SCOPING STUDY REPORT

US 31W at University Blvd. / Chestnut St.

Study of Proposed Intersection Improvements

Warren County, Kentucky
Item No.: 3-131.00

Prepared for:

KENTUCKY TRANSPORTATION CABINET
DISTRICT #3

Prepared by:

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TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

1.1 Background

This project is located on US 31W, at the intersections of University Boulevard and Chestnut Street, in Bowling Green, Kentucky (see *Attachment 1*). The Kentucky Transportation Cabinet (KYTC) retained Qk4, Inc. to conduct the engineering and analysis for this project through our Statewide Design Contract. A Project Scoping/Pre-Design Meeting was held on July 17, 2007 at the District 3 office in Bowling Green, which was followed by a site visit. Minutes of this meeting are included as *Attachment 2* and photographs of the study area are provided in *Attachment 3*.

1.2 Purpose and Methodology of the Study

The purpose of this study is to analyze the performance of these two intersections, compare different mechanisms for improvement (e.g. adding a right turn lane, relocating and/or signalizing Chestnut, roundabouts, pedestrian facilities, etc.) and to recommend a preferred configuration that optimizes performance while controlling costs. Qk4 performed traffic simulations and analysis utilizing VISSIM software. VISSIM is a microscopic simulation program for multi-modal traffic flow modeling.

2.0 EXISTING CONDITIONS

2.1 Existing Intersections

The existing intersections of US 31W at University Boulevard / Loving Way and US 31W at Chestnut Street are separated by approximately 400 feet. The former is a four-way signalized intersection and is located at the southern gateway and landmark sign for Western Kentucky University (WKU) and the latter is an un-signalized intersection just to the north.

2.2 Current and Future Traffic Volumes

The KYTC provided Qk4 with the traffic forecast and turning movements for these intersections. The Traffic Forecast Report, dated September 14, 2007 can be found in *Attachment 4*. The traffic data from this report was used in the development of the VISSIM simulation models.

3.0 CONSIDERED ALTERNATIVES

The following alternative improvement options were developed to address the deficiencies of the subject intersections. A two-phased alternative screening process was used. The first phase included the identification and analysis of a broad range of alternatives. The second phase included a more in depth analysis of a short list of alternatives.

3.1 Initial Alternatives

At the Project Scoping Meeting, KYTC staff indicated the key goals to be 1) improving the left-turn movement from Chestnut Street to US 31W, 2) reducing congestion at University Boulevard and US 31W, 3) the integration of pedestrian facilities and 4) identifying a cost effective recommendation. Qk4 focused this initial study on the following improvement concepts to help alleviate these issues:

- Existing Configuration (2007).
- No-Build (2027).
- Alternative 1 (2027) – Add exclusive right turn lane on US 31W SB to University WB and include an additional through lane on US 31W SB with a merge area south of the intersection with University.
- Alternative 2 (2027) – Relocate Chestnut approximately 300 feet to the north to gain more separation with the University intersection (Chestnut would remain un-signalized).
- Alternative 3 (2027) – Relocate Chestnut to the north (Chestnut would remain un-signalized) in addition to the improvements described in Alternative 1.
- Alternative 4 (2027) – Alternative 2 (Signalize the Chestnut and US 31W intersection and synchronize with the University intersection).
- Alternative 5 (2027) – Dual roundabouts at University and Chestnut.
- Alternative 6 (2027) – Single roundabout at Chestnut.

Once the conceptual designs and initial VISSIM simulations and analysis were complete, a Project Team Meeting was held on November 2, 2007 to screen these alternatives. The summary of the delay analysis for AM and PM peak hours for the above eight configurations is shown in *Attachment 5.* The minutes of this meeting are included as *Attachment 6*. The result of this meeting was the Project Team recommending further development and investigation of Alternatives 1, 3, and 5.

3.2 Short-List Alternatives

The short-list of alternatives, resulting from the Project Team Meeting on November 2, 2007, was additionally developed and presented to the Bowling Green/Warren County Metropolitan Planning Organization on December 17, 2007. The summary of the delay analysis for these more defined alternatives is provided in *Attachment 6A*. The feedback received from local city and WKU officials lead to the development of an additional alternative, Alternative 7 (detailed below). On April 23, 2008, the Project Team decided to extend the added through lane southbound on US 31W to Lansdale Avenue where it would serve as a right turn lane and an extended merge area. This added lane, from University Boulevard to Lansdale Avenue, will affect Alternatives 1, 3, and 7.

The following describes the four alternatives that were advanced and further analyzed:

Alternative 1: Exclusive right turn lane from US 31W SB to University WB with an additional through lane on US 31W SB approximately 1300' to Lansdale Avenue where it ends as a right turn lane. This allows for commuters turning right from Chestnut onto US 31W SB to turn into a through lane, where as currently they turn into the right turn lane for University and then must merge to the left to go straight (*Attachment 7A-1, 7A-2*). No changes to the Chestnut intersection are proposed with this alternative.

Alternative 3: Relocate Chestnut over 300' to the north to gain separation with University in addition to the improvements in Alternative 1. This would allow for longer queue lengths at University and ease of left turn movement at Chestnut (Chestnut will be analyzed as an un-signalized and signalized intersection) (*Attachment 7B-1, 7B-2*).

Alternative 5: Dual roundabouts at University and Chestnut. The roundabout at University is a 4-way dual lane with Loving Way having a single approach. The Chestnut roundabout is 3-Way with dual lane approaches and a single lane exit at Chestnut Street (*Attachment 7C-1*).

Alternative 7: In addition to improvements in alternatives 1 & 3, a through lane is added to US 31W NB beginning south of University and continuing through the relocated Chestnut intersection. The inside NB lane thus serves as a left turn lane at University Boulevard and Chestnut Street. This provides two continuous through lanes through both intersections (Chestnut will be analyzed as an un-signalized and signalized intersection) (*Attachment 7D-1, 7D-2*).

4.0 VISSIM DELAY ANALYSIS

Traffic flow simulations were conducted using VISSIM software to model the AM and PM delay for the four short-list alternatives. A summary of this information is included in *Attachment 8*. All of the build alternatives offer similar levels of operational improvement in the design year 2027. CDs containing VISSIM input data and movie files for simulations of each alternative can be found inside the back cover of this report.

5.0 COST ESTIMATES

Construction cost estimates for Alternatives 1, 3, 5 and 7 are included in *Attachment 9*. Right of way and utility estimates were provided via email by the KYTC District 3 office on May 28, 2008. The right of way, utilities, and construction costs for the alternatives are summarized as follows:

Alternative	Right of Way	Utilities	Construction	Total
Alternative 1	$185,000	$610,000	$442,000	$1,237,000
Alternative 3	$300,000	$785,000	$1,066,000	$2,151,000
Alternative 5	$500,000	$1,550,000	$1,572,000	$3,622,000
Alternative 7	$400,000	$1,985,000	$1,390,000	$3,775,000

The following are included in the current State Highway Plan. State funds are allocated for the year 2010 for right of way and utility work and 2011 for construction.

2008 Highway Plan

Right of Way	Utilities	Construction	Total
$470,000	$760,000	$1,130,000	$2,360,000

6.0 COMPARISON OF ALTERNATIVES

The four short-list alternatives provide similar levels of delay reduction over the no-build alternative. One exception is Alternative 5 (the roundabouts), where the US 31W southbound PM Peak Hour delays do not exhibit as significant a reduction as with the other alternatives. The Project Team also noted that Alternative 5, with two very closely placed dual-lane roundabouts, may be confusing to the travelling public. On July 9, 2008 the Cabinet issued Project Development Memorandum No. 1-2008. This memo states that "roundabouts are no longer to be pursued or considered as an alternative solution for intersection design." For these reasons Alternative 5 was eliminated from consideration.

The remaining alternatives (1, 3 & 7) are essentially staged construction packages beginning with Alternative 1 and ending with the full improvement build-out of Alternative 7. As seen on Attachment 8, the PM Peak Hour delays exhibit the highest congestion; therefore, our comparisons of the alternatives will be addressing the PM Peak Hour delays. Reviewing these PM delays reveals that signalizing Chestnut for either Alternative 3 or Alternative 7 increases the delays for the through movements on US 31W, therefore the signalization of Chestnut should be eliminated from consideration.

As a way to compare the performance of the remaining three alternatives the Overall Average Delay was calculated. The Overall Average Delay for each alternative was calculated by multiplying the number of vehicles for each movement by the average delay for that movement. These values were added together and then divided by the total number of vehicles in the network. The results are contained in Table 1.

TABLE 1
SUMMARY OF PM PEAK HOUR DELAYS (2027)
(Seconds)

From	To	No Build	Alt 1	Alt 3	Alt 7
Northbound US 31	Eastbound Loving	55	51	36	15
Northbound US 31	Northbound US 31	56	55	42	24
Northbound US 31	Northbound Chestnut	86	94	54	40
Northbound US 31	Westbound University	136	135	121	115
Westbound Loving	Northbound US 31	41	32	16	4
Westbound Loving	Northbound Chestnut	38	52	6	25
Westbound Loving	Westbound University	29	23	28	32
Westbound Loving	Southbound US 31	19	17	30	15
Southbound US 31	Northbound Chestnut	218	5	1	3
Southbound US 31	Westbound University	294	16	1	7
Southbound US 31	Southbound US 31	275	47	29	29
Southbound US 31	Eastbound Loving	269	63	32	16
Southbound Chestnut	Westbound University	672	61	38	44
Southbound Chestnut	Southbound US 31	619	94	62	50
Southbound Chestnut	Eastbound Loving	425	99	62	32
Southbound Chestnut	Northbound US 31	356	34	24	27
Eastbound University	Southbound US 31	32	37	30	31
Eastbound University	Eastbound Loving	37	38	32	33
Eastbound University	Northbound US 31	144	136	126	123
Eastbound University	Northbound Chestnut	156	142	116	121
Overall Average Delay		**190**	**70**	**55**	**52**
Percent Reduction from the No-Build			**63%**	**71%**	**73%**

Reviewing Table 1 reveals that Alternative 1 provides for a 63% reduction in PM Peak Hour delays in the design year as compared with the No Build. This significant result produced by Alternative 1 becomes only an incremental decrease for Alternatives 3 and 7. Alternative 3 produces a 71% decrease while Alternative 7 exhibits a 73% decrease as compared with the No Build.

With the Cabinet's initiative on Practical Solutions launched in 2008, maximizing project value is emphasized. In an attempt to quantify the value or cost-benefit for each alternative, the cost per second of reduction in delay achieved was calculated for each alternative and is shown in Table 2.

TABLE 2

Cost per Second of Reduction in Delay

	Reduction in Delay (sec)	Total Alternative Cost	Cost per Second of Delay Reduction
Alternative 1	120	$1,237,000	$10,000
Alternative 3	135	$2,151,000	$16,000
Alternative 7	138	$3,775,000	$27,000

Based on this analysis Alternative 1 produces the most value for reducing the congestion and improving the operation of these two intersections.

This is an important goal of this project but other factors come into consideration when recommending a preferred alternative such as improved pedestrian facilities or increasing the separation between the University Boulevard and Chestnut Street intersections along US 31W.

7.0 RECOMMENDATIONS

Because Alternative 1 is the least expensive and most cost effective solution to meet the primary goal of reducing congestion, it is the most “practical design” and therefore the preferred alternative.

Although Alternative 1 would not include the reconstruction of Chestnut at US 31W (with or without a signal) nor would it include the integration of new pedestrian facilities, it would also not exclude them from being constructed in the future. As stated above, the three short-listed alternatives (1, 3 and 7) are essentially staged construction packages beginning with Alternative 1 and ending with the full improvement build-out of Alternative 7. After implementation of Alternative 1, it is recommended that both a traffic analysis and pedestrian needs assessment be reconsidered for Alternatives 3 and 7 as long term solutions.

Due to low volumes and alternate accessibility, the District 3 office further recommends that the left-turn movement from Southbound US 31W to Loving Way be eliminated upon construction of this project.