**SUMMARY**

US-40/West 6th Street assumes a unique role in the Lawrence-Douglas County transportation system. This principal arterial street currently conveys commuter traffic between Lawrence and the I-70 corridor. Significant growth anticipated within the Planning Area will likely shift the purpose of US-40/West 6th Street to serve not only the needs of commuters, but also to serve as the transportation gateway for the flow of people, goods, and commerce into northwest Lawrence. This chapter summarizes traffic operating conditions for current and future transportation demands.

**METHODOLOGY**

A combination of existing traffic data, historical growth rates, the KDOT’s Travel Demand Model, and the information collected during the public involvement phase enabled a detailed analysis of facilities that may be needed to accommodate urban development.

Traffic engineering analyses included a cursory review of the existing infrastructure and a detailed analysis of the estimated future traffic operating conditions. Traffic operations analyses were completed using the HCS+ software program which uses the *Highway Capacity Manual* methodologies. Analysis was focused primarily on the Level-of-Service (LOS) provided by the Interrupted Flow facilities.

**Table 5.1 – Level of Service Criteria**

<table>
<thead>
<tr>
<th>Level of Service (LOS)</th>
<th>Signalized Intersection Average Control Delay (sec/veh)</th>
<th>Unsignalized Intersection Average Control Delay (sec/veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0 to 10</td>
<td>0 to 10</td>
</tr>
<tr>
<td>B</td>
<td>&gt; 10 to 20</td>
<td>&gt; 10 to 15</td>
</tr>
<tr>
<td>C</td>
<td>&gt; 20 to 35</td>
<td>&gt; 15 to 25</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 35 to 55</td>
<td>&gt; 25 to 35</td>
</tr>
<tr>
<td>E</td>
<td>&gt; 55 to 80</td>
<td>&gt; 35 to 50</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 80</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>
EXISTING TRAFFIC OPERATING CONDITIONS

The Client Team collected existing traffic data to develop this Plan. Similar to the appearance of the Planning Area discussed in the prior chapter, the traffic characteristics are distinctly split by K-10. **Figure 5.1** provides a brief overview of the 2010 daily traffic volumes on US-40/West 6th Street.

![Figure 5.1: Summary of Daily Traffic Volume and Speed](image)

The posted speed limit of US-40 is 55 mph in the rural section west of K-10 and 45 mph in the urban section east of K-10. Spot speed studies were conducted at two locations. The first location was approximately one-quarter mile east of E 800 Road. The second location was approximately midway between K-10 and George Williams Way. **Figure 5.1** summarizes the speed data and the locations where the data was obtained. The current posted speed limits are appropriate for the prevailing speed of existing traffic.
Analysis of the AM and PM Peak Hour traffic flow reveals a very distinct commuter traffic pattern. A very high rate of traffic flow is experienced in the westbound US-40/West 6th Street to northbound K-10 during the AM Peak Hour as commuters leave Lawrence and access I-70. The pattern is reversed during the PM Peak Hour as commuters come back to Lawrence, creating a southbound K-10 to eastbound US-40 traffic pattern. This commuter pattern can be seen in the weekday directional traffic flow shown in Figure 5.2 and the peak hour traffic patterns on Exhibit 5.1.

With exception of two locations, the existing US-40/West 6th Street is providing adequate capacity for existing traffic demands. One of the two exceptions is the US-40/West 6th Street and George Williams Way intersection. The northbound left-turn movement operates below desirable levels-of-service. This movement has also generated a pattern of crashes which will be discussed later in this chapter. Future installation of a traffic signal at this intersection, as identified in Traffic Impact Studies for developments along US-40/West 6th Street, will address the capacity deficiencies.

The second location operating below desirable capacity levels is the US-40 and K-10 Interchange. The PM Peak Hour commuter traffic movement from southbound K-10 to eastbound US-40 currently operates at a LOS F. There are not enough adequate gaps in the free flow east/west US-40 traffic for southbound K-10 traffic to enter the traffic stream. Queues of 20 to 30 vehicles on the southbound off-ramp can be observed daily, with some reports of 1,700' queues approaching the K-10 traveled way. Traffic exiting K-10 and approaching the excessive off-ramp queue has also been observed making an indirect left-turn by making a right-turn to travel west on
US-40 followed by a U-turn west of the interchange to reverse direction and travel east on US-40.

KDOT’s Traffic Engineering Unit completed a Traffic Investigation of the US-40 and K-10 Interchange in August of 2009. The investigation was completed in response to citizen concerns about congestion at the interchange, particularly the southbound K-10 off-ramp. Traffic data collected during the Traffic Investigation revealed traffic demands at both ramp terminals met the criteria of Traffic Signal Warrants #2 and #3 in the *Manual on Uniform Traffic Control Devices (MUTCD)*. Additionally, the east ramp terminal for the northbound K-10 off-ramp met criteria for the combination of Traffic Signal Warrant #1 Conditions A and B. The recommendation of the Traffic Investigation was that KDOT’s Traffic Engineering Unit Staff would not be opposed to installation of traffic signals at the ramp terminals, although additional geometric improvements would need to be implemented prior to installing traffic signals.

The traffic data collected for this Plan was compared against the Traffic Signal Warrants in the *MUTCD*. Existing traffic demands continue to meet the criteria of Traffic Signal Warrants #2 and #3. Additional discussion about capacity improvements at the interchange are discussed in the Analysis of Short Term Traffic Operations later in this chapter. **Exhibit 5.2** presents the AM Peak Hour and PM Peak Hour levels-of-service provided by the current geometry and traffic control.
CRASH HISTORY

KDOT supplied crash data for all reported crashes on US-40 spanning a four year period between 2007 and 2010. The crash reports totaled 22 crashes, including 8 injury crashes, and 14 property damage crashes. Five of the property damage crashes were deer-vehicle collisions. Most of the 22 crashes are located sporadically through the Planning Area. There are, however, three identifiable crash patterns, one of which is a pattern of deer-vehicle collisions occurring just east of E 800 Road.

The second crash pattern is a rear-end crash at US-40 and E 800 Road. Three rear-end crashes occurred in a 2-year span at this location, resulting in a crash rate of approximately 7.0 crashes per ten-million vehicles entering the intersection (c/tmev).

The third crash pattern consists of angle crashes at US-40/West 6\textsuperscript{th} Street and George Williams Way. Four crashes occurred in a 3-year span at this location, resulting in a crash rate of approximately 3.5 (c/tmev). This intersection is a relatively new intersection with essentially no traffic on the north leg. The crashes are the result of northbound George Williams Way traffic failing to yield to US-40 traffic. Two of the crashes involved an eastbound vehicle on US-40 and resulted in injuries. The other two crashes involved westbound vehicles on US-40 and resulted in property damage.

KDOT Statewide Average Crash Rates for Intersections:

Urban Intersections: 10 c/tmev
Rural Intersections: 5 c/tmev

The crashes at key intersections in the Planning Area, although unfortunate, do not result in crash rates that would trigger the need to implement immediate safety improvements.
TRAFFIC FORECASTING

KDOT and the MPO have developed a Travel Demand Model for the Lawrence – Douglas County area to assist with the MPO’s long-range transportation planning efforts. Using the Travel Demand Model, KDOT provided estimates of future daily traffic volumes along the Planning Area for a 30-year horizon period, calendar year 2040. The data for 2040 represents a near fully developed Urban Growth Boundary west of K-10.

A historical data based trend line growth rate was also provided by KDOT. West of K-10, the historical data is based primarily on rural growth as little to no urban development has occurred west of K-10. The trend line growth rate therefore is assumed to represent growth of the existing traffic due to increased population in rural areas of Douglas County. The trend line generates a background traffic growth rate of 1.6% per year for the next 30 years, resulting in an estimated 60% increase in traffic west of K-10 from a “no development” scenario.

Table 5.2 – Historic and Estimated Future Daily Traffic Volumes on US-40

<table>
<thead>
<tr>
<th>Year</th>
<th>±4,000' West of K-10</th>
<th>±1,000' East of K-10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avg. Daily Traffic (vehicles per day)</td>
<td>Growth Rate (% per year)</td>
</tr>
<tr>
<td></td>
<td>Avg. Daily Traffic (vehicles per day)</td>
<td>Growth Rate (% per year)</td>
</tr>
<tr>
<td>1990</td>
<td>7,085</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>7,845</td>
<td>+1% per yr.</td>
</tr>
<tr>
<td>2010</td>
<td>6,200</td>
<td>-2% per yr.</td>
</tr>
<tr>
<td></td>
<td>8,500 (no development)</td>
<td>+1.6% per yr. from 2010</td>
</tr>
<tr>
<td>2030</td>
<td>26,000 (full development)</td>
<td>+7.5% per yr. from 2010</td>
</tr>
<tr>
<td></td>
<td>10,000 (no development)</td>
<td>+1.6% per yr. from 2010</td>
</tr>
<tr>
<td>2040</td>
<td>29,000 (full development)</td>
<td>+5.3% per yr. from 2010</td>
</tr>
</tbody>
</table>

Estimate of Trips Generated by Future Land Uses

The focused size of the Planning Area allowed a detailed analysis of the potential traffic patterns and demands from the anticipated future land uses. Future traffic demands were estimated using the industry standard rates in the Institute of Transportation Engineer’s Trip Generation, 8th Edition. The rates are based on detailed studies of similar land uses throughout the USA. Exhibit 5.3 summarizes the estimated traffic demands generated by the future land uses.


**SHORT TERM TRAFFIC OPERATIONS**

Short Term traffic operations were analyzed to determine if there are any existing operational deficiencies within the Planning Area and to quantify the immediate needs. Consideration was also given to possible transportation needs that may be realized within ±5 years.

Immediate transportation needs include additional capacity at the US-40 and K-10 Interchange and at the US-40/West 6th Street and George Williams Way intersection. The addition of a second left-turn lane to the K-10 off-ramps and the installation of traffic signals at both ramp terminals could improve the traffic operations to a LOS B or better at each ramp terminal. The total delay experienced by traffic at the west ramp terminal in particular could be reduced by roughly 85% during the PM Peak Hour, from 41 total hours of delay to less than 5 hours of total delay.

The short term improvement to the interchange will provide capacity for approximately 50% of the estimated long term traffic demands. Widening of US-40 over K-10 to add a second left-turn lane for east/west US-40 traffic will be needed when additional traffic demands more left-turn queue storage between the ramp terminals.

The intersection of US-40/West 6th Street and George Williams Way has been identified as a future traffic signal controlled intersection. This improvement is anticipated to be needed in part by developments along George Williams Way. The E 902 Road access to US-40 will also be eliminated as part of the Mercato development.

Additional short term transportation needs may include construction of John Wesley Drive north and south from US-40 with temporary access roads connecting to E 900 Road, thus allowing the removal of the existing US-40 and E 900 Road intersection. This short term need would require reconstruction of the US-40 vertical profile for a distance of about 1,400 feet to provide adequate sight distance. The US-40 and John Wesley Drive intersection could operate as a two-way stop controlled facility with John Wesley Drive being the stop controlled approach. Future conversion from a two-way stop intersection to a traffic signal controlled intersection will be needed for the long term improvements to US-40.

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**Figure 5.3: Short Term Intersection Configuration**
2040 LONG TERM TRAFFIC OPERATIONS

Superimposing the trip generation data from Exhibit 5.3 on the growth of the background traffic demands produces the estimated long term traffic demands as shown in Exhibit 5.4.

As identified in T2030, future traffic patterns will generate the need for a 4-lane US-40 facility. The timing of this improvement, however, is more complex. The need to improve US-40/West 6th Street must consider a number of transportation issues including:

- Growth of existing traffic demands requiring more capacity.
- New traffic demands requiring improved access to US-40.
- The sequence of development(s) west of K-10.
- Safety concerns that may come about as traffic increases.
- The need for infrastructure to accommodate other modes of travel such as pedestrian and/or transit.

The goal of the long term traffic analysis was to identify capacity needs to maintain an overall intersection LOS C or better at all signalized intersections. The long term operational analysis of US-40/West 6th Street assumed future intersections spaced at approximately one-quarter mile intervals west of K-10. Traffic signal controlled intersections were assigned a 90 second cycle and a “green time” band width sufficient to provide coordinated progression of east/west traffic. The use of a 90 second cycle time was due primarily to the limited amount of queue storage available between the ramp terminals at the US-40 and K-10 Interchange. Furthermore, longer traffic signal cycles may not be attainable without modifications to the interchange.

Exhibit 5.5 summarizes the estimated Peak Hour LOS. Signalized intersections are estimated to provide an overall LOS C or better. With exception of John Wesley Drive and George Williams Way, individual side street approaches are estimated to operate at LOS D or better. The two exceptions have approaches estimated to operate at LOS E during the PM Peak Hour. The additional delay is due primarily to the need to provide extended green time to the high-volume east/west thru movements on US-40.
PRACTICAL RESERVE CAPACITY

The Project Team expressed the desire to have a flexible Plan to accommodate potential variances between the estimated traffic demands and the actual future traffic demands that may one day be realized. A number of variables affect traffic patterns and traffic demands including the type and density of the future land uses. Variations in future land uses can only be estimated with a relative degree of accuracy. Other variables, such as technological advances or socio-economic changes within the community, are currently unknown.

The traffic engineering concept of “Practical Reserve Capacity” can provide the Plan Partners with a relatively simple way to compare the traffic patterns generated by individual developments within the Planning Area to the estimations of this Plan. Practical Reserve Capacity is the difference between the capacity of a transportation facility and the traffic demand. A positive Practical Reserve Capacity indicates the facility is operating below capacity and may be able to accommodate additional traffic. A negative Practical Reserve Capacity indicates the traffic demand is greater than the capacity of the facility, typically causing significant queues at intersections or significant reductions in travel speed on a highway.

The capacity of a transportation facility is presented in the Highway Capacity Manual as the threshold between LOS E and F. Traffic flow at a facility operating at a LOS E is characterized as unstable, with traffic demands approaching or equal to capacity. LOS F indicates a facility is operating extremely poor, with traffic demands exceeding capacity. Both of these operating conditions, LOS E and LOS F, would result in significant traffic delay and excessive queues for an urban arterial facility with one-quarter mile intersection spacing as is being considered along US-40/West 6th Street.

Considering the LOS operating characteristics and the possible expansion of the current Urban Growth Boundary westward, Practical Reserve Capacity for this Plan represents an estimate of additional capacity at each intersection to the point where the estimated future
LOS deteriorates from LOS D to LOS E for one or more of the approaches to the intersection.

It is important to understand the relationship between increased development intensities and the overall traffic demand at an intersection in order to quantify the amount of additional capacity a facility may have. Background traffic from areas outside of the Planning Area represent approximately one-third of the estimated 2040 long term traffic demands west of K-10. The remaining two-thirds is estimated to be comprised of new traffic generated from urban growth within the Planning Area. A 10% increase/decrease in the estimated traffic generated by urban development west of K-10 therefore results in approximately a 6% increase/decrease in overall 2040 long term traffic flow. Table 5.3 presents the estimated Practical Reserve Capacity of the intersections in the Planning Area in the long term scenario.

**Table 5.3 – Practical Reserve Capacity**

<table>
<thead>
<tr>
<th>Intersection</th>
<th>2040 Practical Reserve Capacity *</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td>US-40 &amp; E 800 Road</td>
<td>+24%</td>
<td>+24%</td>
</tr>
<tr>
<td>US-40 &amp; E 825 Road</td>
<td>+15%</td>
<td>+15%</td>
</tr>
<tr>
<td>US-40 &amp; Aldersgate Road (E850 Road)</td>
<td>+15%</td>
<td>+12%</td>
</tr>
<tr>
<td>US-40 &amp; John Wesley Drive</td>
<td>+3%</td>
<td>+0%</td>
</tr>
<tr>
<td>US-40 &amp; K-10 West Ramp Terminal</td>
<td>+33%</td>
<td>+15%</td>
</tr>
<tr>
<td>Requires the relocation of a Ramp Terminal to obtain PRC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-40 &amp; K-10 East Ramp Terminal</td>
<td>+30%</td>
<td>+15%</td>
</tr>
<tr>
<td>Requires Ramp Terminal relocation and a second westbound right-turn lane to obtain PRC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-40/West 6th Street &amp; George Williams Way</td>
<td>+9%</td>
<td>+6%</td>
</tr>
<tr>
<td>Additional capacity on George Williams Way during the PM Peak Hour can be obtained by reallocating US-40/West 6th Street green time to the side street.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = A +6% results in an estimated 10% increase in traffic generated from a new development.
Exhibit 5.1: 2010 Traffic

AREA TRANSPORTATION PLAN
US-40/West 5th Street and K-10 Interchange

PM Peak Hour Traffic (veh. per hr)
AM Peak Hour Traffic (veh. per hr)
Direction of Traffic Movement

NOTE: Peak Hour Traffic volumes account for all vehicle types, including heavy commercial vehicles.
Exhibit 5.2: 2010 Level-of-Service

KDOT Project: 40-23 KA-1869-01

Date Prepared: March 2012

CONCEPT DISCLAIMER: This map is PRELIMINARY and depicts conceptual ideas only. The exact location, design and right-of-way for items shown cannot be determined from this map and could be different than shown.
Exhibit 5.3: Trip Generation

Area Transportation Plan
US-40/West 5th Street and K-10 Interchange

KDOT Project: 40-23 KA-1869-01
Date Prepared: March 2012

CONCEPT DISCLAIMER: This map is PRELIMINARY and depicts conceptual ideas only. The exact location, design and right-of-way for items shown cannot be determined from this map and could be different than shown.

Internal Capture Rates are estimated and are applied as a percentage reduction to the total trips generated by a Quarter Section. The reduction accounts for trips generated by individual land uses within a Quarter Section which will use the Internal sheet network to access each land use.

PM Peak Hour Trips Generated (vph, per hr)
AM Peak Hour Trips Generated (vph, per hr)
NOTE: Peak Hour Trips Generated account for all vehicle types, including heavy commercial vehicles.

Northwest Quarter Section

Ingress: 205/179, 79W/347
90% from US-40
10% from North/East/West

North-Central Quarter Section

Ingress: 120/199, 346/154
85% from US-40
5% from North and internal capture

South-Central Quarter Section

Ingress: 205/179, 346/154
90% from US-40
5% from South

Southeast Quarter Section

Ingress: 179/440, 649/245
90% from US-40
10% from South and East

Southwest Quarter Section

Ingress: 79W/347, 136/306
90% from US-40
5% from South

KDOT Project: 40-23 KA-1869-01
Date Prepared: March 2012

CONCEPT DISCLAIMER: This map is PRELIMINARY and depicts conceptual ideas only. The exact location, design and right-of-way for items shown cannot be determined from this map and could be different than shown.

Internal Capture Rates are estimated and are applied as a percentage reduction to the total trips generated by a Quarter Section. The reduction accounts for trips generated by individual land uses within a Quarter Section which will use the Internal sheet network to access each land use.

PM Peak Hour Trips Generated (vph, per hr)
AM Peak Hour Trips Generated (vph, per hr)
NOTE: Peak Hour Trips Generated account for all vehicle types, including heavy commercial vehicles.

Northwest Quarter Section

Ingress: 205/179, 79W/347
90% from US-40
10% from North/East/West

North-Central Quarter Section

Ingress: 120/199, 346/154
85% from US-40
5% from North and internal capture

South-Central Quarter Section

Ingress: 205/179, 346/154
90% from US-40
5% from South

Southeast Quarter Section

Ingress: 179/440, 649/245
90% from US-40
10% from South and East

Southwest Quarter Section

Ingress: 79W/347, 136/306
90% from US-40
5% from South
Exhibit 5.4: Long Term Estimated Traffic

**CONCEPT DISCLAIMER**: This map is PRELIMINARY and indicates conceptual ideas only. The exact location, design and right-of-way for items shown cannot be determined from this map and could be different than shown.
CONCEPT DISCLAIMER: This map is PRELIMINARY and depicts conceptual ideas only. The exact location, design and right-of-way for items shown cannot be determined from this map and could be different than shown.

Exhibit 5.5: Long Term Estimated Level-of-Service

AREA TRANSPORTATION PLAN
US-56/West 10th Street and K69 Interchange

KDOT Project: 40-23 KA-1869-01
Date Prepared: March 2012

K-DOT
City of Lawrence
Wieser/Smith

Planning Area
City Limits

PM Peak Hour Level-of-Service
AM Peak Hour Level-of-Service
Direction of Traffic Movement

Planning Area

Controlled Intersection

1" = 800'

800' 0 800' 1,600'

Overall Interaction LOS = C(C)
Total Delay = 16.9 sec. (23.7 sec.)

Overall Interaction LOS = B(C)
Total Delay = 27.2 sec. (26.2 sec.)

Overall Interaction LOS = C(C)
Total Delay = 25.9 sec. (49.3 sec.)

Overall Interaction LOS = B(C)
Total Delay = 24.3 sec. (28.6 sec.)

Overall Interaction LOS = B(B)
Total Delay = 17.9 sec. (17.1 sec.)

Overall Interaction LOS = B(B)
Total Delay = 23.3 sec. (24.6 sec.)

Overall Interaction LOS = C(C)
Total Delay = 19.2 sec. (28.9 sec.)