined in the top 439 urban areas in the United States.

Traffic incidents have been identified as a major contributor to increased congestion. The National Traffic Incident Management Coalition (NTIMC) estimates that **traffic incidents are the cause of about one-quarter of the congestion on US roadways**, and that **for every minute a freeway lane is blocked due to a incident, this results in 4 minutes of travel delay time**.

Improved Traffic Incident Management has been shown to reduce both overall incident duration as well as secondary crashes. In the annual evaluation of its Coordinated Highways Action Response Team (CHART) program, the State of Maryland estimated that the CHART-directed incident management resulted in average incident duration of 22 minutes, as compared to 29 minutes for other agencies, and that this reduction in incident duration resulted in 290 fewer secondary incidents in 2005 alone.

An average incident duration savings of 4 minutes equates to 16 minutes of reduced travel time delay.

The impact of this reduction in incident duration is demonstrated by a study published in the ITS Journal that estimated that **the likelihood of a secondary crash increases by 2.8 percent for every minute that the primary incident remains a hazard**.

In addition to the economic and safety impacts, congestion levies a very real human toll. According to the NTIMC, traffic crashes and struck-by incidents are leading causes of on-duty injuries and deaths for law enforcement, firefighters, and towing and recovery personnel.

As a result, increased responder safety is one of the three core objectives of the NTIMC's National Unified Goal for Traffic Incident Management. An additional benefit of improved Incident Management and reduced congestion that is not often considered is the environmental benefit realized by reducing fuel consumption. The U.S. Environmental Protection Agency estimates that every gallon of gasoline burned emits 19.4 pounds of carbon dioxide (CO_2). For diesel fuel, the average is 22.2 pounds of CO_2 per gallon of diesel fuel.

NCDOT is working with the Capital Area MPO and the Durham-Chapel Hill-Carrboro MPO to develop an interagency partnership with the goal to build support for region-wide standards for incident response and traffic control measures. This partnership would build on the two MPO's Congestion Management Processes.

Along with development of the partnership and standards, Education/ Certification Programs would be developed for emergency responders and incident management personnel as well as education for new drivers, and the general motoring public.

RAMP METERING

The North Carolina Department of Transportation (NCDOT) is leading a ramp metering feasibility study, with its funding partners, the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO. The project study area includes the following freeway type facilities in Durham and Wake Counties: I-85, I-40, I-440, I-540, US 15/501, NC 147, and US 1/64 South. The main objective of ramp metering is to improve freeway efficiency at congested segments along the aforementioned corridors within the Triangle Region. Ramp metering, one of the tools referenced in our CMP Toolbox, is a strategy used to manage traffic on freeways by regulating the rate at which vehicles enter the freeway thus reducing merge conflicts and improving overall traffic flow.

Ramp meters consist of traffic signals located on freeway on-ramps that control when vehicles can access the freeway.

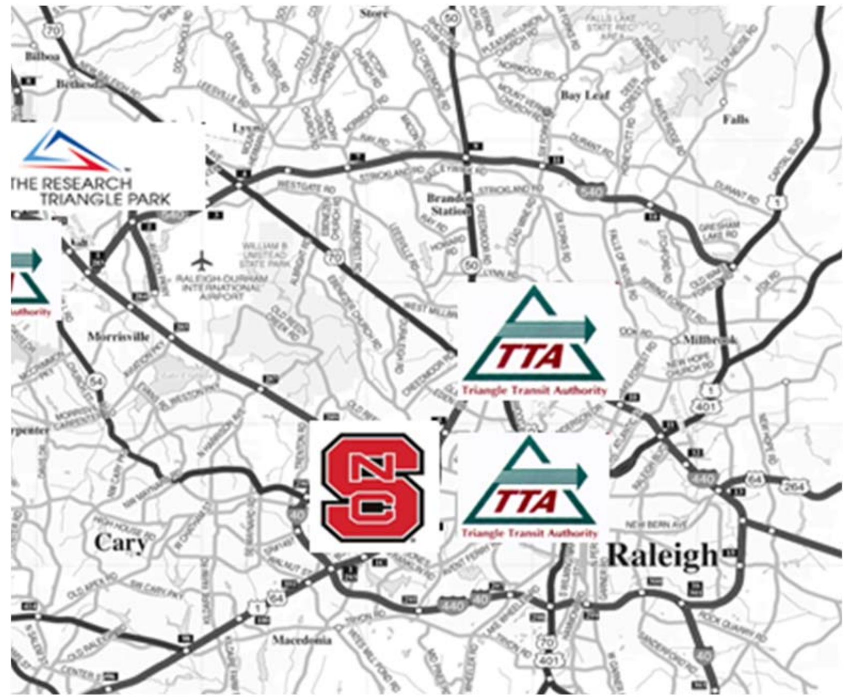
Ramp metering system goals include:

- Safer and smoother merging for vehicles entering freeways,
- Reduced rear-end and side swipe accidents
- Reduced congestion,
- Increased and steadier flow,
- Increased speed,
- Decreased delay,
- Reduced vehicle emissions,
- Improved ramp management to prevent spillback onto the crossing roadways, and

Triangle Transportation Demand Management Program

The Triangle Transportation Demand Management (TDM) Program implements the Triangle TDM Plan[1], which is a joint effort of the North Carolina Department of Transportation (NCDOT), the Capital Area MPO (CAMPO), the Durham-Chapel Hill-Carrboro (DCHC) MPO, Triangle Transit (TTA) and the Triangle J Council of Governments (TJCOG). The goal of the Triangle Regional seven-year TDM Plan is to reduce the growth of commuter vehicle miles traveled (VMT) by 25% (i.e. shift 6,000 regional commuters in single occupant vehicles to non-single occupant vehicles).

Innovative TDM measures are being implemented in four hotspots in the Capital Area MPO. The four hotspots are: (1) Downtown Raleigh, (2) North Carolina State University, (3) North Raleigh/I-440 Corridor, and (4) Research Triangle Park/Wake Technical Community College.



With funding from the CMAQ grant managed by Triangle J Council of Governments (TJCOG), TDM services are available to the Triangle region for any employee or student who lives or works in Wake, Durham, or Orange counties. The outreach and services are focused on supplying services, materials, and staff support through employers, colleges, and universities. A Triangle Transit staff member serves employers outside of downtown Raleigh, a City of Raleigh employee focuses on downtown, and both NCSU and Wake Tech have dedicated staff with grant funding to support their employees and students. Additionally, relationships exist with Meredith College, ITT Tech, and Miller-Motte College through Wake County outreach, and downtown Raleigh works with additional educational institutions that are within or border the central business district.

Since 2010, the total number of users in the Share the Ride NC rideshare- matching database, for Wake County, downtown Raleigh, Wake Tech and NCSU, is 2,059, which includes 1,128 participants in the Emergency Ride Home program, and hundreds of employers. New software, funded in part by the TDM grant from TJCOG and a NCDOT Technology Grant, will launch in FY13. This new software allows each of the 4 outreach coordinators in Wake County to view more detail about each of their participating employers and/or departments and students allowing for more targeted outreach and information-driven relationships.

For Wake County outreach, major employers in Raleigh, Cary, and Morrisville have been the most responsive and participatory in promoting GoTriangle programming, but there is also participation in smaller companies and other municipalities. Major pharmaceutical firms, such as those in Sanford, Holly Springs, and Clayton, also have high participation, including annual on-site events for focused employee education. The towns of Apex, Cary, Morrisville, and Wake Forest, as well as Wake County and State Government all have dedicated staff for providing information and updates to employees, promote Emergency Ride Home programming, and participate in the SmartCommute Challenge.

Annual campaigns promoted by GoTriangle and all four of the outreach coordinators in Wake County include the SmartCommute Challenge with more than 3,000 pledges by employees and students in Wake County and account for 35% of total participation across the Triangle. Other campaigns promoted region-wide include Telework Exchange in February, Earth Day festivities in April, Bike Month in May, Dump the Pump in June, Try Transit Week and Car Free day in September, and the Golden Mode Awards in July that recognize those outstanding employers and commuters within each outreach coordinator's territory. Additionally, there are smaller contests, campaigns, and events held throughout the year such as the current I Heart Transit photo gallery and photo booth event scheduled at Tir na Nog for July 6th from 6 – 10 p.m. and held in coordination with First Friday – the Downtown Raleigh Association-sponsored event where art galleries remain open late for the first Friday of each month, and specials are also offered by many restaurants and other hot spots. Outreach coordinators often have success and focus building relationships with individual employers, and participating in activities promoted by employee appreciation day, health & benefit fairs, and 'green teams' that promote sustainable actions and resources within the work place.

Website. While the current GoTriangle website offers a lot of information, a website with information on commuting options specific to Downtown Raleigh has been created. http://www.raleighnc.gov/services/content/PWksTransit/Articles/CommuteSmartRaleigh.html

Bus on Shoulder System (BOSS) Pilot

North Carolina's first Bus on Shoulder System (BOSS) pilot project began on July 16, 2012 on Interstate 40 in the Research Triangle Region. The BOSS program allows authorized transit buses to operate on freeway shoulders during periods of congestion.   The BOSS operation was initiated by the I-40 Regional Partnership; which includes members of the North Carolina Department of Transportation, the Federal Highway Administration, Triangle Transit, the cities of Raleigh, Durham, Cary and Chapel Hill and their related transit authorities, N.C. State and Duke, the Raleigh-Durham Airport Authority, Wake, Durham and Orange counties, and area Metropolitan Planning Organizations.

The BOSS operation is a low-cost treatment that can provide immediate benefits to transit whenever travel is experiencing moderate to heavy degrees of congestion.

The program provides more reliable transit times for transit buses during congested periods on the pilot corridor of I-40 in Durham County between US 15-501 and Page Road including Research Triangle Park. Signs were installed during June 2012 to alert motorists to possible bus-on-shoulder operations. BOSS operations are limited to times when traffic slows to 35 MPH or less, and buses may only travel in the shoulder up to 15 MPH faster than traffic, or up to a maximum of 35 MPH. Buses also must yield to all emergency operations and obstructions in the shoulder. Contact triangletransit.org for more information.

BOTTOM LINE

The North Carolina Capital Area MPO, working closely with the North Carolina Department of Transportation has produced a number of improvements that have had a positive impact on travel throughout the region in recent years.

Successes such as:

- widening of I-40 between Wade Avenue and US 1/US 64 (Project I-4744), which increased speeds and reduced travel time;
- implementing low cost pavement marking changes near the I-40/US 70 interchange at the Wake/Johnston County line;
- the Bus on Shoulder project yielding a total of 203 uses since it began on July 16, 2012 with no incidents or law enforcement actions.
- the Triangle's Transportation Demand Management Program generating 2,059 users in the Share the Ride NC rideshare-matching database for the Raleigh area since beginning in 2010.

Improvements to noted I-40 bottlenecks have, taking into account average daily traffic, peak-hour volumes and cost savings per hour for cars and trucks, resulted in an approximately $3.0 million per year in cost savings.

The continual challenge for transportation funding for new road construction and/or road improvements has encouraged the Capital Area MPO to examine the use of roadway operational improvements for vehicular movement on existing transportation facilities. An innovative low-cost operational improvement that is being applied in the area is converting sections of existing arterials into "super streets" such as the NC 55 Bypass between Holly Springs Road and Green Oaks Parkway in the Town of Holly Springs. The current Bus on Shoulder project along I-40, which is another low-cost operational improvement, is being reviewed for possible expansion easterly on I-40 during the 2013 calendar year.

Strategies outlined in the CMP toolbox such as the Traffic Incident Management and Ramp Metering will be implemented in the area in near future. The Traffic Incident Management strategy along I-40 has received a funding commitment for the current fiscal year and future years, while the Ramp Metering Feasibility Study will be completed during the spring of 2013. Funding and implementation of ramp meters at suitable interchanges will likely occur following completion of the Feasibility Study.

As measures of delay, vehicle miles of travel, and vehicles hours of travel continue to increase, the Capital Area MPO will continue to examine methods to alleviate congestion. These methods will be targeted to provide solutions that are cost-effective, protect the safety of the public and encourage economic development for this region and the state of North Carolina.

North Carolina's State Traffic Operations Center

Capital Area Metropolitan Planning Organization

North Carolina

APPENDIX A

Congestion Management Process

CMP TOOLBOX

Technical Memorandum

January, 2010

Congestion Management Process

CMP Toolbox

One of the components of the Congestion Management Process for the Capital Area MPO will be a toolbox of potential congestion reduction and mobility strategies. The idea behind this toolbox is to encourage ways to deal with congestion and mobility problems beyond traditional through-lane capacity projects. As the CMP is implemented local municipalities and agencies will use this toolbox as a starting point when considering alternative solutions to be evaluated.

We envision that when cities and agencies find themselves considering roadway capacity projects, that they would use the toolbox like a checklist. They would consider each item in the toolbox in turn, and determine whether a tool had a reasonable potential for providing benefit to the corridor or study area in question. If a tool shows promise, it can be evaluated in detail using the regional model and applicable post-processing methods. If a tool does not make sense, a brief explanation of why it is not appropriate would be provided.

The CMP toolbox of strategies is presented using the following categories:

1. Highway Projects
2. Transit Projects
3. Bicycle and Pedestrian Projects
4. Transportation Demand Management (TDM) Strategies
5. Intelligent Transportation Process (ITS) and Transportation Process Management (TSM) Strategies
6. Access Management Strategies
7. Land Development Strategies
8. Parking Management Strategies

For each of the projects and strategies we have identified their potential for congestion reduction, implementation cost and schedule, and analysis method. The congestion reduction impacts are defined by indicators such as the potential reduction of single occupant vehicles (SOV), improved travel times, and reduced delay.

The implementation costs and schedules consider design and maintenance costs, inter-jurisdictional agreements, and implementation timing over short-term (one to five years), medium-term (five to 10 years), and long-term (over 10 years). The implementation costs and schedules presented in each section are based on information prepared by the Institute of Transportation Engineers (ITE) and Cambridge Systematics, Inc.

In identifying analysis methods we identified the tools needed to evaluate the congestion reduction potential of each strategy or project. The methods include the TDM Evaluation Model, the ITS Deployment Analysis Process (IDAS), and the Triangle Regional Model which form the analytical foundation for the CAPITAL AREA MPO CMP.

Highway Projects

Table 1 presents the potential highway infrastructure projects that may be applicable for the Capital Area MPO. The regional travel model will be the primary analysis tool to assess the transportation impacts. The TDM Evaluation Model and IDAS can also be applied to evaluate HOV lanes.

Transit Projects

Transit services and infrastructure projects have traditionally been implemented in regions to provide an alternative to automobile travel potentially reducing peak-period congestion and improving mobility and accessibility for commuters. Table 2 presents the transit projects that may be applicable for the Capital Area MPO. These projects tend to reduce systemwide VMT in relatively small increments but do improve corridor and systemwide accessibility, improve roadway travel times, and decrease congestion on the roadway system.

Bicycle and Pedestrian Projects

Non-motorized modes of transportation, such as biking and walking, are often overlooked by transportation professionals. Investments in these modes can increase safety and mobility in a cost-efficient manner, while providing a zero-emission alternative to motorized modes. The strategies listed in Table 3 can be implemented in the Capital Area MPO with relatively little cost, but tend to have local rather than systemwide impacts. The effectiveness of an investment in non-motorized travel depends heavily on coordination with local land use policies and connections with other modes, such as transit, for longer distance travel. Safety and aesthetics should also be emphasized in the design of bicycle and pedestrian facilities in order to increase their attractiveness.

TDM Strategies

Transportation demand management (TDM) strategies are used to reduce travel during the peak, commute period. They are also used to help agencies meet air quality conformity standards, and are intended to provide ways to provide congestion relief/mobility improvements without high cost infrastructure projects. Table 4 presents the TDM strategies that may be applicable for the Capital Area MPO. These strategies can potentially build upon current ITS initiatives being implemented in the Capital Area MPO such as the Triangle Transit Rideshare program.

ITS and TSM Strategies

Intelligent transportation system (ITS) and transportation system management (TSM) strategies have traditionally focused on improving the operation of the transportation system without major capital investment and cost. While ITS strategies may be costly compared to more traditional TSM strategies, their relative congestion-reduction impacts can be significant. Table 5 presents the ITS and TSM strategies that may be applicable for the Capital Area MPO. The strategies identified in Table 5 can build upon current ITS initiatives such as the ATMS system and the various traffic signal coordination systems.

Access Management Strategies

Access management is a broad concept that can include everything from curb cut restrictions on local arterials to minimum interchange spacing on freeways. Restricting turning movements on local arterials can reduce accidents and prevent turning vehicles from impeding traffic flow. Similarly, eliminating merge points and weaving sections at freeway interchanges increases the capacity of the facility. The access management strategies listed in Table 6 are applicable to the Capital Area MPO, and can be used in either the modification or original design of a facility.

Land Development Strategies

Land development strategies have been used in some areas to manage transportation demand on the system, and to help agencies meet air quality conformity standards. Land development strategies can include limits on the amount and location of development until certain service standards are met, or policies that encourage development patterns better served by public transportation and non-motorized modes. Table 7 presents the land development strategies that may be applicable for Capital Area MPO.

Parking Management Strategies

Parking management is most often used to decrease automobile trips for both work and non-work purposes, although in the context of enforcement it may also be used to improve traffic flow. Often, policies implemented by local governments and directed towards the private sector must be accompanied by incentives in order to ensure their effectiveness. Several strategies applicable to Capital Area MPO are presented in Table 8.

Table 1. Potential Highway Strategies for the CMP Toolbox

Strategies/Projects	Congestion and Mobility Benefits	Implementation Costs and other Impacts	Implementation Timeframe	Analysis Method
1b. Geometric Design Improvements This includes widening to provide *shoulders*, additional turn lanes at intersections, improved sight lines, auxiliary lanes to improve merging and diverging.	• Increase mobility • Reduce congestion by improving bottlenecks • Increase traffic flow and improve safety	• Costs vary by type of design	• Short-term: • 1 to 5 years	• Regional Travel Model
1c. HOV Lanes This increase corridor capacity while at the same time provides an incentive for single-occupant drivers to shift to ridesharing. These lanes are most effective as part of a comprehensive effort to encourage HOVs, including publicity, outreach, park-and-ride lots, and rideshare matching services.	• Reduce Regional VMT • Reduce regional trips • Increase vehicle occupancy • Improve travel times • Increase transit use and improve bus travel times	• HOV, separate ROW costs • HOV, barrier separated costs • HOV, contraflow costs • Annual operations and enforcement • Can create environmental and community impacts	• Medium-term: • 5 to 10 years • (includes planning, engineering, and implementation)	• Regional Travel Model • TDM Evaluation Model • IDAS
1d. Super Street Arterials This involves converting existing major arterials with signalized intersections into "super streets" that feature grade-separated intersections.	• Increase capacity • Improve mobility	• Construction and engineering substantial for grade separation • Maintenance variable based on area	• Medium-term: • 5 to 10 years • (includes planning, engineering, and implementation)	• Regional Travel Model
1e. Highway Widening by Adding Lanes This is the traditional way to deal with congestion	• Increase capacity, reducing congestion in the short term • Long-term effects on congestion depend on local conditions	• Costs vary by type of highway constructed; in dense urban areas van be very expensive • Can create environmental and community impacts	• Long-term: • 10 or more years (includes planning, engineering, and implementation)	• Regional Travel Model

Source: Cambridge Systematics, Inc. and ITE, A Toolbox for Alleviation Traffic Congestion.

Table 2. Potential Transit Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
2a. Reducing Transit Fares This encourages additional transit use, to the extent that high fares are a real barrier to transit.	• Reduce daily VMT • Reduce congestion • Increase ridership	• Lost in revenue per rider • Capital costs per passenger trip • Operating costs per passenger trip • Operating subsidies needed to replace lost fare revenue • Alternative financial arrangements need to be negotiated with donor agencies	• Short-term: Less than one year	• Regional Travel Model • TDM Evaluation Model
2b. Increasing Bus Route Coverage or frequencies This provides better accessibility to transit to a greater share of the population. Increasing frequency makes transit more attractive to use.	• Increase transit ridership • Decrease travel time • Reduce daily VMT	• Capital costs per passenger trip • Operating costs per trip • New bus purchases likely	• Short-term: 1 to 5 years (includes planning, engineering, and construction)	• TDM Evaluation Model • Regional Travel Model
2c. Implementing Park-and-Ride Lots These can be used in conjunction with HOW lanes and/or express bus services. They are particularly helpful for encouraging HOV use for longer distance commute trips.	• Reduce Regional VMT (up to 0.1 percent) • Increase mobility and transit efficiency	• Structure costs for transit stations	• Medium-term: 5 to 10 years (includes planning, engineering, and implementation)	• TDM Evaluation Model • Regional Travel Model
2d. Implementing Rail Transit This best serves dense urban centers where travelers can walk to their destinations. Rail transit from suburban areas can sometimes be enhanced by providing park-and-ride lots.	• Reduce daily VMT	• Capital costs per passenger • New systems require large upfront capital outlays and ongoing sources of operating subsidies, I addition to funds that may be obtained from federal sources, under increasingly tight competition.	• Long-term: 10 or more years (includes planning, engineering, and implementation)	• Regional Travel Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 3. Potential Bicycle and Pedestrian Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
3a. New Sidewalks and Designated Bicycle Lanes on Local Streets Enhancing the visibility of bicycle and pedestrian facilities increases the perception of safety. In many cases, bike lanes can be added to existing roadways through restriping.	• Increase mobility and access • Increase non-motorized mode shares • Separate slow-moving bicycles from motorized vehicles • Reduce incidents	• Design and construction costs for paving, striping, signals, and signing • ROW costs if widening necessary • Bicycle lanes may require improvements to roadway shoulders to ensure acceptable pavement quality	• Short-term: 1 to 5 years (includes planning, engineering, and construction)	• TDM Evaluation Model
3b. Improved Bicycle Facilities at Transit Stations and Other Trip Destinations. Bicycle racks and bike lockers at transit stations and other trip destinations increase security. Additional amenities such as locker rooms with showers at workplaces provide further incentives for using bicycles.	• Increase bicycle mode share • Reduce motorized vehicle congestion and access routes	• Capital and maintenance costs for bicycle racks and lockers, locker rooms	• Short-term: 1 to 5 years (includes planning, engineering, and construction)	• TDM Evaluation Model
3c. Design Guidelines for Pedestrian-Oriented Development Maximum block lengths, building setback restrictions, and streetscape enhancements are examples of design guidelines that can be codified in zoning ordinance to encourage pedestrian activity.	• Increase pedestrian mode share • Discourage motor vehicle use for short trips • Reduce VMT emissions	• Capital costs largely borne by private sector; developer incentives may be necessary • Public sector may be responsible for some capital and/ or maintenance costs associated with right-of-way improvements • Ordinance development and enforcement costs	• Short-term: 1 to 5 years	• TDM Evaluation Model • Regional Travel Model
3d. Improved Safety of Existing Bicycle and Pedestrian Facilities. Maintaining lighting, signage, striping, traffic control devices, and pave-ment quality, and installing curb cuts, curb extensions, median refuges, and raised cross-walks can increase bicycle and pedestrian safety.	• Increase non-motorized mode share • Reduce incidents	• Increased monitoring and maintenance costs • Capital costs of sidewalk improvements and additional traffic control devises	• Short-term: 1 to 5 years	• TDM Evaluation Model • Regional Travel Model

Table 3. Potential Bicycle and Pedestrian Strategies for the CMP Toolbox (continued)

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
3e. *Exclusive Non-Motorized Rights-of-Way* Abandoned rail rights-of-way and existing parkland can b used for medium-to-long distance bike trails, improving safety and reducing travel times.	• Increase mobility • Increase non-motorized mode shares • Reduce congestion on nearby roads • separate slow-moving bicycles from motorized vehicles • Reduce incidents	• ROW costs • Construction and Engineering Costs • Maintenance Costs	• Medium-term: 5 to 10 years (includes planning, engineering, and construction)	• TDM Evaluation Model • Regional Travel Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 4. Potential TDM Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
4a. *Alternative Work Hours* This allows workers to arrive and leave work outside of the traditional commute period. It can be on a scheduled basis or a true flex-time arrangement.	• Reduce peak-period VMT • Improve travel time among participants	• No capital costs • Agency costs for outreach and publicity • Employer costs associated with accommodating alternative work schedules	• Employer-based Short-term: 1 to 5 year	• TDM Evaluation Model • Regional Travel Model
4b. *Telecommuting* This involves employees to work at home or regional telecommute center instead of going into the office. They might do this all the time, or only one or more days per week.	• Reduce VMT • Reduce SOV trips	• First-year implementation costs for private-sector (per employee for equipment) • Second-year costs tend to decline	• Employer-based Short-term: 1 to 5 years	• TDM Evaluation Model • Regional Travel Model
4c. *Ridesharing* This typically arranged/encouraged through employers or transportation management agencies (TMA), which provides ride-matching services.	• Reduce VMT • Reduce SOV trips	• First-year implementation costs for private-sector (per employee for equipment) • Second-year costs tend to decline	• Employer-based Short-term: 1 to 5 years	• TDM Evaluation Model • Regional Travel Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 5. Potential ITS and TSM Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
5a. Traffic Signal Coordination This improves traffic flow and reduces emissions by minimizing stops on arterial streets	• Improve travel time • Reduce the number of stops • Reduce daily VMT by vehicle miles per day, depending on program	• O&M costs per signal • Signalized intersections per mile costs variable	• Short-term: • 1 to 5 years	• IDAS • Regional Travel Model
5b. Freeway Incident Detection and Management Process This is an effective way to alleviate non-recurring congestion. Systems typically include video monitoring, dispatch systems, and sometimes roving service patrol vehicles.	• Reduce accident delay • Reduce travel time	• Capital costs variable and substantial • Annual operating and maintenance costs	• Medium-to Long-term: likely 10 years or more	• IDAS • Regional Travel Model
5c. Ramp Metering This allows freeways to operate at their optimal flow rates, thereby speeding travel and reducing collisions.	• Decrease travel time • Decrease accidents • Improve traffic flow on major facilities	• O&M costs • Significant costs associated with enhancements to centralized control system • Capital costs	• Medium-term: 5 to 10 years	• IDAS • Regional Travel Model
5d. Highway/ Advanced Traveler Information Systems These systems provide travelers with real-time information that can be used to make trip and route choice decisions. ATIS provides an extensive amount of data to travelers, such as real time speed estimates on the web or over wireless devices, and transit vehicle schedule progress.	• Reduce travel times and delay • Some peak period travel shift	• Design and implementation costs variable • Operation and maintenance costs variable	• Medium-term: 5 to 10 years	• IDAS • Regional Travel Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 6. Potential Access Management Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
6a. Left Turn Restrictions; Curb Cut and Driveway Restrictions Turning vehicles can impede traffic flow and are more likely to be involved in crashes.	• Increased capacity, efficiency on arterials • Improved mobility on facility • Improved ravel times and reduced delay for through traffic • Fewer incidents	• Implementation and maintenance costs vary; range from new signage and striping to more costly permanent median barriers and curbs.	• Short-term: 1 to 5 years (including planning, engineering, and implementation)	• Localized Analysis
6b. Turn lanes and New or Relocated Driveways and Exit Ramps In some situations, increasing or modifying access to a property can be more beneficial than reducing access.	• Increase capacity efficiency • Improved mobility and safety on facility • Improved travel times and reduced delay for all traffic	• Additional right-of-way costs • Design, construction, and maintenance costs	• Short-term: 1 to 5 years (including planning, engineering, and implementation)	• Localized Analysis
6c. *Interchange Modifications* Conversion of a full cloverleaf interchange to a partial cloverleaf, for example, reduces weaving sections on a freeway.	• Increase capacity, efficiency • Improved mobility on facility • Improved travel times and reduced delay for through traffic • Fewer incidents due to fewer conflict points	• Design and construction costs	• Short term: 1 to 5 years (including planning, engineering, and implementation)	• IDAS • Regional Travel Model • Would need to code ramps
6d. *Minimum Intersection/ Interchange Spacing* Reduces number of conflict points and merging areas, which in turn reduces incidents and delay.	• Increase capacity, efficiency • Improved mobility on facility • Improved travel times and reduced delay for through traffic • Fewer incidents	• Part of design costs for new facilities and reconstruction projects	• Medium-term: 5 to 10 years (including planning, engineering, and implementation)	• Local
6e. *Frontage Roads and Collector-Distributor Roads* Frontage roads can be used to direct local traffic to major intersections on both super arterials and freeways. Collector-Distributor roads are used to separate exiting, merging, and weaving traffic from through traffic at closely-spaced interchanges.	• Increase capacity, efficiency • Improved mobility on facility • Improved travel times and reduced delay for through traffic • Fewer incidents due to fewer conflict points	• Additional right-of-way costs • Design, construction, and maintenance costs	• Medium-term: 5 to 10 years (including planning, engineering, and implementation)	• IDAS • Regional Travel Model • Would need more network detail

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 7. Potential Land Use Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	• Implementation Timeframe	Analysis Method
7a. Mixed-Use Development This allows many trips to be made without automobiles. People can walk to restaurants and services rather than use their vehicles.	• Increase walk trips • Decrease SOV trips • Decrease in VMT • Decrease vehicle hours of travel	• Public costs to set up and monitor appropriate ordinances • Economic incentives used to encourage developer buy-in	• Long-term: 10 or more years	• Regional Travel Model • TDM Evaluation Model
7b. Infill and Densification This takes advantage of infrastructure that already exists, rather than building new infrastructure on the fringes of the urban area.	• Decrease SOV • Increase transit, walk, and bicycle • Doubling density decreases VMT per household • Medium/high vehicle trip reductions	• Public costs to set up and monitor appropriate ordinances • Economic incentives used to encourage developer buy-in	• Long-term: 10 or more years	• Regional Travel Model • TDM Evaluation Model
7c. Transit-Oriented Development This clusters housing units and/or businesses near transit stations in walkable communities.	• Decrease SOV share • Shift carpool to transit • Increase transit trips • Decrease VMT • Decrease in vehicle trips	• Public costs to set up and monitor appropriate ordinances • Economic incentives used to encourage developer buy-in	• Long-term: 10 or more years	• Regional Travel Model • TDM Evaluation Model
7d. Transportation Impact Analysis This is an evaluation tool for proposed developments, and assists planners in making major land use decisions.	• Increase bicycle, pedestrian, and transit trips • Decrease SOV Trips •	• Public costs to set up and monitor appropriate ordinances • Economic incentives used to encourage developer buy-in	• Varies	• Regional Travel Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.

Table 8. Potential Parking Management Strategies for the CMP Toolbox

Strategies/Projects	Congestion Impacts	Implementation Costs	Implementation Timeframe	Analysis Method
8a. On-Street Parking and Standing Restrictions Enforcement of existing regulations can substantially improve traffic flow in urban areas. Peak-period parking prohibitions can free up extra general purpose travel lanes or special bus or HOV "diamond" lanes.	• Increase peak-period capacity • Reduce travel time and congestion on arterials • Increase HOV and bus mode shares	• Design, construction, and maintenance costs for signage and striping • Rigid enforcement of parking restrictions	• Short-term: 1 to 5 years (including planning, engineering, and implementation)	• IDAS • Regional Travel Model
8b. Employer/Landlord Parking Agreements Employers can negotiate leases so that they pay only for the number of spaces used by employees. In turn, employers can pass along parking savings by purchasing transit passes or reimbursing non-driving employees with the cash equivalent of a parking space.	• Reduce work VMT • Increase non-auto mode shares	• Economic incentives used to encourage employer and landlord buy-in	• Metropolitan and Employer-based • Short-term: 1 to 5 years	• TDM Evaluation Model
8c. Preferential or Free Parking for HOVs This provides an incentive for workers to carpool.	• Reduce work VMT • Increase vehicle Occupancy	• Relatively low costs, primarily borne by the private sector, include signing, striping, and administrative costs	• Metropolitan and Employer-based • Short term: 1 to 5 years	• TCM Evaluation Model
8d. Location-Specific Parking Ordinances Parking requirements can be adjusted for factors such as availability of transit, a mix of land uses, or pedestrian-oriented development that may reduce the need for on-site parking. This encourages transit-oriented and mixed-use development.	• Reduce VMT • Increase transit and non-motorized mode shares	• Economic incentives used to encourage developer buy-in	• Long-term: 10 or more years	• Regional Travel Model • TDM Evaluation Model

Sources: Cambridge Systematics, Inc. and ITE, a Toolbox for Alleviating Traffic Congestion.