Section 4:
Roadways

How do roadways serve the region?

The 5-County region has a robust system of interconnected freeways, highways, arterials, and local roads which create its transportation network. This integrated system of state highways and local roads are used for commuter trips, for freight movements, for transit, for bike/ped trips and to link activity centers.

Moving into the future, a broader set of strategies needs to be considered, beyond only those that increase capacity by constructing new lanes. Strategies that focus on Transportation System Management, like ramp metering, expansion of KC Scout and variable speed limits or Transportation Demand Management, like expanding transit service and constructing bicycle and pedestrian paths, will be important to consider. These strategies and others are described in detail in Section 11 of this report.

Also critical to future success is the management of KDOT's existing roadway system. The existing system of roads contains nearly 1,800 lane-miles of KDOT-managed highway serving the 5-County region. These lanes must be maintained to provide the current level of service. KDOT performs substantial maintenance on 10 percent of the region's roads per year, creating a 10-year maintenance cycle with an average annual cost of $17 million. This does not include the amount spent to maintain county or city managed roadways which are essential to effective operation of the transportation network. County and city roads are maintained using local funding sources and the Special City County Highway Fund. Maintenance of the existing system is a critical aspect of planning for the future transportation system. This was confirmed during Phase 1 when stakeholders of the 5-County Study identified maintenance of current roads to be the most important issue within the region for the next 10 years.

KDOT Roadway Maintenance At-A-Glance

1,800
*KDOT-managed lane-miles in the 5-County region.**

10%
The number of roads per year that get substantial maintenance from KDOT

10 years
How often each roadway sees maintenance work performed

$17 million
The average annual cost of roadway maintenance along state highways in the 5-County region

**Lane-miles as counted by KDOT Bureau of Materials and Research for use in determining maintenance costs.*

MULTIMODAL USE OF ROADS

The region's existing road network illustrates that the historic focus had been on moving vehicles efficiently. However, as revealed in the public opinion survey in Phase 1, there is an increasing desire to focus on moving people and goods, rather than vehicles. A change in focus opens new opportunities to maximize the capacity of the existing network to serve the needs of travelers and freight in the region. The roads can facilitate a multimodal approach to movement.

With current funding for capacity improvements being limited, it is expected that multimodal and alternative solutions are going to have a bigger role in providing mobility within the 5-County region.

The region's robust road network provides a valuable resource for mobility. The roads must serve personal vehicles, trucks, transit service, bicycles and pedestrians where appropriate. As fuel prices continue to rise, public demand for alternative transportation options is also rising. The American Public Transportation Association (APTA) predicts that when gas reaches a price of $5 per gallon, 1.5 billion new transit riders will seek to use the nation's transit systems[1].

KEY CORRIDORS

Phase 1 of the 5-County Regional Transportation Study identified 13 key corridors in the region along with the needs, opportunities and potential strategies for each corridor. These corridors were identified by the Stakeholder Advisory Panel because they carry high volumes of traffic, create crucial connections within the region, or are projected to serve new development as the region grows. Phase 2 considered the corridors again and broke some of them down into smaller segments. For example the I-70, US-24, State Avenue corridor from Phase 1 was split into three separate corridors, one for each major road in Phase 2. This resulted in 17 corridors with greater resolution in which strategies could be developed to address the prioritized needs described in Phase 1. Each of the corridors is described, analyzed, and recommended strategies are presented in Section 14 of this report.

1 http://www.apta.com/mediacenter/pressreleases/2011/Pages/110314.aspx

Key Corridors

East-West Corridors
- I-70
- I-435 (East-West)
- US-24/40
- US-56
- K-10
- K-92/M-92
- K-68
- 175th Street, 199th Street, 223rd Street
- Shawnee Mission Parkway
- State Avenue

North-South Corridors
- I-35
- I-435 (North-South)
- I-635, I-35, US-69
- K-5
- K-7, US-73, US-169
- Metcalf Avenue
- Western Johnson County North-South Arterial

Potential Outer Loop
A potential outer loop was also studied in Phase 2 as a potential strategy to meet the desired outcomes of the study and to address needs in one or more of the corridors studied.

FUTURE OUTLOOK - ROADWAYS

A holistic view of the region's road network illustrates that by 2040 many of the major highways will be near, at or over their traffic volume capacity during peak hours. Figure 4-1 presents the PM peak volume-capacity ratios for the region in 2010. Figure 4-2 presents the PM peak volume-capacity ratios as forecast for 2040 and takes into account the projects that have committed funding for construction.

These two figures show what changes are expected on the transportation network. The green lines show roads operating at less than 75 percent of their total capacity. Traffic should flow at speeds at or near the posted speed limit and should not experience recurring traffic congestion. The ability to maneuver within the traffic stream varies from unimpeded to somewhat impeded. The yellow roads are those operating between 75 and 95 percent of their total capacity. These roads may experience minor slowing, especially at entrance and exit points along the road, where vehicles are traveling slower than through speeds. Freedom to maneuver within the traffic stream is limited. The red roads are those operating at 95 to 100 percent of their total capacity and are expected to have recurring congestion during the peak hours. Speeds are typically less than 30 mph with virtually no useable gaps in the traffic stream, leaving little room to maneuver. Any disruption can produce a serious breakdown in traffic flow with substantial backups of traffic. The dark red lines indicate road sections where the travel demand exceeds the roadway's traffic carrying capacity. Traffic flow breaks down and is very unstable.

In coordination with projected growth and development, the areas that will see more vehicles using the roads are found along north/south bound I-435, southwest Johnson County, along K-7 in Johnson and Wyandotte Counties, and K-10 between Lenexa and Lawrence. Areas that are currently at or near capacity, such as east/west bound I-435, I-35, US-69, and critical intersections will remain at or above capacity, many with increased vehicle demand. A closer view of the critical network connections shows that I-35 and east/west I-435 are currently and will continue at or near capacity. In 2040, many of the arterial streets that support the network will also near or reach capacity. The length of road segments at or near capacity

LEGEND

Not Congested
Speeds are at or near the speed limit. Ability to maneuver within the traffic stream varies from unimpeded to somewhat restricted.

Moderately Congested
Speeds begin to decline. Freedom to maneuver within the traffic stream is seriously limited.

Congested
Traffic operates at the capacity of the roadway. Speeds are slow (<30 mph). Virtually no useable gaps within the traffic stream, leaving little room to maneuver. Any disruption can produce a serious breakdown in traffic flow with substantial backups of traffic.

Severely Congested
Travel demand exceeds the roadway's traffic carrying capacity. Traffic flow breaks down. Very unstable flow.

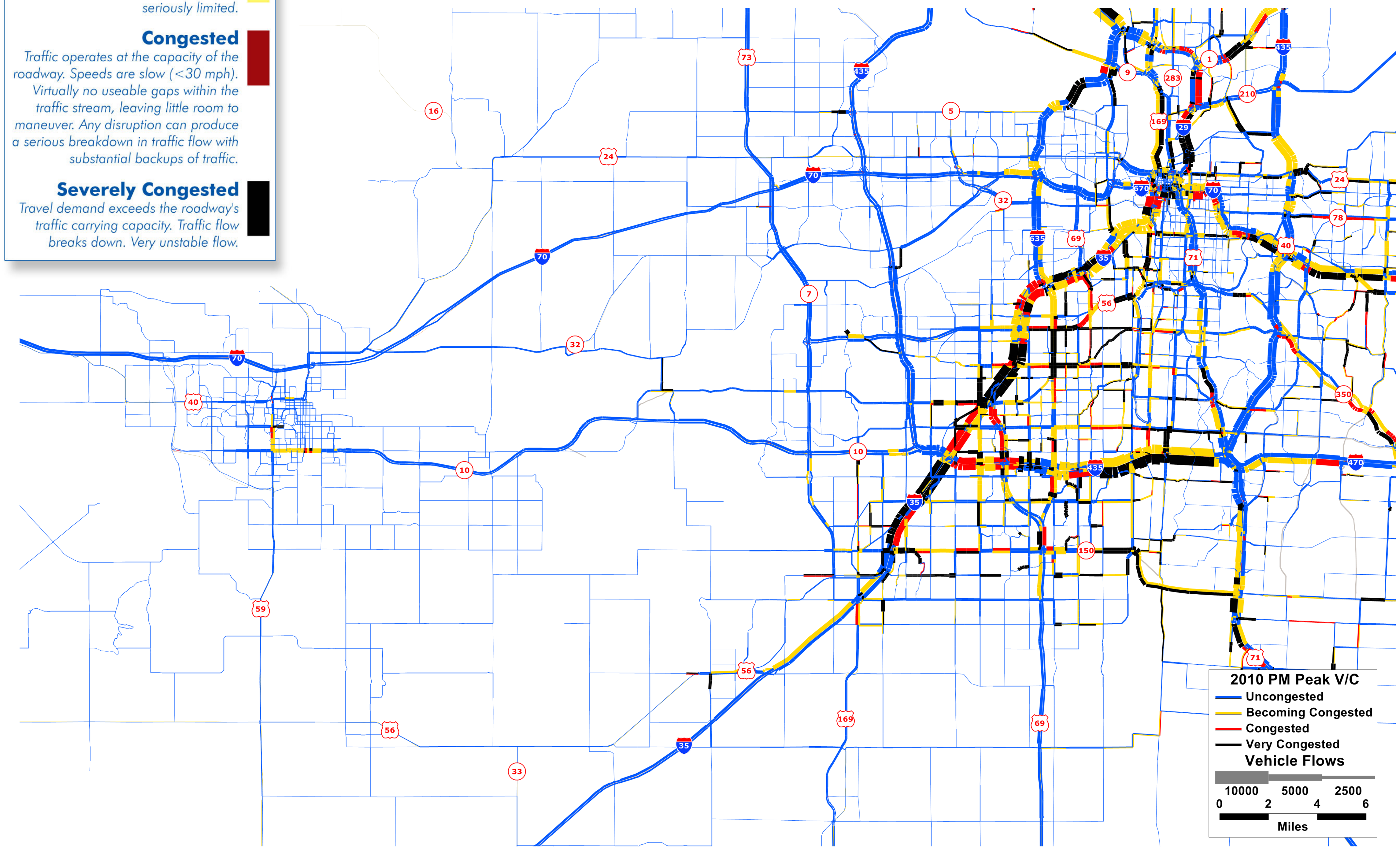


Figure 4-1: 2010 PM Peak Hour Volume to Capacity Ratio

LEGEND

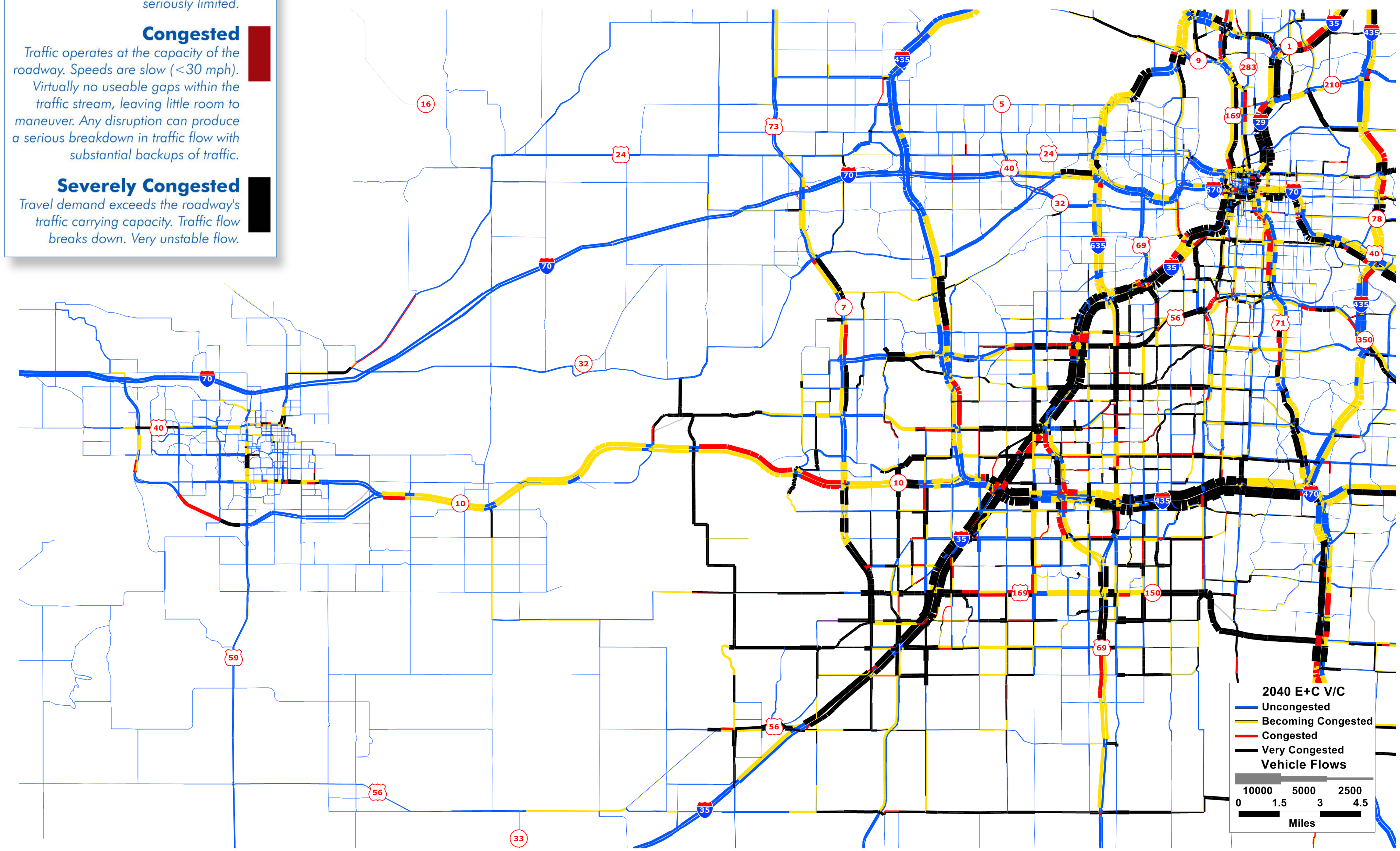
Not Congested
Speeds are at or near the speed limit. Ability to maneuver within the traffic stream varies from unimpeded to somewhat restricted.

Moderately Congested
Speeds begin to decline. Freedom to maneuver within the traffic stream is seriously limited.

Congested
Traffic operates at the capacity of the roadway. Speeds are slow (<30 mph). Virtually no useable gaps within the traffic stream, leaving little room to maneuver. Any disruption can produce a serious breakdown in traffic flow with substantial backups of traffic.

Severely Congested
Travel demand exceeds the roadway's traffic carrying capacity. Traffic flow breaks down. Very unstable flow.

Figure 4-2: 2040 PM Peak Hour Volume to Capacity Ratio for Existing Conditions plus T-WORKS Projects



increase, and the entire network is affected by the increase in traffic volume as travelers seek alternative paths.

Because the majority of the congestion is recurring and tied to commuter patterns, future strategies should include more than those that only look at adding capacity. Strategies should include those in the Transportation Systems Management and Transportation Demand Management categories. Examples of these strategies are provided in detail in Section 11: Transportation Management Toolbox Strategies.

PEAKING CHARACTERISTICS OF HIGHWAYS

Congestion develops daily on the highway network of the 5-County region. The first series of maps in Figure 4-3 on the next page shows a typical weekday morning "rush hour" and the second series shows a typical weekday evening "rush hour." Real-time traffic conditions from Google Maps traffic are displayed over the road as color-coded lines. Specifically, the colors represent the travel speeds on the road. For the maps shown, the colors roughly equate to:

- Green: more than 50 miles per hour
- Yellow: 25 - 50 miles per hour
- Red: less than 25 miles per hour[2]

The roads begin in a free-flow condition, shown by the green connections on the maps. As the commute hour develops the roads become yellow, showing the decreasing travel speeds and increased congestion. Finally, the critical junctions become red during the most congested times where commuters face travel speeds of less than 25 miles per hour. The critical junctions do clear relatively quickly after the peak demand and remain clear until the next peak travel period.

2 Google Maps Help. Traffic color descriptions. Accessed October 19, 2012: http://support.google.com/maps/bin/answer.py?hl=en&answer=61445

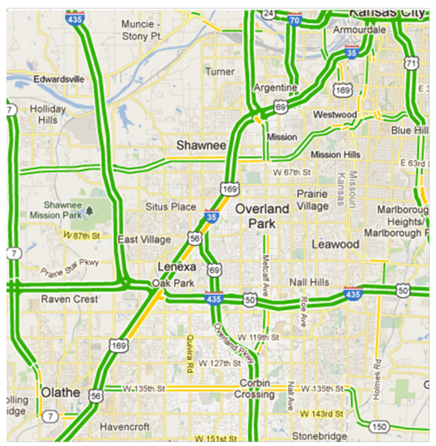
Figure 4-3: Peaking Characteristics of Highways in Johnson & Wyandotte Counties

The following maps depict a typical weekday morning “rush hour” and a typical weekday evening “rush hour” showing real-time traffic conditions from Google Maps. The colors illustrate the levels of congestion that may be encountered on those roads. Specifically, the colors represent the travel speeds on the road. For the maps shown, the colors roughly equate to:

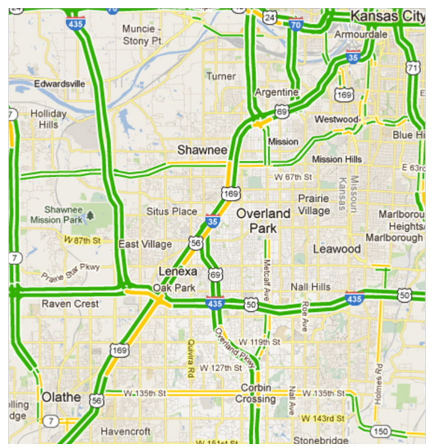
Green: more than 50 miles per hour
Yellow: 25 - 50 miles per hour
Red: less than 25 miles per hour

Typical Weekday AM Peak Commute

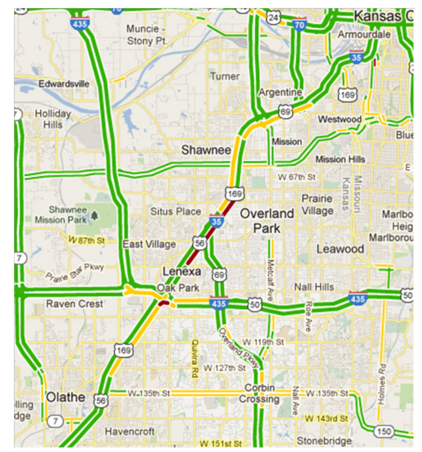
7:15 AM



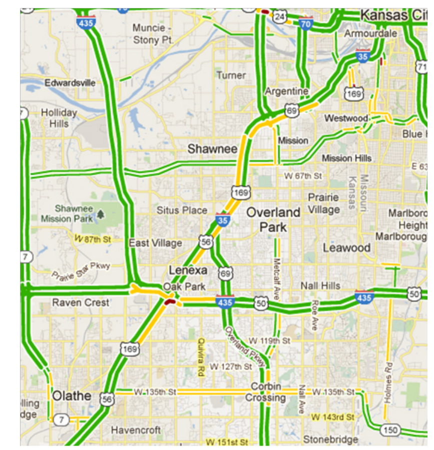
7:30 AM



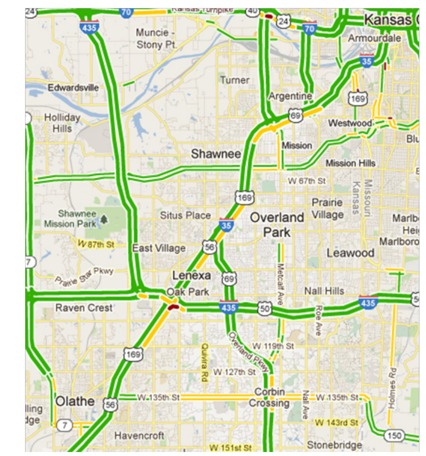
7:45 AM



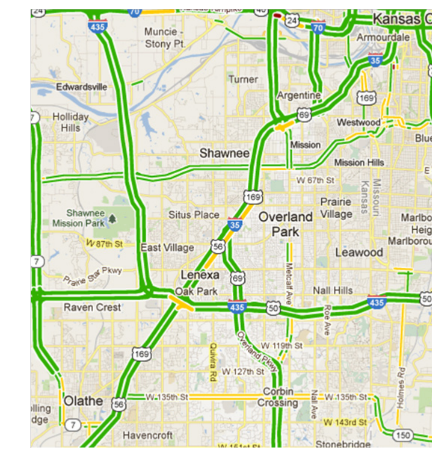
8:00 AM



8:15 AM



8:30 AM

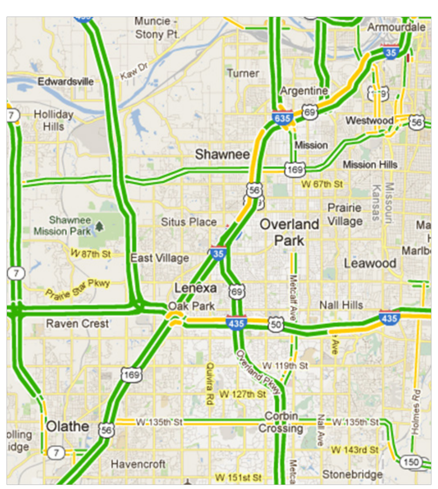


Google maps, accessed Tuesday, July 17, 2012.

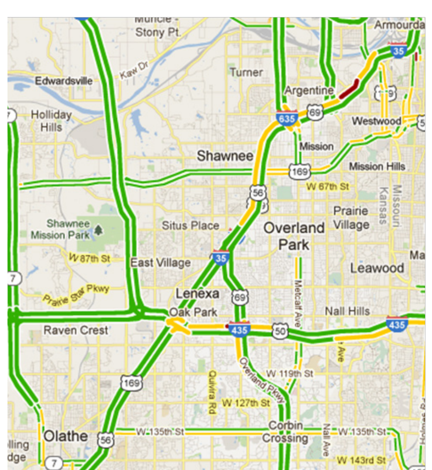
Source: Google

Typical Weekday PM Peak Commute

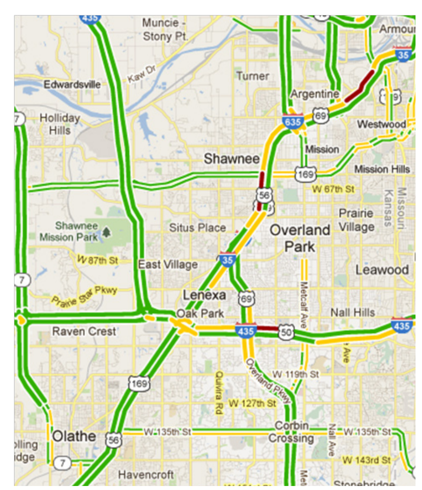
4:45 PM



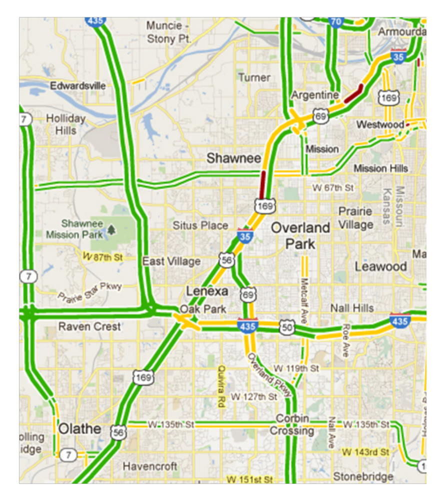
5:00 PM



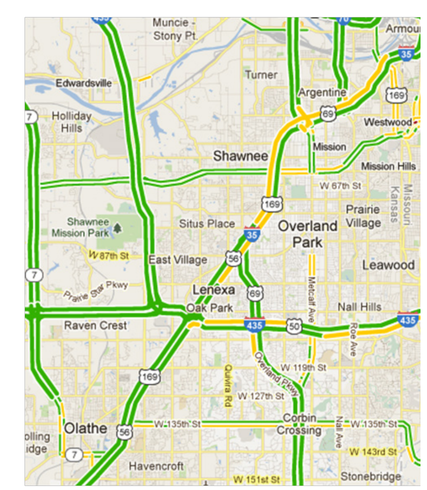
5:15 PM



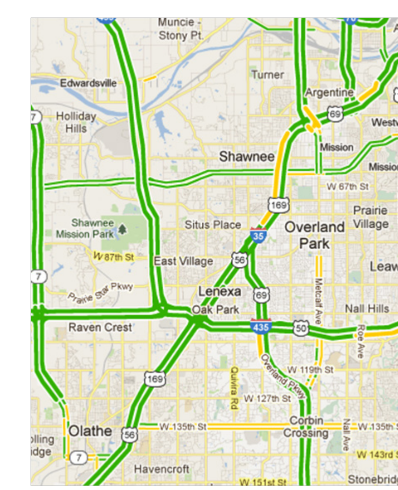
5:30 PM



5:45 PM



6:00 PM



Google maps, accessed Wednesday, July 18, 2012.

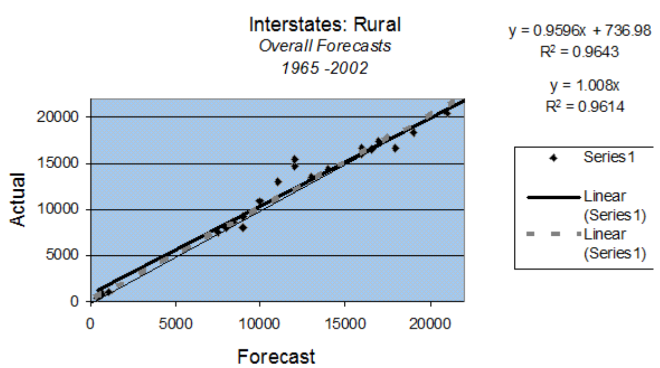
Source: Google

HISTORICAL CASE STUDIES: WHAT HAPPENS TO TRAFFIC VOLUMES WHEN A FREEWAY IS WIDENED?

Building new freeway capacity often draws more traffic than expected to that facility.

In 2002, the Kansas Department of Transportation evaluated the accuracy of the traffic volume forecasts for design projects made since 1965. As shown in Figure 4-4, the forecasted traffic in the "design year" (20 years in the future from the time of construction) for rural interstate highways shows a strong correlation to the actual traffic volumes in the design year. If the actual and forecast volumes match, the data point falls on the thin diagonal line across the graph. The rural data illustrates a close match between projected volumes and actual volumes and most of the data is seen near the diagonal. This means that the forecasts for rural interstate highways have been mostly accurate and actual traffic volumes match what was predicted for future operation.

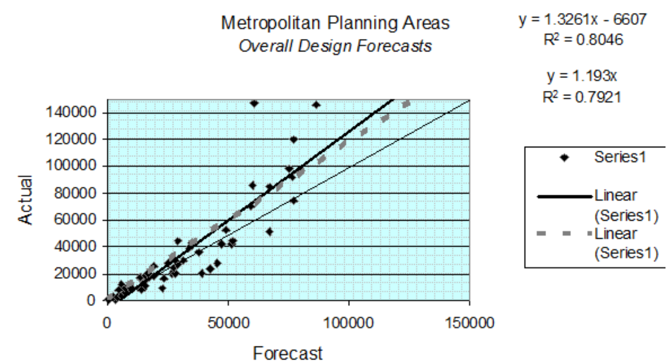
Figure 4-4: Rural Interstates Overall Forecasts



Source: KDOT, "Traffic Forecast Evaluation," 2002.

It is more difficult to forecast future traffic on freeways in metropolitan areas. Figure 4-5 shows that actual traffic volumes can exceed the volumes forecasted for the design year. If the actual and forecast volumes match, the data point falls on the thin diagonal line across the graph. The data for metropolitan areas shows that the forecasts are commonly lower than the actual traffic volume. This means that more people are using the road than were expected. Not only is there a general growth trend for traffic volumes but additional growth results from latent or induced travel demand.

Figure 4-5: Metropolitan Planning Areas Overall Design Forecasts



Source: KDOT, "Traffic Forecast Evaluation," 2002.

Latent and Induced Traffic Demand

When lanes are added to a freeway, the traffic-carrying capacity is increased and therefore congestion and travel time decrease. Long-term traffic growth is expected, but in the short-term, increased travel on the improved facility can come from two sources: latent traffic demand and induced demand. **Latent demand** includes the drivers that would like to use the freeway, but have chosen not to in the past due to congestion or other constraints. When the freeway is widened, the route becomes more desirable and trips are diverted from other parallel roadways. Also, drivers, who may have avoided the peak travel time, may now choose to drive during the peak if that is more desirable. **Induced demand** occurs when new automobile trips are generated due to the improvements. For example, travelers may choose to drive along the improved freeway rather than use public transit.

Decision Making

When decisions are made to add lanes to a freeway, it must be understood that the capacity improvement itself will increase traffic volumes and that a portion of the overall growth in traffic would not have occurred without the capacity improvement. That is not to say that freeway widening should never be considered, however the likely effects of latent and induced travel demand must become a part of the decision making process.

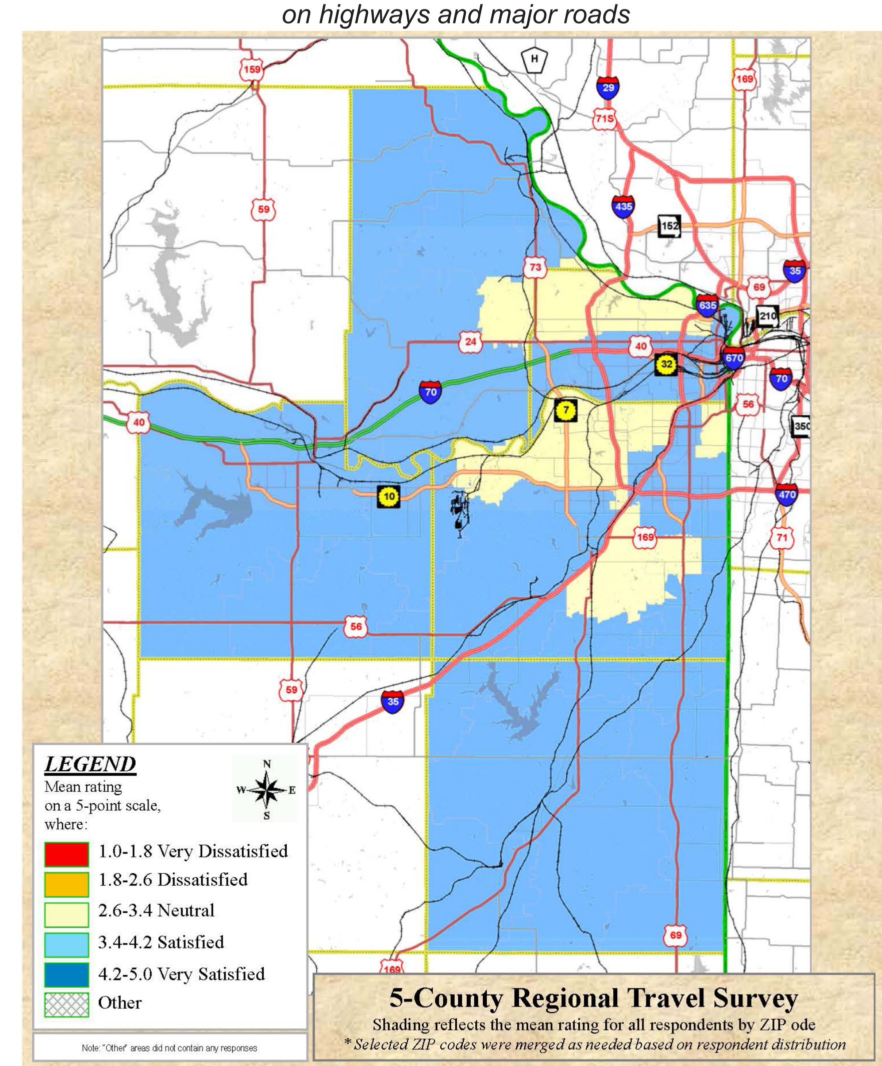
PUBLIC SATISFACTION WITH ROADWAYS

As part of Phase 1 of the 5-County Study, a random sample of residents in the study area responded to a survey regarding issues and opportunities related to transportation planning for the region. This survey was conducted in the Spring of 2009.

One of the major findings of the survey, as shown in Figure 4-6, was that the issues residents were most satisfied with were traffic flow on highway and major roads (65 percent), maintenance of current roads between the cities (56 percent), and the effect of the transportation system on safety (47 percent). When asked to name the most important issue to address over the next 10 years, residents named the maintenance of current roads within the cities, and the traffic flow on highways and major roads.
Sixty percent of those surveyed work outside of the home. When asked about their commute, 17 miles was the mean distance to work, 25 minutes was the mean time it took, and it was expected that seven minutes of time could be saved on the way to work, if there was no traffic congestion.

Those surveyed felt that traffic congestion would get much worse (40 percent) or a little worse (38 percent) over the next 10 years. Those surveyed felt that the issues that had the most impact on traffic congestion were the lack of

Figure 4-6: Level of satisfaction with flow of traffic on highways and major roads



Source: 5-County Regional Transportation Study Phase 1 Survey

alternatives to driving (46 percent), poor timing of traffic lights (44 percent), road construction (39 percent), and poorly planned development (39 percent).

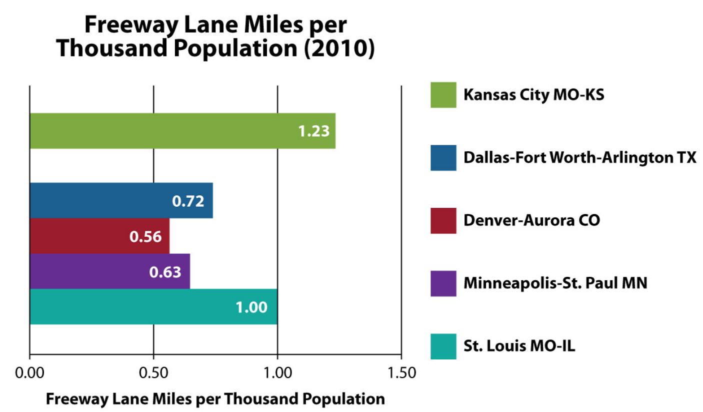
And while 78 percent of those surveyed felt that traffic congestion would get worse to some degree over the next 10 years, 64 percent felt that more emphasis should be placed on maintaining the existing transportation system than on expanding it.

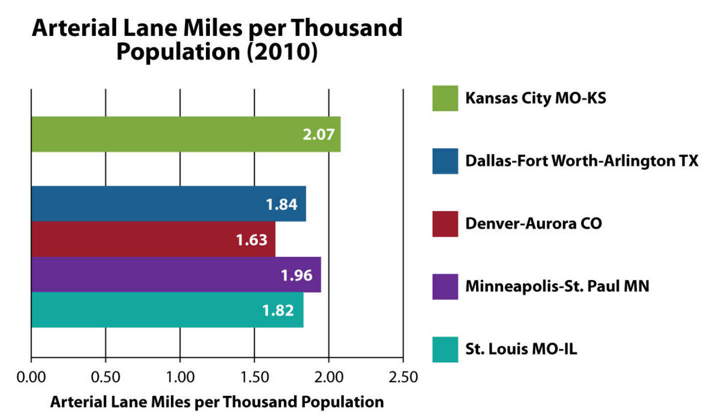
LANE-MILES PER CAPITA

The Kansas City Metropolitan Area is well recognized for its vast, well-maintained and functional roads. In fact, the Kansas City region has more than double the number of freeway miles per capita found in Denver, as seen in Figure 4-7, and exceeds all other mid-western peer cities[3]. The Kansas City region also exceeds all other peer cities in arterial street lane miles per capita, as also seen in Figure 4-7. Our roadway capacity is very high and the associated maintenance costs will last in perpetuity. This gives credence to the idea that the region can no longer afford to rely on adding lanes as the sole solution to its transportation issues.

3 TTI Urban Mobility Report from 2011.

Figure 4-7: Lane Miles per Thousand Population





Source: Lomax, Tim and Schrank, David. (2010) Urban Mobility Report. Texas A&M Transportation Institute, Strategic Solutions Center. http://tti.tamu.edu/group/stsc/2011/03/09/2010-urban-mobility-report/.

Note: Data represented in figure above is from the Kansas Metro area and does not cover the entire 5-County region.

COST OF CONSTRUCTION

Construction cost estimates in this study were based on historical costs from this region. These estimates, shown in Table 4-1, indicate that one additional mile of a highway lane (lane-mile) will cost $3.4 million in 2020. Bridges, overpasses, and interchanges are additional costs that must be added to a per-lane mile cost if new construction will connect to an existing facility. These costs do not include right-of-way procurement, utility relocation, engineering design costs or ongoing maintenance.

Table 4-1: 2020 Road Construction Cost Estimates

	2020
Lane Mile	$3,400,000
Interchange (service)	$18,000,000
Overpass	$9,000,000
Expressway Intersection Enhancements	$553,000

As additional validation for construction cost estimates, actual costs for regional projects were adjusted for inflation to compare cost estimates, as show in Table 4-2.

Table 4-2: Project Cost Estimates

	2005 Cost	2020 Cost Adjusted for Inflation
I-35/K-7 Interchange	$ 110,000,000	$197,000,000
K-10/K-7 Interchange	$ 150,000,000	$267,500,000
K-7/Kansas River Bridge	$ 11,400,000	$20,400,000
I-70/K-7 Interchange	$ 99,400,000	$177,300,000

COST OF MAINTENANCE

During KDOT's T-LINK local consultant program, funding the maintenance of roads and bridges was universally seen as the first priority for transportation investments. Oftentimes, costs associated with maintenance are not fully discussed during the planning of new roadways. Looking at the life-cycle cost of a transportation improvement, and not just the initial construction cost, gives a broader perspective on the value of the investment. The following two sections provide information about current KDOT maintenance costs for highways and bridges on the State system in the 5-County region. It should be noted that these costs only apply to those highways and bridges that are part of the KDOT system (Kansas Highways, U.S. Highways, or Interstate Highways). County and City roadways and bridges also require substantial maintenance and are done through local funding.

Highway Maintenance

KDOT manages a substantial highway system that requires annual maintenance to keep in a state of good repair. In order to do this, KDOT has two categories for highway maintenance: routine maintenance and substantial maintenance. Routine maintenance typically includes roadside clearing, grass cutting, cleaning of ditches and culverts, patching and pothole repair. KDOT's annual routine maintenance costs can be averaged to $5,000 per lane mile, per year.

Substantial maintenance / highway preservation typically includes such activities as resurfacing, overlay and pavement reconstruction. Costs associated with this type of activity are summarized in Table 4-3.

Table 4-3: Highway Maintenance Averages from 2001-2011

County	Approximate KDOT Lane Miles	Approximate KDOT Lane Miles Receiving Substantial Maintenance Per Year	Average Cost per Lane Mile for Substantial Maintenance
Douglas	250	20	$30,000
Johnson	580	80	$105,000
Leavenworth	305	35	$30,000
Miami	275	10	$40,000
Wyandotte	355	50	$135,000
	Total	**195**	**$340,000**

Source: Kansas Department of Transportation

The averages are from 2001-2011 and an analysis of the data shows that costs by county are highly variable over the last 10 years for substantial maintenance work. This is due to the different types of projects that were done in the region, the age of the pavements in the region, and the fact that the state had quite a bit of older concrete pavements that needed work. Examples of this are in Johnson and Wyandotte Counties which had higher cost projects that needed substantial patching - a very expensive type of work. A good number of projects were constructed in these counties at the same time in the 1980s and 1990s, meaning they all needed to be repaired at the same time, as well. In addition, the cost for traffic control is higher in higher traffic areas and during this period of time night work, which was more expensive, became much more prevalent in the more populous areas.

Bridge Maintenance

In addition to KDOT's road maintenance program, there is a Bridge Preservation program that keeps the bridges in KDOT's system in good repair. Because each bridge is different, it is difficult to quantify the annual cost to maintain one bridge. In the 5-County region, Table 4-4 shows the annual bridge maintenance costs for the years 2001-2011. This data only represents the state highway system maintained by KDOT and does not include data from local roadways or the Kansas Turnpike Authority.

Table 4-4: 2001-2011 Annual Bridge Maintenance Costs

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Annual Average
Douglas	$312,641			$61,601	$151,005			$258,683	$153,941		$676,064	$1,613,935	$146,721
Johnson	$561,960	$588,732	$1,876,315	$795,850	$1,427,758	$2,224,139	$883,168	$3,383,059	$3,466,647	$2,497,774	$3,932,990	$21,638,393	$1,967,127
Leavenworth	$75,889		$209,945	$965,805	$310,012				$344,943		$2,358,948	$4,265,542	$387,777
Miami	$6,241,195	$925,405	$872,164		$13,381		$393,520	$59,363				$8,505,028	$773,184
Wyandotte	$497,342	$23,447,601	$4,726,229	$1,861,736	$1,378,165	$4,111,402	$2,068,604	$830,564	$4,631,456	$848,826	$2,289,741	$46,691,666	$4,244,697
Total	**$7,689,027**	**$24,961,738**	**$7,684,653**	**$3,684,992**	**$3,280,321**	**$6,335,541**	**$3,345,292**	**$4,531,669**	**$8,596,987**	**$3,346,600**	**$9,257,743**	**$82,714,564**	**$7,519,506**

Source: Kansas Department of Transportation

In addition to regular maintenance, bridge replacement is at times necessary for bridges that require substantial repair. Table 4-5 shows the 10-year costs associated with the bridge replacement program at KDOT.

Table 4-5: 2001-2011 Annual Bridge Replacement Costs

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Annual Average
Douglas				$74,066						$913,412		$987,478	$89,771
Johnson	$973,626			$9,430,765	$4,555,905	$335,865		$2,426,893			$6,239,534	$23,962,587	$2,178,417
Leavenworth				$2,262,450		$858,090						$3,120,540	$283,685
Miami	$172,014	$1,591,204										$1,763,218	$160,293
Wyandotte*													
Total	**$1,145,640**	**$1,591,204**		**$11,767,281**	**$4,555,905**	**$1,193,955**		**$2,426,893**		**$913,412**	**$6,239,534**	**$29,833,823**	**$2,712,166**

*No bridges were replaced during the 10-year period. KDOT is now looking at the Lewis & Clark Viaduct and the Fairfax Bridge

Source: Kansas Department of Transportation

AVAILABLE FUNDING

In order to estimate the amount of funding that may be available for State highway projects during the decades of 2020-2030 and 2030-2040, the study team analyzed the amount of state and federal funding that was expended in this region over previous years. In doing this, the study team used a baseline of $1.2 billion that was available in the 5-County region for funding transportation projects under T-WORKS from 2010-2020. This baseline was adjusted for inflation and $1.3 billion was assumed to be available from 2020-2030 and $1.4 billion from 2030-2040 billion. There are ongoing changes in both transportation technology and funding that may change the way projects are identified and implemented in the future, therefore the estimates identified in this study should be considered only for planning purposes.

While this may seem to be a large amount of funding that could accommodate many projects, it actually would only be able to fully fund a very small portion of the identified needs in the 5-County region. The T-WORKS program funding for the 5-County region was similar to the funding amount that the study team has identified for the future decade. Even with this large amount of funding, the following were the only major expansion projects funded in the region for 2010-2020:

Douglas

- K-10 (South Lawrence Trafficway) – new build from U.S. 59 to existing K-10 east of Lawrence

Johnson

- US-69: From 119th Street north to I-435 in Johnson County.
- Johnson County Gateway- I-435, I-35 and K-10 junction in Northeast Johnson County

Leavenworth

- No major expansion projects were selected for construction funding, however KDOT is conducting a preliminary engineering study of the Centennial Bridge.

Miami

- No major expansion projects were selected

Wyandotte

- Improvements to the I-70 / K-7 Interchange
- No construction funding has been identified, but a study of the Lewis & Clark Bridge is currently underway.

As transportation projects in urbanized areas continue to increase in complexity and cost, it can be assumed that there will only be funding available for a limited number of major projects throughout the region in the coming decades. Transportation officials will be challenged to best utilize the existing system through technology and multimodal programming in order to forego costly expansion projects while maintaining necessary capacity.