K-10 Transportation Study

Kansas Department of Transportation
MARC
Mid-America Regional Council
Lawrence-Douglas County
Metropolitan Planning Office
HDR
HNTB

May, 2005

FINAL REPORT

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Prepared for:

Kansas Department of Transportation
Mid-America Regional Council
Lawrence-Douglas County Planning Commission

Prepared by:

HDR
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1. Executive Summary

1.1 Study Purpose and Process

The K-10 Transportation Study was sponsored by the Kansas Department of Transportation (KDOT), the Mid-America Regional Council (MARC), and the Lawrence-Douglas County Metropolitan Planning Commission.

The purpose of the study was to identify needed future improvements for the K-10 highway corridor between the city of Lawrence and the Kansas City metropolitan area. The limits of the study were Franklin Road on the west end, and I-435 on the east end (approximately 23 miles). Aspects of the I-435 corridor from K-10 to U.S. 69 (approximately 2 miles) were also examined. Figure 1-1 illustrates the study area.

At the initial public and Advisory Committee meetings held for the project, the motivation for the study was described:

> *Douglas County and Johnson County are two of the fastest-growing counties in Kansas. K-10 is the principal highway linking these two counties. While K-10 is predominantly rural in character now, it is rapidly urbanizing and will continue to do so. A plan [is needed] to coordinate land use and transportation in this area.*

At these meetings, the study objectives were characterized as follows:

- Determine how and when to widen K-10.
- Determine impacts of widening.
- Establish where new interchanges will be considered.
- Plan for other modes of transportation within the corridor.
- Study bicycle and pedestrian issues along and crossing K-10.

As the study progressed, two additional objectives were developed:

- Provide guidance to local agencies when making land-use decisions.
- Provide guidance to the two MPOs when making transportation planning and programming decisions.

The study included an examination of existing conditions, including traffic operations, crash history, mainline geometrics, interchange configurations, and environmental resources. Future (2030) traffic forecasts were developed in order to allow analysis of future traffic operations. Corridor-wide capacity and geometric improvements were developed for two different scenarios: (1) assuming that no new service interchanges would be added to the corridor (but that a future K-10 freeway-to-freeway extension would be added at the west end); and (2) assuming that five new service interchanges, requested by communities along the corridor, would be constructed (plus the K-10 freeway-to-freeway extension). Preliminary cost estimates were developed for these improvements.

The study also investigated the needs and opportunities for improved Intelligent Transportation Systems (ITS) technologies within the corridor.

The study included a public and agency involvement process designed to gain input from stakeholders at key intervals. An Advisory Committee, consisting of staff from agencies along the corridor, met four times during the course of the study. Two public meetings were held – one early in the process, and one after preliminary recommendations had been developed – and several other public outreach tools were used to obtain feedback. Project team meetings, including representatives of KDOT, MARC, Lawrence-Douglas County Planning Commission, and the consultants, were held on an ongoing basis throughout the project.

1.2 Study Findings and Recommendations

Widening of K-10

- *Lane Needs and Timing:* On K-10 between I-435 and K-7, the study projects the need to expand the mainline from four to six lanes by providing an additional lane in each direction (six-lane typical section) within the next five years. The need for a second additional lane in each direction (eight-lane typical section) is projected within 15 years. West of K-7, the need to expand the K-10 mainline from four to six lanes by providing an additional lane in each direction is projected within the next 20 years in Johnson County and by the year 2030 in Douglas County. These improvements, and the associated timing, could vary depending on the level of service (LOS) thresholds that are considered tolerable. They also reflect a set of growth assumptions developed in consultation with, and approved by, local communities.
- *Typical Section:* The proposed eight-lane typical section east of K-7 would widen to the inside (with a depressed closed median) and would include 12-foot inside shoulders adjacent to a concrete safety barrier. For the proposed six-lane typical section west of K-7, a closed-median option and an open-median option have been developed. The closed-median option assumes K-10 would be widened to the inside, including 12-foot inside shoulders adjacent to a concrete safety barrier, and would generally require no additional right-of-way. The open-median concept consists of a 60-foot-wide open (grassed) median with widening occurring on the outside, and would require additional right-of-way. A decision about which option to build will be made at the time widening is programmed for construction. The open-median concept was used in assessing right-of-way needs since it represented the most impact. Existing bridges over the mainline would need to be widened to

Figure 1-1: Study Area

accommodate additional cross-street lanes, while all existing mainline pavement will likely need to be replaced within the anticipated timeframe of the proposed improvements. The preliminary concepts developed in this study indicate that K-10 can be widened largely within existing right-of-way, except at certain mainline locations and interchanges.

- *Environmental Considerations:* The widening of K-10 will need to be designed and constructed with attention to a number of environmentally sensitive areas, including several wetlands, six floodplains, two parks, two HAZMAT sites, and two existing pedestrian/bicycle trails. Other existing potential private property right-of-way encroachments, as well as utility issues, will also require review during the design process. It is recommended that a buffer be provided between the edge of the ultimate K-10 right-of-way and any future development. The buffer would minimize future noise issues, accommodate landscape improvements, and potentially serve as a location for a pedestrian/bicycle trail. The study identifies a 100-foot width for this buffer easement on both sides of K-10. As land develops adjacent to K-10, cities and counties should work closely with developers to ensure that this easement is provided along the entire length of K-10. KDOT is willing to provide assistance to cities and counties in their efforts to provide this easement.

Interchange Improvements

- *Existing Interchanges:* Anticipated 2030 traffic volumes at the K-10/K-7 interchange would require a fully directional four-level interchange. If adjacent interchanges at Lone Elm Road and Clare Road were constructed, it is possible that only a three-level interchange would be needed (eliminating two lengthy ramp structures and resulting in a potentially significant cost savings). Further study would be needed to verify this conclusion. The construction of the K-10/K-7 interchange could be sequenced over time, with the westbound-to-southbound flyover built first. Other existing interchanges along the corridor will require minor modifications - including adding ramp turn lanes, widening cross streets, and realigning frontage roads.
- *New "As Requested" Interchanges:* Five new interchanges requested by communities were considered in the study:
  - K-10/Franklin Road (Lawrence)
  - K-10/Winchester Road (Eudora)
  - K-10/Prairie Star Parkway (Lenexa/Olathe)
  - K-10/Clare Road (Lenexa/Olathe)
  - K-10/Lone Elm Road (Lenexa/Olathe)

  Based on the conceptual planning-level analysis of this study, these "as requested" interchanges do not appear to compromise operations on K-10 as long as necessary associated improvements are made (i.e. auxiliary lanes, grade-separated braided ramps to eliminate weaving movements, etc.). This initial finding does not, however, constitute approval or endorsement on KDOT's behalf of these new interchanges. The communities will need to submit formal break-in-access requests (including a more detailed traffic operational analysis) to receive approval for these interchanges. Finally, KDOT is not planning to fund these interchanges; therefore, the cost would most likely be borne by local entities or others.
- *K-10/I-435/I-35 Interchange:* The 1999 I-35/US-69 Major Investment Study identified conceptual improvements for the K-10/I-435/I-35 interchange area. These improvements will need to extend as far west as the Ridgeview Road interchange. A future study will need to include detailed simulation analysis, with more origin-destination information, to refine the proposed concept of braided ramps and C-D roads.
- *K-10 Extension:* The study included the assumption that K-10 will eventually be extended to form a freeway-to-freeway connection, either with I-70 to the north, or existing K-10 south of Lawrence. West of the new extension, 23rd Street would no longer be part of the State Highway System and would not be designated as a "city connecting link" by KDOT. Therefore, future decisions regarding improvements to this section would be solely within the purview of the City of Lawrence.

Other Considerations

- *Transit:* It is recommended that a fixed-route bus service, with the potential for route deviations, be studied further, and that a pilot project be implemented along K-10. An operating plan should be developed (by the transit operator or operators) for service to generally operate between the K-10/I-435 industrial area and the University of Kansas (KU)/downtown Lawrence, with additional fixed stops at key intervening residential/employment centers. The study estimated that the potential for daily transit ridership in this corridor could range from 350 to 500 round-trip patrons. Potential riders would include commuters living in Douglas County traveling to/from employment in Johnson County, commuters living in Johnson County traveling to/from employment in Douglas County, students living in Johnson County traveling to/from KU, and students living in Douglas County traveling to Johnson County Community College. The service should make use of future Transit Centers identified in MARC's Smart Moves plan.
- *Bicycle/Pedestrian Considerations:* Previous studies have identified an interest in providing for pedestrian and bicycle travel through the K-10 corridor. A number of alternative routes are under consideration; it is recommended that further studies be performed by regional and local agencies to solidify an alignment. If a route immediately adjacent to K-10 is chosen, the proposed trail will need to be separated from the highway by fencing or some other physical barrier to discourage encroachment on the highway by bicyclists and pedestrians. It is not KDOT's general practice to allow bicycle/pedestrian routes on KDOT right-of-way due to safety and maintenance concerns, but if sufficient right-of-way exists, KDOT would consider allowing a trail within the right-of-way. In the case of the K-10 corridor, the study team believes that K-10 can be widened largely within existing right-of-way, except at certain mainline locations and interchanges. In order to accommodate a bicycle/ pedestrian trail, new right-of-way would have to be purchased. In KDOT's current Comprehensive Transportation Program, no funds are programmed for right-of-way purchases for either capacity improvements or bicycle/pedestrian trails.

  Any trail crossings of K-10 and intersecting cross streets would need to address safety and access for pedestrians and bicyclists. The need for bicycle/pedestrian crossings of K-10 has been identified along Lone Elm Road in Lenexa/Olathe and Church Street in Eudora due to existing school locations. The need may arise on all crossings as urbanization occurs.
- *ITS:* Certain Intelligent Transportation Systems (ITS) devices have already been installed at the east end of the K-10 corridor, including cameras and a Variable Message Sign (VMS). It is recommended that future capacity improvements along K-10 incorporate ITS elements, including communications conduit along the entire length, ramp metering (at least as far west as K-7), detection at spacings determined reasonable, and cameras/VMS at key locations along the corridor. The conceptual-level interchange designs for this study have incorporated ramp lengths that account for the potential ramp-metering. An incident management program will be an important component of future planning for this corridor, because diversion opportunities are currently extremely limited. Also, tying in to existing local traffic control and communications systems will be an important consideration.

Next Steps

KDOT currently has no funds to preserve right-of-way or build any of the improvements recommended with this study. As a result, the challenge will be for KDOT and the local communities to work together to see that these improvements can occur over time. The first step will be to develop individual Memoranda of Understanding (MOUs) with each local community to lay the groundwork and preserve the ability to carry out the study's recommendations. Focusing on the preservation of key parcels of land will be a first priority. Another early priority will be the development of a K-10 transit operating plan. Ultimately, a long-term plan needs to be developed to fund the widening improvements. It is hoped that both MPOs will adopt this study by amending it into their respective Long-Range Transportation Plans (LRTPs).

2. Introduction/Background

2.1 Study Purpose

The Kansas Department of Transportation (KDOT), the Mid-America Regional Council (MARC), and the Lawrence-Douglas County Metropolitan Planning Commission have sponsored a study to identify future improvements for the K-10 corridor between the Kansas City metropolitan area and the city of Lawrence. As mentioned in the Executive Summary, the study was motivated by rapid growth and urbanization along the corridor, and had several objectives:

- Determine how and when to widen K-10.
- Determine impacts of widening.
- Establish where new interchanges will be considered.
- Plan for other modes of transportation within the corridor.
- Study bicycle and pedestrian issues along and crossing K-10.
- Provide guidance to local agencies when making land-use decisions.
- Provide guidance to the two MPOs when making transportation planning and programming decisions.

In addition, the study examined I-435 from K-10 to U.S. 69. At some levels, this section was examined in less detail than K-10, but it was included in the study because its interaction with K-10 and I-35 forms a complex interchange system that will continue to serve increasing demand.

2.2 Previous Studies

Several past studies are relevant to the current study. Some of these studies focused on specific areas of K-10, and some evaluated K-10's role in a regional transportation context. These studies formed an important information base for the current study. Brief summaries follow.

Kaw Connects Major Corridor Study (2001)----------------------------------KDOT/KTA
The Kaw Connects Study evaluated future transportation needs in the region between Topeka and Kansas City, a study area of approximately 50 miles by 26 miles. The study included development of a regional-scale transportation demand forecasting model to predict traffic levels on major highways and roadways in the study area. K-10 was one of the many facilities evaluated in this study, and, along with I-70, was rated the facility most needing additional capacity in the future.

K-10 Corridor Study Update (2003)--------------------------------------Johnson County
The original K-10 Corridor Study was completed in 1991. The 2003 update supported ongoing and planned efforts of the original document, including an emphasis on the importance of sustaining quality development, staging of "second phase" growth, and reuse of the Sunflower Army Ammunition Plant. Specific recommendations stated in this study include encouraging economic development, preserving agricultural land and open spaces, and enhancing the corridor appearance through high quality design standards.

Comprehensive Planning Documents-------------------------Various Jurisdictions
Several documents produced by local and regional agencies were gathered and used in developing travel demand forecasts for the study area. These included: Lawrence (*Transportation 2025*, *Farmland Development* (2003)), Eudora (*Comprehensive Plan 2003*, *Church Street/County Road 1061 Corridor Study* (2003)), De Soto (*Comprehensive Plan 2003*), Johnson County (*Countyscape 2020*, *Comprehensive Arterial Road Network Plan* (1998), *Sunflower Army Ammunition Plant Conceptual Land-use Plan*), and MARC (*Transportation Outlook 2030*).

K-7 Corridor Study (2002)---KDOT
The study area extended North along K-7 from the Johnson/Miami County line to East Mary Street in Lansing. The study looked at crash history, cost implications of various improvement strategies, and right-of-way impacts. The study corridor included areas near K-10, but did not specifically recommend improvements to the K-7/K-10 interchange. A follow-up study is currently underway to examine the K-7 corridor in more detail.

I-35/US-69 Major Investment Study [MIS] (1999)-----------------------------------KDOT
As part of a larger overall scheme for I-35, this study included the area of K-10 from Renner Road to I-435, illustrating how the capacity of the K-10/I-435/I-35 interchange complex could be improved with additional mainline lanes, auxiliary lanes, relocated ramps, new direct connector ramps, and collector-distributor roads.

23rd Street Corridor Study (2002)----------------------------Lawrence-Douglas County
The study corridor extended from Iowa Street (US-59) to Noria Road along 23rd Street (an urban extension of K-10 within Lawrence). With varied speed limits, fronting land uses, and traffic volumes throughout the corridor, specific recommendations varied from section to section. In the eastern section, from Franklin Road to Noria Road, the study recommended transitioning from a four-lane freeway to a six-lane expressway entering the city, reducing the speed limit from 65 to 45 mph, constructing a new interchange at Franklin Road, and reducing the frequency of median breaks to quarter-mile spacing.

K-10/Lone Elm Road Interchange Study (1999)------------------------City of Lenexa
This study analyzed the transportation impacts of building a new interchange on K-10 at Lone Elm Road. The study included a traffic analysis, a comparison of alternatives, and an analysis of local and system-wide performance. The recommended layout for the proposed interchange was a partial folded diamond with a standard diamond configuration at the north end and a folded configuration in the southwest quadrant.

West Lenexa Roadway Study (2000)--------------------------------------City of Lenexa
This study established design objectives for five arterial roadways: Prairie Star Parkway, Cedar Niles Road, Mize Road, 99th Street, and Clare Road. These corridors will provide access to a 3.5-square-mile tract of currently undeveloped property in the recently annexed western portion of Lenexa. The study included preliminary geometrics for new interchanges along K-10 at Prairie Star Parkway and Clare Road, and addressed improvements to the existing K-10/Cedar Creek/Mize interchange.

College Boulevard Corridor Study, K-7 to Lone Elm (2001)----------City of Olathe
Multiple traffic demand scenarios for the design year (2020) were developed for College Boulevard from K-7 to Lone Elm Road. The results of this study indicate that College Boulevard would operate at a desirable level of service in the design year if improved to a four-lane divided roadway, with improvements to cross streets to allow for additional turn lanes. The construction of an interchange at K-10/Lone Elm Road and a well-planned internal roadway network would assist in the reduction of traffic along College Boulevard.

111th Street Corridor Study, K-7 to Clare (2000)-------------------------City of Olathe
This traffic study was performed to analyze a one-mile corridor on 111th Street from K-7 to Clare Road. At the time of this study the corridor was primarily vacant, and the objectives were to determine the traffic demand for 2020 and determine a preferred design concept with appropriate levels of access management and intersection control. A preferred alternative was recommended based on the stipulation that an interchange would be built at K-10 and Clare Road, thus relieving substantial traffic that would otherwise be traveling in the study corridor.

College Boulevard Growth Management, K-7 to Clare (2000)------City of Olathe
Prepared in response to concerns raised from the 111th Street Corridor Study completed in 2000, this Growth Management Study identified additional ways in which to reduce the number of trips in the study area. In addition to building the interchange at K-10 and Clare Road, it recommended reducing the number of signals along the corridor and reducing the allowable land use intensity.

2.3 Study Process and Methodology

The study process included the following elements:

- Gather information from local agencies along the K-10 corridor, including previous available studies, land-use/traffic information, perceived future needs, existing concerns, and other data.
- Analyze existing conditions, including both physical and operational characteristics of the corridor. Traffic operations were generally analyzed using the methods of the *Highway Capacity Manual* (HCM), suitable for planning analysis.
- Analyze crash trends on the K-10 mainline, as well as the study section of I-435.
- Develop 2030 traffic volume forecasts based on historical traffic growth trends, population/land-use growth expectations provided by local communities, and examination of other transportation demand models used in portions of the study area.
- Analyze 2030 levels of service on the K-10 corridor, assuming no new interchanges are built. Develop mainline and interchange lane needs based on this assumption.
- Analyze 2030 levels of service including interchanges requested by local agencies (a total of five future interchanges), and develop mainline/interchange lane needs.
- Assess the ability to widen K-10 to the inside and/or outside, including preliminary examination of issues such as environmental concerns, grading/right-of-way, bridge widening/culvert extensions, side-street/frontage road impacts, and costs.
- Examine other important transportation issues associated with the K-10 corridor, including transit potential, Intelligent Transportation Systems (ITS) possibilities, and bicycle/pedestrian provisions.
- Conduct a meaningful public and agency involvement process to gather community input and direction on the study progress and results.
- Develop a set of long-term recommendations with a preliminary timeframe for needed improvements, with the understanding that no KDOT funding has been identified for any improvements along the K-10 corridor.

3. Existing Conditions

3.1 Corridor and Facility Description

K-10 provides a direct link between Lawrence and the Kansas City metropolitan area. It connects the cities of Eudora, De Soto, Olathe, and Lenexa along the study corridor. K-10 is the only east-west high-speed freeway alternative to I-70 between Kansas City and Lawrence, varying in distance from 5 to 11 miles south of the interstate. In the past, K-10 has served largely as a commute corridor between Lawrence and the Kansas City metropolitan area. This is changing, as development along the corridor has begun to intensify. With this increasing urbanization, traffic patterns will also change (as discussed in later sections of this report).

Between I-435 and eastern Lawrence, existing K-10 is a four-lane freeway with a grass median. A freeway is defined as a divided highway with access provided only at grade-separated interchanges. The freeway type of roadway maximizes mobility by restricting access. Typically, interchange spacing on freeways allows for smooth transitions for vehicles entering and exiting the roadway, maintains adequate access, and meets the operational requirements of the facility.

Within the Lawrence city limits, K-10's design speed decreases, and cross-road access reverts from interchanges to at-grade intersections. K-10 transitions into 23rd Street, a significant arterial in eastern Lawrence. 23rd Street's original design intent was to function as an arterial, not to carry the freeway-level traffic volumes that are expected on K-10 in the future.

There are 13 existing interchanges on K-10 between Lawrence and I-435 (including the K-10/I-435 interchange). From west to east, the following roadways/highways have interchanges with K-10:

- 1900 Road, located between Lawrence and Eudora
- Church Street, in Eudora
- 1400 Road, just east of Eudora
- Evening Star Road, approximately 2 miles east of Eudora
- Edgerton Road, approximately 4 miles east of Eudora
- Lexington Avenue, just west of De Soto
- Kill Creek Road, in De Soto
- Cedar Creek Parkway/Mize Road (Lenexa/Olathe), roughly 2 miles west of K-7
- K-7 (Lenexa/Olathe), approximately 4.5 miles west of I-435
- Woodland Road (Lenexa/Johnson County), approximately 2 miles east of K-7
- Ridgeview Road (Lenexa/Olathe), approximately 1.5 miles west of I-435
- Renner Road, in Lenexa just west of the I-435 Interchange.

All existing interchanges are diamond configurations, with the exception of Lexington Road (folded diamond), K-7 (full cloverleaf), and Renner Road (folded diamond). Appendix A contains data tables summarizing key characteristics of existing K-10.

3.2 Existing Pavement/Bridge Conditions

The following is a brief history of pavement conditions along the K-10 study corridor:

- *From Lawrence city limits to a point 1.3 miles east.* Concrete pavement was constructed in 1971. The pavement has been overlaid three times and is now on a 5- to 7-year cycle for rehabilitation work.
- *From 1.3 miles east of Lawrence to K-7.* Asphalt pavement was constructed between 1976 and 1977. The pavement has been overlaid three times since the original construction. The Douglas County original section was 7 inches and has had several additional 7-inch overlays, the last occurring in 1999. The Johnson County original section was 6 inches and has had several additional 8-inch overlays, the last occurring in 2001. These sections are on a 7- to 8-year cycle for rehabilitation work.
- *From K-7 to I-435.* This section is concrete pavement constructed in 1984. In 1997, a dowel-bar retrofit project was completed. In 2002, a 4.5-inch asphalt overlay was added to the section.

The existing mainline bridges along K-10 are considered to be in good condition and do not require replacement in the near future (from a structural standpoint). These bridges were constructed at the same time as the original pavement section, but generally are considered to have a 50-year design life.

3.3 Existing Constraints

The study team examined elements of existing K-10 that could constrain future improvements. Some key constraints are listed below:

- *Existing Design Criteria.* The existing plans indicate one area that does not meet current design criteria. The section of K-10 just east of Lawrence has a flat profile grade (zero percent) for approximately 1.5 miles from just west of Noria Road to the east, less than is typically desirable.
- *Existing Utilities.* A cursory review during the study revealed only a few existing utilities that might conflict with future improvements of K-10. One location is west of K-7, where two major pipelines cross K-10 on north-south alignments. Also, a mile west of the K-10/Cedar Creek Parkway/Mize Boulevard interchange, there is a transatlantic cable station located on the south side of K-10, with lines running both east-west and north-south.
- *Existing Development.* Development exists along the entire K-10 corridor, but especially within and near the various city limits. This is a high growth area and will continue to develop.
- *Floodway/Floodplain.* Johnson County is currently completing watershed studies on the major watersheds in the county. The preliminary results from these studies have generally indicated an increase in flows and will impact the existing FEMA maps. Currently, the County has submitted these studies to FEMA for their first review. No final floodways have been set for the watershed study areas.

3.4 Traffic Operations

Methodology

For the purposes of this study, operational results were characterized using analysis methods based on the *Highway Capacity Manual* (HCM). The fundamental HCM parameter describing operational quality is level of service (LOS), an A-through-F ranking scale.

For freeway elements (including mainline segments, ramp junctions, and weave segments), LOS is based on density, defined as the number of vehicles per hour per lane. Freeway elements were analyzed using the Highway Capacity Software (HCS). For intersections (such as ramp terminal intersections with local roads), LOS is based on the average control delay per entering vehicle. (Control delay includes not only stops at signals, but also slower speeds as vehicles advance in queue or decelerate upstream of an intersection.) Intersections were analyzed using the Synchro software, which provides an HCM report.

Table 3-1 summarizes the HCM definitions for LOS. For rural areas, AASHTO's *A Policy on Geometric Design of Highways and Streets* (also known as the "Green Book") suggests a target of LOS C or better for future conditions; for urban areas, the guidelines suggest a target of LOS D. Although the majority of K-10 is currently rural, it is rapidly urbanizing. For this reason, the study used LOS C as a desirable goal and LOS D as a minimum standard. The LOS analysis was conducted for the p.m. peak hour.

Table 3-1: LOS Criteria *(source: HCM)*

Freeways		Maximum Density (vehicles per mile per lane)		
		Mainline	Weave	Ramp
A	Free flow	11	10	10
B	Slight restriction to free flow	18	20	20
C	Restrictions to free flow	26	28	28
D	Noticeable restriction, declining speeds	35	35	35
E	No gaps in traffic, volatile speeds	45	43	>35
F	Breakdown, recurring congestion, large queues	>45	>43	demand > capacity

Intersections		Average Stopped Delay (seconds per vehicle)	
		Signalized Intersections	Unsignalized Intersections
A	Most vehicles do not stop	≤ 10	≤ 10
B	Some vehicles stop, slightly below LOS A	> 10 and $\leq$ 20	> 10 and $\leq$ 15
C	Significant number of stops, some do not stop	> 20 and $\leq$ 35	> 15 and $\leq$ 25
D	Many stop, individual cycle failure	> 35 and $\leq$ 55	> 25 and $\leq$ 35
E	Frequent individual cycle failure: at capacity	> 55 and $\leq$ 80	> 35 and $\leq$ 50
F	Arrival rate exceeds capacity	> 80	> 50

Although the operational analysis methods of the HCM were the basis for the LOS calculations, they were used as planning tools. Certain complex types of freeway operations (such as certain weaving and C-D road situations) may be outside the domain of the HCM. Often in this study, the mainline and ramp HCM analysis methods are used as the best proxies to determine operational characteristics at a planning level.

As an additional point of reference, it can be useful to relate LOS to Average Daily Traffic (ADT). Although the HCM does not directly contain such a correlation, an approximate relationship can be obtained by converting the HCM's peak-hour density-based thresholds to volume-based thresholds through assumptions regarding key parameters, and applying factors to expand these peak-hour volumes to daily volumes. Figure 3-1 illustrates typical order-of-magnitude LOS thresholds for freeways and arterials similar to those found in the study area. Table B-1, in Appendix B, summarizes the derivations of these thresholds from the basic HCM parameters. The study team developed these thresholds to help communicate the basic capacities that could be expected with improvements to the K-10 corridor, and as a check on peak-hour calculations made using the HCM methodology. As can be inferred from the graph, K-10's current capacity is roughly 65,000 to 80,000 vehicles per day (vpd).

Data Collection

To aid in analyzing existing conditions, KDOT provided both daily and peak-hour count information along the K-10 corridor. The count data included heavy vehicle percentages in most cases. Other items contributing toward the capacity analysis were collected from available sources (aerial photos, existing as-built plans, and field observation); these included mainline and ramp grades (where available), lane patterns, intersection control (at ramp termini), and posted speeds.

Existing Traffic Volumes

KDOT provided existing traffic volume information for the study, including Average Daily Traffic (ADT) and p.m. peak-hour volumes on the K-10 mainline, as well as p.m. peak-hour turning movements at the 13 existing interchanges and three at-grade study intersections along K-10.

As Figure 3-2 illustrates, K-10 carries approximately 25,000 to 61,000 vehicles per day (vpd). Based on the graph presented in Figure 3-1, these daily volumes are generally within the capacity of a four-lane freeway. However, volumes on the east end of the corridor (near I-435) fall in the LOS D range of the graph, approaching LOS E. Figure 3-2 also illustrates that I-435 carries 108,000 vpd east of K-10.

The daily volume and capacity values provide rough indications of LOS, but the peak-hour information allows a more refined calculation of LOS using the standard HCM methodology (see the next section). It also allows an examination of intersection operations (not afforded by daily counts). Figure 3-3, on the following page, illustrates existing (2003) p.m. peak-hour volumes on K-10, including interchange turning movements. As the figure indicates, the heavy direction during the p.m. peak hour is westbound - with 3,450 vehicles on the heaviest segment (near the east end), decreasing to under 1,400 vehicles (near the west end). These volumes reflect the commute nature of K-10, with many motorists returning westward from employment in the Kansas City metropolitan area. A reversed directionality occurs during the morning peak period, but this time period was not evaluated as part of this study.

Existing Peak-Hour Levels of Service

Table 3-2 illustrates existing p.m. peak-hour LOS for the study freeway elements, including mainline segments, ramp junctions, and ramp intersections. (The study focused on the p.m. peak hour as the heavier of the two peaks.) As the table indicates, the majority of the K-10 system currently operates at LOS C or better during the p.m. peak hour. However, certain areas are operating below this level:

- The mainline segments and ramp junctions between I-435 and Woodland Avenue are currently operating at LOS D during the p.m. peak hour. This finding correlates well with the ADT capacity relationship discussed earlier.
- At two unsignalized at-grade intersections at the west end of the corridor (K-10/East Hills Road and K-10/Noria Road/1750 Road), side-street turning movements and mainline left turns function at LOS E, as these movements are delayed waiting for gaps in the heavy peak-hour traffic.
- At the K-10/Lexington Avenue westbound ramps, side-street movements operate at LOS E and F.
- At the K-10/Ridgeview Road westbound ramps, the heavy peak-hour left-turn movement (537 vehicles) operates at LOS F.

Note that the K-10/K-7 interchange and the K-10/I-435 interchange are not included in the existing conditions analysis. Both these interchanges have been analyzed by others, and are discussed in greater detail later in this report.

Appendix B contains detailed LOS calculations for existing conditions.

Figure 3-1: Daily LOS Thresholds

For a derivation, see Table B-1 of Appendix B.

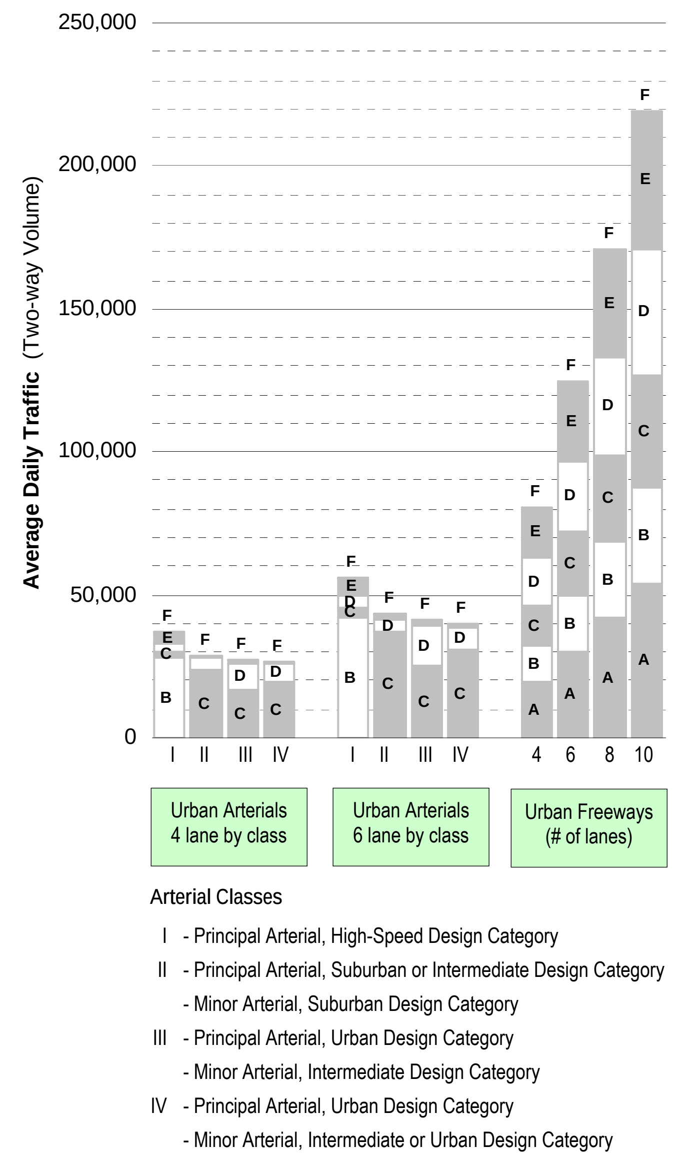
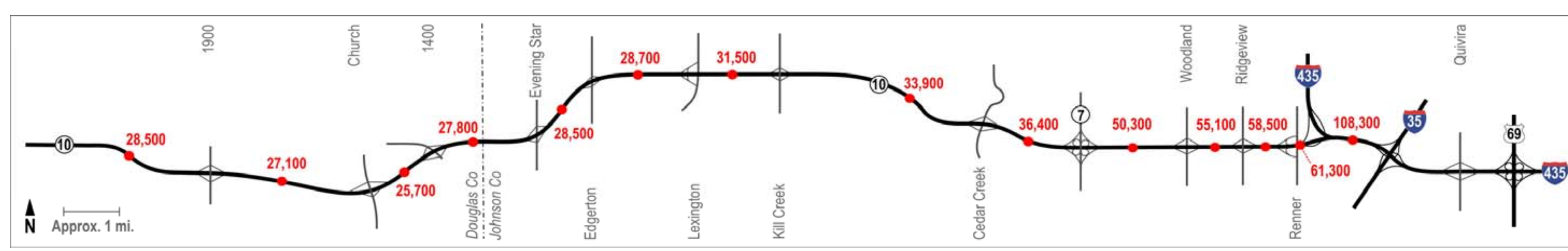
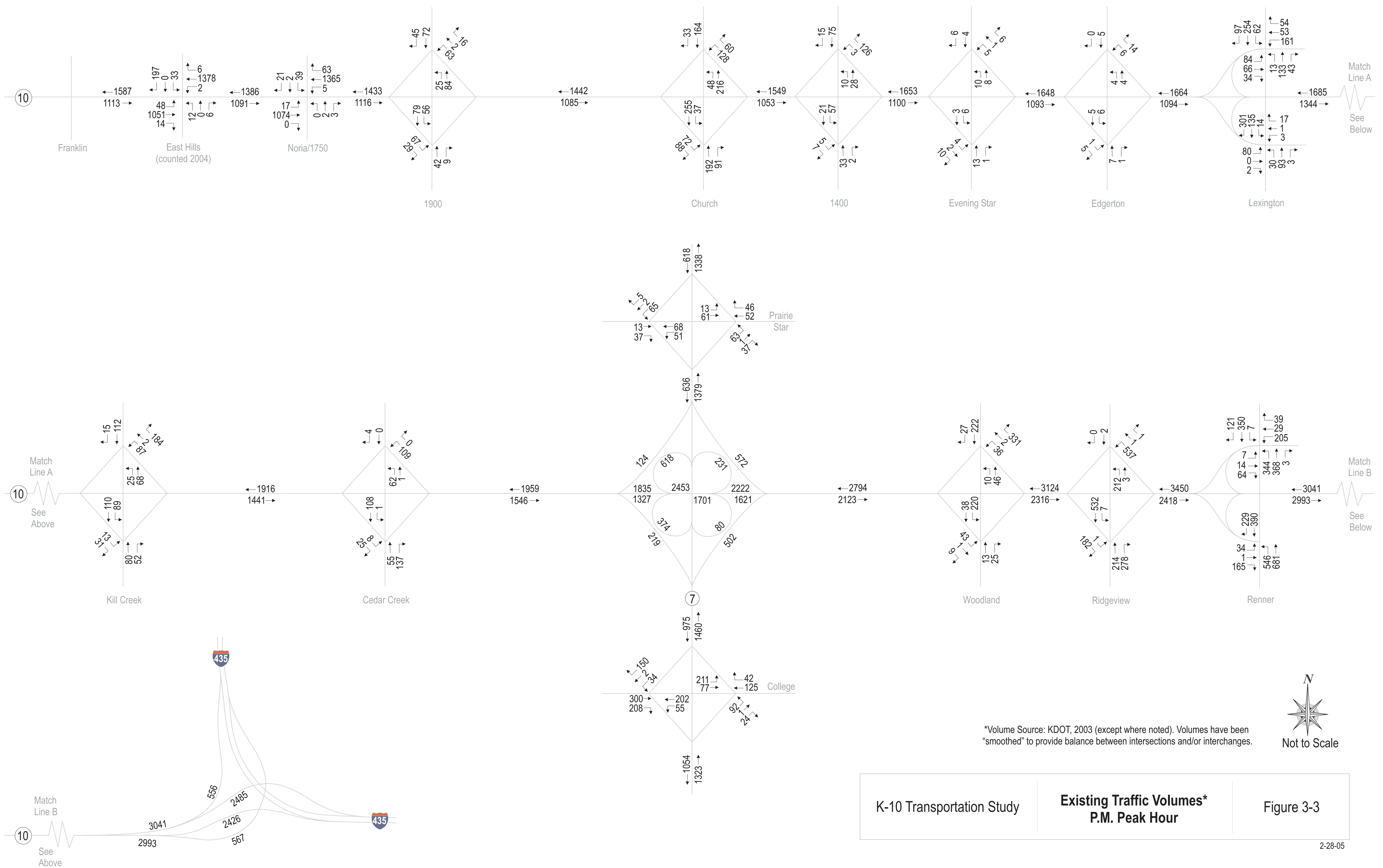


Figure 3-2: Existing ADTs (2003 KDOT counts)





*Volume Source: KDOT, 2003 (except where noted). Volumes have been "smoothed" to provide balance between intersections and/or interchanges.

K-10 Transportation Study	**Existing Traffic Volumes* P.M. Peak Hour**	Figure 3-3

2-28-05

Table 3-2: Existing LOS

Intersections

	Delay (sec/veh)	LOS
K-10 & East Hills***	--- (---)	A (F)
K-10 & E 1750***	2.0 (46.2)	A (E)
K-10 & 1900 WB Ramps	3.7 (9.4)	A (A)
K-10 & 1900 EB Ramps	6.0 (8.8)	A (A)
K-10 & Church WB Ramps	5.9 (14.3)	A (B)
K-10 & Church EB Ramps	4.3 (13.1)	A (B)
K-10 & 1400 WB Ramps	4.7 (8.6)	A (A)
K-10 & 1400 EB Ramps	4.3 (6.1)	A (A)
K-10 & Evening Star WB Ramps	4.2 (5.8)	A (A)
K-10 & Evening Star EB Ramps	4.5 (6.7)	A (A)
K-10 & Edgerton WB Ramps	4.0 (6.6)	A (A)
K-10 & Edgerton EB Ramps	3.4 (5.6)	A (A)
K-10 & Lexington WB Ramps	28.8 (56.2)	D (F)
K-10 & Lexington EB Ramps	3.5 (13.8)	A (B)
K-10 & Kill Creek WB Ramps	7.1 (11.5)	A (B)
K-10 & Kill Creek EB Ramps	3.8 (6.8)	A (A)
K-10 & Cedar Creek WB Ramps	10.6 (10.9)	B (B)
K-10 & Cedar Creek EB Ramps	1.1 (9.6)	A (A)
K-10 & Woodland WB Ramps	6.5 (11.7)	A (B)
K-10 & Woodland EB Ramps	8.4 (11.4)	A (B)
K-10 & Ridgeview WB Ramps	377.1 (382.3)	F (F)
K-10 & Ridgeview EB Ramps	2.4 (15.8)	A (C)
K-10 & Renner WB Ramps**	12.3	B
K-10 & Renner EB Ramps*	30.4	C

* Signalized intersection.
** Intersection will be signalized in the near future, and was therefore analyzed as signalized.
*** At-grade intersections with K-10. All other listed intersections are K-10 ramp intersections with the local cross-street.

For unsignalized intersections, LOS is reported as follows: Values outside parentheses represent the average delay/LOS for all vehicles entering the intersections, and values inside parentheses represent delay/LOS for minor movements only (those required to stop or yield).

The K-10/I-435 and K-10/K-7 interchanges were not explicitly analyzed using HCM methods in this study, because they have been analyzed in previous documents.

Basic Freeway Segments (Mainline)

	Speed (mph)	Density (veh/mi/ln)	LOS
Eastbound			
East Hills to 1750****	65	10.2	A
1750 to 1900 off	70	9.7	A
1900 on to Church off	70	8.8	A
Church on to 1400 off	70	8.5	A
1400 on to Evening Star off	70	8.9	A
Evening Star on to Edgerton off	70	8.8	A
Edgerton on to Lexington off	70	8.8	A
Lexington on to Kill Creek off	70	10.8	A
Kill Creek on to Cedar Creek off	70	11.7	B
Cedar Creek on to K-7 off	70	12.1	B
K-7 on to Woodland off	70	16.1	B
Woodland on to Ridgeview off	70	17.8	B
Ridgeview on to Renner off	65	20.0	C
Renner on to I-435 off	64.8	24.9	C
Westbound			
I-435 on to Renner off	63.9	28.1	D
Renner on to Ridgeview off	60.8	33.5	D
Ridgeview on to Woodland off	67	27.9	D
Woodland on to K-7 off	69.9	21.2	C
K-7 on to Cedar Creek off	70	15.6	B
Cedar Creek on to Kill Creek off	70	15.3	B
Kill Creek on to Lexington off	70	13.4	B
Lexington on to Edgerton off	70	13.3	B
Edgerton on to Evening Star off	70	13.1	B
Evening Star on to 1400 off	70	13.2	B
1400 on to Church off	70	12.4	B
Church on to 1900 off	70	11.3	B
1900 on to 1750	70	11.2	B
1750 to East Hills	65	11.6	B
East Hills to Franklin			

**** This segment was analyzed as a freeway for consistency with the remainder of the segments, although its operation would have aspects of a multi-lane rural highway.

Ramp Junctions

	Speed (mph)	Density (veh/mi/ln)	LOS
Eastbound			
1900 off	57.7	9.9	A
1900 on	62.3	10.0	A
Church off	57.5	9.3	A
Church on	62.1	9.9	A
1400 off	58.0	7.3	A
1400 on	62.5	9.1	A
Evening Star off	58.0	6.6	A
Evening Star on	62.6	8.8	A
Edgerton off	58.0	7.1	A
Edgerton on	62.5	9.3	A
Lexington off	57.8	9.0	A
Lexington on	63.2	9.1	A
Kill Creek off	57.8	11.4	B
Kill Creek on	62.1	12.7	B
Cedar Creek off	57.9	12.3	B
Cedar Creek on	62.1	13.4	B
Woodland off	57.8	18.5	B
Woodland on	61.3	19.5	B
Ridgeview off	57.5	19.5	B
Ridgeview on	61.1	20.6	C
Renner off			
Westbound			
Renner on			
Ridgeview off	56.5	34.3	D
Ridgeview on	57.4	31.3	D
Woodland off	57.1	31.1	D
Woodland on	61.6	20.0	B
Cedar Creek off	57.7	17.3	B
Cedar Creek on	61.7	16.8	B
Kill Creek off	57.2	16.7	B
Kill Creek on	62.0	14.8	B
Lexington off	57.5	12.2	B
Lexington on	61.9	14.9	B
Edgerton off	58.0	12.9	B
Edgerton on	62.3	13.5	B
Evening Star off	58.0	12.4	B
Evening Star on	62.0	14.4	B
1400 off	57.7	13.5	B
1400 on	61.9	14.2	B
Church off	57.5	13.7	B
Church on	62.4	11.8	B
1900 off	57.8	11.9	B
1900 on	62.1	12.4	B

3.5 Safety

KDOT’s electronic crash database was used to analyze recent historical safety trends on both K-10 and I-435 to assist in the development of recommendations to improve operating conditions on these facilities.

Crash Rates

Running crash rate graphs were developed using data from the Kansas Accident Reporting System (KARS). KARS includes a database of crashes across Kansas containing data on when, why and where the crashes occurred. A five-year period (1998-2002) was used for crash data collection.

The *statewide average crash rate* is calculated using the total number of crashes and vehicle-miles traveled on a specific road type in Kansas. Therefore, different facility types will have different crash rates. For the K-10 study area, several statewide rates were calculated, as K-10 has both rural and urban sections and I-435 is classified differently than K-10.

The *critical crash rate* is a function of the crash rate on a given segment, the statewide average crash rate for similar facilities, and vehicle exposure on the segment. This function also includes a statistical constant that determines a level of confidence for the rate so that a segment identified with a high crash rate is not a false detection. The critical rate varies in a manner similar to the statewide average rate for different road classifications and exposure.

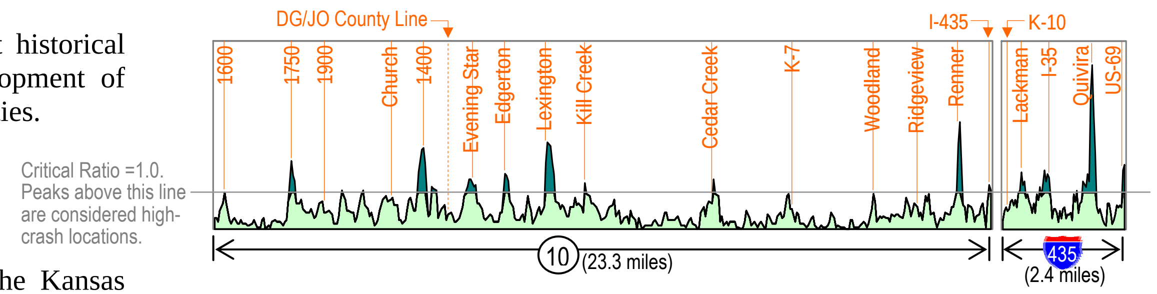
One way to incorporate both the statewide crash rate and the critical crash rate in a visual comparison is to compute the *critical ratio*, which is equal to the statewide rate divided by the critical rate. Any areas with statewide rates exceeding the critical rate will have a critical ratio exceeding 1.0. Figure 3-4 illustrates the “running” critical ratio for K-10 and I-435 in the study area. The “running” ratio uses a moving 0.3-mile window, which slides at 0.1-mile intervals to provide an overlap of data.

Figure 3-4 exhibits many peaks as well as valleys. The low areas correspond to low crash rates while the peaks show potential problem sites. The unit of measure for crash rates (all crashes) is crashes per million vehicle-miles. Vehicle-miles are determined by multiplying the total vehicle volume on a roadway segment by the length of that segment for a given study period.

The areas of concern on the graphs are those locations where the critical ratio exceeds 1.0. These areas, delineated using a darker color, represent statistically significant high crash sites relative to the Statewide Average.

General reasons for high crash locations can include highway geometrics, driver confusion due to improper signage, or insufficient capacity. For instance, a curve in the road may limit sight distance or a confusing sign may mislead drivers so they have less time to react. Insufficient capacity can force vehicles to travel closer together and can cause greater speed differences between vehicles. Such speed differences can result in undesirable situations, such as a faster car slowing (sometimes quickly and unsafely) to avoid striking a slower car. On- and off-ramps can also be adversely affected by insufficient capacity, as described later. The reasons listed above may or may not be present at the high crash locations along K-10. The remainder of this chapter examines the crash record in more detail.

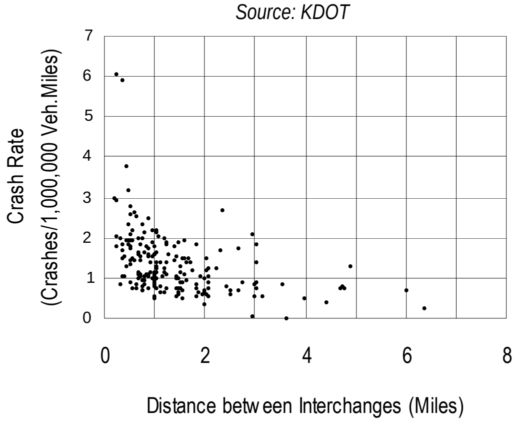
Figure 3-4: K-10 Running Critical Crash Ratios, 1998-2002



As can be seen in Figure 3-4, many of these high crash locations occur at or near interchanges. There are many conflict points around an interchange: each exit and entrance ramp introduces conflicts as motorists must either decelerate and maneuver to the off-ramp, or accelerate and merge onto the highway. Sometimes, inattentive or unfamiliar drivers may not anticipate an upcoming off-ramp and thus may try to change lanes under unsafe conditions. Also, in heavy traffic, all travel lanes may be occupied while a driver is trying to merge into traffic. If surrounding vehicles are unable to let an entering car merge, safety concerns may result.

Figure 3-4 also shows that the crash rates tend to increase in magnitude if interchanges are closer together. The number of conflict points around two closely spaced interchanges is increased compared to a more isolated interchange. For example, the reduced distance may contribute to increased weaving concerns between ramps. This situation can be worsened with heavy traffic. Figure 3-5 includes crash rates on KDOT highway segments throughout the Kansas City metropolitan area, plotted against interchange separation. As the figure illustrates, more closely spaced interchanges (especially with spacing below one mile) tend to have higher crash rates.

Figure 3-5:
1997-2000 Metro Average All Crashes
Source: KDOT



The closeness of interchanges and weaving problems may explain the substantial rate peak around Quivira Road and for all of I-435 in the study area, where the crash rate is higher on average than on K-10 (which generally has more distance between interchanges). Higher volumes on I-435, as well as other factors, are also likely contributors to the crash rates.

Crash Characteristics

To more closely examine safety issues, K-10 was divided into six logical segments, and I-435 was divided into two. The output from KARS was used to stratify the crash data according to several types, as summarized in Table 3-3. The table combines segments of similar character, resulting in three segments for K-10 and treating I-435 as a single segment. (Appendix C contains more detailed crash statistics.) Some key information drawn from the crash statistics includes:

- The rural freeway segment of K-10 exhibited a crash rate slightly above the statewide critical rate, as did the aggregated I-435 segment.
- There were 14 fatal crashes on K-10 during the study period - 10 on the rural freeway section and four on the urban freeway section. There was one fatal crash on I-435 (between Quivira Road and K-10).
- On the rural freeway portion of K-10, “Animal” and “Fixed Object” were the predominant crash types. On the urban portion, the frequency of rear-end collisions was higher. On I-435, rear-end collisions dominated as a crash type.
- Ice and snowpack were more often present during crashes on the rural freeway section of K-10, especially the portion between the Johnson County line and the Lenexa city limit.

Table 3-3:
Summary of K-10, I-435 Crash Statistics: 1998-2002

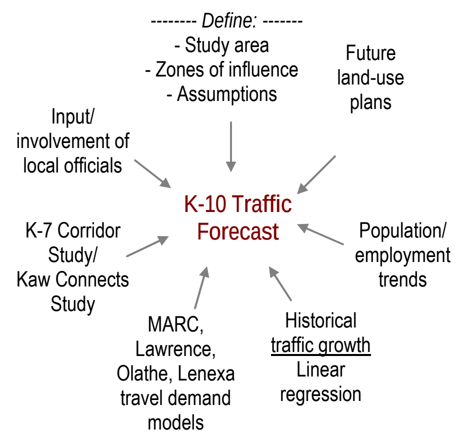
	K-10			
	Arterial (1600 to 1750)	Rural Freeway (1750 to Lxa limit)	Urban Freeway (Lxa limit to I-435)	I-435 (K-10 to US-69)
Segment length, mi	1.634	15.406	7.848	3.526
Number of accidents	92	715	525	1,237
Accident rate (per MVM)	1.048	0.942	1.004	1.895
Critical ratio*	0.397	1.162	0.717	1.244
Severity (%)				
Property damage only	72	75	76	78
Injury	28	23	23	22
Fatal	0	1	1	0
Type (%)				
Animal	20	31	24	1
Fixed object	18	26	21	10
Other non-collision	3	5	3	2
Overturned	3	8	6	2
Angle	23	8	8	11
Rear-end	21	10	24	57
Sideswipe - overtaking	10	4	6	9
Other types (<5% ea)	2	8	8	8
Time of Day (%)				
12a – 7a	21	23	19	8
7a – 9a	11	11	21	27
9a – 4p	29	25	24	32
4p – 6p	15	13	13	20
6p – 12a	24	29	23	12
Road Surface Condition (%)				
Dry	72	73	76	78
Wet	22	11	10	11
Snow or slush	3	3	5	4
Ice or snowpacked	3	13	8	7
Other	0	0	1	1

**A critical ratio >1.0 indicates a crash rate that significantly exceeds the Statewide average. See discussion in text.*

4. Future Conditions

4.1 Travel Demand Forecasting Methodology

Figure 4-1: Forecast Sources



The traffic projections were developed by KDOT, and were reviewed and approved by MARC, Lawrence-Douglas County Metropolitan Planning Commission, the City of Eudora, the City of De Soto, the City of Olathe, the City of Lenexa, and Johnson County. Figure 4-1 illustrates the sources that were used in preparing the traffic projections. The remainder of this section describes the process used to develop the forecasts.

Data Gathering

The first step in developing the forecasts was to collect and analyze historical traffic count information, planning documents from local city/county governments, technical studies completed of the area, land-use plans from the city/county governments, and socio-economic/demographic data from the US Census Bureau for the corridor. This included defining the zones of influence along the corridor and around the interchanges, identifying vacant and occupied land in the study area, identifying existing land use, and establishing the existing road network.

Identifying Interchange Influence Zones

An interchange influence zone is a specific area adjacent to and served by an interchange and bound by natural barriers (e.g., rivers) and other obstacles that may or may not impede travel into other adjacent zones (e.g., incomplete local road network). The specific zone associated with an interchange includes all areas to or from which traffic that is entering or exiting the freeway may be traveling. In other words, these zones include the areas and their associated land uses that influence the traffic utilizing the interchange. The purpose of developing these influence zones was to better understand the link between the traffic on K-10 and the land uses adjacent to K-10 that are generating traffic.

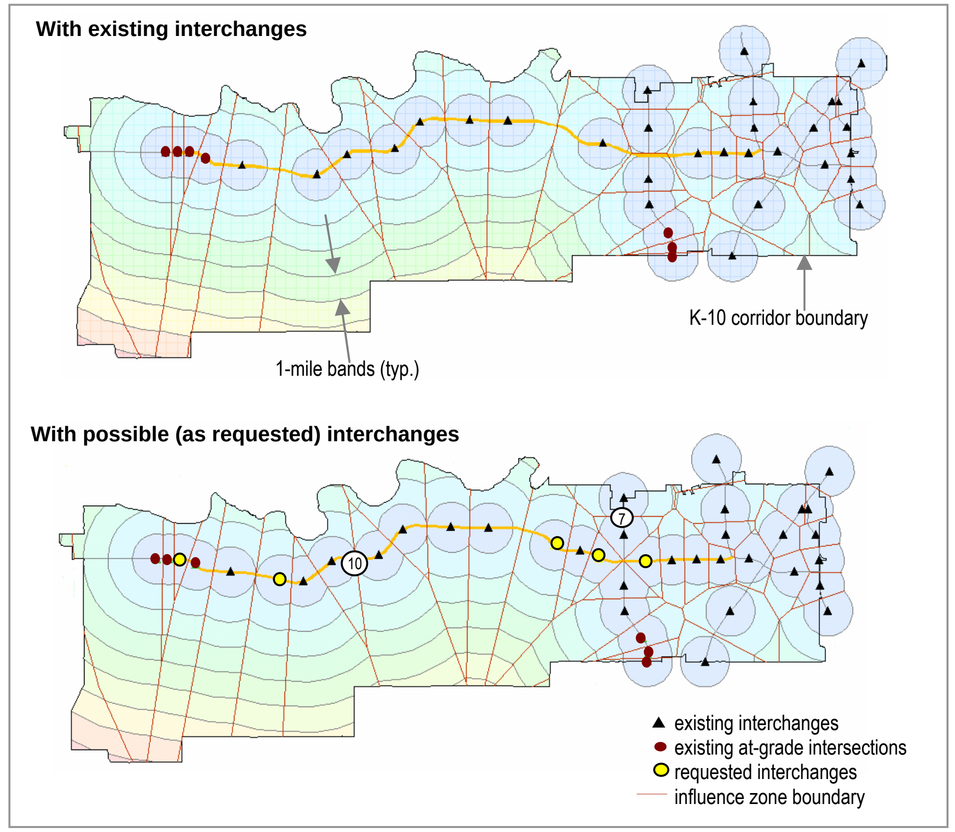
In order to define interchange influence zones, KDOT considered two major factors:

Continuity. Interchanges in cities with a well-developed and functional system of urban collectors and/or arterials may have zones that are more difficult to define because traffic can effectively move along the arterial streets and enter the freeway at a number of different locations. Therefore, the continuity of collector and arterial city streets parallel to a given corridor is a major factor in determining influence zone boundaries.

Natural Barriers. Natural barriers can be obstacles that may influence traffic to move in a specific direction (toward one interchange and away from another). Also, natural barriers - such as rivers, deep ravines, densely wooded areas, and protected wildlife habits - can act as major deterrents to future roadway construction and other transportation-related boundaries.

Figure 4-2 illustrates the study area and the corresponding influence zones. The lower half of the figure illustrates how the addition of the possible (as requested) interchanges would affect the influence zones.

Figure 4-2: Study-area Influence Zones



Development of Projections

KDOT developed future traffic volume projections using a combination of forecasts from several travel demand forecasting models – MARC, the City of Lenexa, the City of Olathe, the Lawrence-Douglas County Metropolitan Planning Office, and the KAW Connects Study (HDR, 2000) – as well as historical traffic count data and socioeconomic/demographic trends of the region. KDOT used the following procedure to develop future traffic projections:

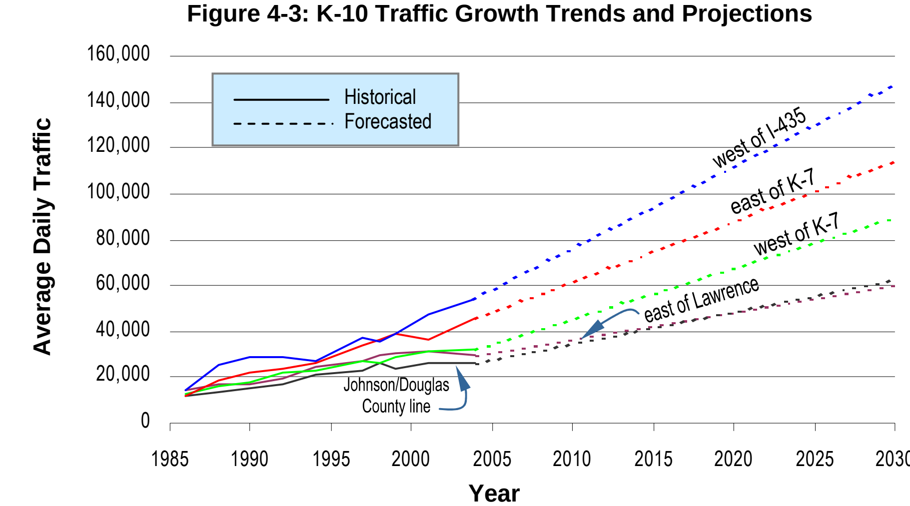
1) Analyzed the region's historical traffic counts and used linear regression to determine the Historical Traffic Growth Rates (HTGR) for the period from 1990 to 2000.
2) Collected historical population and employment data from the US Census and developed Historical Population and Employment Growth (HPGR) trends using linear regression (1990 to 2000).
3) Determined Population and Employment Growth rates (PEGR) for the period 2000 to 2030.
4) Calculated Future Traffic Growth Rates (FTGR) using the following formula: FTGR = HTGR x (PEGR / HPGR).
5) Determined the 2030 "total ramp" volumes for each specific interchange by applying the future traffic growth rate to 2000 total ramp volumes.
6) Compared draft forecasted traffic volumes to other local travel demand model assignments (Olathe, Lenexa, Lawrence, MARC, and KAW Connects) for reasonableness check. Made adjustments as needed.
7) Presented findings to city and local governments along the corridor for feedback. Feedback was then incorporated back into the forecast until all agencies agreed that the future traffic volumes were representative of their future land use and expected development.
8) Converted the final daily traffic volumes to peak hour volumes by calculating the Design Hour Volume (DHV) and Directional Distribution (D) for the corridor.

Additional assumptions that influenced the forecast development process included the following:

- Sunflower Ammunition Plant will develop in accordance with the Johnson County plan and in accordance with information from the City of De Soto.
- A freeway-to-freeway connection ("K-10 extension") will exist at the western end of the corridor by 2030.
- The K-10 Corridor will develop according to the land-use plans presented to KDOT by the cities and counties along the corridor.
- Current (2003) peak hour directional trends will remain fairly constant over the next 26 years.
- The traffic forecast is a demand forecast with unconstrained capacity along both K-10 and the cross-roads. The forecast assumes that capacity will be added to K-10 and the cross-roads to accommodate projected demand.
- The provision of transit service will not change vehicle occupancy rates.

To give context to the projections, Figure 4-3 compares the forecasts to historical volume trends on K-10 at several points along the corridor. The following sections describe the forecasts, and their consequences, in more detail.

Figure 4-3: K-10 Traffic Growth Trends and Projections



4.2 2030 Baseline Assumptions

KDOT developed 2030 projections for two network scenarios: (1) with existing interchanges and (2) with the addition of new “as requested” interchanges. In both scenarios, it was clear that the majority of K-10 would operate at LOS E or worse if the existing geometric configuration remained. In general, the mainline, as well as the interchanges, are considerably undersized for forecasted 2030 demand. Therefore, a true “No Build” scenario was not analyzed, but rather both 2030 scenarios included improvements necessary to allow K-10 to operate at levels of service deemed acceptable. These improvements included the following (illustrated in Appendix E and F):

- Widening to eight basic lanes from I-435 to K-7, including additional auxiliary lanes between most interchanges; and
- Widening to six basic lanes from K-7 to east Lawrence.
- Improving the thirteen existing interchanges. At the majority of these interchanges, signalization and ramp/cross-road improvements would be needed. (The K-10/1400 Road ramp terminals were assumed to be converted to roundabouts, as described in Chapter 5.) Geometrics were developed for each interchange based on LOS needs. Appendix F includes diagrams illustrating these recommended configurations; more detailed discussion of each is provided in Chapter 5.

Two assumptions used in the operational analysis for existing conditions were modified for the 2030 analysis. Due to the urbanizing nature of K-10, the truck percentage on K-10 was assumed to increase to 5 percent by 2030 (from existing levels of 2 to 3 percent). Also, a uniform Peak Hour Factor (PHF) of 0.9 was assumed, reflective of an urbanized corridor.

Most of the auxiliary lanes mentioned above exceeded the HCM-prescribed maximum length to qualify as a weave section (2,500 feet). Therefore, for this planning-level study, they were analyzed as mainline sections with ramp junctions at either end.

The following two sections document the operational analysis. Detailed LOS calculations are included in Appendix B.

4.3 2030 Operations - With Existing Interchanges

Figure 4-4 illustrates the 2030 ADT forecasts for K-10 assuming no new interchanges are built; Figure 4-5 illustrates the 2030 p.m. peak-hour forecasts. Table 4-1 summarizes the results of the LOS analysis for this scenario. As the table illustrates, most elements west of K-7 would operate at LOS C or better with the recommended geometrics. East of K-7, most elements would operate at LOS D or better. As stated previously, these findings assume significant capacity enhancements at many of the existing interchanges in the Lenexa/Olathe area. One entry in the table merits further discussion:

- *Woodland Westbound on-ramp.* HCS indicated that the total flow entering the ramp influence area would exceed the maximum desirable limit, but that downstream mainline capacity would not be exceeded. Even though HCS reports this condition as LOS F, the HCM indicates that locally high densities are expected, but no queueing would occur on the freeway, and operations would be stable.

Figure 4-4: 2030 ADT Forecasts – With Existing Interchanges

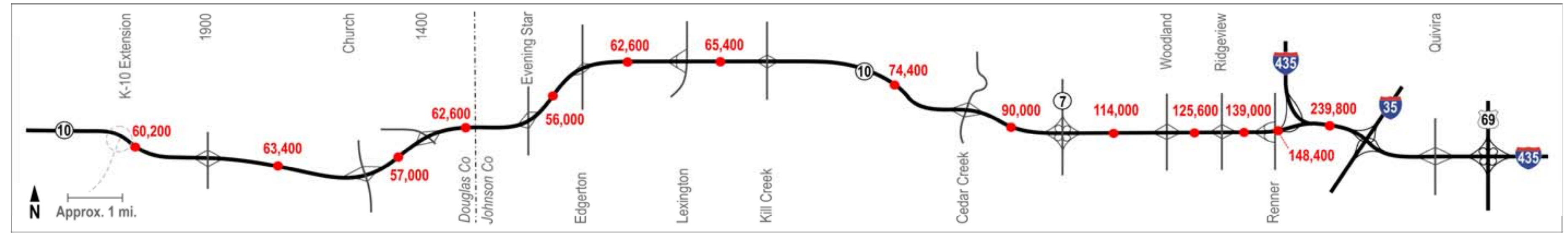


Table 4-1: 2030 LOS – With Existing Interchanges (and widened K-10 mainline)

Intersections

	Delay (sec/veh)	LOS
K-10 & 1900 WB Ramps[1]	9.6 (18.0)	A (C)
K-10 & 1900 EB Ramps[1]	7.1 (14.2)	A (B)
K-10 & Church WB Ramps	18.4	B
K-10 & Church EB Ramps	15.4	B
K-10 & 1400 WB Ramps[2]	6.0	A
K-10 & 1400 EB Ramps[2]	8.8	A
K-10 & Evening Star WB Ramps	18.6	B
K-10 & Evening Star EB Ramps	17.4	B
K-10 & Edgerton WB Ramps	13.8	B
K-10 & Edgerton EB Ramps	9.4	A
K-10 & Lexington WB Ramps	28.0	C
K-10 & Lexington EB Ramps	28.8	C
K-10 & Kill Creek WB Ramps	15.6	B
K-10 & Kill Creek EB Ramps	14.8	B
K-10 & Cedar Creek WB Ramps	18.8	B
K-10 & Cedar Creek EB Ramps	21.8	C
K-10 & Woodland WB Ramps	21.3	C
K-10 & Woodland EB Ramps	20.4	C
K-10 & Ridgeview WB Ramps	17.8	B
K-10 & Ridgeview EB Ramps	21.5	C
K-10 & Renner WB Ramps	36.8	D
K-10 & Renner EB Ramps	23.3	C

All intersections analyzed as signalized except where noted:

[1] Stop-control assumed on off-ramp. LOS is reported as follows: Values outside parentheses represent the average delay/LOS for all vehicles entering the intersections, and values inside parentheses represent delay/LOS for minor movements only (those required to stop or yield).

[2] Roundabout control assumed.

The K-10/I-435 and K-10/K-7 interchanges were not explicitly analyzed using HCM methods in this study, because they have been analyzed in previous documents.

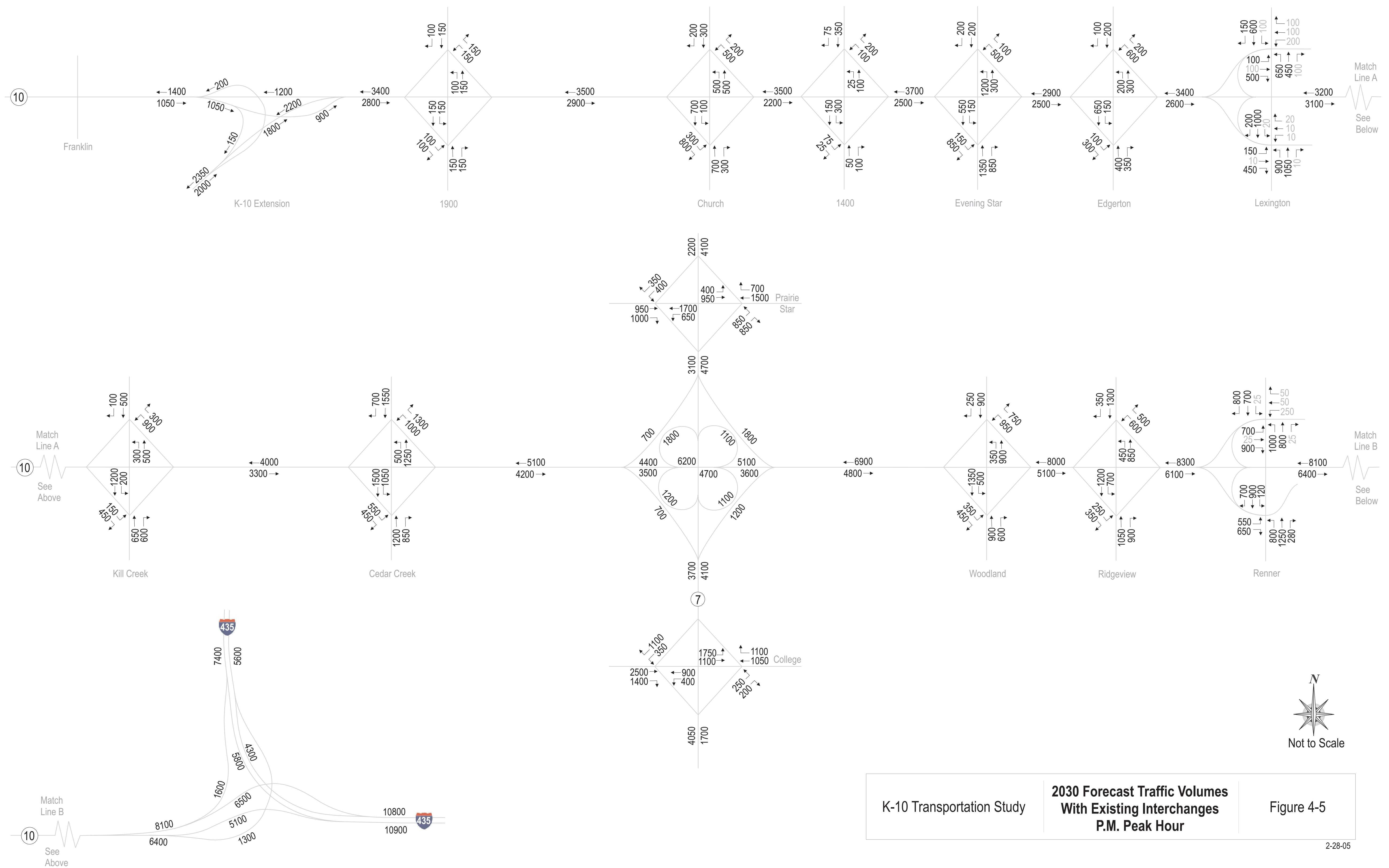
Basic Freeway Segments (Mainline)

	Speed (mph)	Density (veh/mi/ln)	LOS
Eastbound			
1900 on to Church off	67.0	16.4	B
Church on to 1400 off	65.5	12.7	B
1400 on to Evening Star off	66.1	14.4	B
Evening Star on to Edgerton off	64.6	14.7	B
Edgerton on to Lexington off	66.1	14.9	B
Lexington on to Kill Creek off	67.0	17.6	B
Kill Creek on to Cedar Creek off	67.0	19.6	C
Cedar Creek on to K-7 off	65.5	18.3	C
K-7 on to Woodland off	66.8	20.5	C
Woodland on to Ridgeview off	63.8	18.2	C
Ridgeview on to Renner off	64.6	21.5	C
Renner on to I-435 off	69.0	21.1	C
Westbound			
I-435 on to Renner off	66.7	27.7	D
Renner on to Ridgeview off	66.0	28.6	D
Ridgeview on to Woodland off	65.8	28.4	D
Woodland on to K-7 off	63.3	31.0	D
K-7 on to Cedar Creek off	65.5	22.1	C
Cedar Creek on to Kill Creek off	66.9	22.7	C
Kill Creek on to Lexington off	67.0	18.1	C
Lexington on to Edgerton off	66.1	19.5	C
Edgerton on to Evening Star off	66.1	16.7	B
Evening Star on to 1400 off	66.1	21.3	C
1400 on to Church off	67.0	19.8	C
Church on to 1900 off	65.5	20.3	C

Ramp Junctions

	Speed (mph)	Density (veh/mi/ln)	LOS
Eastbound			
1900 off	58.9	17.3	B
1900 on	60.1	16.6	B
Church off	56.3	20.5	C
Church on	60.4	13.7	B
1400 off	59.2	12.3	B
1400 on	59.8	14.0	B
Evening Star off	55.7	16.1	B
Evening Star on	59.4	15.6	B
Edgerton off	57.8	14.2	B
Edgerton on	59.6	15.1	B
Lexington off	57.3	17.1	B
Lexington on	60.1	17.0	B
Kill Creek off	58.2	19.9	B
Kill Creek on	59.6	20.1	C
Cedar Creek off	57.1	22.6	C
Cedar Creek on	60.2	20.5	C
Woodland off	60.8	7.0	A
Woodland on	59.1	18.5	B
Ridgeview off	61.6	2.6	A
Ridgeview on	59.1	21.6	C
Renner off	58.6	28.5	D
Westbound			
Renner on	63.4	22.5	C
Ridgeview off	63.4	14.7	B
Ridgeview on	61.3	21.1	C
Woodland off	61.2	14.5	B
Woodland on	53.9	34.0*	F*
Cedar Creek off	57.6	17.9	B
Cedar Creek on	59.5	25.1	C
Kill Creek off	57.6	26.1	C
Kill Creek on	59.8	18.4	B
Lexington off	57.9	18.4	B
Lexington on	58.7	21.2	C
Edgerton off	57.1	20.6	C
Edgerton on	59.6	15.6	B
Evening Star off	57.5	17.0	B
Evening Star on	59.1	24.0	C
1400 off	59.5	21.8	C
1400 on	59.5	19.5	B
Church off	58.0	22.8	C
Church on	59.5	20.3	C
1900 off	59.1	21.5	C
1900 on	59.3	18.9	B

* Local high densities, but no freeway queueing (HCM p 25-8)



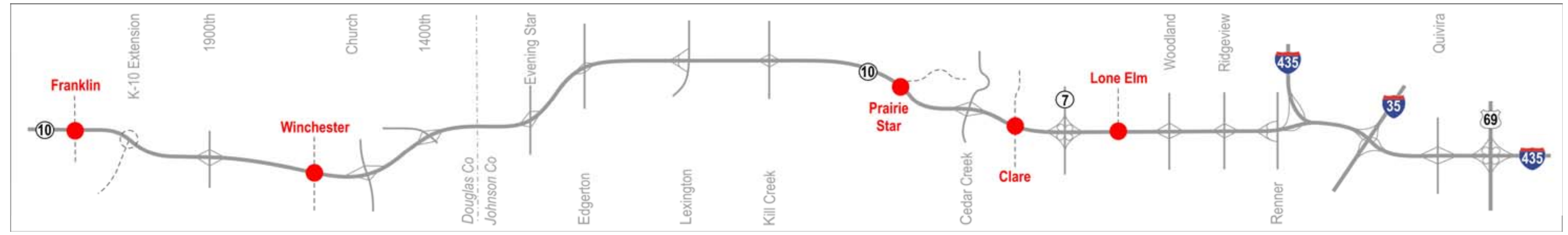
K-10 Transportation Study

2030 Forecast Traffic Volumes With Existing Interchanges P.M. Peak Hour

Figure 4-5

2-28-05

Figure 4-6: Locations of New Interchanges



The K-10/K-7 interchange, not analyzed using HCM methods, merits special discussion. Currently, the interchange is a full cloverleaf configuration, with loop ramps in all four quadrants. For these reasons, a focused (non-calibrated) simulation model was developed near the interchange (extending roughly one mile in each direction) to provide additional perspective on future traffic operations and interactions. In the "With Existing Interchanges" scenario, ramp and weave volumes were forecasted to exceed the capacity of the cloverleaf configuration (in addition to posing safety issues arising from the four short weave sections, which do not meet AASHTO minimum lengths). Ultimately, a four-level interchange, with directional ramps, would be desirable. Several of the directional ramps would ultimately need two lanes. Further issues arise at the K-10/K-7 interchange under the "With New Interchanges" scenario; these are addressed in Section 4.4.

The K-10/I-435 interchange, and points east, also merit focused discussion. Concepts for this interchange complex were previously developed as part of the *I-35/US-69 Major Investment Study* (MIS). Due to the very close proximity of K-10/Renner Road to K-10/I-435, and the major movements between K-10, I-435, and nearby I-35, the MIS developed a system of collector-distributor (C-D) roads and direct connectors that would eliminate the majority of weaving maneuvers. A detailed analysis of this interchange complex was outside the scope of this study, but ramp lane requirements were developed at a preliminary level based on KDOT's traffic forecasts.

4.4 2030 Operations - With New Interchanges

The new requested interchanges, illustrated in Figure 4-6, were sized to accommodate forecasted demand. Chapter 5 includes more detail on the specific configurations of each interchange. Appendix F includes conceptual diagrams of the new interchanges.

Figure 4-7 illustrates the forecasted 2030 p.m. peak-hour volumes for the "New Interchanges" scenario. With these interchanges added, some of the neighboring service interchanges (such as Cedar Creek Parkway and Woodland Road) would be relieved of heavy traffic volumes and could therefore be downsized in comparison to the "With Existing Interchanges" scenario. Table 4-2 summarizes the results of the LOS analysis with the new interchanges. The majority of the elements would operate at LOS C or better under this scenario. East of K-7, several areas of LOS D are forecasted but are considered acceptable. The Woodland interchange would experience the same issues discussed in Section 4.3 but would have stable operations. Detailed LOS calculations are included in Appendix B.

It appears that the K-7 interchange would be relieved by the Clare Road and Lone Elm Road interchanges, to the degree that a three-level interchange would likely suffice rather than four levels. However, the proximity of these two service interchanges to a major system interchange would present additional weaving concerns. At the planning level, it is prudent to consider the addition of grade-separated braided ramps to eliminate weaving on K-10 between K-7 and each of these two interchanges. The braided ramp concept is illustrated in Figures F-14 through F-16 in Appendix F. More discussion on these interchanges is included in Chapter 5.

Table 4-2: 2030 LOS With New Interchanges – P.M. Peak Hour

Intersections

	Delay (sec/veh)	LOS
K-10 & Franklin WB Ramps	10.4	B
K-10 & Franklin EB Ramps	10.0	B
K-10 & 1900 WB Ramps[1]	9.6 (18.0)	A (C)
K-10 & 1900 EB Ramps[1]	7.1 (14.2)	A (B)
K-10 & Winchester WB Ramps[1]	4.7 (12.6)	A (B)
K-10 & Winchester EB Ramps[1]	6.2 (14.1)	A (B)
K-10 & Church WB Ramps	13.8	B
K-10 & Church EB Ramps	15.2	B
K-10 & 1400 WB Ramps[2]	6.0	A
K-10 & 1400 EB Ramps[2]	8.8	A
K-10 & Evening Star WB Ramps	18.6	B
K-10 & Evening Star EB Ramps	17.4	B
K-10 & Edgerton WB Ramps	13.8	B
K-10 & Edgerton EB Ramps	9.4	A
K-10 & Lexington WB Ramps	28.0	C
K-10 & Lexington EB Ramps	28.8	C
K-10 & Kill Creek WB Ramps	15.6	B
K-10 & Kill Creek EB Ramps	14.8	B
K-10 & Prairie Star WB Ramps[2]	9.0	A
K-10 & Prairie Star EB Ramps[2]	8.8	A
K-10 & Cedar Creek WB Ramps	17.1	B
K-10 & Cedar Creek EB Ramps	12.8	B
K-10 & Clare WB Ramps	20.2	C
K-10 & Clare EB Ramps	9.7	A
K-10 & Lone Elm SPUI	15.4	B
K-10 & Woodland WB Ramps	26.9	C
K-10 & Woodland EB Ramps	16.6	B
K-10 & Ridgeview WB Ramps	17.8	B
K-10 & Ridgeview EB Ramps	21.5	C
K-10 & Renner WB Ramps	36.8	D
K-10 & Renner EB Ramps	23.3	C

All intersections analyzed as signalized except:

[1] Stop-control assumed on off-ramp. Values outside parentheses represent the average delay/LOS for all vehicles entering the intersections; values inside parentheses represent delay/LOS for minor movements only (those required to stop or yield).

[2] Roundabout control assumed.

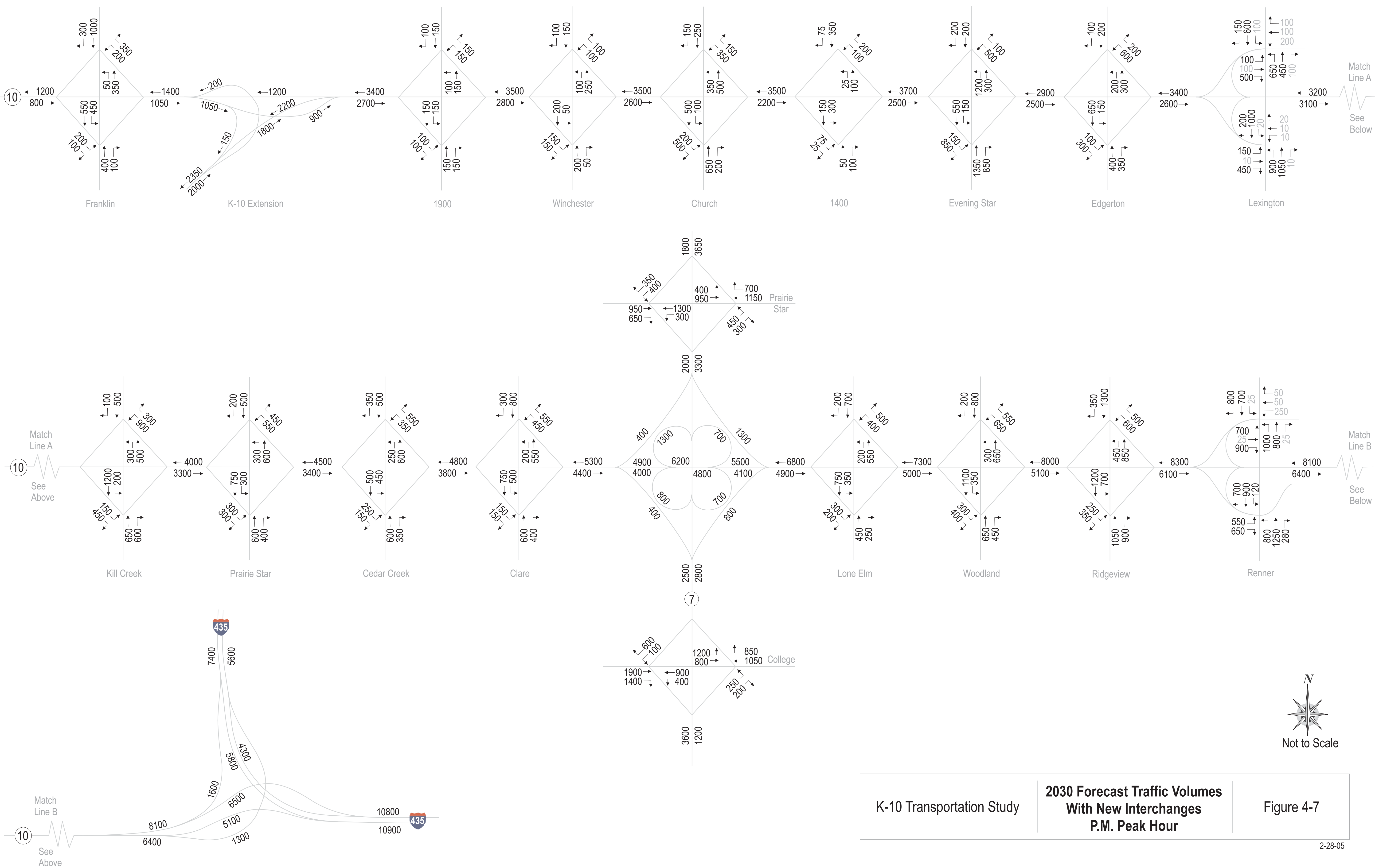
Basic Freeway Segments (Mainline)

	Speed (mph)	Density (veh/mi/ln)	LOS
Eastbound			
Franklin on to K-10 Extension off	64.5	6.2	A
K-10 Extension on to 1900 off	67.0	15.3	B
1900 on to Winchester off	67.0	15.9	B
Winchester on to Church off	66.1	14.9	B
Church on to 1400 off	64.6	12.9	B
1400 on to Evening Star off	66.1	14.4	B
Evening Star on to Edgerton off	64.6	14.7	B
Edgerton on to Lexington off	66.1	14.9	B
Lexington on to Kill Creek off	67.0	17.6	B
Kill Creek on to Prairie Star off	66.1	19.0	C
Prairie Star on to Cedar Creek off	66.1	20.5	C
Cedar Creek on to Clare off	66.8	16.2	B
Clare on to K-7 off	66.8	18.8	C
K-7 on to Lone Elm off	66.8	20.9	C
Lone Elm on to Woodland off	66.0	21.6	C
Woodland on to Ridgeview off	63.0	18.4	C
Ridgeview on to Renner off	63.8	21.8	C
Renner on to I-435 off	69.0	21.1	C
Westbound			
I-435 on to Renner off	66.7	27.7	D
Renner on to Ridgeview off	65.5	28.9	D
Ridgeview on to Woodland off	65.2	28.6	D
Woodland on to Lone Elm off	60.6	34.3	D
Lone Elm on to K-7 off	63.7	30.4	D
K-7 on to Clare off	66.8	22.6	C
Clare on to Cedar Creek off	66.8	20.5	C
Cedar Creek on to Prairie Star off	65.5	26.1	D
Prairie Star on to Kill Creek off	66.1	23.0	C
Kill Creek on to Lexington off	67.0	18.1	C
Lexington on to Edgerton off	66.1	19.5	C
Edgerton on to Evening Star off	66.1	16.7	B
Evening Star on to 1400 off	66.1	21.3	C
1400 on to Church off	67.0	19.8	C
Church on to Winchester off	66.1	20.1	C
Winchester on to 1900 off	67.0	19.8	C
1900 on to K-10 Extension off	67.0	19.3	C
K-10 Extension on to Franklin off	64.5	8.2	A

Ramp Junctions

Eastbound	Speed (mph)	Density (veh/mi/ln)	LOS	Westbound	Speed (mph)	Density (veh/mi/ln)	LOS
Franklin off	56.8	4.8	A	Renner on	61.2	22.5	C
Franklin on	59.3	8.0	A	Ridgeview off	63.4	14.7	B
1900 off	60.2	16.7	A	Ridgeview on	61.3	21.1	C
1900 on	60.2	16.1	B	Woodland off	61.2	14.5	B
Winchester off	58.9	17.5	B	Woodland on	50.6	36.5*	F*
Winchester on	59.6	14.9	B	Lone Elm off	59.9	34.5	D
Church off	56.9	17.7	B	Lone Elm on	59.2	26.8	C
Church on	59.8	13.4	B	Clare off	60.7	26.5	C
1400 off	59.2	12.3	B	Clare on	61.2	19.7	B
1400 on	59.8	14.0	B	Cedar Creek off	62.9	7.0	A
Evening Star off	55.7	16.1	B	Cedar Creek on	58.6	26.0	C
Evening Star on	59.4	15.6	B	Prairie Star off	57.8	28.0	C
Edgerton off	57.8	14.2	B	Prairie Star on	59.3	23.6	C
Edgerton on	59.6	15.1	B	Kill Creek off	57.6	26.1	C
Lexington off	57.3	17.1	B	Kill Creek on	59.8	18.4	B
Lexington on	60.0	17.3	B	Lexington off	57.9	18.4	B
Kill Creek off	58.2	19.9	B	Lexington on	58.7	21.2	C
Kill Creek on	59.6	20.1	C	Edgerton off	57.1	20.6	C
Prairie Star off	58.6	21.0	C	Edgerton on	59.6	15.6	B
Prairie Star on	58.7	21.0	C	Evening Star off	57.5	17.0	B
Cedar Creek off	58.2	21.8	C	Evening Star on	59.1	24.0	C
Cedar Creek on	62.0	16.8	B	1400 off	59.5	21.8	C
Clare off	63.3	16.2	B	1400 on	59.5	19.5	B
Clare on	61.5	18.5	B	Church off	58.0	22.8	C
Lone Elm off	62.3	22.0	C	Church on	60.1	19.7	C
Lone Elm on	60.4	20.3	C	Winchester off	59.7	21.3	C
Woodland off	62.8	6.8	A	Winchester on	60.7	20.0	B
Woodland on	58.5	17.9	B	1900 off	59.1	21.5	C
Ridgeview off	61.6	2.6	A	1900 on	59.3	18.9	B
Ridgeview on	59.1	21.6	C	Franklin off	56.2	9.4	A
Renner off	58.6	28.5	D	Franklin on	60.3	8.2	A

* Local high densities, but no freeway queueing. (HCM p 25-8)



K-10 Transportation Study

2030 Forecast Traffic Volumes With New Interchanges P.M. Peak Hour

Figure 4-7

2-28-05

5. Widening Assessment

5.1 Improvement Recommendations

Mainline Widening Recommendations

Based on the forecasted traffic volumes identified in Chapter 4, it is recommended that the K-10 mainline be widened to six lanes west of K-7 and eight lanes east of K-7. Each of these sections is discussed below:

- *East of K-7 (to I-435).* The proposed eight-lane typical section would widen to the inside with a depressed median including a concrete safety barrier, and would generally include 12-foot inside shoulders adjacent to the barrier. Figure 5-1 illustrates a conceptual typical section for this portion of K-10. The six-foot level area shown in the figure allows for existing and future bridge pier locations in areas where needed.
- *West of K-7 (Johnson County).* Two options have been developed for the proposed six-lane typical section from K-7 to the Johnson/Douglas County line.
  - The closed median option includes 12-foot inside shoulders adjacent to a concrete safety barrier and would generally require no additional right-of-way.
  - The open median concept consists of a 60-foot-wide open (grassed) median with widening occurring on the outside, and would require additional right-of-way.

  A decision about which option to build will be made at the time widening is programmed for construction. The open median concept was used in assessing right-of-way needs since it represents the most impact. Figure 5-2 illustrates conceptual typical sections for both the closed and open median options.
- *West of K-7 (Douglas County).* Just as in Johnson County, two options have been developed for the proposed six-lane typical section from the Johnson/Douglas County line to Franklin Road. These options are identical to the Johnson County options, and are illustrated in Figure 5-2.

Existing bridges over the mainline would need to be widened to accommodate additional cross-street lanes (and bicycle/pedestrian provisions where applicable – see Section 6.3), while all existing K-10 mainline pavement would likely need to be replaced within the anticipated timeframe of the proposed improvements. In general, at existing locations where K-10 crosses over existing side roads, current bridge pier spacing is adequate to accommodate need widening of the cross-streets. Design criteria used in developing the improvements are contained in Appendix D.

It is important to note that the forecasts indicate the need for auxiliary lanes between most of the interchanges. These will increase the right-of-way requirements.

It is also recommended that a buffer be provided along both sides of K-10, between the edge of the ultimate K-10 right-of-way and any future development. The buffer would minimize future noise issues, accommodate landscape improvements, and potentially serve as a location for a pedestrian/bicycle trail. As land develops adjacent to K-10, cities and counties should work closely with developers to ensure that this easement is provided along the entire length of K-10. KDOT is willing to provide assistance to cities and counties in their efforts to provide this easement.

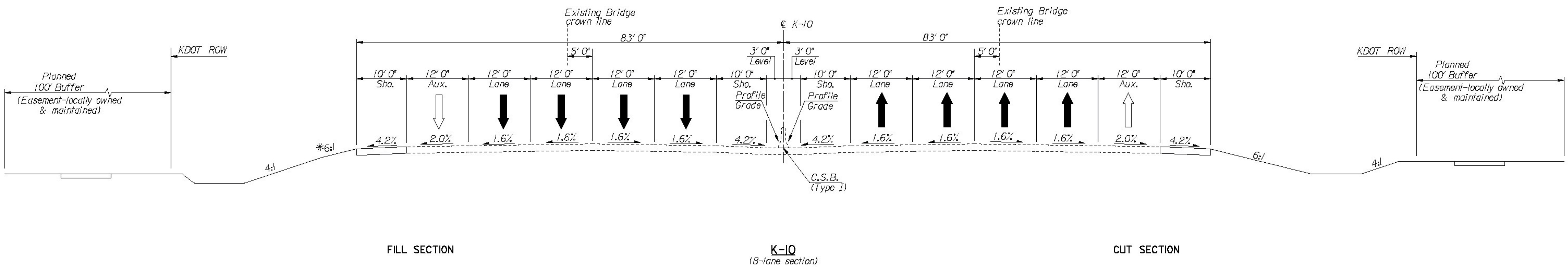
Appendix E includes 20 figures that overlay the recommended improvements on aerial imagery at a scale of 1 inch = 500 feet. The purpose of these figures is to illustrate the level of improvements that will meet the forecasted 2030 traffic demand. All of the new "as requested" interchanges are included; the purpose of their inclusion is to illustrate the size/type of interchange that would be needed, and any other special accommodations (e.g. braided ramps, auxiliary lanes). The inclusion of these new interchanges is not intended to imply endorsement or approval on the part of KDOT. As described later in this report, further analysis and approvals are necessary to arrive at that stage.

The following sections describe the improvements needed at existing interchanges, as well as potential configurations for future "as requested" interchanges. Note that the absence of these future interchanges would require additional capacity enhancements to certain existing interchanges; these are also discussed below. Chapter 9 includes discussion related to the potential timing of these improvements.

Existing Interchanges

Improvements are recommended for the majority of the existing interchanges. A few locations do not meet current design criteria. Most, however, need to be upgraded for year 2030 projected traffic volumes. Upgrades include side-road and bridge widening, as well as ramp modifications (adjustments to the horizontal/vertical geometry and/or the addition of storage lanes). These upgrades are briefly described below, and each interchange is illustrated in Appendix F.

- *East 1900 Road (County 1057):* For the study horizon, this interchange can remain unsignalized and 1900 Road can remain at its current width. See Figure F-2.
- *Church Street (East 2200 Road):* This interchange can retain a diamond configuration, but both ramp intersections will require signalization. Both off-ramps will need to be widened to provide exclusive left-turn lanes. Approaching the interchange and on the overpass structure, Church Street will need to be widened to a four-lane road, with turn lanes onto the on-ramps. The westbound on-ramp will need to be widened to accept dual northbound-to-westbound left-turn lanes. If the Winchester Road interchange is not built, the eastbound off-ramp would need an additional lane, and southbound Church Street would need additional through capacity. See Figure F-4.
- *North 1400 Road (County 442):* Due to the close spacing of the frontage roads, it is recommended that both ramp intersections be converted to five-leg single-lane roundabouts, incorporating the frontage roads. The existing underpass could continue to provide two lanes. See Figure F-5.
- *Evening Star Road:* This interchange can retain a diamond configuration, but both ramp intersections will require signalization. Both off-ramps will need to be widened to provide two additional lanes at their respective intersections with Evening Star Road. Approaching the interchange from the south, and through the K-10 underpass, Evening Star Road will need to be widened to a four-lane road, with turn lanes onto the on-ramps. To the north, the Evening Star Road could remain a two-lane facility due to lower forecasted traffic volumes. Both on-ramps will need to be widened to accept dual turn lanes. See Figure F-6.
- *Edgerton Road:* This interchange can retain a diamond configuration, but both ramp intersections will require signalization. The ramps will need to be realigned due to the skew angle of Edgerton Road. The frontage road on the north side of the interchange will also need to be relocated to meet minimum spacing requirements. Both off-ramps will need to be widened to provide additional lanes at their respective intersections with Evening Star Road (two additional lanes westbound, and one additional lane eastbound). Approaching the interchange from the south, and through the K-10 underpass, Edgerton Road will need to be widened to a four-lane road, with single turn lanes onto the on-ramps. See Figure F-7.
- *Lexington Avenue:* Due to existing land-use constraints, it is recommended that the interchange remain in a "folded diamond" configuration. However, to meet minimum KDOT criteria, it is recommended that the loop radii be increased from the existing 230 feet to 525 feet (requiring reverse curvature to tie the ramp intersections back into the current locations). Lexington Avenue itself would need to be widened to four lanes plus exclusive left- and right-turn lanes, and the on- and off-ramps would also need additional lanes to improve capacity. Both ramp intersections would need to be signalized. An alternative configuration – a half-diamond layout - was explored for the southern portion of the intersection, and is a possible alternative. See Figure F-8.
- *Kill Creek Road:* In the vicinity of the interchange, Kill Creek Road – including the overpass structure - will need to be widened to four lanes (with turn lanes as shown in Appendix F), and the ramp intersections will require signalization. The off-ramps would need to be widened to provide additional turn lanes, and the eastbound on-ramp would need to be widened to accept two lanes. See Figure F-9.
- *Cedar Creek Parkway/Mize Boulevard:* Both Cedar Creek Parkway and Mize Boulevard would need to be widened to four lanes in the vicinity of the interchange, including turn lanes as shown in Appendix F. The ramp intersections would need to be signalized. The off-ramps would each need to be widened to provide an additional lane, and the eastbound on-ramp would need to be widened to accept two lanes. If the Prairie Star Parkway and Clare Road interchanges are not built, this interchange would require greatly enhanced capacity, including additional ramp lanes, and additional through capacity on Cedar Creek Parkway and Mize Boulevard. See Figure F-11.



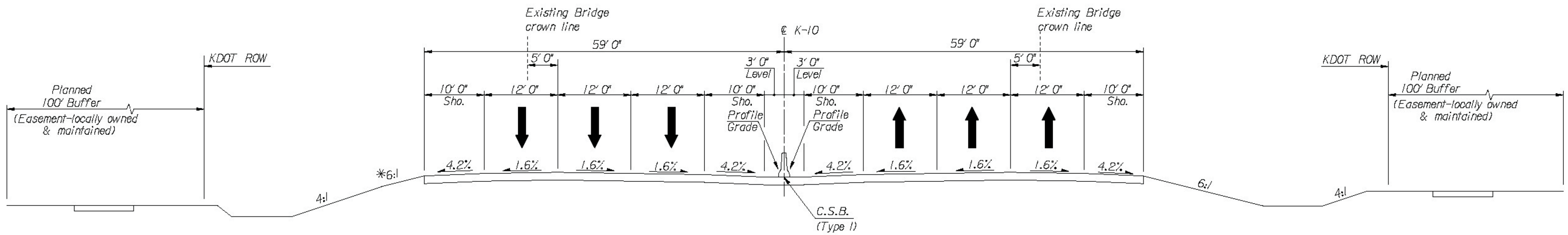
Note: Auxiliary lanes to be included between interchange and constructed to through lane to achieve 8-lane section in future.

Dimensions and slopes are for standard ditches and fills.

✳ 6:1 used to limits of clear zone

K-10 Transportation Study	**Typical Section K-7 to I-435**	Figure 5-1

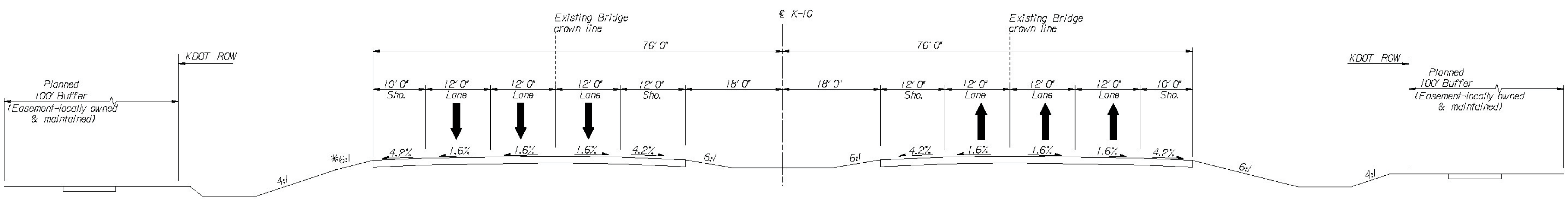
5-17-05



FILL SECTION

K-10 CLOSED MEDIAN
(6-lane section)

CUT SECTION



FILL SECTION

CUT SECTION

K-10 OPEN MEDIAN
(6-lane section)

Note: Auxiliary lanes will be used between interchanges spaced closer than 2 miles withing urban areas.

Dimensions and slopes are for standard ditches and fills.

* 6:1 used to limits of clear zone

K-10 Transportation Study	**Typical Sections Franklin Road to K-7**	Figure 5-2

5-17-05

- *K-7*: Operational issues related to the K-10/K-7 interchange are discussed in Chapter 4. Appendix E shows a four-level interchange with directional ramps for all movements. The appendix also shows braided ramps between the interchange and all four adjacent interchanges, both on K-7 and K-10 (assuming the Lone Elm Road and Clare Road interchanges are built.)
- *Woodland Road:* In the vicinity of the interchange, Woodland Road will need to be widened to four lanes (with turn lanes as shown in Appendix F), and both ramp intersections would need to be signalized. Both off-ramps would need to be widened to provide additional turn lanes, and both on-ramps would need to be widened to accept two lanes. The need for ramp metering would need to be considered. See Figure F-14.
- *Ridgeview Road:* Ridgeview Road will need to be widened to provide four lanes on either side of the interchange. An additional southbound through lane will be needed in advance of the interchange, eventually becoming a second southbound-to-eastbound turn lane onto the eastbound on-ramp. Dual northbound-to-westbound left-turn lanes will also be needed onto the westbound on-ramp. Both off-ramps will need widening to provide additional turn lanes as shown in Appendix F. A braided eastbound off-ramp for I-435/I-35 is also shown in Appendix F. Both ramp intersections would need to be signalized. The need for ramp metering would also need to be considered. See Figure F-15.
- *Renner Road:* Renner Road will need to be widened to six lanes in the vicinity of the interchange. The westbound on-ramp and eastbound on-loop will require two lanes to accept dual turn lanes as shown in Appendix F. Off-ramps will need to be widened to provide substantial additional capacity. Appendix F also shows braided ramps, C-D roads, and auxiliary lanes expected with the I-35/I-435/K-10 interchange complex. Both ramps would already be signalized in the future, but signal modifications would be required along with the geometric improvements. The need for ramp metering would also need to be considered. See Figure F-16.
- *I-435:* The K-10/I-435 interchange, already a fully directional three-leg configuration, will need additional ramp and mainline capacity. The addition of a C-D road between this interchange and the I-35/I-435 interchange was previously recommended in the *I-35/US-69 MIS*, and has been conceptually carried forward into this study. Figure E-20 illustrates the proposed layout.

All existing ramps will need to be modified in conjunction with the widening of K-10. Many of the existing ramps also need other adjustments, such as reducing the terminal angle to be less than a 15-degree skew angle. Many existing ramps will need to be lengthened due to either mainline widening, increased storage length for future traffic projections, or ramp metering provisions. Some will need additional storage lanes. These lanes should be built to the inside of the ramp if possible to limit the extra right-of-way needed at existing interchange sites. Table 5-1 includes a summary of the projected ramp modifications.

Table 5-1: Projected Ramp Modifications, Existing Interchanges

Interchange	Ramp	Modify for widening	Lengthen for storage	Add storage lanes	Anticipate ramp metering	Adjust terminal Angle	Realign
E. 1900 Rd	WB Ent	●					
	EB Exit	●				●	
	EB Ent	●					
	WB Exit	●				●	
Church	WB Ent	●	●	●			●
	EB Exit	●		●			
	EB Ent	●					
	WB Exit	●		●			
N. 1400 Rd	WB Ent	●					●
	EB Exit	●					●
	EB Ent	●					●
	WB Exit	●					●
Evening Star	WB Ent	●	●	●		●	
	EB Exit	●	●	●		●	
	EB Ent	●	●	●		●	
	WB Exit	●		●		●	
Edgerton	WB Ent	●				●	
	EB Exit	●		●		●	
	EB Ent	●				●	
	WB Exit	●		●		●	
Lexington	WB Ent	●		●			●
	EB Exit	●		●			●
	EB Ent	●		●			●
	WB Exit	●		●			●
Kill Creek	WB Ent	●					
	EB Exit	●		●			
	EB Ent	●	●	●		●	
	WB Exit	●	●	●		●	
Cedar Creek/ Mize	WB Ent	●					
	EB Exit	●		●			
	EB Ent	●		●			
	WB Exit	●		●			
Woodland	WB Ent	●		●	●		
	EB Exit	●		●			
	EB Ent	●		●	●		
	WB Exit	●		●			
Ridgeview	WB Ent	●		●	●		
	EB Exit	●		●			
	EB Ent	●	●	●	●		
	WB Exit	●		●			
Renner	WB Ent	●	●	●	●		●
	EB Exit	●		●			●
	EB Ent	●		●	●		●
	WB Exit	●		●			●

New "As Requested" Interchanges

As mentioned in Chapter 4, five new K-10 interchange locations have been proposed by local agencies, both to handle the increased traffic volumes expected in the year 2030 and to increase access. These new locations were selected for study by KDOT with input from the impacted cities and counties. As part of this study, conceptual-level designs were developed for each interchange. At some locations, more than one option was examined. The interchanges are described below and are illustrated in more detail in Appendix F.

- *Franklin Road (Lawrence*). This interchange would replace an existing at-grade intersection. In conjunction with the new interchange, the current access to East Hills Business Park would be closed, and a new roadway connection would be established between the business park and Franklin Road. The interchange would most likely be a tight diamond configuration and would require signalization. See Figure F-1. If a freeway-to-freeway interchange is built on K-10 in the vicinity of existing Noria Road/1750 Road, as this study has assumed, existing 23rd Street will no longer be part of the State Highway System. Thus, the decision to build a Franklin Road interchange would be solely at the discretion of the City of Lawrence. See Figure F-1.
- *Winchester Road/East 2100 Road/County 1061 (Eudora):* This interchange would be constructed in approximately the same location as the existing Winchester Road overpass of K-10 (approximately one mile west of the existing K-10/Church Street/2200 Road interchange). It would provide more direct access to western Eudora. A standard diamond configuration was preferred by the City at this location. This configuration would result in right-of-way impacts to an existing residential subdivision. The interchange would not require signalization. See Figure F-3.
- *Prairie Star Parkway (Lenexa):* This interchange would complete Lenexa's westward extension of 95th Street, known as Prairie Star Parkway, providing access to key growth areas in western Lenexa. For the purposes of this study, a diamond configuration with multi-lane roundabouts at both terminals was considered for this location. Using roundabouts at the ramp terminals would allow the frontage roads to tie in without relocation. See Figure F-10.
- *Clare Road (Lenexa/Olathe):* This interchange would provide relief to the K-10/K-7 interchange by serving future growth west of K-7. Its proximity to both the K-10/K-7 interchange and the K-10/Cedar Creek Parkway/Mize Road interchange (which are already separated by less than two miles) would cause weaving concerns (and result in the need for braided ramps, as discussed in relation to the K-10/K-7 interchange). Previous concepts for this interchange have shown one-quadrant "hook" ramps on both sides of K-10; the concept developed for this study is a more standard diamond configuration. See Figure F-12.

- *Lone Elm Road (Lenexa/Olathe):* This interchange would provide relief to the K-10/K-7 interchange by serving future growth on the east side of K-7. The interchange would present interchange spacing issues similar to those of Clare Road (although K-7 and Woodland Road are slightly farther apart – roughly 2 miles). Various configurations have been studied in the past for the Lone Elm interchange; the current concept is a single-point configuration (with braided ramps to K-7) in order to minimize impacts to the existing homes in the southeast quadrant of the interchange. The Lone Elm Road alignment has been shifted west to increase separation between the interchange and an existing residential subdivision in the southeast quadrant. The need for ramp metering would need to be considered. See Figure F-13.

K-10 Extension

One interchange that is part of this study is neither an existing nor "as requested" interchange. The K-10 extension, which would be located approximately in the area of the existing K-10/Noria Road intersection, was assumed to be in place for the purposes of the traffic forecasting. This interchange would provide a freeway bypass of Lawrence by connecting either to I-70 to the north or existing K-10 on the south side of Lawrence. It is assumed that the K-10/Noria intersection would no longer exist, and local access would be rerouted to adjacent interchanges or intersections. Figure E-2 illustrates a potential configuration for the K-10 extension interchange.

5.2 Grading and Right-of-Way Impacts

Current right-of-way and adjacent property lines will be affected. Areas where new right-of-way may be needed have been identified as much as possible without creating profiles and without the use of the existing surface Digital Terrain Model (DTM). The figures in Appendices E and F illustrate areas where new right-of-way would be required.

5.3 Bridge Widening/Culvert Extension Impacts

The existing side-road bridges over K-10 have all been reviewed and are long enough to accommodate widening of K-10. However, these bridges would generally need to be widened to accommodate additional cross-street lanes. All existing mainline K-10 pavement will likely need to be replaced within the anticipated timeframe of the proposed improvements. At locations where K-10 has a bridge over an existing cross-street, the study team has preliminarily determined that existing bridge pier spacing is adequate to accommodate the necessary widening of the cross-streets. Existing pipes and culverts should be extended rather than replaced wherever possible, as long as their capacities are still adequate.

5.4 Cross-Street and Frontage Road Impacts

This study has preliminarily identified frontage roads that need to be relocated due to grading impacts or drainage, such as the one just southeast of the 1400 Road interchange. The study also identified frontage roads that need to be relocated due to their proximity to existing or future interchanges. The frontage road tying into Edgerton Road north of K-10 is one of these locations. Appendices E and F illustrate locations where frontage road relocations have been identified.

5.5 Environmental Issues

In considering the proposed changes within the K-10 corridor, it is important to examine existing environmental and socioeconomic conditions that could be impacted. If a condition or concern cannot be avoided, then minimizing the project impacts followed by mitigation is the next course of action. Environmental and socioeconomic impacts that were identified for this study include wetlands, floodplains, parks, HAZMAT sites, golf courses, trails, and existing utilities. Figure 5-3 illustrates some of these environmental issues.

Wetlands

Several wetland areas are affected - mainly small ponds. Appropriate mitigation measures and permitting requirements will need to be accounted for in the planning of improvements to K-10.

Floodplains

The K-10 corridor crosses several floodplains:

- The Wakarusa River valley is just west of Lawrence and has a large floodplain through the K-10 corridor.
- The Captain Creek floodplain is located on both sides of the corridor between 1400 Road and Evening Star Road, on the Douglas County side of the county line.
- The Kill Creek floodplain crosses the corridor between Lexington Road and Kill Creek Road.
- Camp Creek has a small floodplain and crosses K-10 about midway between the Kill Creek Road and Cedar Creek Road interchanges.
- Cedar Creek has a floodplain in the area of the proposed Prairie Star Pkwy Interchange.
- Finally, Mill Creek has some floodplains along the corridor between the existing Woodland Road and Renner Road interchanges.

Parks/Recreation

The mainline widening could also impact two existing parks. However, it is possible that retaining walls could provide an alternative to the encroachment.

- The proposed grading limits encroach slightly onto part of the Mill Creek Streamway Park. This encroachment is less than a quarter of an acre.
- The second park, between Lexington Avenue and Kill Creek Road just south of K-10, is encroached upon by about three quarters of an acre.

The proposed K-10/K-7 interchange improvements indicate the need for additional right-of-way in the northeast quadrant, impacting an existing golf course (Smiley's).

Hazardous Material Sites

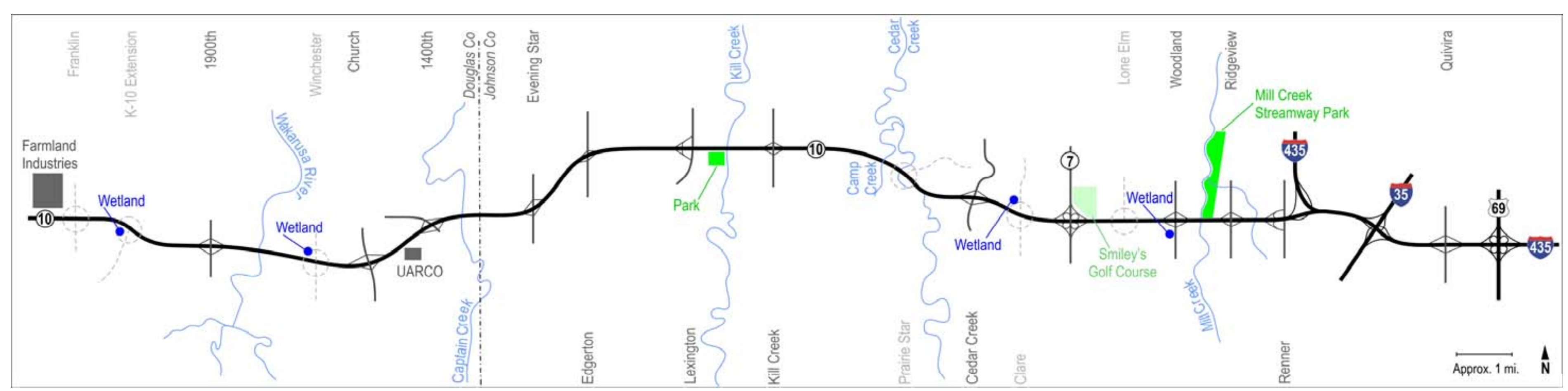
Two HAZMAT sites were identified in the proposed corridor vicinity from the available mapping:

- The UARCO site in Eudora is very near the K-10 mainline. This is probably an old site or was cleaned up prior to the initial construction of K-10.
- The Farmland Industries Inc. site just east of Lawrence does not appear to be directly affected by proposed K-10 improvements (particularly if 23rd Street west of Noria Road is removed from the state highway system), but needs to be accounted for in future design and construction.

Existing Utilities

Existing utilities in the area of improvement must also be accounted for. The proposed alignment for Clare Road lies between two major pipelines, and it crosses over the pipelines in two locations.

Figure 5-3: Environmental Issues



Trails

Two existing Johnson County hike/bike trails, crossing the K-10 corridor under mainline bridges, will need to be maintained as well.

- The Gary L. Haller Trail through the Mill Creek Streamway Park has recently undergone repairs and will need to be accounted for in any proposed design and construction.
- The second trail runs along Kill Creek and also needs to be protected.

Agency Consensus

The proposed improvements affect both Douglas County and Johnson County. They also affect the cities of Lawrence, Eudora, De Soto, Lenexa, Olathe, and Overland Park. To be successful, the final design will require consensus from all these agencies.

5.6 Cost Estimates

Preliminary cost estimates were developed for the K-10 mainline widening, bridge work, improvements to existing interchanges, and construction of requested interchanges. Estimates were obtained by applying preliminary quantities to KDOT recommended unit costs. The costs shown below are in 2004 dollars and **do not include** an inflation factor. (Such a factor would need to be applied by agencies developing future fiscally constrained plans.) In addition, average percentages were applied to quantities that have not yet been calculated (such as earthwork, drainage, and pavement marking) to obtain a general estimate. Table 5-2 summarizes the unit costs used in developing the estimates.

Table 5-2: Unit Costs ($2004)

Item	Unit	Unit Cost
Concrete Pavement (12" Uniform) (AE) (NRDJ)	yd^2	$42
Concrete Pavement (12" Variable) (AE) (Plain)	yd^2	$38
Lime (hydrated)	ton	$95
Manipulation (lime-treated subgrade)	yd^2	$3
Water (lime-treated subgrade)	Mgal	$4,165
Cement treated base (4")	yd^2	$8
9" PCCP Ramps	yd^2	$42
Base (drainable, 4")	yd^2	$5
6" line-treated subgrade	yd^2	$8

Table 5-3 summarizes the cost estimates. The table is divided into two parts:

(1) *Improvements to the K-10 mainline and existing interchanges.* Several assumptions underlay the development of these costs:

- Utility relocation along the mainline was preliminarily assumed to be 5 percent of the total construction cost.
- Right-of-way area was preliminarily estimated by offsetting the existing mainline construction limits the width of the proposed mainline widening, then adding an additional 30 feet (accounting for grades, drainage, room for construction, etc.) to obtain the proposed right-of-way line. An average cost per acre was applied to the total area where the proposed right-of-way is outside the limits of the existing right-of-way. The average cost per acre varies from segment to segment based on each segment's known characteristics.
- Existing interchange improvement costs include roadway re-surfacing, cross-street reconstruction, guardrail installation, bridge work, and pavement marking. These costs are included in the cost estimate summary.
- Engineering costs include both preliminary engineering and construction engineering costs. These costs are estimated at 24.5 percent of the total construction cost.

(2) *Construction of the new "as requested" interchanges.* These cost estimates were developed based only on the construction of the ramps, bridges and associated side-road improvements. It might be necessary to construct some associated portion of the K-10 improvements in conjunction with these interchanges, such as continuous auxiliary lanes between adjacent interchanges and braided ramps, depending on when the new interchanges are constructed. Utility costs are estimated at 5 percent of the construction cost, and engineering costs (preliminary and construction) are estimated at 24.5 percent of the construction costs.

As Table 5-3 indicates, improving existing K-10 from Lawrence to Renner Road would cost roughly $501 million, and constructing the new "as requested" interchanges would cost an additional $65 million. Note that these costs do not include noise barrier construction or any landscaping/aesthetic enhancements.

Table 5-3: Summary of Cost Estimates

	Costs (thousands of 2004 dollars)				
	Construction	Utilities	ROW	Engineering	Total
Mainline Sections					
Lawrence to DG/JO County line*	97,200	1,900	1,000	23,800	123,900
DG/JO County line to K-7	128,500	2,300	5,100	31,500	167,400
K-7 to Renner Rd.**	166,100	900	17,600	40,700	225,300
Subtotal	391,800	5,100	23,700	96,000	516,600
New Interchanges					
Franklin Rd.	6,900	300	600	1,500	9,300
Winchester Rd.	5,200	200	200	1,100	6,700
Prairie Star Pkwy.	10,700	300	100	1,700	12,800
Clare Rd.	12,300	600	1,300	3,100	17,300
Lone Elm Rd.	15,100	900	2,600	4,400	23,000
Subtotal	53,200	2,300	4,800	11,800	69,100
Grand Total	445,000	7,400	23,700***	107,800	583,900***

** The K-10 extension is assumed to be in place independent of this study, and is not a part of the cost estimates.*
*** This section also includes the K-7 improvements between Prairie Star Parkway (95th Street) and College Boulevard.*
****The mainline costs also include right-of-way for the new interchanges. The Grand Total is computed to account for this right-of-way only once.*

6. ITS/Modal Considerations

6.1 Intelligent Transportation Systems (ITS)

ITS is a broad term that embraces many elements. One definition states that ITS

> *Encompass[es] a broad range of wireless and wireline communications-based information, control and electronics technologies. When integrated into the transportation system infrastructure, and in vehicles themselves, these technologies help monitor and manage traffic flow, reduce congestion, provide alternate routes to travelers, enhance productivity, and save lives, time and money*[1].

In the Kansas City area, the most visible ITS initiative is the Kansas City Scout, a joint collaboration by MoDOT and KDOT that includes variable message signs (VMS), CCTV cameras, vehicle detectors, and other elements – all connected to a traffic operations center (TOC) in Lee's Summit, Missouri, by a fiberoptic communications backbone. The Scout system is in Phase I of its deployment and will ultimately cover 75 miles of freeway in the Kansas City metropolitan area.

Scout's Web site includes a live traffic conditions map.

The remainder of this section describes ITS as it could relate to K-10.

Existing and Planned ITS Elements

Some ITS equipment has already been installed on K-10 as part of Phase 1 of the Scout project. This includes a camera and variable message sign at the K-10/Ridgeview Road interchange, as well as continuous fiberoptic cable extending from the Ridgeview Road interchange east to connect in with the remainder of the Scout system.

The Strategic Deployment Plan (SDP), a document that helped define the limits and components of the Scout system, showed K-10 as part of Scout Phase 4 (the final phase), and included ITS elements as far west as K-7. In addition to the equipment that has recently been installed, the plan also showed three more cameras on K-10 (at I-435, Woodland Avenue, and K-7), as well as one additional message sign (at K-7). Note that Phase 4, although included in the SDP, was found not to be justified from a cost/benefit standpoint in the 1996 study. However, it is possible that the section of K-10 east of K-7 will eventually show up on the Kansas Statewide ITS Deployment Plan.

Operations Center

Any ITS elements east of (and including) the K-7 interchange would be part of the Scout system, based on the Scout's current western boundary. However, this boundary could be extended further west to the Johnson/ Douglas County line, since urbanization is expected to continue in that direction. In Douglas County, it is unclear what operations center would support any K-10 ITS elements. A study is currently underway to determine the best location for a KDOT Statewide Operations Center; locations under consideration include Topeka (perhaps downtown, or south on U.S. 75 near Forbes Field) and Salina. It is possible that the City of Lawrence may ultimately consider its own Operations Center, but this has not been a priority for the City to date. In short, there are multiple options for exactly where ITS on the western section would be "hubbed"; this issue has a significant effect on planning considerations.

Potential ITS Elements on K-10

K-10 is an unusual corridor: although it can be classified as a rural freeway, it functions differently from most of Kansas' other rural freeways (e.g., I-70 in much of Kansas) because it serves a heavy commute demand in a rapidly urbanizing area. Also, north-south diversion routes are nonexistent for much of the corridor. For these reasons, it is important to consider K-10's long-term ITS needs based on its ultimate classification.

Conduit. At a minimum, conduit would be needed along the entire length of the study corridor to support any needed future ITS equipment. LightCore (formerly DTI) already has three conduits on K-10 extending out from I-435 to the Johnson/Douglas County line, and two conduits in Douglas County. This conduit alone would probably not be sufficient for future needs. Depending on the number of ITS elements placed along the corridor, additional conduit might be necessary as part of future improvements.

Signs, Cameras. Variable message signs and cameras would ultimately be beneficial along the corridor, although quantities and locations are unclear. These would likely need to be located near the metropolitan areas only. The proposed K-10 extension near east Lawrence could be an influence. In the future, congested or accident-prone areas would be likely candidates to be monitored using ITS elements.

Detection. Some form of detection would also be advisable. The half-mile spacing used within Scout is probably too extreme for this corridor; greater spacing would probably suffice. In the rural areas, side-fire detection would probably be more applicable than loops.

Ramp Metering. In the urbanized Kansas City area (east of K-7), KDOT's policy is that any new interchanges should be designed to accommodate ramp metering (with ramp lengths adequate to accommodate both storage and acceleration needs). Neither KDOT nor AASHTO currently has design standards for metered ramps. Currently, there is no national source, and much variation among available sources. For this planning-level study, future ramp metering was assumed to be needed on K-10 as far west as the interchange with K-7. The minimum ramp length needed for metering includes a storage component (in advance of the meter), and an acceleration component (past the meter, to allow vehicles to accelerate from a stopped condition to freeway merge speeds). The storage component was based on vehicular arrivals during a 120-minute cycle, and the acceleration component was based on standard AASHTO acceleration criteria. Ramp-metering considerations are important at the planning stages because they can affect the amount of right-of-way that must be reserved/acquired. KDOT statewide policy requires the consideration of potential ramp metering for interchange projects in metropolitan areas, including the purchase of additional right-of-way to accommodate the lane geometry required for metering.

511 System. In January of 2004, KDOT initiated its 511 system, a telephone traveler information system (part of a national initiative supported by the FCC). In addition to providing information on items such as construction-related delay, the 511 traveler information system could also ultimately tie in with transit services and concierge-type services. The 511 system will play a role in the future of K-10.

Freeway Service Patrols. ITS can be very involved in back-and-forth communication with services such as Motorist Assist. Currently, no such service operates on K-10. The expansion of this program is subject to funding availability.

Incident Management Plan. KDOT considers a long-term Incident Management Plan to be essential for K-10, especially given the current lack of potential parallel routes for diversion. Coordination with local fire, police, EMS, etc. will be important. Incident management would probably be the primary benefit of ITS on the K-10 corridor.

Tie-ins with Local Systems. As ITS is implemented on K-10, it will be important to coordinate with local agencies' traffic control and communications systems as they evolve.

Funding Sources

All federal funding sources can be used for ITS, including CMAQ, STP, etc. Money is available not only from FHWA, but from FTA as well. KDOT's ITS Set-Aside Fund, which is currently funded for $2 million per year, is also a potential source for seed money.

Earmarked funds are another potential source for ITS. An important note: Once a facility is classified as "urban", earmarked funds can only be used for "integration" (which could include communication but no actual ITS devices). However, facilities classified as "rural" can use earmarked funds for "deployment" items, such as actual devices. Many earmarked funds require 50/50 matching.

[1] www.itsa.org

6.2 Transit

This section describes existing transit service, explores planned transit initiatives, and presents service options for improving connections between Johnson and Douglas Counties along the K-10 corridor.

Existing Transit Service

There are four transit service providers in the metropolitan areas connected by the K-10 Corridor: KU on Wheels, Lawrence Transit, Johnson County Transit and the Kansas City Area Transit Authority.

KU on Wheels

KU on Wheels is the only student-owned/operated transit system in the United States. The Student Senate Transportation Board, the student governing board for KU on Wheels, contracts with the Lawrence Bus Company to provide bus service. This system is funded in part by the Campus Transportation Fee (an $18 per semester fee paid by all students), and its primary mission is to serve students by providing transportation to and from campus. KU on Wheels is not affiliated with the Lawrence Transit System, the city-run public transportation system. KU on Wheels operates approximately 25 buses a day on 12 routes within the University of Kansas campus and vicinity.

- Current K-10 Service: None
- Planned K-10 Service: None

Lawrence Transit

Lawrence Transit (the T) is the City of Lawrence's transit system. The T began service in January 2001 and is not affiliated with KU on Wheels. The T operates eight fixed routes; complementary paratransit service is available through "T Lift Transports" to those individuals certified as eligible.

- Current K-10 Service: One route on K-10/23rd Street within city limits
- Planned K-10 Service: None additional

Johnson County Transit

Johnson County Transit (the JO) operates over 20 routes per weekday serving Johnson County, Kansas, as well as downtown Kansas City, Missouri, and Kansas City, Kansas. The JO Special Edition provides curb-to-curb service for disabled, elderly, and low-income residents of Johnson County. Other special routes include the Chiefs Express, providing service from Johnson County to the Truman Sports Complex in Jackson County, Missouri.

- Current Service on K-10: None
- Planned Service on K-10: See Smart Moves transit plan

Kansas City Area Transit Authority

Kansas City Area Transit Authority (KCATA) is an interstate agency of Missouri and Kansas. KCATA has a seven-county jurisdiction which includes the counties of Cass, Clay, Jackson and Platte in Missouri and Johnson, Leavenworth, and Wyandotte in Kansas. KCATA is governed by a board of commissioners. KCATA operates 70 bus routes throughout the metropolitan area and an operating budget of $40.5 million. KCATA does not operate fixed-route transit service in the K-10 Corridor.

- Current Service on K-10: None
- Planned Service on K-10: See Smart Moves transit plan

Mid-America Regional Council

MARC sponsors RideShare, a free, publicly funded commuter service designed to inform people about less expensive and environmentally friendly commuting alternatives. These include carpooling, vanpooling, transit programs, and employer services such as flextime and telecommuting. RideShare's mission is to increase mobility and reduce congestion by providing information on, and promoting, commuter transportation services in order to enhance the quality of life for residents in communities throughout the metropolitan area. RideShare offers free ride-matching service to commuters interested in forming carpools.

- Current Service on K-10: Limited
- Planned Service on K-10: Expanded options

Planned Transit Initiatives

At least two regional plans address the issue of future transit service along the K-10 corridor.

Smart Moves Regional Transit Plan

MARC, in cooperation with the region's transit providers, developed a comprehensive regional transit plan for the metropolitan area. Known as Smart Moves, the plan was developed to facilitate the following actions:

- Develop a regional public transportation connecting seven counties.
- Provide an innovative bus system linked to commuter rail service.
- Allow people to get to places throughout the metropolitan area efficiently and quickly.
- Reduce dependence on automobiles.
- Get people to and from work without sitting in traffic.
- Give people better choices in how they move around the metro area.
- Provide a higher quality of life through improved mobility.
- Keep up with other American cities in public transit services.
- Keep the air cleaner.

Smart Moves includes Freeway Flyer commute service along K-10 to the Johnson County/Douglas County line. It is intended that this service connect to Lawrence. However, the cost for Douglas County service is not included in the service plan, nor is a detailed operating strategy. These routes would also provide reverse-commute service to residents in the metropolitan core who work in outlying areas.

Transportation Outlook 2030 - Metropolitan Kansas City's Long Range Transportation Plan

Transportation Outlook 2030 strongly recommends enhanced funding for non-auto modes including regional transit service. The Regional Transit Initiative and Smart Moves advocate regional transit planning and the identification of high-capacity regional transit connectors in corridors with high commuter travel volumes. Both plans identify several potential commuter corridors where future regional transit service may be an option. As previously mentioned, Smart Moves identifies K-10 as "freeway flyer" route.

Lawrence Long Range Transportation Plan (LRTP)

The Lawrence LRTP identifies transportation goals for the Lawrence/Douglas County region. Some of the key goals identified within this plan include:

- Serve the needs of travelers throughout the region
- Manage congestion
- Increase bicycle travel opportunities
- Enhance transit options

The Public Transportation Advisory Committee (PTAC) of the Lawrence/Douglas County MPO provides direction and feedback relating to all forms of public transportation for Lawrence and Douglas County. The PTAC had identified a number of items for future consideration, including the provision of commuter links with Johnson County. Specifically, the PTAC and the Lawrence LRTP identify K-10 as a potential transit commuter link.

KCATA Bus Rapid Transit (BRT) Study

KCATA is currently sponsoring a bus rapid transit (BRT) study to identify corridors where the level of service is appropriate based upon potential ridership and regional needs. This study will be used to identify phasing and implementation plans for the region.

Potential Transit Ridership

To estimate future transit needs along the corridor, potential transit ridership was derived from county-level work trips and the number of full-time students commuting from Johnson County to the University of Kansas in Lawrence. The student population was provided by the University of Kansas and reflects full-time students who live in Johnson County year-round and commute to Lawrence.

The year 2000 census reports that approximately 5,600 residents of Douglas County work in Johnson County. In addition, nearly 1,500 residents of Johnson County work in Douglas County. More refined information regarding the place of work will become available with the release of the Census Transportation Planning Package in 2005. Information from the University of Kansas indicated that there are 2,060 full-time students attending the University of Kansas who reside in Johnson County.

Transit share for this travel within the K-10 Corridor was derived from estimating transit share rates and from a review of regional travel studies. A comparison of an existing transit share was completed by examining the transit share of trips taken between Johnson County and downtown Kansas City, Missouri. This rate was compared with the results from the mode choice model developed as part of the *Regional Commuter Rail Study*, which examined potential rail and bus mode share. Based upon these sources, it is estimated that a transit capture rate of 3 to 5 percent could be achieved along the K-10 Corridor:

- The typical work-trip mode share would range from 3 to 4 percent.
- It was assumed that for student trips to and from the University of Kansas, a higher potential capture - as much as 5 percent - could be achieved.

Additional factors were accounted for, including percentage of work trips, and the fact that not all students attend classes year-round or every day.

Based upon this analysis, a general order-of-magnitude was developed depicting potential transit ridership along the corridor. The ridership estimates are shown in Table 6-1.

This analysis provides only a general magnitude of expected transit ridership. There are other trip movements that could be served, such as travel between the main Kansas University campus and the Edwards campus, as well as some non-work travel. Other factors would also likely impact transit ridership, such as service frequency, quality, cost, and convenience. However, the analysis does indicate that there is a market for transit travel between the two metropolitan areas, and that providing this service should be further explored.

Table 6-1: Potential Daily Transit Ridership
(Two-way Trips)

Johnson County to Lawrence and back	
Work trips	50 – 74
Student trips	102 – 144
SubTotal	152 – 218
Lawrence to Johnson County and back	
Work trips	190 – 284
Grand Total	342 - 502

Transit Service Options

Several potential transit service options were developed for K-10 based upon a survey of existing transit service and planned initiatives.

Coordinated ridesharing

Coordinated ridesharing assists individuals in finding riding opportunities with other commuters. The RideShare program is included in the State Implementation Plan for air quality attainment submitted by the states of Kansas and Missouri to the Environmental Protection Agency. It is also included in the Long-Range Transportation Plan developed by MARC. It is funded primarily by the use of Congestion Mitigation and Air Quality (CMAQ) Improvement funds. All of RideShare's services are available to individuals and employers at no cost.

Demand-responsive van service

Demand-responsive van service provides passengers with the ability to request transportation from a specific location to another specific location at a certain time. Transit vans providing demand-response van service do not follow a fixed route, but travel throughout communities and areas adjacent to the corridor transporting riders according to their specific requests. These services usually, but not always, require advance reservations.

Busway

Busways are an innovative rapid transit system aimed at increasing the speed, reliability and comfort of bus services. They are systems of bus stations and interchanges connected by dedicated bus lanes while maintaining the flexibility to continue traveling on the road system after exiting the busway.

Fixed-route transit

Fixed-route transit service provides vehicles that run on regular, pre-designated, pre-scheduled routes, with no deviation. Typically, fixed-route service is characterized by printed schedules or timetables at designated bus stops.

Deviated fixed-route transit

Deviated fixed-route service is a hybrid of fixed-route and demand-response services. It involves a bus or van passing along fixed stops and keeping to a timetable, with the ability to deviate its course between two stops to go to a specific location for a pre-scheduled request. This type of service is often used to provide accessibility to persons with disabilities.

Recommended Transit Program

Based on the analysis of potential transit demand and discussions with KU on Wheels, the T, the JO, KCATA, and MARC, it was determined that a fixed-route service, with the potential for route deviations, should be further explored as the first step in initiating transit service along K-10. While more route planning would be needed to provide a specific service plan, this service would generally operate fixed-route service from the college/university area and the K-10/I-435 industrial area in Johnson County to the University of Kansas campus and downtown Lawrence. Additional fixed stops along K-10 could include residential areas and/or employment centers in Lenexa, Olathe, De Soto and Eudora. In addition to these fixed routes, deviated service could occur between stops along K-10 and the Edwards campus and Johnson County Community College. Potential stops are listed in Table 6-2.

Table 6-2: Potential Transit Stops

Potential Transit Stop	Jurisdiction
Edwards Campus	Overland Park
Johnson County Community College	Overland Park
K-10/I-435 Industrial Area	Lenexa
Woodland Road Area	Olathe/Lenexa
K-10/K-7 Industrial Area	Olathe/Lenexa
Lexington Avenue	DeSoto
Church Street	Eudora
KU Campus (Student Union)	Lawrence
Downtown Lawrence (9^{th}/Massachusetts)	Lawrence

For illustrative purposes, two buses per direction per peak hour were assumed based on initial transit ridership estimates to develop baseline costs for transit service along K-10. Additional service may be added if warranted by demand. The specific service plan for K-10 should be jointly developed by Lawrence Transit and Johnson County Transit. Table 6-3 summarizes the potential costs of such a program.

Table 6-3: Preliminary Transit Program and Cost Estimates

Route	Daily Trips	Annual Hours	Annual Operating Cost
Lawrence to Johnson Co.	4	1040	$48,880
Johnson Co. to Lawrence	4	1040	$48,880
Capital Costs (2 buses @ $300k)			$600,000
Total Estimated Service Cost			$697,760

Each transit stop along K-10 should be configured as a park-and-ride location. The exceptions are transit stops identified within urban areas, such as Downtown Lawrence and sections of the KU Campus.

Agency Role

The two primary transit providers in the K-10 Corridor, Johnson County Transit and Lawrence Transit, will need to take the primary role in advocating transit service in the K-10 Corridor. These agencies would be supported by MARC as well as by KDOT. Both of these agencies could assist in grant preparation and other funding and coordination assistance.

During discussions with these transit agencies, the idea of examining a deviated fixed-route transit service as a pilot project was identified. Both KDOT and MARC have sources that could be used to fund the operation and possibly non-federal portions of capital expenses for a 2- to 3-year service period. Following that time, the transit agencies or some other entity would have the option to continue the service with another funding source. Potential pilot project funding sources include a multimodal transportation funding source at KDOT, and the Congestion Management/Air Quality (CMAQ) funds available through MARC. These funding sources are competitive, and a requesting agency would need to complete an application to be considered.

CMAQ funding has been previously used very successfully to initiate new transit services in Blue Springs, Missouri and Lee's Summit, Missouri. These services were very successful in attracting riders and were popular enough that each city decided to provide funding when the pilot project funding ended.

Conclusion

Although transit service along K-10 between Johnson and Douglas Counties has been generally identified in the MARC Smart Moves Plan, the Johnson County K-10 Corridor Study and the Lawrence Long Range Transportation Plan, no specific plan has been developed to date. The implementation of a fixed-route bus service, with the potential for route deviations along K-10, is supported by this study. An operating plan should be developed by the transit operators for service to generally operate between the K-10/I-435 industrial area and the University of Kansas (KU)/downtown Lawrence, with additional fixed stops at key intervening residential/employment centers. The service should make use of Transit Centers identified in MARC's Smart Moves plan that may also be constructed in the near future. Local transit systems are encouraged to provide bus transfer passes to make connections between different service providers as seamless and convenient as possible. The study estimated that the potential for daily transit ridership in this corridor could range from 350 to 500 patrons. Potential riders would include commuters living in Douglas County traveling to/from employment in Johnson County, commuters living in Johnson County traveling to/from employment in Douglas County, students living in Johnson County traveling to/from KU, and students living in Douglas County traveling to/from Johnson County Community College.

6.3 Bicycle and Pedestrian Facilities

This section describes planned initiatives and presents options for improving bicycle and pedestrian connections between Johnson and Douglas Counties along the K-10 corridor.

Purpose

Bicycles play an increasingly important role in our region's transportation system. Unfortunately, bicyclists often feel squeezed out of the traffic mix, and many bike riders complain of high stress levels as they travel along the roadway. The source of this stress is well documented. The US Department of Transportation (USDOT) statistics show that more than 8,000 bicyclists died and 700,000 were injured in motor vehicle-related crashes in the past decade. More than one-third of all bicycle fatalities involve riders 5 to 20 years old, and 41 percent of non-fatal injuries occur to children under the age of 15. These statistics merit consideration for the K-10 corridor, along which several schools are located. The need for safe, convenient, and attractive facilities to encourage safe biking is often considered when new roadway projects are being designed, and this need is a consideration of the K-10 corridor study.

Planned Initiatives

A number of local and regional planning efforts have been conducted in recent years to consider ways to improve the environment for bicycle and pedestrian travel. These reports include:

MARC's *K-10 SmartTrail* (*The Bicycle and Pedestrian Trail Feasibility Study for Johnson and Douglas County*) outlines a conceptual plan for a designated shared-use trail along K-10 connecting Johnson and Douglas Counties. This plan includes a specific recommendation for bicycle and pedestrian travel within the K-10 corridor. The plan identifies a "proposed routing plan" for the trail. This plan was delineated by a site analysis which included a walking tour through the study area. As a result of this process, a trail route was delineated on the north side of K-10. The trail alignment occasionally crosses to the south side of K-10 to provide access to amenities, neighborhoods and communities on that side. The plan recommends that if K-10 is widened, then additional right-of-way should be acquired adjacent to K-10 for a trail and a landscaped buffer. This buffer could include the restoration of native prairie providing habitat for Kansas wildlife.

MetroGreen, a plan developed by MARC, identifies a regional greenway system intended to establish an interconnected system of trails that will serve and link together the Kansas City metropolitan area. The system is principally comprised of linear corridors of land along streams, adjacent to roadways, and within abandoned railroad corridors. The system includes over 1,144 miles of existing and proposed trails and greenways. The greenways envisioned in *MetroGreen* for Johnson County were delineated in coordination with the County Park and Recreation District and correspond with similar proposals in *MAP 2020.*

MAP 2020 is a County-wide master plan for Johnson County that identifies future locations for parks, trails and open space based on a survey of environmentally sensitive areas including woodlands, grasslands and major riparian corridors. The strategies within this master plan included the need to chart a course for expanding and managing open space and recreational opportunities, including utilizing streamways for regional trail connections.

Bicycle/Pedestrian Trail Options

As part of the K-10 planning process, KDOT identified a bicycle/pedestrian advisory group composed of representatives from MARC, the KU Transportation Center, Johnson County Planning and the City of Lenexa. Based upon discussions with the advisory group, several potential bicycle/pedestrian alignment options were identified. These options are listed below:

Adjacent to the Kansas River. MetroGreen and *Map 2020* identify the Kansas River and other greenways as potential greenway links. *MetroGreen* identifies the segment of the Kansas River within the east-west boundaries of the K-10 Study as a "priority three" greenway. Priority three greenways are identified as long-term implementation projects with anticipated acquisition and construction to take place over the next 15 to 25 years. The two trail options along the Kansas River include: incorporating a trail along the levy, or locating the trail outside of the floodway. The Corps of Engineers regulates the property along the levy and have strict regulations and requirements for anything built within the floodway. In some instances, trails and other obstructions are not allowed due to the existing constraints of the area. In any case, portions of the trail would have to be located outside of the floodway which would require land acquisition costs from multiple property owners.

Adjacent to Old K-10. Currently, the primary east-west travel route option for bicyclists and pedestrians between Johnson and Douglas Counties is the old K-10 corridor through Lenexa, De Soto and unincorporated Johnson and Douglas Counties. Within these communities, the old corridor is an arterial street section with a narrow sidewalk. This leaves the bicyclist with the option of using the sidewalk (where available) or sharing the street with vehicular traffic. Unfortunately, many bicyclists do not feel comfortable riding along with traffic on high-speed arterial streets or highways. When bicyclists choose to use the sidewalks, they generally encounter conflicts with vehicular traffic turning at major intersections and driveways. In fact, due to safety concerns, the City of De Soto banned bicyclists from 83rd Street. Further improvement of old K-10 for bicycle use would likely require construction of roadway shoulders or a separate trail located adjacent to the roadway.

Adjacent to Existing/Future K-10. The *SmartTrail* plan identified a separated 16.8-mile bicycle/pedestrian trail along the outer K-10 right-of-way. One concern with this alignment option is the separation between the vehicular highway traffic and the bicyclists and pedestrians. If such an alignment were selected, the trail should be placed well outside the highway right-of-way. *SmartTrail* recommended that a native prairie habitat buffer could be maintained between the trail and future K-10. Another concern with this alignment is the difficulty of crossing the highway. *SmartTrail* identifies breaks at the major road sections, interchanges, bridges, and tunnels. Unfortunately, the existing roadway facilities, including interchanges and overpasses, were not designed to accommodate bicyclists or pedestrians. Existing facilities would need to be retrofitted and new facilities designed to accommodate future connections as part of the future reconstruction. An additional concern related to the alignment is whether, given the vehicular speeds and projected traffic volumes on K-10, an adjacent trail would be desirable and attractive to bicyclists.

Regardless of the ultimate location of any east-west bicycle/pedestrian corridor, future interchanges and overpasses along K-10 should be designed to accommodate separate bicyclist/pedestrian connections. The future interchanges identified in this study that could serve as possible crossing points include:

- Lone Elm Road (Lenexa/Olathe)
- Clare Road (Lenexa/Olathe)
- Prairie Star Parkway (Lenexa/Olathe)
- Winchester Road (Eudora)
- Franklin Road (Lawrence)

Bicycle/Pedestrian Recommendation

There are two primary travel movements for bicycle and pedestrian travel – travel across K-10 and travel along K-10. The travel across K-10 will be considered in the redesign of interchanges and other crossings of K-10 as it is reconstructed.

The K-10 Association, Johnson County Planning and MARC advocate a trail option along K-10 in the K-10 Smart Trail Plan. The K-10 corridor provides a direct connection between communities, businesses and residences. The area around the Kansas River is less populated and provides a more circuitous route between communities. Moreover, a multi-use trail along K-10 does not preclude a future recreational trail along the Kansas River. The advisory group considered the Kansas River a viable long-term option for a regional recreation trail.

Given the location of K-10, the possibility exists for a bicycle/pedestrian trail to be constructed adjacent to K-10. As mentioned earlier, such a trail would need to be separated from the highway by fencing or other physical barriers to discourage encroachment on the highway by bicyclists and pedestrians. It is not KDOT's general practice to allow bicycle/pedestrian routes on KDOT right-of-way due to safety and maintenance concerns, but if sufficient right-of-way exists, KDOT would consider allowing a trail within the right-of-way. In the case of the K-10 corridor, the study team believes that K-10 can be widened largely within existing right-of-way, except at certain mainline locations and interchanges. In order to accommodate a bicycle/ pedestrian trail, new right-of-way would have to be purchased. KDOT will try to accommodate bicycle/pedestrian crossings along K-10 Highway, particularly in urban and urbanizing areas within the corridor and where bicyclist/pedestrian safety is a concern.

The cities and counties along the corridor all agree that the local provision of a 100-foot easement adjacent to both sides of the K-10 right-of-way would enhance community livability by affording opportunities for landscaping features, noise mitigation and bicycle/pedestrian accommodation. As land develops adjacent to K-10 Highway, cities and counties should work closely with developers to ensure that this easement is provided along the entire length of K-10. KDOT is willing to provide assistance to cities and counties in their effort to provide this easement.

Under this option, a majority of the trail alignment should be located on the north side of K-10, but may switch to the south side of K-10 when necessitated by physical constraints or the need to serve key development sites. This alignment recommendation follows the MARC SmartTrail alignment. Trail crossings should occur at key points along the corridor. Unfortunately, current facilities are not designed to accommodate bicyclists or pedestrians. Retrofitting existing facilities can be costly and problematic. Despite these challenges, a trail connection should be considered for the Church Street interchange in Eudora to provide a safe connection to the high school. Future interchanges (listed in the previous section) and overpasses should be designed to accommodate a separate bicyclist/pedestrian connection.

Agency Coordination

Planning for acquisition of right-of-way, construction and maintenance of the trail will need to be coordinated among a number of local communities along K-10, including Johnson County, Douglas County, MARC, and the Lawrence-Douglas County Metropolitan Planning Commission. The K-10 Corridor Association can also provide a strong supporting role in the development of a trail system. The K-10 Corridor Association Inc., is a non-profit corporation of cities, counties, businesses, individuals, utility companies, agricultural interests and interested persons. The organization trademarked K-10 "America's Smart Corridor®" as a strategy to prepare for and attract high technology development. KDOT can also play a supportive role to assist and coordinate development of the trail.

Funding

Costs associated with the trail include planning, land acquisition, construction and ongoing maintenance. At this time, any costs associated with the potential trail have not been programmed by KDOT. Funds from KDOT's Transportation Enhancement (TE) program could potentially be applied to such a trail. Also, Surface Transportation Program (STP) funds, which Johnson County, Douglas County, and MARC receive, can be used for trails.

After construction, maintenance of the trails and adjacent buffer would likely be the responsibility of the communities along the corridor.

TEA-21/SAFETEA

There are a variety of funding sources that local governmental agencies can pursue to fund the proposed recommendations. This plan is a first step toward securing some of the financing needed. Most federal and state funding programs require communities to undertake planning studies such as these to qualify for funding. The Transportation Equity Act for the 21st Century (TEA-21) is the major source of federal funding for all transportation projects in the United States. Several TEA-21 programs offer funding for trails and other transportation enhancements. As the two Metropolitan Planning Organizations (MPOs) for the study area, MARC and the Lawrence-Douglas County Metropolitan Planning Commission are responsible for reviewing and administering TEA-21 funding. The reauthorization of a similar measure (Safe, Accountable, Flexible and Efficient Transportation Equity Act – SAFETEA) is expected in 2005.

Conclusion

To date, there has been considerable interest in developing a bicycle/pedestrian connection between Johnson and Douglas counties. The SmartTrail report outlined a conceptual plan for a shared-use trail along an improved K-10 corridor. This plan supports the continuation of efforts to improve bicycle and pedestrian connections between the communities located in the K-10 Corridor. Given the nature of high vehicle speeds on K-10 and other roadways in the K-10 corridor, the safest option for bicycle and pedestrian travel is a separate path located outside of the future K-10 right-of-way. Planning, financing, land acquisition, construction and maintenance of this trail should be coordinated between the communities along K-10 as well as MARC and the Lawrence-Douglas County Metropolitan Planning Office.

7. Public/Agency Involvement

Public Involvement for the K-10 Transportation Study included a variety of tools to inform the public and gather feedback at various stages of the project. It was important for the project team both to provide information to the public and to allow the opportunity for public comment.

The Public Involvement approach helped to educate stakeholders and the public about the future transportation needs of K-10 and to facilitate discussions about land use and transportation as the corridor evolves from mostly rural in nature to more urban. Public comments allowed the study team to understand the concerns of the public, and the team worked to address those concerns throughout the technical process.

A variety of tools were utilized to present information to the public and gather feedback, including:

- Advisory Group
- Informational meetings
- Agency meetings
- Public meetings
- Newsletters
- Media releases
- Drop-in centers/Kiosk

A summary of the Public Involvement activities conducted during the project follows. Supporting material, such as handouts, can be found in Appendix G.

Mailing List

During the course of the study, a mailing list was developed that included property owners along the corridor, public officials, stakeholders, and other interested parties. Names and addresses were collected through public meetings, the drop-in center, comment forms, and contacts with the project team.

Informational Meetings

Informational meetings were held at the MARC Total Transportation Policy Committee and the Lawrence-Douglas County Planning Commission to kick off the study. At the conclusion of the study additional meetings were held with the MPOs to present the recommendations of the study.

The study team also attended informational meetings with the K-10 Corridor Association.

Advisory Committee

An Advisory Committee was created to serve as a project feedback mechanism and to ensure involvement from the various affected communities along the corridor. The committee was composed of city/county staff members, transit officials, and representatives of the K-10 Corridor Association. Four Advisory Committee meetings were held during the course of the study, as summarized in Table 7-1. A list of the Advisory Committee members can be found at the beginning of this report.

Table 7-1: Advisory Committee Meeting Schedule

	Date	Location
Meeting 1: Project background and introductory meeting	September 5, 2003	Lawrence
Meeting 2: Status report and existing traffic conditions	February 27, 2004	De Soto
Meeting 3: Interchange locations, alternative widening concepts	May 27, 2004	Olathe
Meeting 4: Next steps, alternative concept recommendations	October 13, 2004	Lenexa

The Advisory Committee was also allowed to review and comment on the draft report for this study. Responses to the comments are included in Appendix G.

Agency Meetings

During the course of the project, members of the study team met with staff from various local jurisdictions along the corridor, including the De Soto, Eudora, Johnson County, Lawrence, Lenexa, and Olathe. These agencies provided important information, such as land-use and development data, and valuable feedback on study progress, such as review and approval of the traffic forecasts.

Public Meetings

Two rounds of Public Meetings were held on the

K-10 Transportation Study:

Round 1 included two meetings presenting identical information at two locations along the corridor. The purpose of Round 1 was to present information on the status of the study and to show the proposed improvements at a conceptual level. The two meetings occurred at the following locations:

- Tuesday, June 29, 2004, from 4:00 to 7:00 p.m. in Lenexa at the National Guard Armory in the multipurpose room. Twenty-four people signed in at the Lenexa meeting and three people left written comments.
- Wednesday, June 30, 2004, from 4:00 to 7:00 p.m. in Eudora at Nottingham Elementary School in the gymnasium. Twenty-six people signed in at the Eudora meeting and five people left written comments.

Each meeting had exhibit boards on display presenting information on the purpose of the project, traffic projections, crash rates, typical sections of the proposed widening concepts, alternative transportation, and bicycle/pedestrian options. Aerial display maps of the corridor and interchange concepts were available for public inspection. Project team members were available to answer questions. A fact sheet was available for each person who attended the meeting.

Round 2 consisted of a single meeting presenting the findings and recommendations of the study - on Wednesday, November 10, 2004, from 5-7 pm at De Soto High School. Twenty-eight people signed and one person left a written comment.

Exhibit boards displayed information on the purpose of the project, widening recommendations (and the impacts of those recommendations), "as requested" interchange locations, fixed-route bus service recommendations, and bicycle/pedestrian considerations. Aerial display maps of the corridor and interchange concepts were on display as well as "Next Steps" information. Project team members were available to answer questions. A fact sheet was available for each person who attended the meeting.

The sign-in sheet offered individuals the opportunity to sign up to receive further information about the Lenexa/Olathe Prairie Star Parkway/Lone Elm Road/Clare road interchanges study. Fifteen expressed interest in more information as it is made available.

Generally, those who attended the meeting appreciated the information and were in agreement with the recommendations. Some verbal comments from the meeting included: "*We wish it would be done faster*" and "*We wish there was funding available to get started now.*" Other comments included: *"The interchange at Lone Elm Road is very important; when will that be completed?"* and *"This corridor needs to be a scenic corridor."*

Drop-In Centers

Drop-in centers were provided at various locations during the study to provide updated information throughout the planning process. Locations included:

- Lawrence Public Library: April 6-20, 2004
- Olathe Public Library: April 7-21, 2004
- Eudora City Hall: April 22-May 1, 2004
- Lenexa Public Library: April 26-May 13, 2004
- Lenexa City Hall: May 13-May 26, 2004
- De Soto Public Library: May 25- June 15, 2004

Media Outreach

Press releases and media advisories were issued before all public events.

8. Recommendations

This study reached the following conclusions:

(1) K-10 will ultimately need to be widened to six lanes west of K-7 and eight lanes east of K-7.

In addition to basic mainline lanes, auxiliary lanes will be needed in many locations. The timing for the widening is dependent on future growth and development, but improvements will be needed as soon as 5 years on certain portions of the corridor, and as late as 20 years on others. East of K-7, the eight-lane section is proposed to have a concrete safety barrier for right-of-way reasons. West of K-7, the decision regarding a closed vs. open median will be made when the improvements are programmed. The widening will need to account for a number of environmentally sensitive areas, including several wetlands, six floodplains, two parks, two HAZMAT sites, and two existing pedestrian/bicycle trails.

(2) A buffer is recommended between the edge of the K-10 right-of-way and any future development.

The buffer would minimize future noise issues, accommodate landscape improvements, and potentially serve as a location for a pedestrian/bicycle trail. The study identified a 100-foot width for this buffer easement on both sides of K-10. The buffer would be outside KDOT's right-of-way; it is anticipated that it would need to be acquired by the local governments through dedications by land owners and developers. KDOT is willing to provide assistance to cities and counties in their efforts to provide this easement.

(3) Existing interchanges will need to be improved.

Anticipated volumes at the K-10/K-7 interchange would require a fully directional four-level interchange. If adjacent interchanges at Lone Elm Road and Clare Road were built, the fourth level would not be needed. The construction of the K-10/K-7 interchange would be sequenced over time with the westbound-to-southbound flyover built first.

Conceptual improvements to the I-435/K-10/I-35 interchange complex will need to extend as far west on K-10 as Ridgeview Road. A future study will need to perform more detailed analysis to refine the proposed concept of braided ramps and C-D roads.

Other existing service interchanges along the corridor will require modifications, including additional ramp turn lanes, widened cross-streets, signalization, conversion of ramp terminal intersections to roundabouts, and realigned frontage roads.

(4) Requested future interchanges are forecasted to operate acceptably.

Based on the conceptual planning-level analysis of this study, the five "as requested" interchanges do not appear to compromise operations on K-10 as long as necessary associated improvements are made. This initial finding does not, however, constitute approval or endorsement on KDOT's behalf of these new interchanges. (See Chapter 9 for "Next Steps" toward approval.)

(5) The development of fixed-route bus service, with the potential for route deviations, is recommended for the K-10 corridor.

An operating plan should be developed (by the transit operator/operators) for a pilot service to generally operate between the K-10/I-435 industrial area and the University of Kansas (KU)/downtown Lawrence, with additional fixed stops at key intervening residential/employment centers. The study estimated that the potential for daily transit ridership in this corridor could range from 350 to 500 patrons. The service should make use of future Transit Centers identified in MARC's Smart Moves plan.

(6) Provisions for a continuous bicycle/pedestrian linkage should be encouraged throughout the K-10 corridor.

A number of alternative bicycle/pedestrian routes are under consideration; it is recommended that further studies be performed by regional and local agencies to solidify an alignment. If a route immediately adjacent to K-10 is chosen, the proposed trail will need to be separated from the highway by fencing or some other physical barrier to discourage encroachment on the highway by bicyclists and pedestrians. It is not KDOT's general practice to allow bicycle/pedestrian routes on KDOT right-of-way due to safety and maintenance concerns, but if sufficient right-of-way exists, KDOT would consider allowing a trail within the right-of-way. In the case of the K-10 corridor, the study team believes that K-10 can be widened largely within existing right-of-way, except at certain mainline locations and interchanges. In order to accommodate a bicycle/pedestrian trail, new right-of-way would have to be purchased. In KDOT's current Comprehensive Transportation Program, no funds are programmed for right-of-way purchases for either capacity improvements or bicycle/pedestrian trails.

(7) Future design improvements on K-10 should incorporate Intelligent Transportation Systems (ITS) as appropriate.

Future ITS elements would include communications conduit along the entire length, ramp metering (at least as far west as K-7), detection at spacings determined reasonable, and cameras/VMS at key locations along the corridor. An incident management program will be an important component of future planning for this corridor, because parallel-route diversion opportunities are currently extremely limited.

9. Next Steps

Although this study has resulted in a series of recommendations for long-term improvements to K-10, neither KDOT nor its partners currently have funds available to implement any of these improvements. As a result, the challenge will be for KDOT and the local communities to work together to see that these improvements can occur over time. The first step will be to develop Memoranda of Understanding (MOUs) with each local community to lay the groundwork and preserve the ability to carry out the study's recommendations. Focusing on the preservation of key parcels of land will be a first priority. Among the first priorities will be the development of a K-10 transit operating plan. Ultimately, a long-term plan needs to be developed to fund the widening improvements.

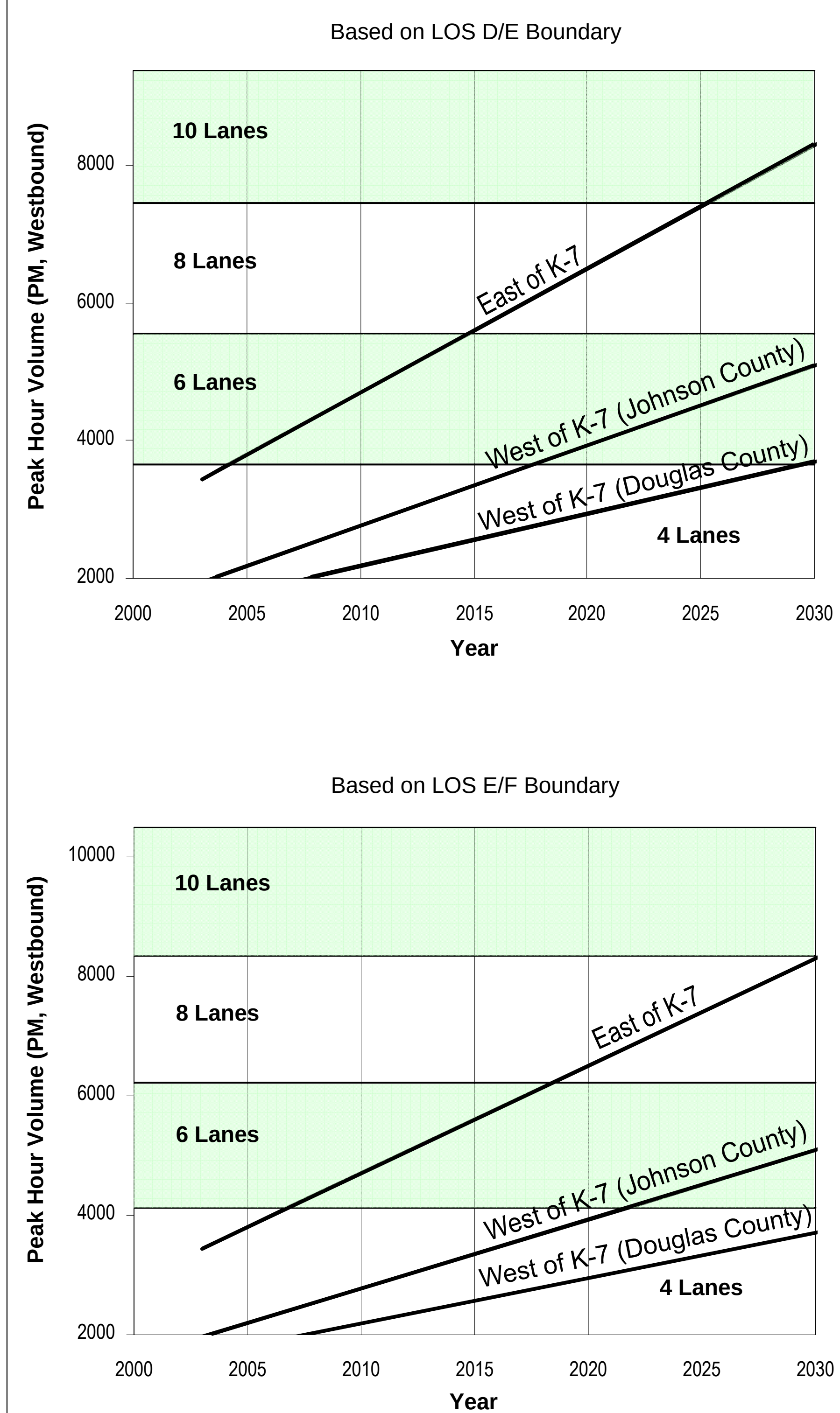
Figure 9-1 illustrates the expected growth on K-10 over time, resulting in a general timeframe for needed improvements. The upper half of the figure shows a timetable that assumes improvements will be needed before the facility reaches LOS E. Using this criterion, the graph illustrates the following:

- *East of K-7:* The need for an additional lane in each direction is projected almost immediately, with a second lane in each direction needed within 10 to 15 years.
- *West of K-7 (Johnson County):* The need to widen K-10 to six lanes in the portion of Johnson County west of K-7 is projected to occur within the next 15 years
- *West of K-7 (Douglas County):* The need to widen K-10 to six lanes in Douglas County is projected to occur within the next 25 to 30 years.

The lower graph in Figure 9-1 is based on a less stringent criterion: that improvements will be needed before the facility reaches LOS F. Using this criterion results in the following conclusions:

- *East of K-7:* The need for an additional lane in each direction is projected within the next five years, with a second lane in each direction needed within 15 years.
- *West of K-7 (Johnson County):* The need to widen K-10 to six lanes in the portion of Johnson County west of K-7 is projected to occur within the next 20 years.
- *West of K-7 (Douglas County):* In Douglas County, the timeframe for needing a six-lane section is forecasted to exceed the study horizon of 2030.

Figure 9-1: Planning Level Thresholds for K-10 Widening



If local communities desire to pursue the potential new interchanges examined as part of this study, they will need to submit formal break-in-access requests (including more detailed traffic operational analyses) to receive approval for these interchanges. One such study is already underway: The Cities of Lenexa and Olathe are conducting an important follow-up study, covering K-10 from Woodland Road to the future Prairie Star Parkway. The study will include more refined operational analysis of this corridor, including adjacent local streets and intersections, and will recommend configurations for new interchanges, improvements to existing interchanges, and improvements to the K-10 mainline. Crucial to any package of improvements promoted by local agencies will be identification of funding sources.