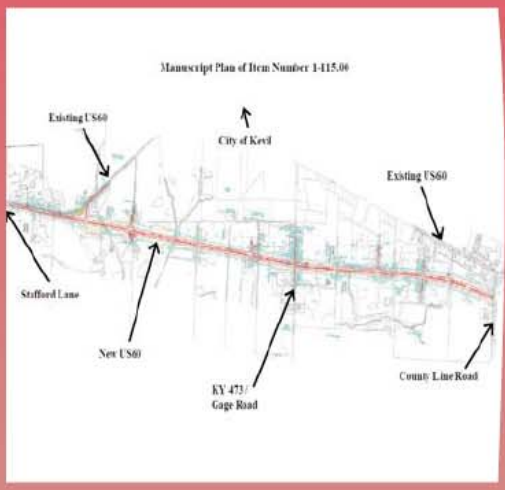
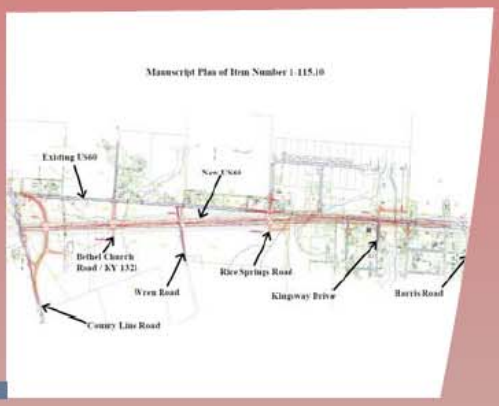
Value Engineering Study

Us60 RECONSTRUCTION

BALLARD & MCCRACKEN COUNTIES, KY

ITEM NUMBERS 1-115.00 & 1-115.10
VE STUDY NUMBER 201109





Study Date: November 14-17, 2011

Kentucky Transportation Cabinet
Frankfort, Kentucky

URS

US60 RECONSTRUCTION
BALLARD AND MCCRACKEN COUNTIES, KENTUCKY

Item Numbers 1-115.00 & 1-115.10

VE Study Number 201109

VALUE ENGINEERING STUDY
for
Kentucky Transportation Cabinet
Frankfort, Kentucky

Study Date: November 14 – 17, 2011

Final Report

December 22, 2011

URS

EXECUTIVE SUMMARY

General

URS conducted a Value Engineering (VE) study of the US60 reconstruction in Ballard and McCracken Counties, Kentucky. The Item Numbers (Nos.) are 1-115.00 and 1-115.10. The topic was the 90% design submission prepared by American Engineers, Inc. (AEI) for Item Number (No.) 1-115.00 and District 1 of the Kentucky Transportation Cabinet (KYTC) for Item No. 1-115.10.

The VE Team undertook the task assignment using the value engineering work plan and approach. The ideas generated from this process and chosen for full development as VE Team Recommendations are presented in Section 3 of this report. These recommendations are presented to all project stakeholders for judgment as to whether they should be implemented.

Estimate of Construction Costs and Budget

The preliminary construction cost estimate provided to the VE Team with the project documents indicates a total construction cost of $16,987,182 (Item No. 1-115.00) and $8,902,127 (Item No. 1-115.10) not including right-of-way. This project is scheduled to be developed as a traditional design/bid/build project, thus the cost of construction will be determined on a contractor bid.

Summary of VE Study Results

During the speculation phase of this VE study, 30 creative ideas were identified; 11 of these ideas were developed into VE recommendations and 14 were developed into design comments with cost implications where applicable. Many of the ideas represent changes in design approach, reconsideration of criteria, and in some cases, modification of the project scope. In general, the idea evaluation took into account the economic impact, other benefits obtained, and the effect on the overall project objectives.

The following table presents a summary of the ideas developed into recommendations and design comments with cost implications where applicable. Since cost is an important issue for comparison of VE proposals, the costs presented in this report are based upon original design quantities with unit rates obtained from the estimate as prepared by the Design Team and included in their submission, published cost databases, and VE Team member experience.

The table also identifies the recommendations and alternatives that, in the opinion of the VE Team, are the best combination of all the VE recommendations. This selection takes into account that the cost savings of these recommendations can be added together (summarily additive), and it also considers whether the cost savings or project improvement potential are worth the change to the project design.

For this project, the VE Team selected two mutually exclusive scenarios to represent a range recommendations and potential cost savings. These scenarios are comprised of a combination of individual recommendations as shown in the Summary of VE Recommendation table. The VE Team's Selected Combination #1 represents an estimated potential cost savings of $7,380,000. VE Team Selected Combination #2 results in an estimated potential cost savings of $7,632,000. Total cost savings realized will be based upon the final implementation status of these VE recommendations.

SUMMARY OF VE RECOMMENDATIONS			
Rec #	Recommendation Description	1st cost savings (or cost)	VE Selected Combo
VE-1	Utilize a 30 ft depressed grass median in lieu of a 40 ft depressed grass median	$308,000	2
VE-2	Utilize 11 ft traffic lanes and 8 ft paved outside shoulders in lieu of 12 ft traffic lanes and 10 ft paved outside shoulders	$1,070,000	
VE-3	Reduce shoulder asphalt section in lieu of full depth shoulders	$351,000	1*,2*
VE-4	Where intersecting roads are to be reconstructed, reduce the asphalt section from 9.25 inches to 5.75 inches where applicable	$183,000	1,2
VE-5	Adjust the profile grade to improve the balance of earthwork	$1,031,000	1*,2*
VE-6	Adjust profile grades to reduce the fill at culvert crossings which will eliminate the need for guardrail	$638,000	
VE-7	Utilize 90 degree culvert crossings and relocated streams to eliminate the skewed culvert crossings	($9,000)	
VE-8	Combine the two culverts at Stations 470+68 and 474+24 in lieu of two separate culverts	$23,000	1,2
VE-9	Construct initial 2 lanes (ultimate 4 lanes) lieu of 4 lanes for both Item Nos.	$6,427,000	2
VE-10	Construct a 2 lane ultimate roadway in lieu of 4 lanes for both Item Nos.	$7,233,000	
VE-11	Construct a 2 + 1 lane design in lieu of 4 lanes for both Item Nos.	$6,483,000	1

Summary of VE Team Selected Combination # 1: $7,380,000
Summary of VE Team Selected Combination # 2: $7,632,000

* If recommendations VE-11 or VE-9 are implemented, the cost savings available for other recommendations will be reduced

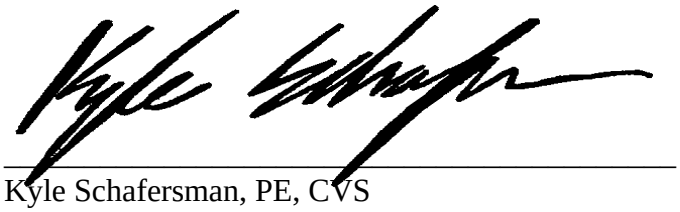
SUMMARY OF VE DESIGN COMMENTS	
DC #	Design Comment Description
DC-1	Review access control plan to consolidate and reduce the number of access points and median openings
DC-2	Construct Item No. 1-115.00 concurrent with Item No. 1-115.10
DC-3	Utilize the current allocated funds to purchase all right-of-way for Item Nos. 1-115.00 and 1-115.10 in lieu of treating the projects as separate entities
DC-4	Straighten the right-of-way lines in lieu of jagged right-of-way lines for Item No. 1-115.00
DC-5	Revise the cost estimates for right-of-way on both Item Nos.
DC-6	Validate the $2,500,000 allowance for utility relocations is reasonable for each Item No.
DC-7	Verify the quantity of guardrail specified in the cost estimate for Item No. 1-115.00
DC-8	Verify the quantity of woven wire fence specified in the cost estimate for Item No. 1-115.10
DC-9	Construct offset left turn lanes in lieu of standard left turn lanes
DC-10	Utilize a right turn lane at the industrial park where significant truck turns are expected
DC-11	Investigate the temporary tie-in of US60 to existing US60 at County Line Road if Item No. 1-115.10 is constructed before Item No. 1-115.00
DC-12	Utilize a cul-de-sac in lieu of a dead end for the access road north of US60 at Station 491+00
DC-13	Utilize cement stabilized roadbed for Item No. 1-115.00 in lieu of lime stabilized base as indicated in the cost estimate
DC-14	Reconcile the unit prices in the cost estimate for both Item Nos. and the Kentucky average unit prices

Acknowledgments
A thank you is given to the staff members from the Kentucky Transportation Cabinet and AEI for their participation. Special thanks are also extended to Mr. Brent Sweger for his assistance with this study.

Value Engineering Study Team

Name	Discipline / Role	Organization	Telephone
Stephen Curless, PE	Geometrics Expert	URS	513-419-3504
Greg Groves, PE	Roadway Design Engineer	URS	502-569-2301
Mike Guter, PE	Constructability	URS	616-574-8477
Kyle Schafersman, PE, CVS	VE Team Leader	URS	913-344-1019
Brent Sweger, PE, AVS	VE Coordinator	KYTC	502-564-3280

Certification
This is to verify that the Value Engineering study was conducted in accordance with standard value engineering principles and practices.



Kyle Schafersman, PE, CVS
Value Engineering Program Manager

TABLE OF CONTENTS

Section and Title *Page No.*

Appendices

SECTION 1 - INTRODUCTION

This report documents the results of a value engineering study on the US60 reconstruction in Ballard and McCracken Counties, Kentucky. The Item Nos. are 1-115.00 and 1-115.10. The study was held at the KYTC offices in Frankfort, KY on November 14-17, 2011. The study team was from URS and KYTC. Kyle Schafersman, a Certified Value Specialist (CVS), Professional Engineer (PE), and team leader from URS, facilitated the study. The names and telephone numbers of all participants in the study are listed in Appendix A.

The Job Plan

This study followed the value engineering methodology as endorsed by SAVE International, the professional organization of value engineering. This report does not include any detailed explanations of the value engineering / value analysis processes used during the workshop in development of the results presented herein. This would greatly expand the size of the report. The sole purpose of this report is to document the results of the study. Additional information regarding the processes used during the study can be obtained by contacting the Certified Value Specialist team leader that facilitated the study.

Ideas, Recommendations, and Design Comments

Part of the value engineering methodology is to generate as many ideas as is practical, evaluate each idea, and then select as candidates for further development only those ideas that offer added value to the project. If an idea thus selected, turns out to work in the manner expected, that idea is put forth as a formal value engineering recommendation. Recommendations represent only those ideas that are proven to the VE Team's satisfaction. Some ideas that did not make the selection for development as recommendations, were, nevertheless judged worthy of further consideration. These ideas have been written up as Design Comments and are included in Section 3 after the recommendations.

Level of Development

Value analysis studies are working sessions for the purpose of developing and recommending alternative approaches to a given project. As such, the results and recommendations presented are of a conceptual nature, and are not intended as a final design. Detailed feasibility assessment and final design development of any of the recommendations presented herein, should they be accepted, remain the responsibility of the owner. VE Team members have not and will not sign or seal any recommendations and comments contained in this report as certifiable engineering or architectural design. These value analysis alternatives have been developed by individual VE Team members and may not reflect the entire VE Team's opinion.

Organization of the Report

The report is organized in the following outline.

A. Introductory Information
    Section 1- Introduction
    Section 2- Project Description
B. Primary body of results
    Section 3- Recommendations and Design Comments
C. Supporting documentation
    Appendices

SECTION 2 – PROJECT DESCRIPTION

The proposed project will construct a new four lane road for US60. This construction will relieve congestion through Kevil, encourage the use of US60 as a route for freight movement and improve safety by providing alignments and roadway widths that meet current standards. The project will also support continued economic development in Ballard and McCracken Counties.

This is part of a long range plan to 4-lane US60 west of Paducah. This project will provide 4 lanes from Harris Lane (east of Kevil) to Stafford Lane (west of Kevil) which is approximately 4 miles. Construction of 4 lanes has already been completed from KY 1154 to Paducah (east of this project) and preliminary work is beginning on a project to extend the 4 lanes to the east limits of La Center (west of this project).

The typical section of the proposed road will consist of 4 lanes (two – 12 ft lanes in each direction), outside shoulders of 12 ft (10 ft paved) and inside shoulders of 6 ft (4 ft paved) with a 28 ft depressed grass median. The project will have partial control of access with a 1,200 ft minimum spacing between access points. Geometry will be based on a 60 MPH design speed. The project design was based on AASHTO's *Geometric Guidelines for Highways & Streets and also the KYTC Highway Design Guidance Manual.* The functional classification of US60 is a "Rural Principal Arterial."

Existing US60 through the project area is a 2 lane road. Lane widths are 11 feet. Shoulders are 2 to 4 ft wide through most of the project. The existing road does not meet current geometric standards, and sight distance is restricted at several locations. Also, the existing road does not meet current requirements for lane width and shoulder width. The current speed limit is 55 MPH.

This project has been separated into two separate Item Nos. as described below:

ITEM NO. 1-115.00

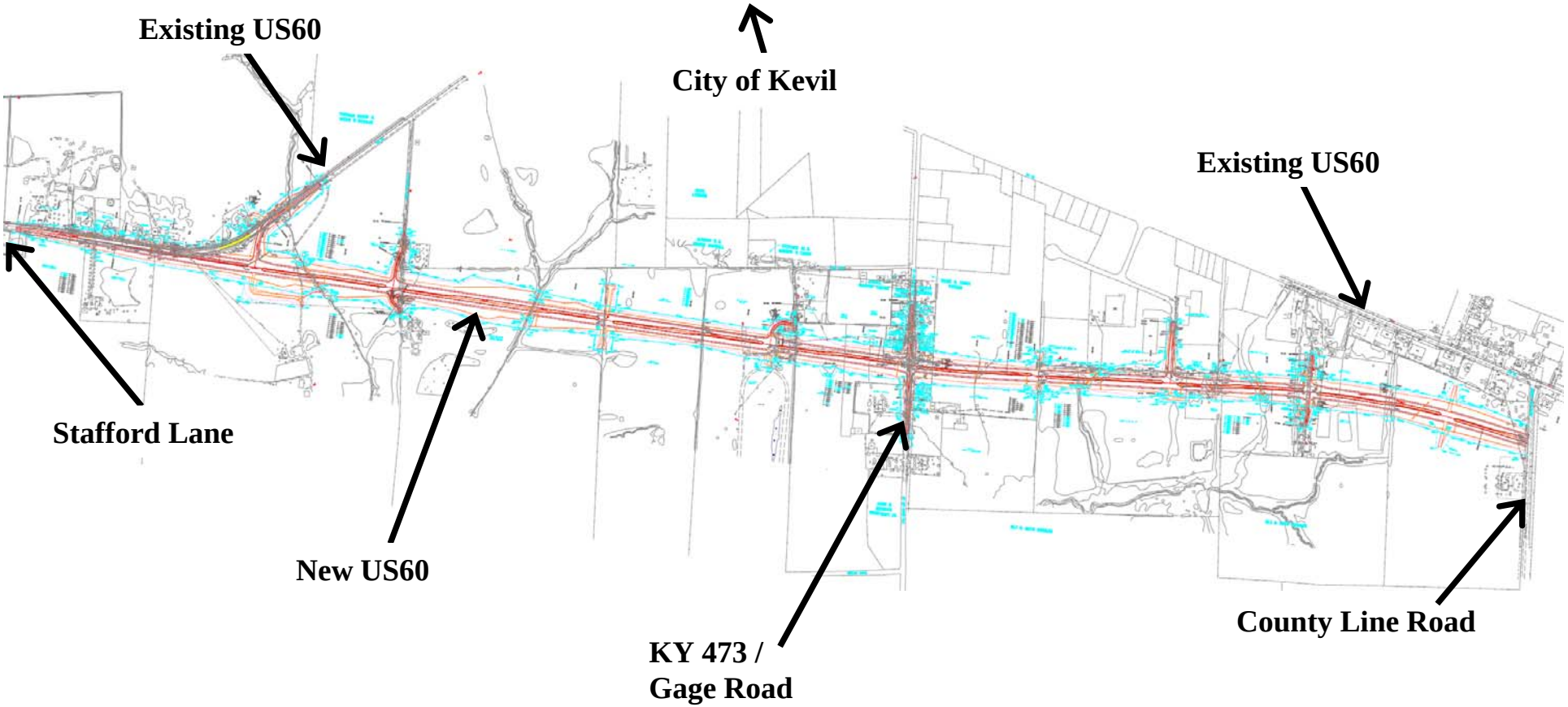
This Item No. will provide 4 lanes from the Ballard-McCracken County Line west to Stafford Lane west of Kevil in Ballard County. The mainline project length is approximately 2.5 miles. This Item No. has a cost estimate of approximately $16,987,000 (construction only), and it will be funded with State Project (SP) funding.

ITEM NO. 1-115.10

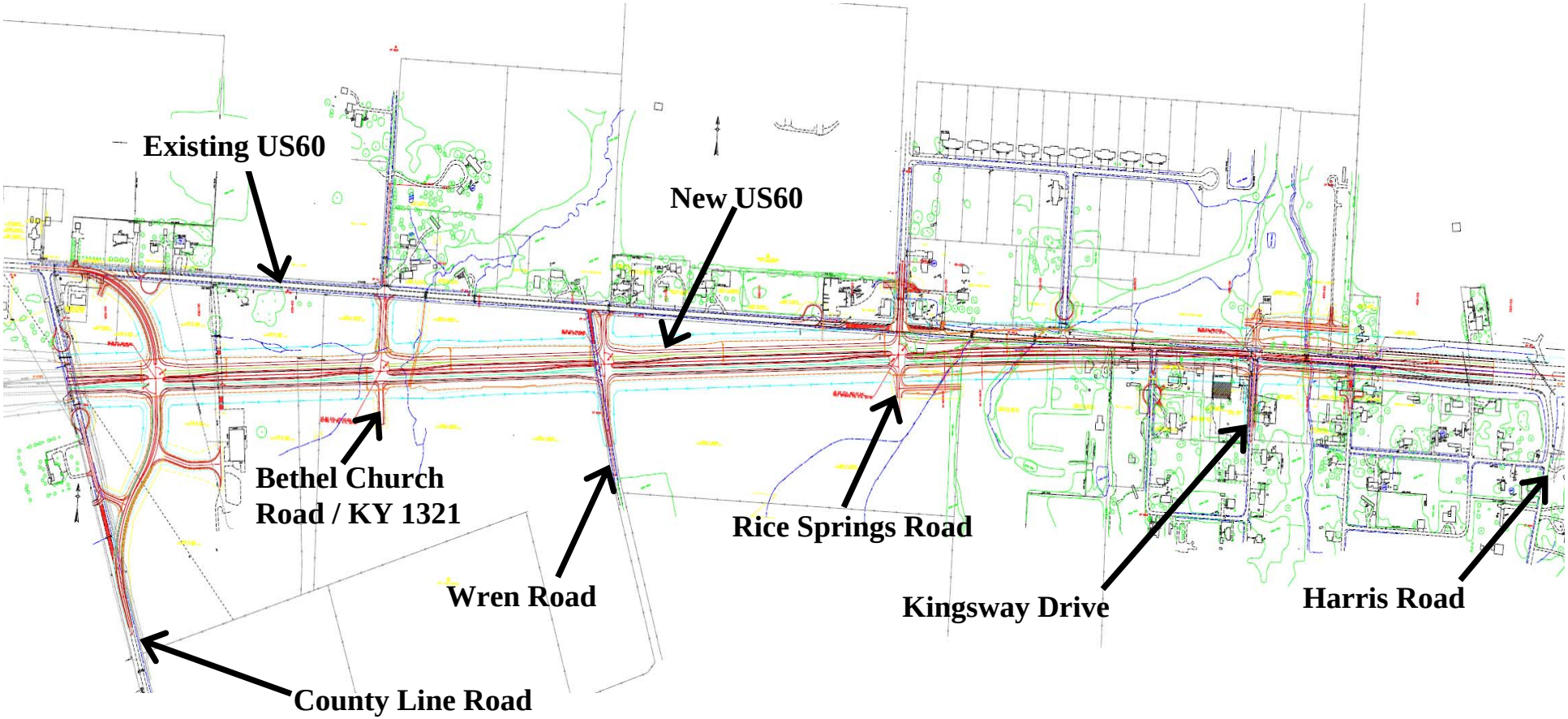
This Item No. begins just east of Kevil at the Ballard-McCracken County Line. The project extends east approximately 1.5 miles to Harris Lane (MP 1.507). The project will tie into the 4 lane section of US60 that has already been constructed. Along the existing route there are approximately 23 homes and 5 businesses, including Rudy's Farm Center, and 5 mobile homes. A large complex of duplexes is located adjacent to the project off of Rice Springs Road and Roberts Road. This Item No. has a cost estimate of approximately $8,902,000 (construction only), and it will be funded with State Project Priority (SPP) funding.

Map of Project Location (Item Nos. 1-115.00 and 1-115.10)

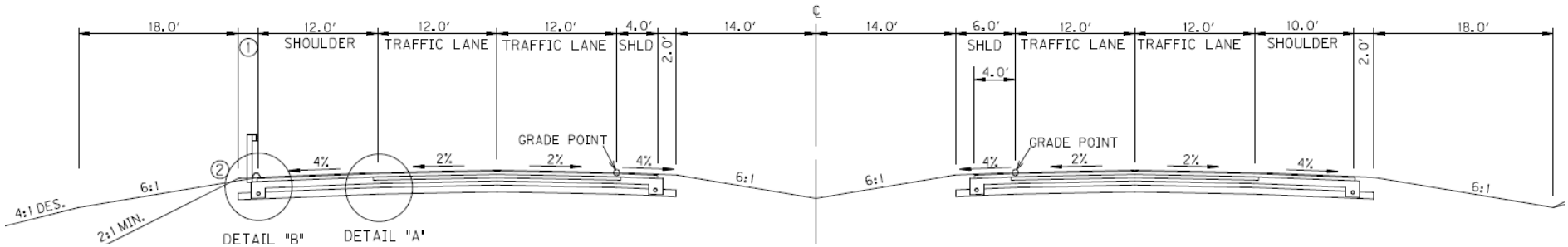
Manuscript Plan of Item No. 1-115.00



Manuscript Plan of Item No. 1-115.10



Typical Section for Mainline US60



SECTION 3 - VE RECOMMENDATIONS & DESIGN COMMENTS

Organization of Recommendations
This section contains the complete documentation of all recommendations that have resulted from this study. Each recommendation has been marked by a unique identification number.

The parent idea, or ideas from which the recommendation began, can be determined from the Creative Idea List and Evaluation located in Appendix D of this report.

Each recommendation is documented by a separate write-up that includes:
- a description of both the original design and recommended change,
- a list of advantages and disadvantages,
- sketches where appropriate,
- calculations,
- estimate of initial or first cost,
- the economic impact of the recommendation on the first cost (i.e., amount of dollars saved or added),
- and where applicable, the life cycle (LC) cost.

The economic impact is shown in terms of savings or added cost.

Acceptance of VE Recommendations
The Summary of VE Recommendations table presented in the Executive Summary of this report identifies the recommendations that, in the opinion of the VE Team, are the best combination of all the VE recommendations. This selection takes into account not only that the recommendations, and likewise their cost savings, are summarily additive (can be added together), but also the likelihood and ease of implementing the recommendations.

However, this report also includes other recommendations that could enhance the value of this project. These recommendations are either mutually exclusive of the recommendations selected by the VE Team (i.e., implementing one immediately precludes the implementation of another) or they require additional design and/or evaluation prior to implementation. These recommendations should be evaluated individually to determine whether they are worthy of implementation or not. Consideration should be given to the areas within a recommendation that are acceptable and implement those parts only. Any recommendation can be accepted in whole or in part as the owner and Design Team see fit.

Design Comments
Design Comments are ideas that in the opinion of the VE Team were good ideas, but for any number of reasons were not selected for development as VE recommendations. Design Comments can be notes to the owner or designer, a documentation of various thoughts that come up during the course of the study, a reference to possible problems, suggested items that might need further study, or questions that the owner and designer might want to explore. These comments may have implications on project cost, but due to time constraints, the VE Team did not develop cost savings estimates for Design Comments. Some comments might relate to things of which the owner or designer is already aware. Because the study is done on a design in progress and as an independent team, the VE Team may not be aware of everything intended by the owner and designer. The following comments are presented with the intent that they may aid the Design Team in some way.

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-1

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 30 ft depressed grass median in lieu of a 40 ft depressed grass median.

ORIGINAL DESIGN:
The original design specifies a 40 ft depressed median throughout the corridor.

RECOMMENDED CHANGE:
The VE Team recommends reducing depressed median section from 40 ft wide to 30 ft wide throughout mainline section. This 10 ft reduction in template width will decrease the earthwork volumes, right of way footprint and shorten the drainage structures.

ADVANTAGES:

- Reduces roadway excavation
- Requires less maintenance/mowing
- Reduces right of way requirements
- Reduces length of drainage structures
- Keeps more property in private ownership, thus generating more taxes

DISADVANTAGES:

- Redesign required
- Reduces green space
- May require median barrier (cable rail)
- May reduce approval from Director if Highway Design
- Does not match the typical section to the east

VALUE ENGINEERING RECOMMENDATION # VE-1

DISCUSSION CONTINUED

JUSTIFICATION:
The recommended change still maintains a positive separation from the travel lanes which is an improvement from the existing two lane undivided typical. Also, the narrower median will essential function the same from a traffic operation standpoint allowing space to develop left turns in the median and U-turns as needed. The change would reduce total earthwork (excavation and embankment) on the project. The narrowing of median will also result in shortening the drainage structures, decrease the right of way footprint and reduce the quantity for minor miscellaneous bid items such as seeding, clearing and grubbing, along with eliminating the need for long term maintenance cost for mowing.

ASSUMPTIONS:
For Roadway Excavation:
Used a percentage change of the entire typical width (150 ft) therefore 10/150 = 7% reduction. Total roadway excavation cost = (473,657 + 2,335,706) = 2,809,363.
7% reduction in cost is $196,655.

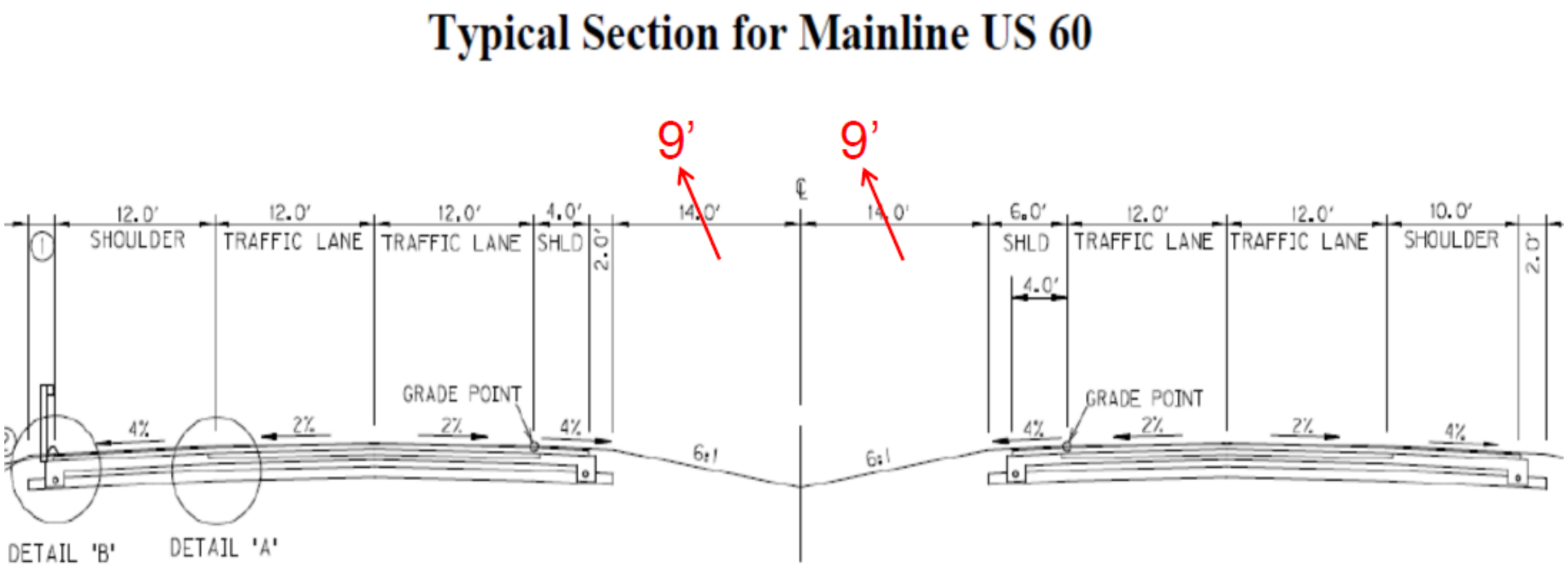
For Reinforced Concrete Box Culvert (RCBC):
10 ft X 4 ft RCBC (Station 122+50 +/-) @ $500/LF. 10 ft reduction = $500 X 10 = $5,000.
20 ft X 10 ft RCBC (Station 141+00 +/-) @ $1,100/LF. 10 ft reduction = $1100 X 10 = $11,000.
7 ft X 4 ft RCBC (Station 204+00 +/-) @ $400/LF. 10 ft reduction = $400 X 10 = $4,000.
8 ft X 4 ft RCBC (Station 441+50 +/-) @ $400/LF. 10 ft reduction = $400 X 10 = $4,000.
8 ft X 4 ft RCBC (Station 470+50 +/-) @ $400/LF. 10 ft reduction = $400 X 10 = $4,000.
Double 10 ft X 8 ft RCBC (Station 489+00 +/-) @ $2,000/LF. 10 ft reduction = $2000 X 10 = $20,000.
Total = $48,000

Right of Way Cost:
Approximate project length with median is 3.5 miles X 5,280 = 18,480 LF
18,480 ft X 10 ft = 184,800 SF / 43,560 (SF/acre) = 4.2 acres
4.2 acres X $15,000/acre = **$63,600 savings**

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,921,000	$0	$2,921,000
RECOMMENDED DESIGN	$2,613,000	$0	$2,613,000
ESTIMATED SAVINGS OR (COST)	$308,000	$0	$308,000

VALUE ENGINEERING RECOMMENDATION # VE-1

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-1

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Roadway Excavation	LS	$2,809,363	1	1	$2,809,363	0.93	$2,612,708
Right-of-way	ac	$15,000	1	4.24	$63,600		
RCBC Reduction	LS	$48,000	1	1	$48,000		
Total					$2,920,963		$2,612,708

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-2

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 11 ft traffic lanes and 8 ft paved outside shoulders in lieu of 12 ft traffic lanes and 10 ft paved outside shoulders.

ORIGINAL DESIGN:
The original design specifies 12 ft travel lanes and 10 ft paved outside shoulders.

RECOMMENDED CHANGE:
The VE Team recommends utilizing an 11 ft traffic lane versus a 12 ft traffic lane as studies have shown that there is not an appreciable change in operation or safety by reducing the lane width from 12 ft to 11 ft. Similarly, the VE Team recommends utilizing an 8 ft paved outside shoulder width versus a 10 ft paved outside shoulder as it complies with the ASSHTO and KYTC Highway Design Manual.

ADVANTAGES:
- Reduces asphalt material
- Reduces Dense Graded Aggregate (DGA) materials
- Small reduction in culvert lengths.

DISADVANTAGES:
- Required design plan changes

JUSTIFICATION:
The change to the reduced width of 11 ft travel lanes and 8 ft paved shoulders meet AASHTO standards and will function essentially the same from an operation standpoint given the proposed paved shoulders. FHWA recognizes this point as can be seen in the graphs on the next page.

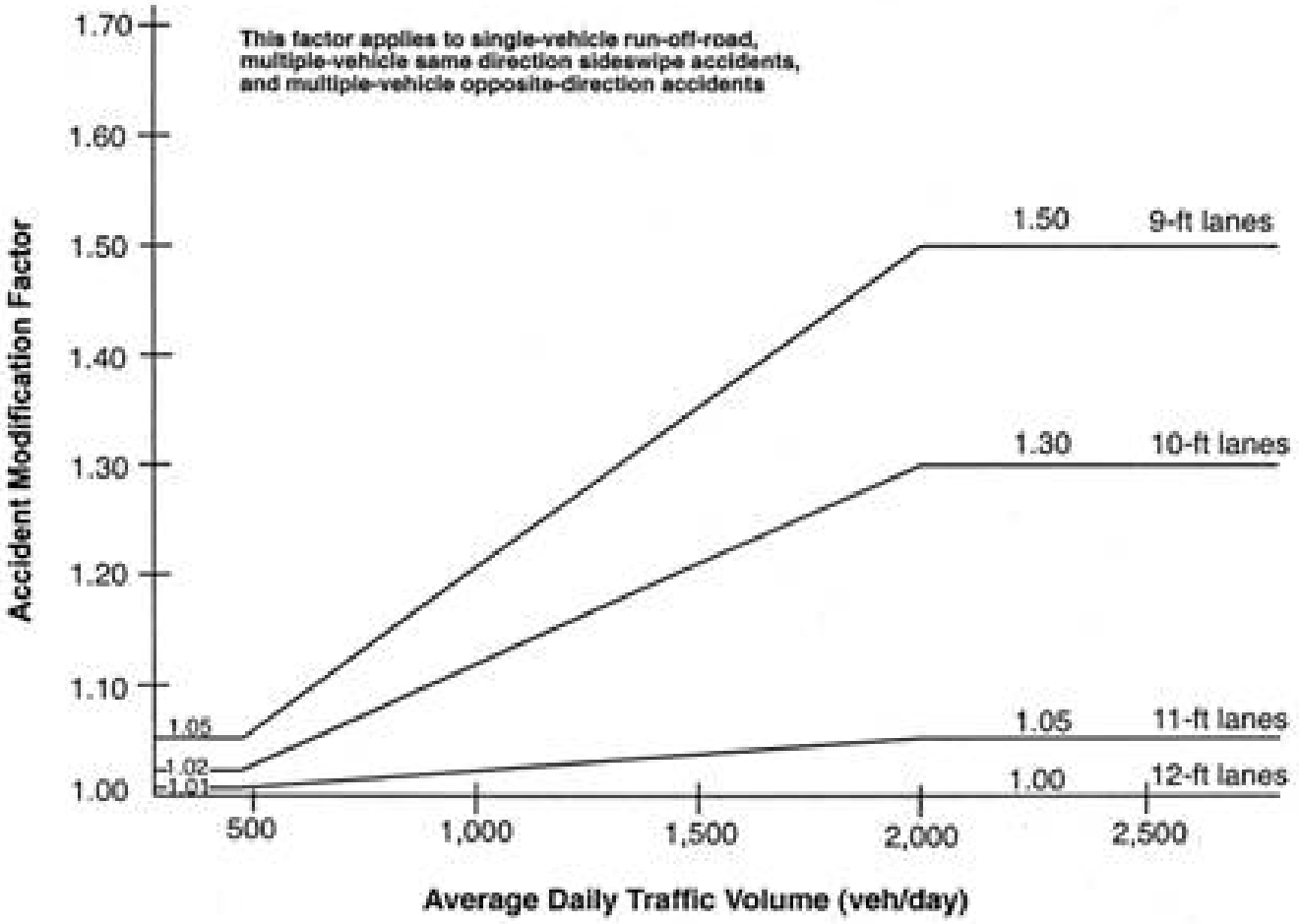
ASSUMPTIONS:
- $57/SY OR $6.33/SF of pavement per the provided cost estimate
- Project length is 4 miles or 21,120 ft
- Reduction of pavement for traffic lane is: 1 ft/lane X 4 lanes = 4 ft X 21,120 ft = 84,480 SF. The resulting cost reduction would be: 84,480 SF X 6.33/SF = $534,758; say $535,000.
- Reduction of pavement for shoulder is: 2 ft/shoulder X 2 outside shoulder = 4 ft X 21,120 ft = 84,480 SF. The resulting cost reduction would be: 84,480 SF X 6.33/SF = $534,758; say $535,000.
- Total cost savings is $1,070,000

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,070,000	$0	$1,070,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$1,070,000	$0	$1,070,000

VALUE ENGINEERING RECOMMENDATION # VE-2

ADDITIONAL INFORMATION

The figure below shows accident modification factors for variations in lane width on rural two-lane highways. Note that there is little difference between 11 and 12 ft lanes.



Accident Modification Factors for Lane Width on Rural Two-Lane Highways.

(Source: Prediction of the Expected Safety Performance of Rural Two-Lane Highways, FHWA)

VALUE ENGINEERING RECOMMENDATION # VE-2

ADDITIONAL INFORMATION

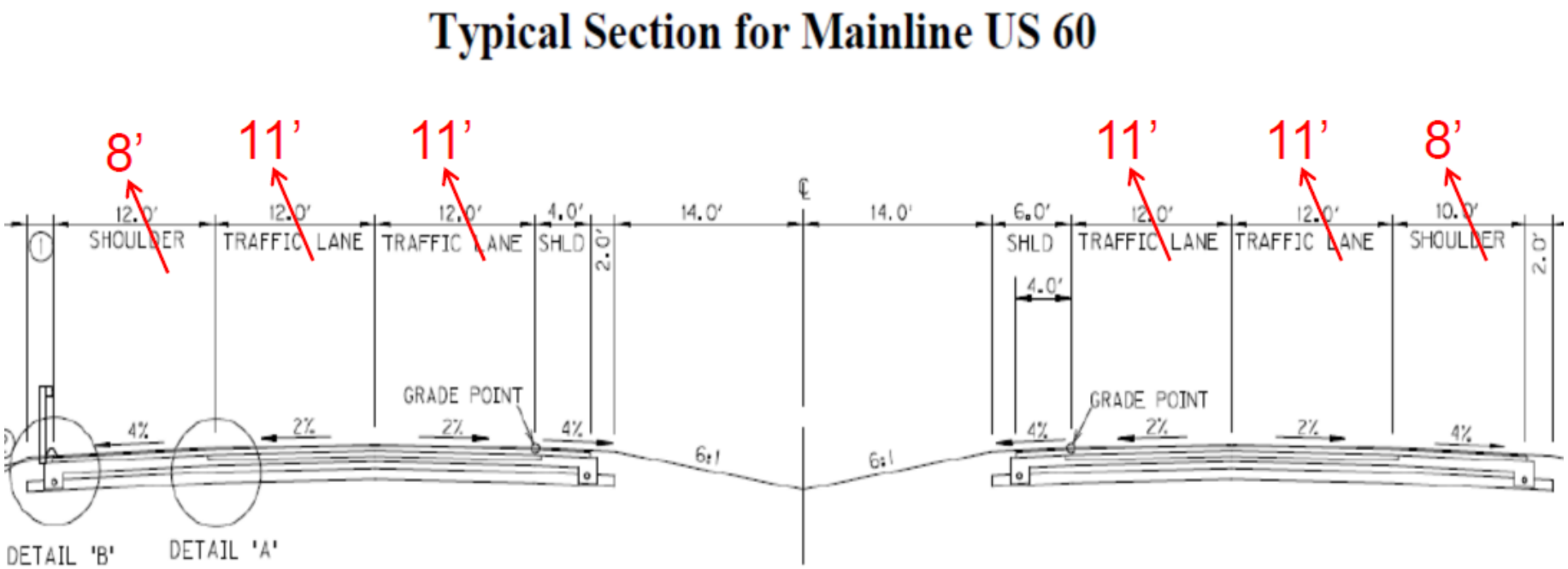
Ranges for Minimum Shoulder Width

Type of Roadway	Rural		Urban	
	US (feet)	Metric (meters)	US (feet)	Metric (meters)
Freeway	4–12	1.2–3.6	4–12	1.2–3.6
Ramps (1–lane)	1–10	0.3–3.0	1–10	0.3–3.0
Arterial	2–8	0.6–2.4	2–8	0.6–2.4
Collector	2–8	0.6–2.4	2–8	0.6–2.4
Local	2–8	0.6–2.4	–	–

Source: A Policy on Geometric Design of Highways and Streets, AASHTO

VALUE ENGINEERING RECOMMENDATION # VE-2

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-2

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Traffic lane pavement	SF	$6.33	1	84,480	$534,758		
Shoulder pavement	SF	$6.33	1	84,480	$534,758		
Total					$1,069,517		$0

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1, 2

VALUE ENGINEERING RECOMMENDATION # VE-3

DESCRIPTIVE TITLE OF RECOMMENDATION:
Reduce shoulder asphalt section in lieu of full depth shoulders.

ORIGINAL DESIGN:
The original design specifies asphalt shoulders that have the same depth as the asphalt mainline. This design is reflected in the subsequent graphics. The total asphalt depth of 9.25 inches is comprised of 1.25 inches asphalt surface with Cl 2 PG 64-22 in the shoulders and Cl 3 PG76-22 in the mainline, 4 inches of asphalt base with Cl 2 PG64-22 in the shoulders and Cl 3 PG76-22 in the mainline, and 4 inches of asphalt base with Cl 2 or Cl 3 PG64-22 in the shoulders and mainline.

RECOMMENDED CHANGE:
The VE Team recommends replacing the lower 4 inches of asphalt base in the shoulders with Drainage Blanket (Type II). The graphic above provides a detail for this change and the graphic below provides an example of the depth transition between shoulder and mainline.

ADVANTAGES:
- Reduces asphalt tonnage

DISADVANTAGES:
- Constructability is more difficult

JUSTIFICATION:
The asphalt depth is determined by a pavement design for the mainline. The mainline pavement design is dictated by traffic loading that applies to the mainline only. The shoulders will see a small fraction of the mainline traffic loading. Therefore the pavement design and asphalt depth for the shoulders should more closely match with what is actually required. The lower asphalt base is replaced with drainage blanket instead of DGA so that the function of the drainage blanket is not compromised.

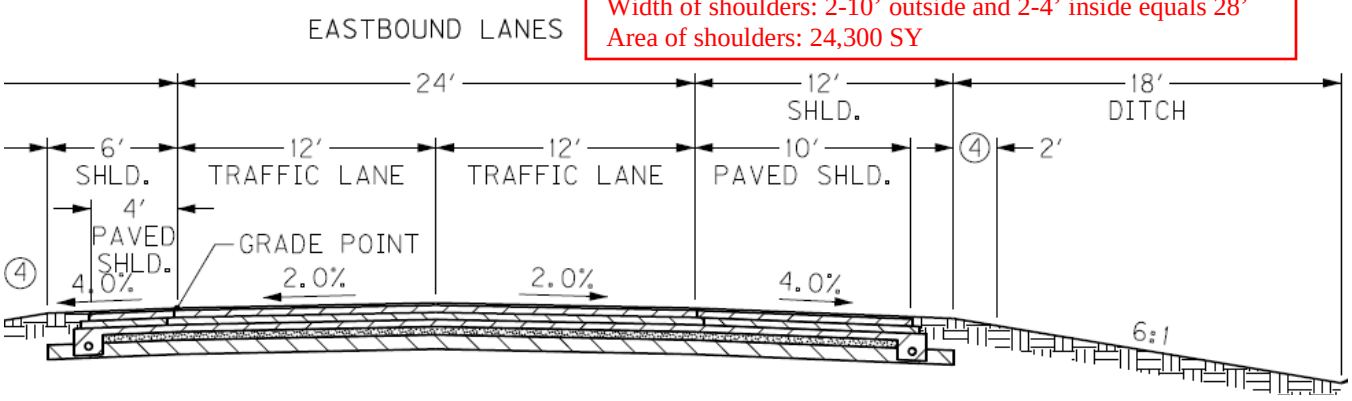
SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$725,000	$0	$725,000
RECOMMENDED DESIGN	$374,000	$0	$374,000
ESTIMATED SAVINGS OR (COST)	$351,000	$0	$351,000

VALUE ENGINEERING RECOMMENDATION # VE-3

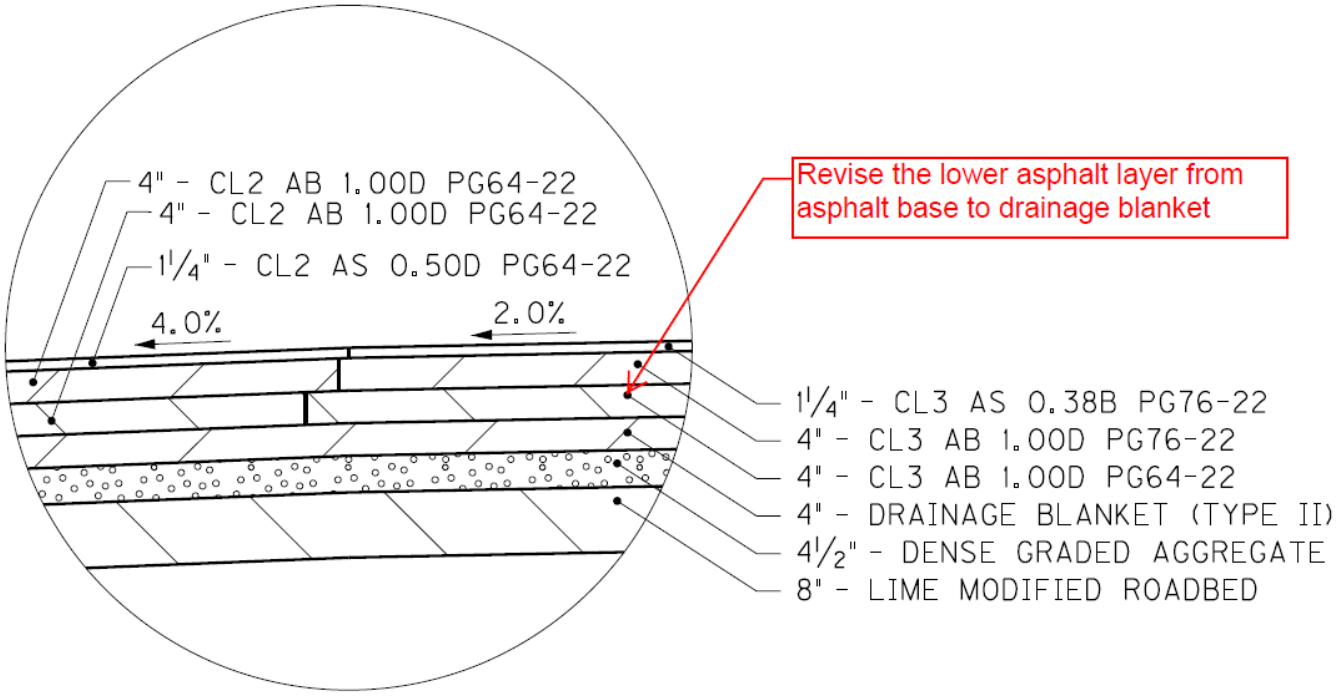
SKETCH OF ORIGINAL DESIGN

Item No. 1-115.00
Length of road: Sta 112+00 to Sta 228+00 equals 11,600 LF
Width of shoulders: 2-10' outside and 2-4' inside equals 28'
Area of shoulders: 36,100 SY

Item No.: 1-115.10
Length of road: Sta 423+00 to Sta 501+00 equals 7,800 LF
Width of shoulders: 2-10' outside and 2-4' inside equals 28'
Area of shoulders: 24,300 SY



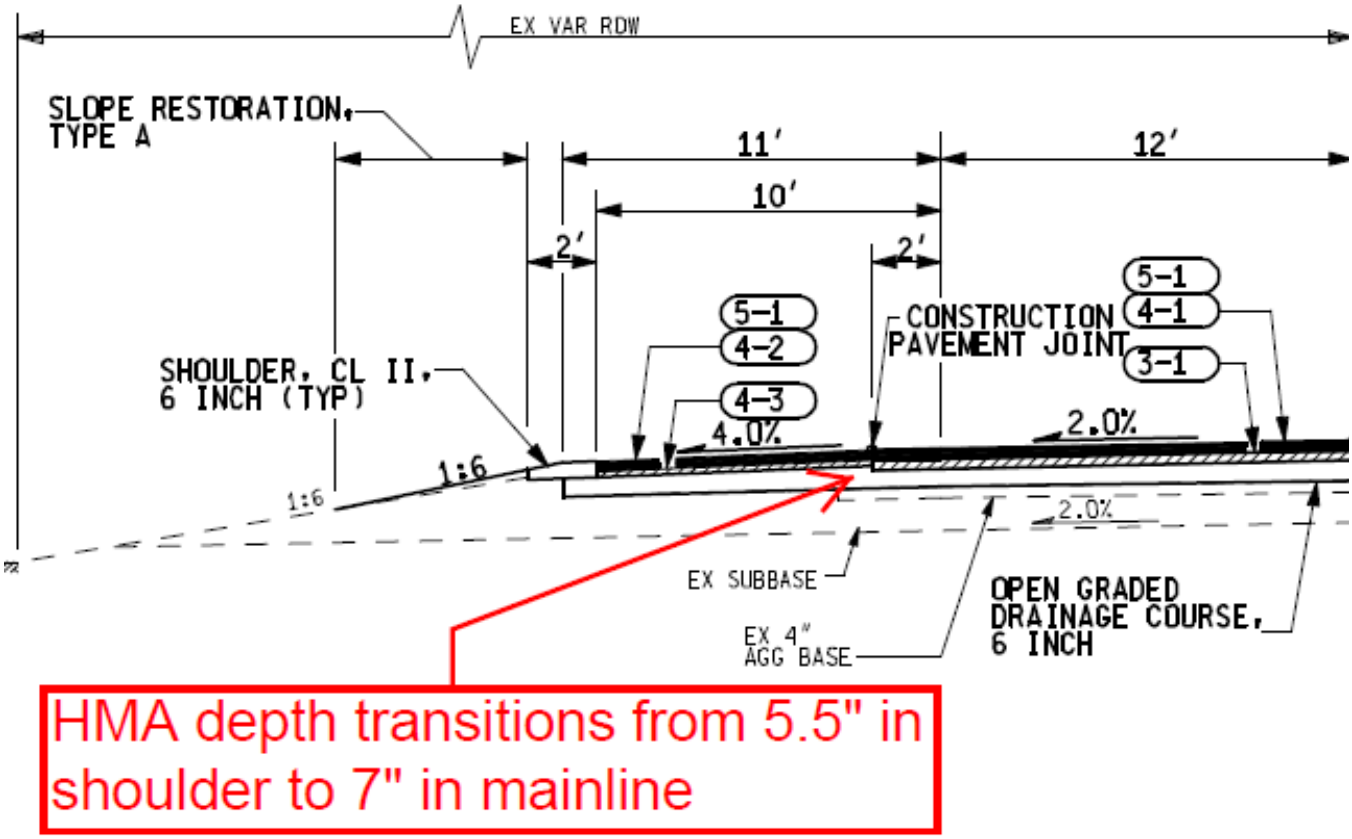
US60 Typical Section (EB Section Shown)



US60 Pavement Design

VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF EXAMPLE DESIGN



Example of Hot Mix Asphalt (HMA) Depth Transition Between Shoulder and Mainline

VALUE ENGINEERING RECOMMENDATION # VE-3

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Item No. 1-115.00							
Cl 2 AB 1.00D PG64-22	SY	$12.00	2,7	36,100	$433,200		
Drainage Blanket (Type II)	SY	$6.20	2,7			36,100	$223,820
Item No. 1-115.10							
Cl 2 AB 1.00D PG64-22	SY	$12.00	2,7	24,300	$291,600		
Drainage Blanket (Type II)	SY	$6.20	2,7			24,300	$150,660
Note: Asphalt base price per square yard is derived from using KY average unit price (AUP) $54 per ton at a 4-inch depth application using 110 pounds per square yard per inch of depth.							
Note: Drainage blanket price per square yard is derived from using KY AUP $36 per ton at a 4-inch depth application using 115 pounds per cubic foot.							
Total					$724,800		$374,480

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1, 2

VALUE ENGINEERING RECOMMENDATION # VE-4

DESCRIPTIVE TITLE OF RECOMMENDATION:
Where intersecting roads are to be reconstructed, reduce the asphalt section from 9.25 inches to 5.75 inches where applicable.

ORIGINAL DESIGN:
The original design specifies asphalt approaches that have the same depth as the asphalt mainline. This design is reflected in the subsequent graphics. The total asphalt depth of 9.25 inches is comprised of 1.25 inches asphalt surface with Cl 2 PG 64-22 in the shoulders and Cl 3 PG76-22 in the approach lanes, 4 inches of asphalt base with Cl 2 PG64-22 in the shoulders and Cl 3 PG76-22 in the approach lanes, and 4 inches of asphalt base with Cl 2 or Cl 3 PG64-22 in the shoulders and approach lanes.

The asphalt approaches where this situation exists are as follows:
Item No. 1-115.00

Existing Route 60 Connector – 1,000 LF times 28 ft total width equals 3,100 SY
KY 473 – 1,100 LF times 22 ft total width equals 2,700 SY
Industrial Blvd – 700 LF times 28 ft total width equals 2,200 SY

Item No. 1-115.10

KY 2532 – 2,000 LF times 28 ft total width equals 6,200 SY

RECOMMENDED CHANGE:
The VE Team recommends an asphalt approach design that is appropriate for the low traffic volumes on the approach roads and drives. The asphalt approach design that is recommended is shown below. This asphalt approach design is taken from the Item No. 1-115.10 plans and already applies to a number of the approaches on that project.

ADVANTAGES:
- Reduces asphalt tonnage
- Pavement design is appropriate for traffic volumes

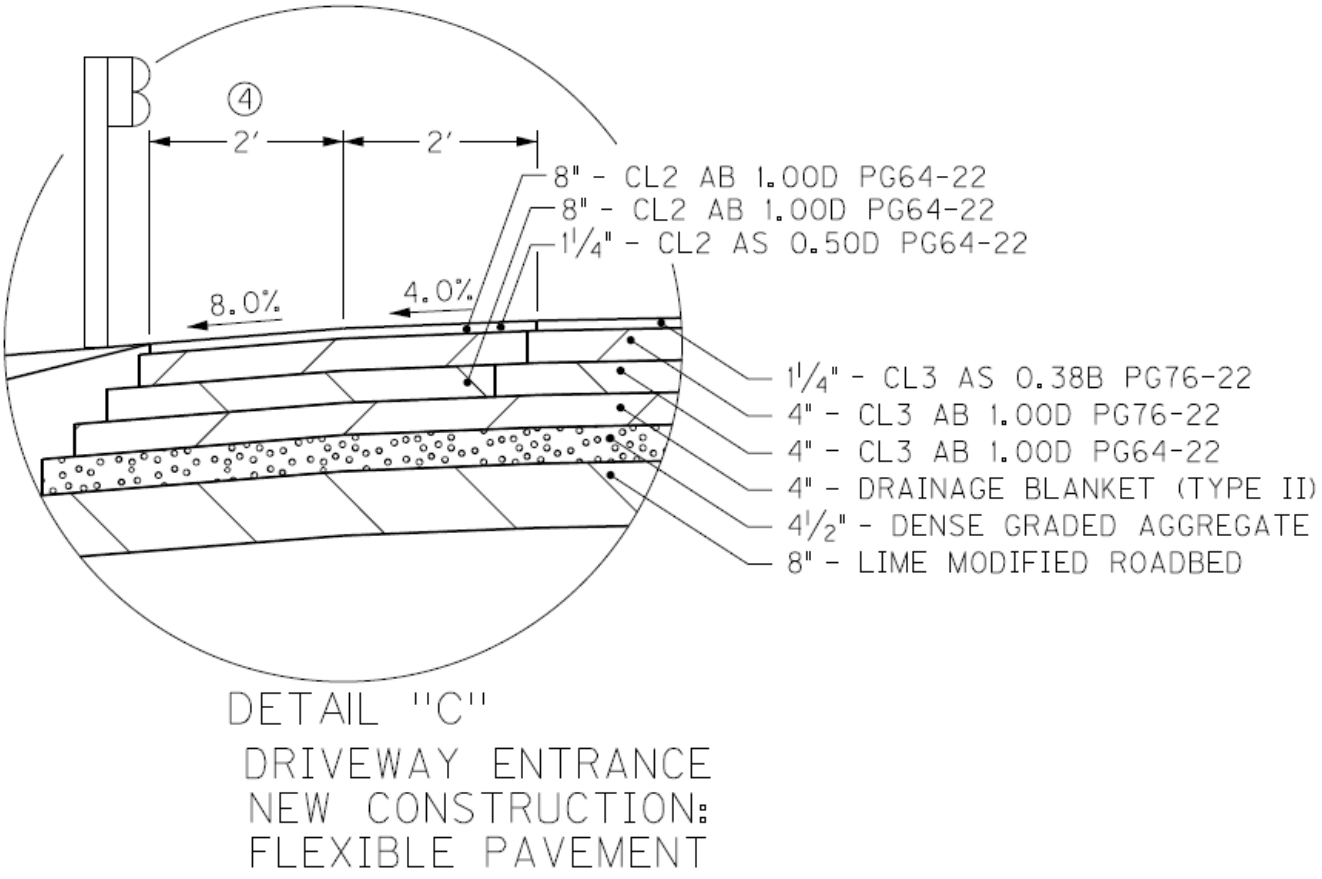
DISADVANTAGES:
- None

JUSTIFICATION:
The asphalt depth is determined by a pavement design for the US60 mainline. The mainline pavement design is dictated by traffic loading that applies to the mainline only. The approaches will see a small fraction of the mainline traffic loading. Therefore the pavement design and asphalt depth for the approaches should more closely match with what is actually required.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$288,000	$0	$288,000
RECOMMENDED DESIGN	$105,000	$0	$105,000
ESTIMATED SAVINGS OR (COST)	$183,000	$0	$183,000

VALUE ENGINEERING RECOMMENDATION # VE-4

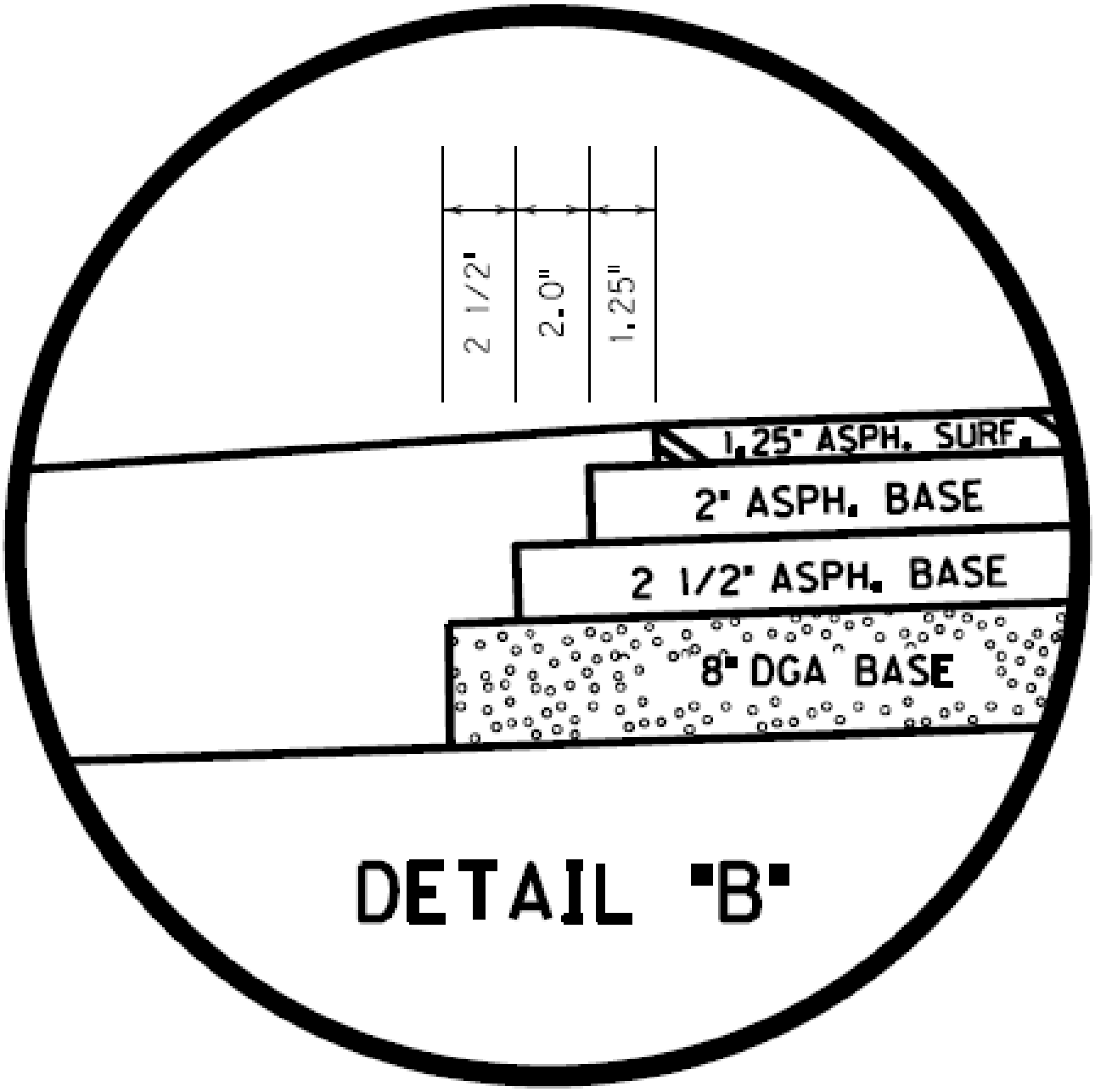
SKETCH OF ORIGINAL DESIGN



Item No. 1-115.00 Typical Section Applied to Asphalt Approaches

VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF RECOMMENDED DESIGN



Recommended Pavement Design for Approaches from Item No. 1-115.10

VALUE ENGINEERING RECOMMENDATION # VE-4

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Item No. 1-115.00							
Cl 2 AB 1.00D PG64-22	SY	$10.40	2,7	8,000	$83,200		
Drainage Blanket (Type II)	SY	$6.20	2,7	8,000	$49,600		
DGA Base - 4 inches	SY	$3.70	2,7	8,000	$29,600		
DGA Base - 8 inches	SY	$7.40	2,7			8,000	$59,200
Item No. 1-115.10							
Cl 2 AB 1.00D PG64-22	SY	$10.40	2,7	6,200	$64,480		
Drainage Blanket (Type II)	SY	$6.20	2,7	6,200	$38,440		
DGA Base - 4 inches	SY	$3.70	2,7	6,200	$22,940		
DGA Base - 8 inches	SY	$7.40	2,7			6,200	$45,880
Note: Asphalt base price per square yard is derived from using KY AUP $54 per ton at a 3.5 inches (4.5 inches of base retained and 3.5 inches eliminated) depth application using 110 pounds per square yard per inch of depth.							
Note: Drainage blanket price per square yard is derived from using KY AUP $36 per ton at a 4 inches depth application using 115 pounds per cubic foot.							
Note: DGA base price per square yard is derived from using KY AUP $19 per ton at a 4 inches or 8 inches depth application using 130 pounds per cubic foot.							
Total					$288,260		$105,080

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1, 2

VALUE ENGINEERING RECOMMENDATION # VE-5

DESCRIPTIVE TITLE OF RECOMMENDATION:
Adjust the profile grade to improve the balance of earthwork.

ORIGINAL DESIGN:
For Item Nos. 1-115.00 and 1-115.10, the original design specifies unbalanced earthwork quantities. The following summarizes the original design quantities.

Item No. 1-115.00
274,789 cubic yard of common excavation
220,429 cubic yard of total embankment
54,360 cubic yard of excavation removal required

Item No. 1-115.10
117,825 cubic yard of common excavation
70,915 cubic yard of total embankment
46,910 cubic yard of excavation removal required

RECOMMENDED CHANGE:
The VE Team recommends balancing the earthwork on this project. Minor changes to the road profiles have the potential to balance the earthwork. Because excavation removal is required on both projects, in our opinion the remedy for balancing the earthwork is to raise the profile in flatter areas where the road is being cut into the existing ground. The VE Team estimates that the balancing common excavation quantities for Item No. 1-115.00 is 250,000 CY and for Item No. 1-115.10 is 100,000 CY.

ADVANTAGES:
- Reduce excavation removal
- Reduce truck movements off-site

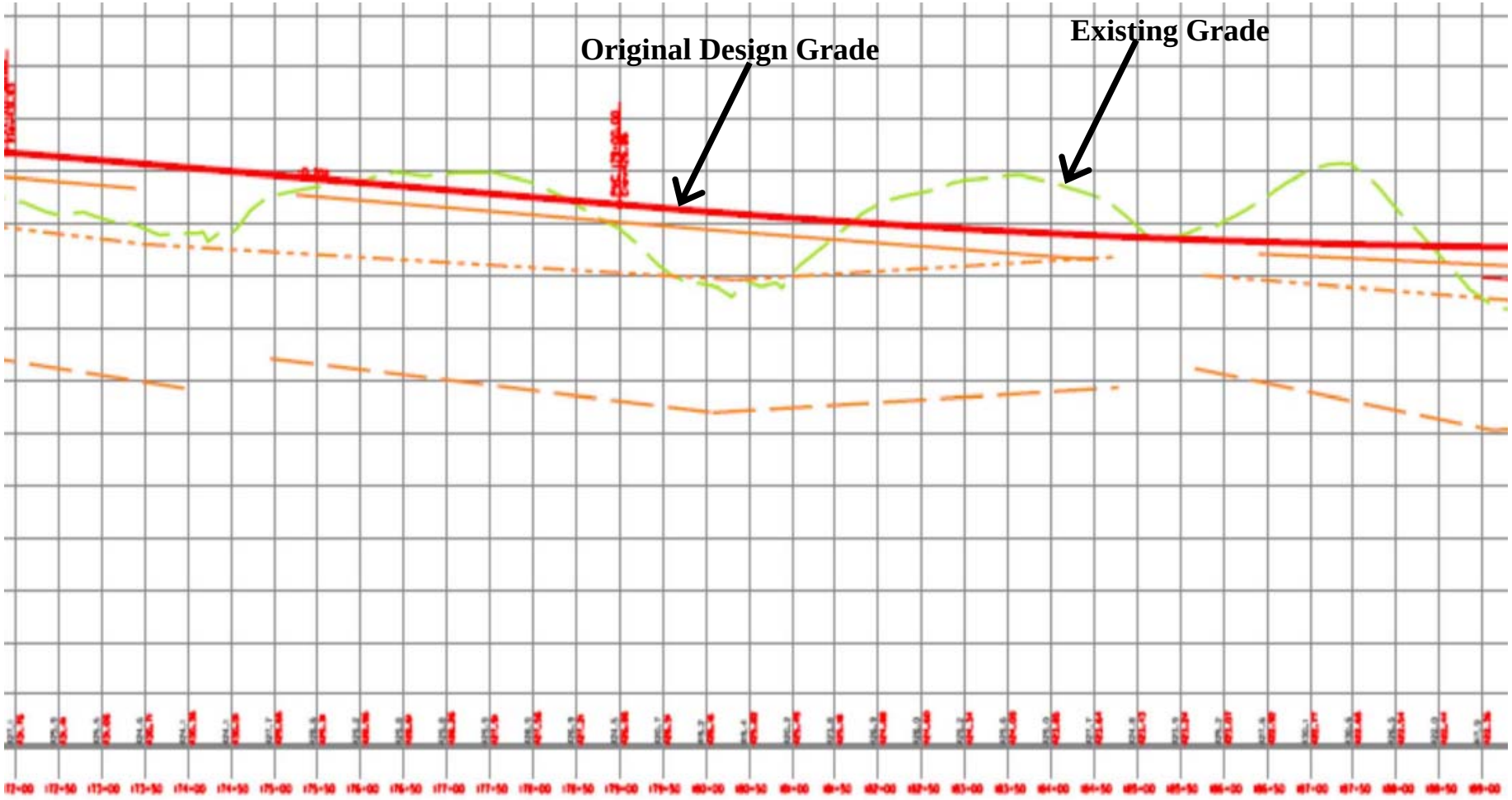
DISADVANTAGES:
- All material on-site must be acceptable for embankment if project is balanced

JUSTIFICATION:
The balancing of earthwork is desirable on most projects. This project has the potential for earthwork balancing by applying slight modifications to the road profile and therefore earthwork balancing should be a goal. The roadway excavation item will have a reduced unit price if excavation removal is reduced.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,809,000	$0	$2,809,000
RECOMMENDED DESIGN	$1,778,000	$0	$1,778,000
ESTIMATED SAVINGS OR (COST)	$1,031,000	$0	$1,031,000

VALUE ENGINEERING RECOMMENDATION # VE-5

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-5

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Item No. 1-115.00							
Roadway excavation	CY	$8.50	1	274,789	$2,335,707		
Roadway excavation	CY	$5.08	2			250,000	$1,270,000
Item No. 1-115.10							
Roadway excavation	CY	$4.02	1	117,825	$473,657		
Roadway excavation	CY	$5.08	2			100,000	$508,000
Total					$2,809,363		$1,778,000

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-6

DESCRIPTIVE TITLE OF RECOMMENDATION:
Adjust profile grades to reduce the fill at culvert crossings which will eliminate the need for guardrail.

ORIGINAL DESIGN:
Item No. 1-115.00
The current design includes a maximum profile grade of 2.11%. The current design includes significant embankment depth at the following locations:
Station 120+00 to 126+00 – 15 ft of embankment
Station 138+00 to 145+00 – 20 ft of embankment

Item No. 1-115.10
The current design includes a maximum profile grade of 1.59%. The current design includes significant embankment depth at the following location:
Station 467+00 to 477+00 – 10 ft of embankment

RECOMMENDED CHANGE:
The VE Team recommends using maximum allowable grade and minimum allowable sight distance to reduce the embankment depth at the locations listed above. The maximum allowable grade of 2.65% is identified in the Item No. 1-115.00 Design Executive Summary shown in the figure below. The minimum allowable sight distance of 570 ft (K=151) is shown in Exhibit 3-76 of the AASHTO-Geometric Design of Highways and Streets that is subsequently included.

The embankment depths were reduced by using the maximum grade of 2.65% and the minimum allowable sight distance of 570 ft. An example road profile revision is shown in the attached drawing, vertical curve tables, and road elevation comparison table. These vertical curve and road elevation revisions were roughly applied to Item No. 1-115.00 Stations 117+00 to 150+00. Another option within these stations that was not explored is to lower the elevation of the hill between the two low areas (and therefore the point of intersection of Sullivan Lane) in order to eliminate the down/up/down profile that is part of the attached example.

In order to achieve earthwork balance on these projects, profile adjustment is required elsewhere to reduce excavation and increase embankment in order to offset the embankment reduction at these locations.

VALUE ENGINEERING RECOMMENDATION # VE-6

DISCUSSION CONTINUED

ADVANTAGES:

- Allows for elimination of 2:1 slopes
- Allows for the application of 6:1 / 4:1 barn roof section
- May eliminates need for guardrail
- Reduces need for guardrail
- Eliminates long term maintenance requirements of guardrail and 2:1 slopes
- Reduces embankment

DISADVANTAGES:

- If guardrail is eliminated, culvert ends may need to be lengthened to a point outside of clear zone

JUSTIFICATION:

Typical road design practice aims to provide a safe and cost effective road by balancing items such as profile, earthwork, drainage, and clear zones for slopes and stationary objects. AASHTO establishes minimum criteria for safe road operations for some of these items. On this project, the Design Team has opted to apply more stringent criteria than AASHTO will allow. This is the case with maximum allowable grade and stopping sight distance criteria. The VE Team agrees that this relatively flat project site does not justify the AASHTO maximum allowable grade of 4% and agree that the 2.65% chosen by the Design Team is reasonable. However, the stopping sight distance increase from 570 ft to 914.22 ft may not be reasonable. In addition, the VE Team notes that the current design does not even apply the maximum allowable grade and remains substantially beneath 2.65% in most cases.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,231,000	$0	$2,231,000
RECOMMENDED DESIGN	$1,593,000	$0	$1,593,000
ESTIMATED SAVINGS OR (COST)	$638,000	$0	$638,000

VALUE ENGINEERING RECOMMENDATION # VE-6

ADDITIONAL INFORMATION

DESIGN CRITERIA	EXISTING	TYPICAL	PROJECT TEAM RECOMMENDATION
Number of Lanes	2	2	4
Pavement Width	11' Lanes	12' Lanes	12' Lanes
Shoulder Width, Slope	1' @ 4%	8' @ 4% Paved	12' @ 4% Paved
Bridge Width	N/A	N/A	N/A
Minimum Radius (e_{max} = 4%)	950'	1505'	7500'
Maximum Grade	5.28%	4%	2.65%
Minimum Sight Distance	360'	570'	914.22'
Border Area (urban)	N/A	N/A	N/A

Excerpt from Item No. 1-115.00 Design Executive Summary Submitted July 3, 2007

AASHTO—Geometric Design of Highways and Streets

Metric				US Customary			
Design speed (km/h)	Stopping sight distance (m)	Rate of vertical curvature, K[a]		Design speed (mph)	Stopping sight distance (ft)	Rate of vertical curvature, K[a]	
		Calculated	Design			Calculated	Design
20	20	0.6	1	15	80	3.0	3
30	35	1.9	2	20	115	6.1	7
40	50	3.8	4	25	155	11.1	12
50	65	6.4	7	30	200	18.5	19
60	85	11.0	11	35	250	29.0	29
70	105	16.8	17	40	305	43.1	44
80	130	25.7	26	45	360	60.1	61
90	160	38.9	39	50	425	83.7	84
100	185	52.0	52	55	495	113.5	114
110	220	73.6	74	60	570	150.6	151
120	250	95.0	95	65	645	192.8	193
130	285	123.4	124	70	730	246.9	247
				75	820	311.6	312
				80	910	383.7	384

[a] Rate of vertical curvature, K, is the length of curve per percent algebraic difference in intersecting grades (A). K = L/A

Exhibit 3-76. Design Controls for Stopping Sight Distance and for Crest and Sag Vertical Curves

VALUE ENGINEERING RECOMMENDATION # VE-6

ADDITIONAL INFORMATION

URS Corporation

Project No	15009086
Project Title	US60 in Ballard County Item Number 115.00
Date	16-Nov-11
Engineer	msg
Contract ID	Item Number 115.00
Job Number	NA
Title	Proposed vertical curves between Stations 117 and 150 - Rec 10

	station	elevation
pc =	11950.00	411.60
pi =	12350.00	401.00
pt =	12750.00	411.60

curve length = 8.00 stations
beginning grade % -2.650
ending grade % 2.650

r = 0.6625
x = 4.0000
K = 151

	station	curve elevation	tangent elevation
pc	11950.00	411.60	411.60
	11900.00	413.01	412.93
	12000.00	410.36	410.28
	12100.00	408.37	407.63
	12200.00	407.05	404.98
	12300.00	406.38	402.33
pi	12350.00	406.30	401.00
	12400.00	406.38	402.33
	12500.00	407.05	404.98
	12600.00	408.37	407.63
	12700.00	410.36	410.28
pt	12750.00	411.60	411.60

	station	elevation
pc =	12750.00	410.40
pi =	13150.00	421.00
pt =	13550.00	410.40

curve length = 8.00 stations
beginning grade % 2.650
ending grade % -2.650

r = -0.6625
x = 4.0000
K = -151

	station	curve elevation	tangent elevation
pc	12750.00	410.40	410.40
	12800.00	413.01	411.73
	12900.00	416.32	414.38
	13000.00	420.30	417.03
	13100.00	424.93	419.68
pi	13150.00	427.50	421.00
	13200.00	430.23	419.68
	13300.00	436.20	417.03
	13400.00	442.82	414.38
	13500.00	450.11	411.73
pt	13550.00	454.00	410.40

	station	elevation
pc =	13850.00	403.10
pi =	14250.00	392.50
pt =	14650.00	403.10

curve length = 8.00 stations
beginning grade % -2.650
ending grade % 2.650

r = 0.6625
x = 4.0000
K = 151

	station	curve elevation	tangent elevation
pc	13850.00	403.10	403.10
	13900.00	485.88	401.78
	14000.00	496.48	399.13
	14100.00	507.75	396.48
	14200.00	519.67	393.83
pi	14250.00	525.88	392.50
	14300.00	532.26	393.83
	14400.00	545.51	396.48
	14500.00	559.42	399.13
	14600.00	574.00	401.78
pt	14650.00	581.53	403.10

Proposed Vertical Curves Between Stations 117+00 and 150+00

VALUE ENGINEERING RECOMMENDATION # VE-6

ADDITIONAL INFORMATION

URS Corporation

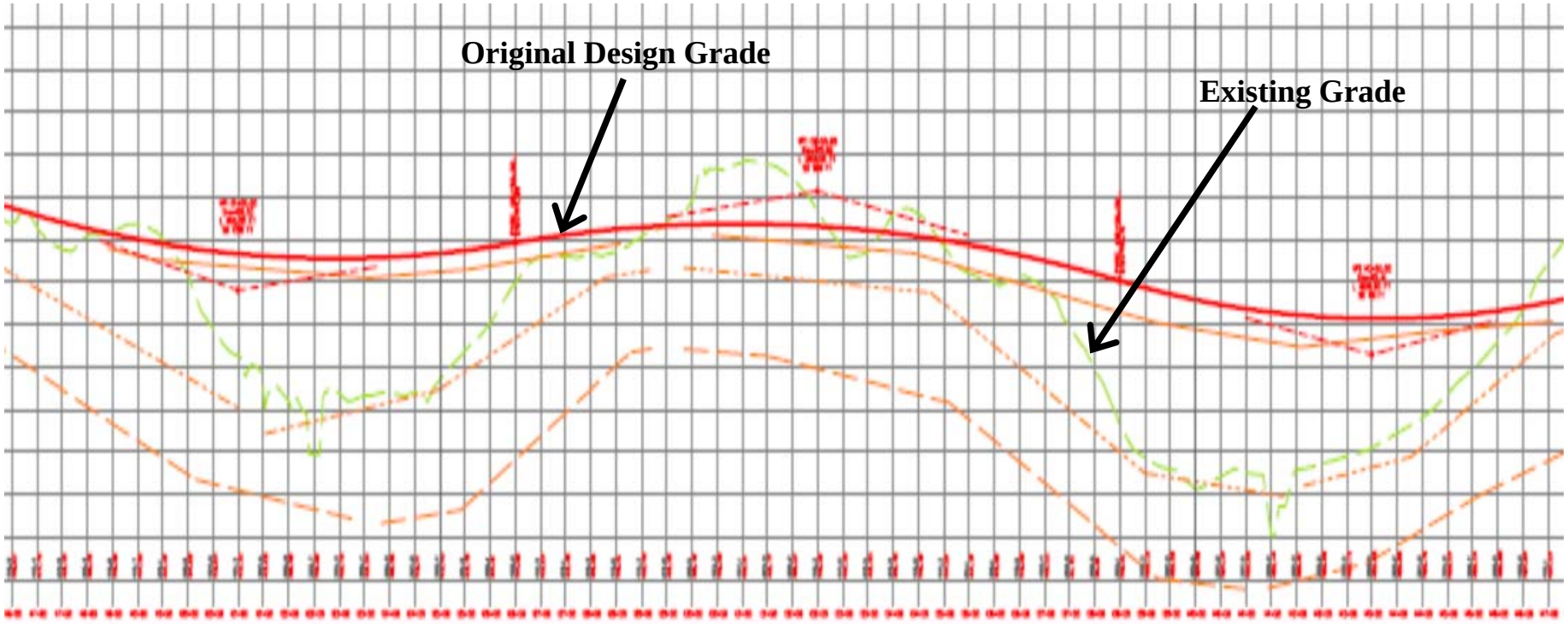
Project No	15009086
Project Title	US60 in Ballard County Item Number 115.00
Date	16-Nov-11
Engineer	msg
Contract ID	Item Number 115.00
Job Number	NA
Title	Existing versus Proposed Elevation Summary - Rec 10

Station	Existing Elev	Proposed Elev	Difference in Elev
11600	419.62		
11700	417.79	418.31	-0.52
11800	416.25	415.66	0.59
11900	414.99	413.01	1.98
12000	414.01	410.36	3.65
12100	413.32	408.37	4.95
12200	412.91	407.05	5.87
12300	412.79	406.38	6.40
12400	412.95	406.38	6.56
12500	413.39	407.05	6.34
12600	414.12	408.37	5.75
12700	415.08	410.36	4.72
12800	415.86	411.64	4.21
12900	416.41	413.63	2.78
13000	416.73	414.95	1.77
13100	416.82	415.62	1.20
13200	416.68	415.62	1.06
13300	416.30	414.95	1.35
13400	415.70	413.63	2.07
13500	414.87	411.64	3.23
13600	413.82	408.99	4.83
13700	412.53	406.34	6.19
13800	411.01	403.69	7.32
13900	409.33	401.86	7.47
14000	407.92	399.87	8.05
14100	406.85	398.55	8.30
14200	406.12	397.88	8.23
14300	405.73	397.88	7.84
14400	405.68	398.55	7.13
14500	405.97	399.87	6.10
14600	406.60	401.86	4.74
14700	407.57	404.51	3.06
14800	408.88	407.16	1.72
14900	410.49	409.81	0.68
15000	412.14	412.46	-0.32

Road Elevation Comparison Between Existing and Proposed

VALUE ENGINEERING RECOMMENDATION # VE-6

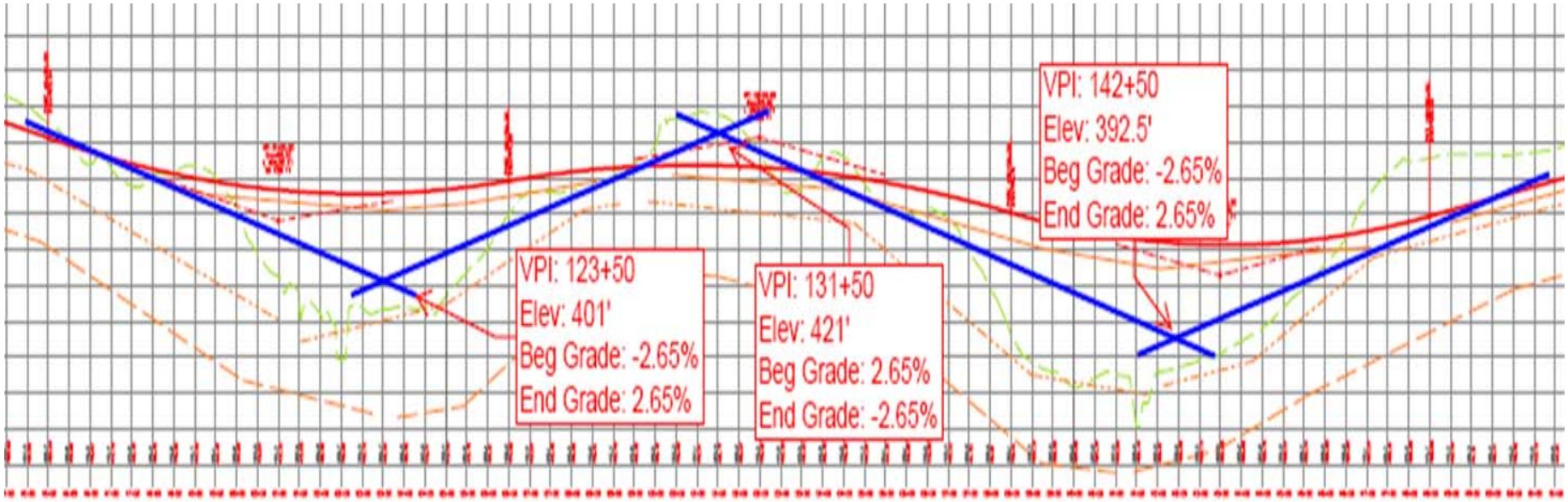
SKETCH OF ORIGINAL DESIGN



Sketch of Original Design Vertical Curves at Westerly End of Item No. 1-115.00

VALUE ENGINEERING RECOMMENDATION # VE-6

SKETCH OF RECOMMENDED DESIGN



Sketch of Recommended Approximated Tangents for Vertical Curves at Westerly End of Item No. 1-115.00

VALUE ENGINEERING RECOMMENDATION # VE-6

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Item No. 1-115.00							
Roadway Excavation	CY	$5.08	2	274,789	$1,395,928	200,000	$1,016,000
Guardrail-Steel W Beam-S Face	LF	$21.84	1	8,170	$178,433	6,520	$142,397
Guardrail Terminal Section No. 1	EA	$44.27	1	8	$354	4	$177
Guardrail End Treatment Type 4A	EA	$1,925	1	8	$15,403	4	$7,701
Item No. 1-115.10							
Roadway Excavation	CY	$5.08	2	117,825	$598,551	80,000	$406,400
Guardrail-Steel W Beam-S Face	LF	$14.30	1	2,312	$33,062	1,036	$14,815
Guardrail Terminal Section No 1	EA	$46.11	1	4	$184	3	$138
Guardrail End Treatment Type 1	EA	$2,462	1	2	$4,925	1	$2,462
Guardrail End Treatment Type 2A	EA	$606.77	1	5	$3,034	3	$1,820
Guardrail End Treatment Type 7	EA	$965.76	1	1	$966	1	$966
Note: Roadway excavation reduction is estimated and is based upon an assumption that reduced embankment will be coupled with roadway profile modifications that will cause reduced excavation and earthwork balancing.							
Total					$2,230,839		$1,592,877

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-7

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 90-degree culvert crossings and relocated streams to eliminate the skewed culvert crossings.

ORIGINAL DESIGN:
The following culverts are installed on a skew to the roadway in line with the original water course:
Existing US60 Station 17+00
US60 Station 122+50
US60 Station 189+00
US60 Station 204+00

RECOMMENDED CHANGE:
The VE Team recommends using 90-degree culvert crossings and relocated streams at the locations listed above as shown in the following sketches.

ADVANTAGES:
- Eliminates need for guardrail at 3 of the locations
- Simplifies culvert and wingwall construction
- Reduces long term maintenance

DISADVANTAGES:
- Stream relocation design and construction is required
- Stream relocation costs are required

JUSTIFICATION:
The VE Team was asked to review this change. The team believes that the following benefits can be derived from this change at each culvert as follows:

Existing US60 Station 17+00 – Revised box culvert location fits from ditch bottom to ditch bottom with 4:1 slopes. This allows for elimination of guardrail as long as the ends of the culvert are outside the clear zone.

US60 Station 122+50 – Revised box culvert location still requires 2:1 slopes and therefore guardrail. If the profile is lowered and the embankment is reduced, the potential exists to use the barn roof section at this location and eliminate guardrail as well.

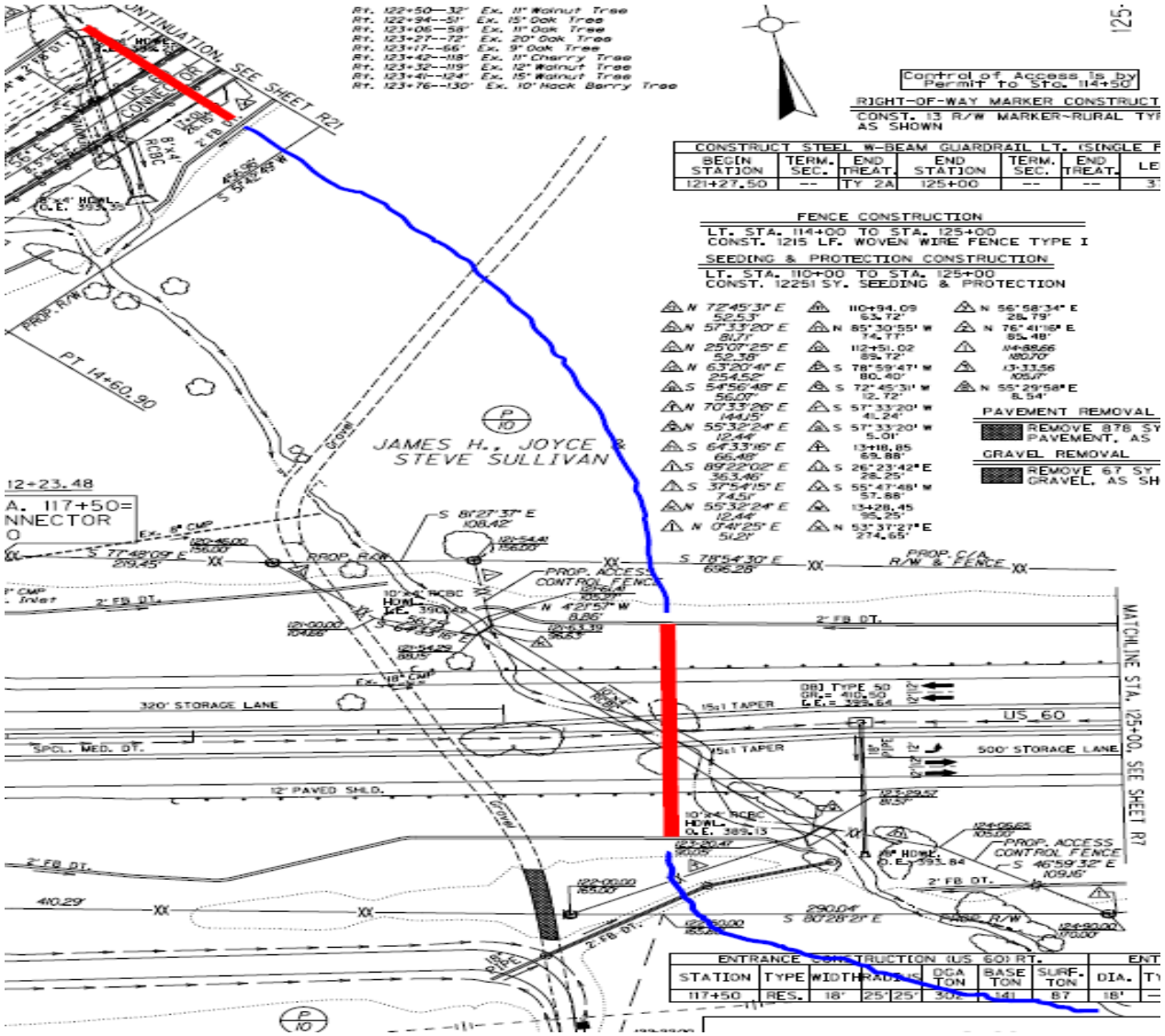
US60 Station 189+00 – The double barrel 36-inch culverts are straightened and travel to the bottom of the barn roof slopes, therefore allowing for the elimination of guardrail.

US60 Station 204+00 – The box culvert is straightened and travels to the bottom of the barn roof slopes, therefore allowing for the elimination of guardrail.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$329,000	$0	$329,000
RECOMMENDED DESIGN	$338,000	$0	$338,000
ESTIMATED SAVINGS OR (COST)	($9,000)	$0	($9,000)

VALUE ENGINEERING RECOMMENDATION # VE-7

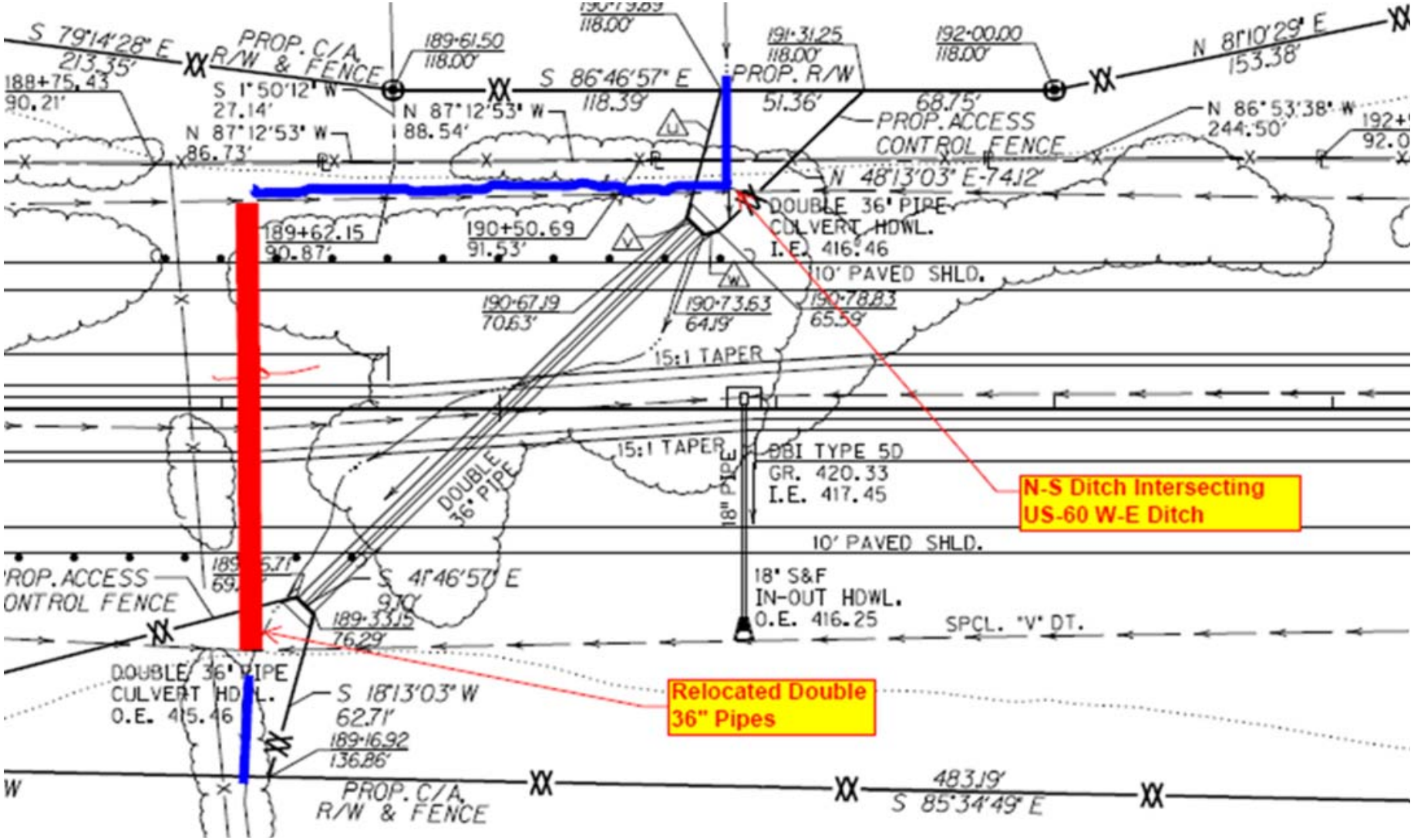
SKETCH OF RECOMMENDED DESIGN



Sketch of Existing US60 17+00 and US60 122+50 Culvert Modification and Stream Relocation at the West End of Item No. 1-115.00

VALUE ENGINEERING RECOMMENDATION # VE-7

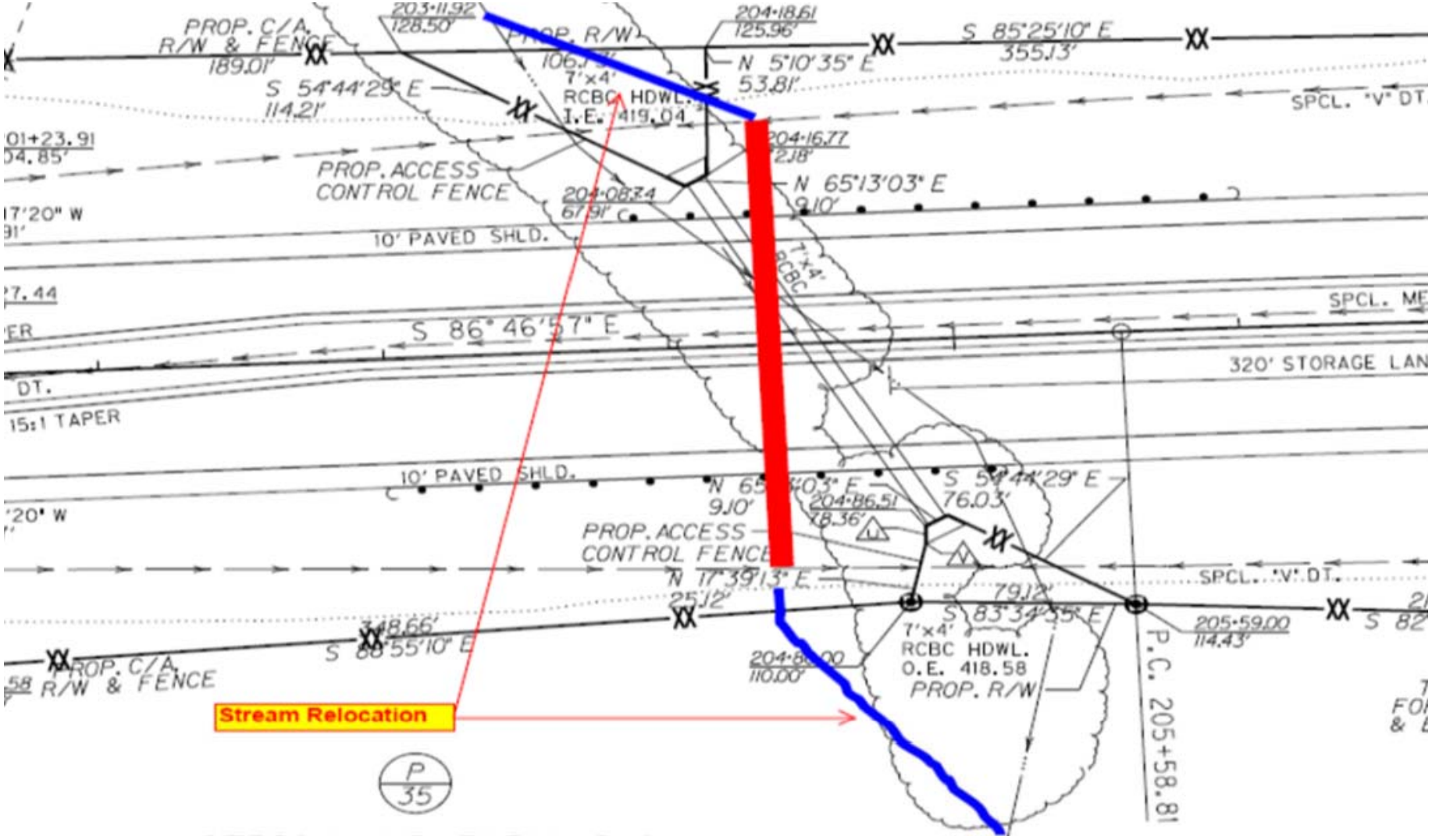
SKETCH OF RECOMMENDED DESIGN



Sketch of US60 189+00 Culvert Modification West of Industrial Boulevard

VALUE ENGINEERING RECOMMENDATION # VE-7

SKETCH OF RECOMMENDED DESIGN



Sketch of US60 204+00 Culvert Modification and Stream Relocation East of Industrial Boulevard

VALUE ENGINEERING RECOMMENDATION # VE-7

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Existing US60 17+00 and US60 122+50							
8 ft x 4 ft RCBC	LF	$400.00	1,7	150	$60,000	100	$40,000
10 ft x 4 ft RCBC	LF	$500.00	1,7	250	$125,000	170	$85,000
Stream Relocation	LF	$200.00	7			500	$100,000
Guardrail-Steel W Beam-S Face	LF	$21.84	1	1,056	$23,063		
Guardrail Terminal Section No 1	EA	$44.27	1	2	$89		
Guardrail End Treatment Type 4A	EA	$1,925.33	1	2	$3,851		
US60 189+00							
Culvert Pipe-36 Inch Equivalent	LF	$64.61	1	400	$25,844	310	$20,029
Guardrail-Steel W Beam-S Face	LF	$21.84	1	425	$9,282		
Guardrail Terminal Section No 1	EA	$44.27	1	2	$89		
Guardrail End Treatment Type 4A	EA	$1,925	1	2	$3,851		
US60 204+00							
7 ft x 4 ft RCBC	LF	$370.00	1,7	175	$64,750	175	$64,750
Stream Relocation	LF	$200.00	7			140	$28,000
Guardrail-Steel W Beam-S Face	LF	$21.84	1	425	$9,282		
Guardrail Terminal Section No 1	EA	$44.27	1	2	$89		
Guardrail End Treatment Type 4A	EA	$1,925	1	2	$3,851		
Total					$329,039		$337,779

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1, 2

VALUE ENGINEERING RECOMMENDATION # VE-8

DESCRIPTIVE TITLE OF RECOMMENDATION:
Combine the two culverts at Stations 470+68 and 474+24 in lieu of two separate culverts.

ORIGINAL DESIGN:
The original design specifies that an 8 ft x4 ft reinforced concrete box culvert (215 ft long plus headwalls) be constructed at Station 470+68 (Culvert 1) and a 48-inch pipe culvert (229 ft long plus headwalls) be constructed at Station 474+24 (Culvert 2), each aligned along the original flow line. The contributing area for each is on the southern side of US60 and the direction of flow is northward into the same proposed ditch that flows eastwardly. The purpose is to convey storm water northeastwardly to beyond the project limits.

RECOMMENDED CHANGE:
The VE Team recommends that the contributing area of Culvert 1 be conveyed in a ditch along the south side of proposed US60 to approximately Station 473+30 to meet the existing flowline of the second swale, then cross under proposed US60 in one culvert perpendicular to the proposed centerline. The new combined culvert would be larger, and is estimated to be ~9 ft x5 ft reinforced concrete box culvert (~180 ft long plus headwalls).

ADVANTAGES:
- Fewer culverts
- Shorter culvert length
- Shorter guardrail on north side
- Less future maintenance

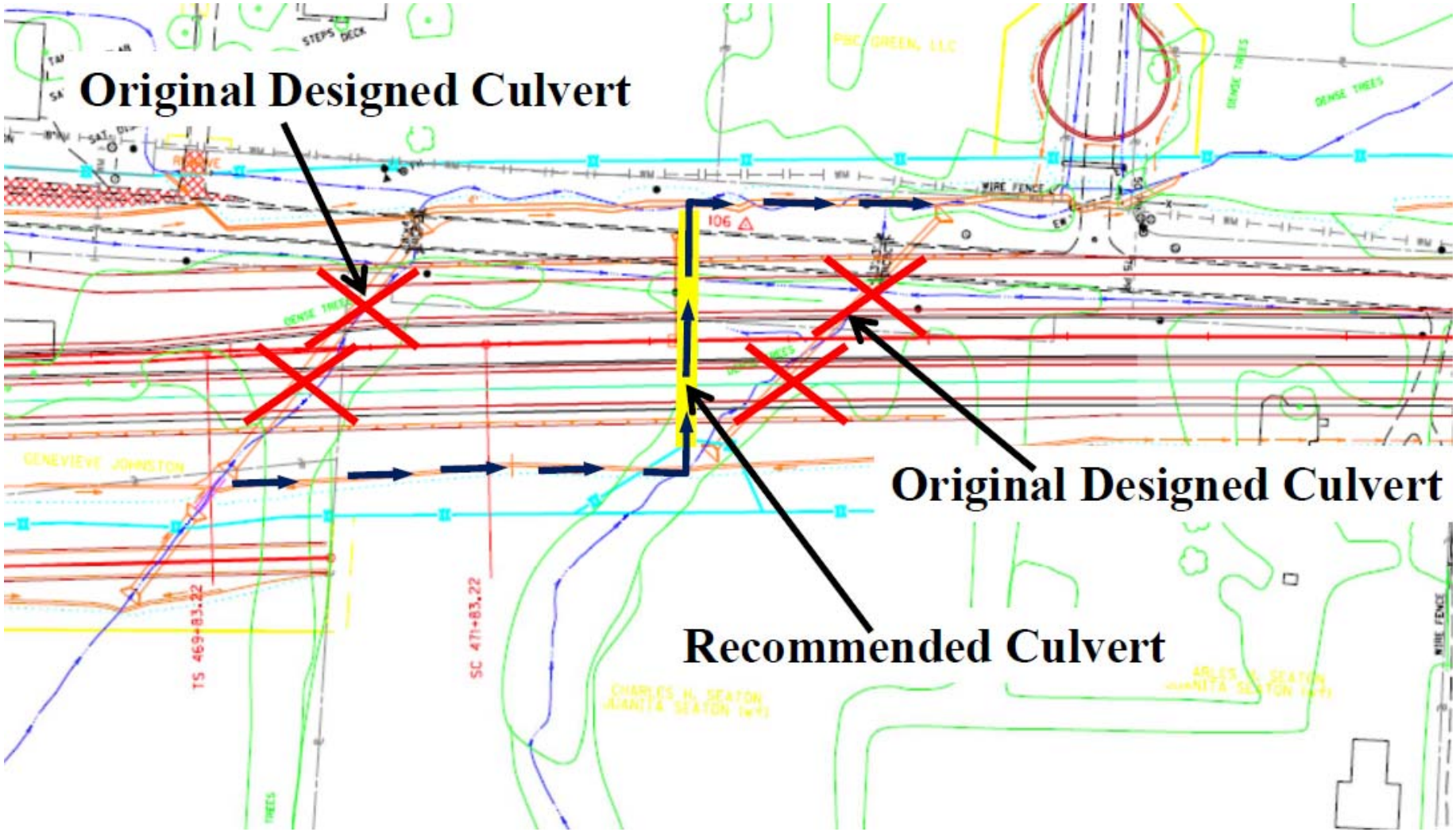
DISADVANTAGES:
- Greater depth of maximum flow
- More energy dissipation required

JUSTIFICATION:
Fewer culverts and shorter length would reduce costs. The ditch on the north side would be smaller and the ditch on the south side would be larger. Guardrail on the north side could be shortened. Although it is anticipated that the depth of flow would be greater and that the abrupt alignment changes at each end would require more energy dissipation, the overall cost would be improved.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$109,000	$0	$109,000
RECOMMENDED DESIGN	$86,000	$0	$86,000
ESTIMATED SAVINGS OR (COST)	$23,000	$0	$23,000

VALUE ENGINEERING RECOMMENDATION # VE-8

SKETCH OF RECOMMENDED DESIGN



East End of Item No. 1-115.10

VALUE ENGINEERING RECOMMENDATION # VE-8

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Culvert Pipe 48-inch	LF	$99.70	1	229	$22,831		
8 ft x 4 ft RCBC	LF	$400.00	1	215	$86,000		
9 ft x 5 ft RCBC	LF	$480.00	7			180	$86,400
$/Unit = area ratio							
Total					$108,831		$86,400

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-9

DESCRIPTIVE TITLE OF RECOMMENDATION:
Construct initial 2 lanes (ultimate 4 lanes) lieu of 4 lanes for both Item Nos.

ORIGINAL DESIGN:
The original design specifies that both Item Nos. 1-115.00 and 1-115.10 be constructed with four lanes.

Proposed Item No. 1-115.00 extends from existing US60 near Stafford Road eastward 2.5 miles to County Line Road, ~500 ft south of existing US60. This alignment shifts the mainline traffic from the existing two lanes having an alignment with ~1000-foot radius curves to proposed 4 lanes having an alignment with minimum radius of 7,500 ft.

Proposed Item No. 1-115.10 extends from County Line Road, ~500 ft south of existing US60, eastward 1.5 miles to meet the existing 4-lane section near Lester Harris Road. This Item No. shifts the mainline traffic from the existing two lanes on tangent alignment to proposed four lanes on an alignment having minimum radius of 22,920 ft.

RECOMMENDED CHANGE:
The VE Team recommends that both Item Nos. 1-115.00 and 1-115.10 be constructed with initial two lanes on one side of the ultimate roadbed.

ADVANTAGES:
- Reduce construction materials, labor, and duration

DISADVANTAGES:
- Reduced level of service
- Does not meet public expectation

JUSTIFICATION:
There is significant benefit to constructing a new controlled access road to facilitate movement of through traffic and allow local properties to access the new facility at limited locations. The new facility will provide smooth curves and wider shoulders for better safety. However, current traffic volumes do not warrant four lanes at this time, but may in the future. Construction of two initial lanes would reduce initial cost and would allow additional lanes to be constructed in the future with minimal traffic disruption.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$10,193,000	$0	$10,193,000
RECOMMENDED DESIGN	$3,766,000	$0	$3,766,000
ESTIMATED SAVINGS OR (COST)	$6,427,000	$0	$6,427,000

VALUE ENGINEERING RECOMMENDATION # VE-9

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Paving (.00)	SY	$57.00	1	56,000	$3,192,000		
Paving (.10)	SY	$57.00	1	32,000	$1,824,000		
Shoulder Base (.00)	CY	$12.27	1	1,472	$18,061		
Shoulder Base (.10)	CY	$12.27	1	848	$10,405		
Excavation (.00)	LS	$2,335,706	1	1	$2,335,706	0.80	$1,868,565
Excavation (.10)	LS	$473,656	1	1	$473,656	0.80	$378,925
Lime Stabilization (.00)	LS	$435,016	1	1	$435,016	0.55	$239,259
Cement Stabilization (.10)	LS	$187,136	1	1	$187,136	0.55	$102,925
4-inch Perforated Pipe (.00)	LF	$6.01	1	26,000	$156,260		
4-inch Perforated Pipe (.10)	LF	$6.01	1	15,000	$90,150		
Culverts (.00)	LS	$853,536	1	1	$853,536	0.80	$682,829
Culverts (.10)	LS	$617,000	1	1	$617,000	0.80	$493,600
Total					$10,192,926		$3,766,102

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-10

DESCRIPTIVE TITLE OF RECOMMENDATION:
Construct a 2 lane ultimate roadway in lieu of 4 lanes for both Item Nos.

ORIGINAL DESIGN:
The original design specifies a 4-lane, divided highway with partial control of access.

RECOMMENDED CHANGE:
The VE Team recommends the construction of a 2-lane undivided highway with turning lanes. Partial control of access should be implemented to minimize conflicts.

ADVANTAGES:

- Reduced right-of-way and impacts to property owners
- Reduced construction materials and labor
- Reduced environmental impacts
- Adequate for traffic flow
- Safe design

DISADVANTAGES:

- Reduced reserve capacity

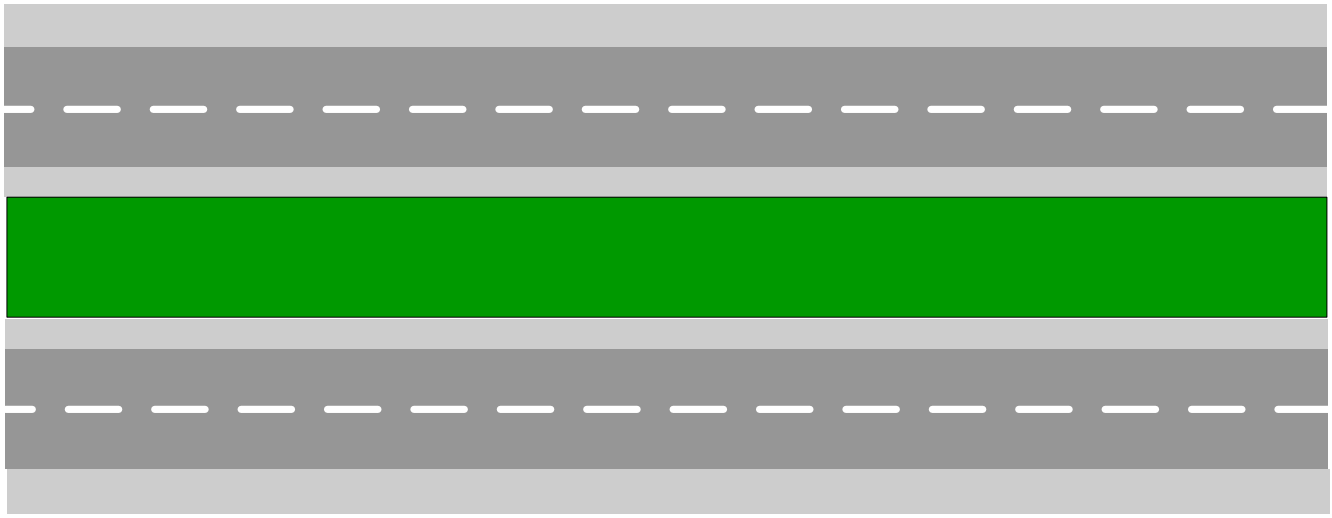
JUSTIFICATION:
The traffic forecast was done in 2003 on based volumes from 2002. The current traffic counts in this area show that volumes have remained stable with very low growth. For example, the traffic count in 2011 just west of Wren Road was 8,104 vehicles per day (VPD) and the 2002 base count was 8,300 VPD. In addition, the forecasts show that the peak ADT for this roadway to be only 13,620 VPD. The current counts and the forecast only demonstrate a need for a two-lane roadway.

Reconstruction of a two-lane roadway on new alignment (same alignment used in the original design) would allow for the construction of turning left turn lanes at intersections and the control of access which provides for safer and more efficient driving conditions. This alternative is substantially less in construction and right-of-way costs compared to the original design.

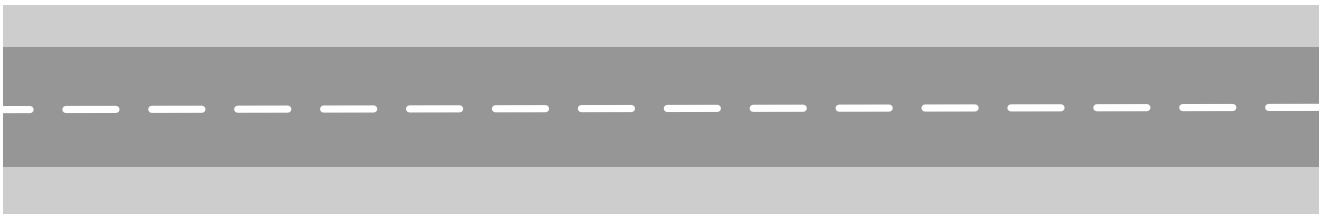
SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$10,680,000	$0	$10,680,000
RECOMMENDED DESIGN	$3,447,000	$0	$3,447,000
ESTIMATED SAVINGS OR (COST)	$7,233,000	$0	$7,233,000

VALUE ENGINEERING RECOMMENDATION # VE-10

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN



Original Design: 4 lanes with depressed grass median



Recommended Design: 2 lanes undivided roadway

VALUE ENGINEERING RECOMMENDATION # VE-10

CALCULATIONS

Length:

1-115.00 = 13,250 ft
1-115.01 = 7,630 ft

Paving:

Subtract 38 ft (SY/9SF)
Add 2 ft for additional shoulder width

Base:

Subtract 4 ft base DGA

Right-of-way:

Subtract 70 ft width (28 ft median width and 42 ft roadway width)

Excavation:

Assume reduction of 1/3 of excavation

VALUE ENGINEERING RECOMMENDATION # VE-10

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Paving (.00)	SY	$57.00	1	56,000	$3,192,000	3,000	$171,000
Paving (.10)	SY	$57.00	1	32,000	$1,824,000	1,700	$96,900
Shoulder Base (.00)	CY	$12.27	1	1,472	$18,061		
Shoulder Base (.10)	CY	$12.27	1	848	$10,405		
Right-of-way (.00)	ac	$15,000	1	21	$315,000		
Right-of-way (.10)	ac	$15,000	1	12	$172,500		
Excavation (.00)	LS	$2,335,706	1	1	$2,335,706	0.67	$1,564,923
Excavation (.10)	LS	$473,656	1	1	$473,656	0.67	$317,350
Lime Stabilization (.00)	LS	$435,016	1	1	$435,016	0.50	$217,508
Cement Stabilization (.10)	LS	$187,136	1	1	$187,136	0.50	$93,568
4-inch Perforated Pipe (.00)	LF	$6.01	1	26,000	$156,260		
4-inch Perforated Pipe (.10)	LF	$6.01	1	15,000	$90,150		
Culverts (.00)	LS	$853,536	1	1	$853,536	0.67	$571,869
Culverts (.10)	LS	$617,000	1	1	$617,000	0.67	$413,390
Total					$10,680,426		$3,446,508

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-11

DESCRIPTIVE TITLE OF RECOMMENDATION:
Construct a 2 +1 lane design in lieu of 4 lanes for both Item Nos.

ORIGINAL DESIGN:
The original design specifies a four-lane, divided highway with partial control of access.

RECOMMENDED CHANGE:
The VE Team recommends the implementation of a concept called 2 + 1 road design. This calls for a continuous three-lane cross section, with alternating passing lanes. It is recommended that this concept be examined for the entire stretch of US60 between Wickliffe and the transition to the existing four-lane section west of Paducah (approximately 18 miles).

2+1 road designs have been used extensively in Europe as a more cost effective alternate to a four-lane roadway in rural areas. As a rule-of-thumb, 2 + 1 designs work effectively with ADT ranging from 15,000 to 25,000 VPD. Germany uses these designs with ADTs up to 30,000 VPD; they have found crash rates are 36% lower than conventional two-lane roads.

Passing lanes generally are alternated at spacing ranging from ½ mile to 1 mile. This allows for frequent passing opportunities and ability to improve the level-of-service (LOS). It is recommended that a four-foot buffer (flush median) be used to separate opposing traffic. A cable barrier may be used to minimize crossover crashes. Partial control of access should be implemented to minimize conflicts.

ADVANTAGES:
- Reduced right-of-way and impacts to property owners
- Reduced construction labor and materials
- Reduced environmental impacts
- Adequate for traffic flow
- Safe design

DISADVANTAGES:
- Reduced reserve capacity

VALUE ENGINEERING RECOMMENDATION # VE-11

DISCUSSION CONTINUED

JUSTIFICATION:
The traffic forecast was done in 2003 on based volumes from 2002. The current traffic counts in this area show that volumes have remained stable with very low growth. For example, the traffic count in 2011 just west of Wren Road was 8,104 VPD and the 2002 base count was 8,300 VPD. In addition, the forecasts show that the peak ADT for this roadway to be only 13,620 VPD. The current counts and the forecast only demonstrate a need for a two-lane roadway.

This alternative changes the pavement cross section to a 2+1 roadway configuration. By implementing this, the level of service for the roadway will be higher than the original design. Per the definition in the Highway Capacity Manual 2010 (Chapter 15), this route, after being upgraded would be classified as a Class 1 two-lane highway. For Class 1, LOS is determined by two measures of effectiveness:

1. Average travel speed (ATS)
2. Percent time spent following (PTSF)

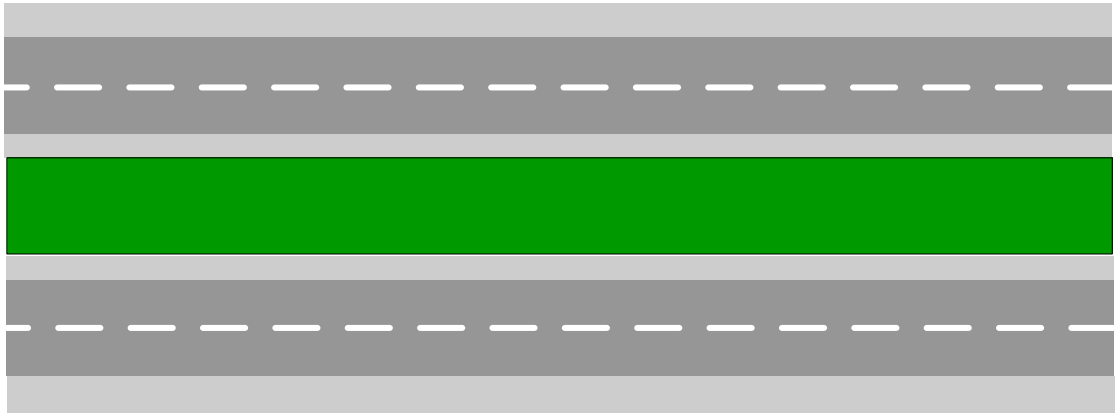
The original design addresses ATS by designing to have a 60 mph design speed. The current roadway generally has good geometry so not much will change with ATS. On the other hand, a new two-lane design, the grades and sight distance of the original design will allow for drivers to pass using the lane in the opposite direction when adequate gaps in traffic exist. A driver may get caught driving behind a slow moving vehicle and feel uncomfortable passing even when a passing opportunity exists. The 2+1 alternate gives alternating safe locations, every one to two miles, for drivers to pass, therefore greatly improving the PTSF over the current conditions. This may be especially important when a queue of vehicles occurs behind a slow vehicle traveling such as a tractor trailer or a farm vehicle.

This alternative addresses capacity and safety needs and is substantially less in construction and right-of-way costs compared to the original design. This design is proposed with 12 ft travel lanes and 8 ft paved shoulders.

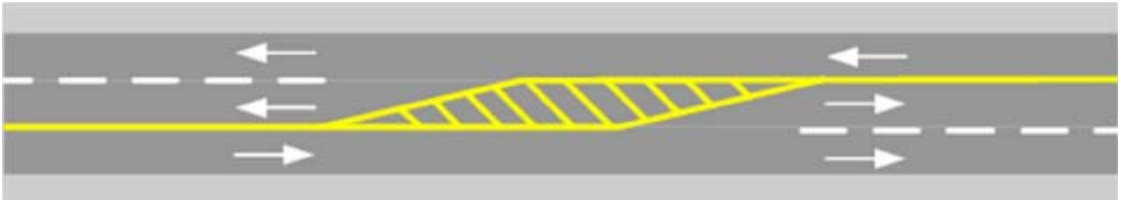
SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$10,568,000	$0	$10,568,000
RECOMMENDED DESIGN	$4,085,000	$0	$4,085,000
ESTIMATED SAVINGS OR (COST)	$6,483,000	$0	$6,483,000

VALUE ENGINEERING RECOMMENDATION # VE-11

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN



Original Design: 4 lanes with depressed grass median



Recommended Design: 2+1 Roadway Configuration

Example of Recommended Design: 2+1 Roadway Configuration

VALUE ENGINEERING RECOMMENDATION # VE-11

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Paving (.00)	SY	$57.00	1	56,000	$3,192,000	20,600	$1,174,200
Paving (.10)	SY	$57.00	1	32,000	$1,824,000	11,900	$678,300
Shoulder Base (.00)	CY	$12.27	1	1,472	$18,061		
Shoulder Base (.10)	CY	$12.27	1	848	$10,405		
Right-of-way (.00)	ac	$15,000	1	16	$240,000		
Right-of-way (.10)	ac	$15,000	1	9	$135,000		
Excavation (.00)	LS	$2,335,706	1	1	$2,335,706	0.33	$778,491
Excavation (.10)	LS	$473,656	1	1	$473,656	0.33	$157,727
Lime Stabilization (.00)	LS	$435,016	1	1	$435,016	0.50	$217,508
Cement Stabilization (.10)	LS	$187,136	1	1	$187,136	0.50	$93,568
4-inch Perforated Pipe (.00)	LF	$6.01	1	26,000	$156,260		
4-inch Perforated Pipe (.10)	LF	$6.01	1	15,000	$90,150		
Culverts (.00)	LS	$853,536	1	1	$853,536	0.67	$571,869
Culverts (.10)	LS	$617,000	1	1	$617,000	0.67	$413,390
Total					$10,567,926		$4,085,053

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING DESIGN COMMENT # DC-1

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Review access control plan to consolidate and reduce the number of access points and median openings.

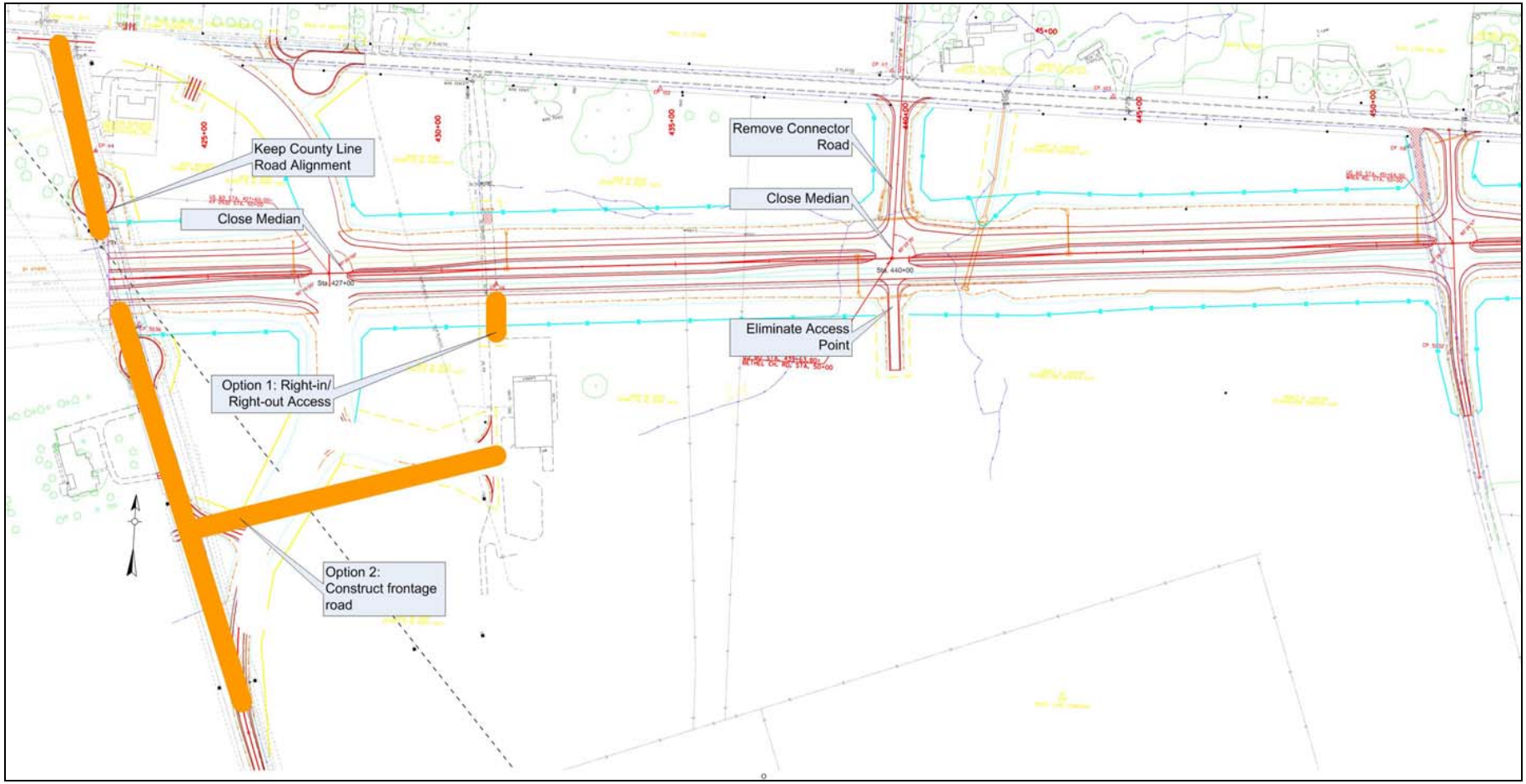
COMMENTARY:
Reducing and separating the number of conflict points is a proven method to reduce the number of locations with the potential for crashes. The current design uses an access control scheme based on 1,200 foot spacing of entrances and median openings. There are several locations along the project (both Item Nos.) where the design could be modified to remove access, remove a frontage road, or close a median opening. Finding opportunities to minimize conflict points will be important for the long term viability of creating and maintaining efficient, long-distance travel through this corridor. There are also some opportunities to provide direct access to the new roadway that would save cost on creating a frontage road with little impact to operations and safety.

The following may be opportunities for the project team to consider:

A.	130+00	Close median opening; make Sullivan Lane right-in/right-out; Sullivan Lane also has access on existing US60.
B.	164+00	Close median opening; remove realignment of Pine Lane and make right-in/right-out; Pine Lane also has access on existing US60.
C.	220+00	Eliminate access from south side of the road; property has access from County Line Road.
D.	220+00	Eliminate access from north side of the road; property has access from existing US60.
E.	427+00	Do not realign County Line Road. Keep current alignment at station 423+00. Paired with option D, median opening spacing is increased.
F.	431+00	Keep farm store entrance at original location with right-in/right-only access. Left turns would be achieved through U-turns at County Line Road and Bethel Church Road (KY1321). An option to this is to create a driveway (of the same width as the current driveway) from the existing County Line Road to the farm store.
G.	440+00	Eliminate access point and close median opening. Property on the south has access from Wren Road. Property on the north has access from existing US60.
H.	467+00	Remove frontage road on the south side. Create right-in/right-out. This would be a way to save cost with little effect on traffic operations.
I.	490+50	On the north side, remove the frontage road and make the property right-in/right out with no median opening.

VALUE ENGINEERING DESIGN COMMENT # DC-1

SKETCH OF RECOMMENDED DESIGN



Examples of potential modifications to access management design

VALUE ENGINEERING DESIGN COMMENT # DC-2

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Construct Item No. 1-115.00 concurrent with Item No. 1-115.10.

COMMENTARY:

During the value engineering kick-off meeting, it was indicated that Item No. 1-115.10 is planned to be constructed before Item No. 1-115.00. Proposed Item No. 1-115.10 extends from County Line Road, ~500 ft south of existing US60, eastward 1.5 miles to meet the existing 4-lane section near Lester Harris Road. This Item No. shifts the mainline traffic from the existing two lanes on tangent alignment to proposed four lanes on an alignment having minimum radius of 22,920 ft. If this Item No. is constructed first for an unspecified duration, then a significant incompatibility would occur at County Line Road such that traffic would need to negotiate a 90-degree turn only one mile from the gentle curve. The risk of serious accidents would be very great.

The VE Team recommends that Item No. 1-115.00 be constructed concurrent with, or immediately prior to, Item No. 1-115.10. Proposed Item No. 1-115.00 extends from existing US60 near Stafford Road eastward 2.5 miles to County Line Road, ~500 ft south of existing US60. This alignment shifts the mainline traffic from the existing two lanes having an alignment with ~1,000 ft radius curves to proposed 4 lanes having an alignment with minimum radius of 7,500 ft. If this Item No. is constructed concurrently with Item No. 1-115.10, then it would directly align with Item No. 1-115.10 and would eliminate the aforementioned 90-degree turn. Providing a through alignment for mainline traffic would significantly improve safety.

VALUE ENGINEERING DESIGN COMMENT # DC-3

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize the current allocated funds to purchase all right-of-way for Item Nos. 1-115.00 and 1-115.10 in lieu of treating the projects as separate entities.

COMMENTARY:
The VE Team reviewed the two sections of this project and believes it would be better to utilize the current funding available for right of way on Item No. 1-115.10 and use it for both sections. This was discussed in earlier Project Team meetings but the project was later split due to funding availability. The VE Team understands the funding constraints levied on the Project Team by the current Six Year Plan which is shown below for reference:

Ballard County (Item No. 1-115.00)

Phase	Fiscal Year	Funding Code	SYP Amount	Current Estimate
R	2010	SP	$9.98 million	Unknown
U	2010	SP	$5.72 million	Unknown
C	Future	SP	$20.56 million	$17 million

McCracken County (Item No. 1-115.10)

Phase	Fiscal Year	Funding Code	SYP Amount	Current Estimate
R	2010	SPP	$2.1 million	Unknown
U	2010	SPP	$2.6 million	Unknown
C	2012	SPP	$10.13 million	$8.9 million

Knowing the lack of state funds (SP) available for projects in the state, the VE Team was concerned of a long delay between the construction on Section 1 (1-115.10) and Section 2 (1-115.00). It was felt that Section 1 was not a usable section and could lead to driver confusion and frustration given the introduction of turns (one right and one left) where previously you just went straight.

Also, since there are no estimates available for the right of way and utility phases on Section 1, we roughly estimated the phase costs and believe the available SPP funding for these phases ($2.1 + $2.6 = $4.7 million) is significantly more than required for that section. Therefore, we recommend using the excess funding for the right of way acquisition on Section 2, thereby moving forward on all the right of way acquisition at one time.

The VE Team realizes this design comment is easier said than done, however the VE Team feels the timing of this VE study provides a unique opportunity to discuss the project with its legislative sponsor to see if the funding could be redistributed over both projects so they progress as one.

VALUE ENGINEERING DESIGN COMMENT # DC-4

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Straighten the right-of-way lines in lieu of jagged right-of-way lines for Item No. 1-115.00.

ORIGINAL DESIGN:
The original design shows proposed right-of-way lines that seem to closely follow the proposed lateral construction limits. This produces a right-of-way line with many angle points and a fence line with many corner posts. The VE Team recommends that consideration be given to straightening some of the right-of-way lines, which would simplify surveying effort, simplify the remaining portions of right-of-way, and would allow the right-of-way fences to have fewer corner posts.

VALUE ENGINEERING DESIGN COMMENT # DC-5

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Revise the cost estimates for right-of-way on both Item Nos.

COMMENTARY:
According to the KYTC Project Manager, Michael P. McGregor, the estimated amounts for right-of-way in the KYTC Six Year Plan are as follows:

1-115.00 - $9,980,000
1-115.10 - $2,210,000

These amounts were prepared years ago by the previous KYTC Project Manager. The VE Team recommends reviewing and modifying these estimates to reflect current right-of-way conditions. The VE Team assumes the right-of-way in this location of Kentucky is currently going for approximately $15,000/acre. The following tables indicate a conservative approximate right-of-way cost for each Item No.:

Item No. 1-115.00							
Start Station	End Station	Width (ft)	Length (ft)	Area (SF)	Area (Acres)	$/Acre	Subtotal
100	230	240	13,000	3,120,000	71.6	$15,000	$1,074,389
						Subtotal Item No. 1-115.00:	**$1,074,389**

Item No. 1-115.10							
Start Station	End Station	Width (ft)	Length (ft)	Area (SF)	Area (Acres)	$/Acre	Subtotal
420	470	240	5,000	1,200,000	27.5	$15,000	$413,226
470	490	120	2,000	240,000	5.5	$15,000	$82,645
						Subtotal Item No. 1-115.00:	**$495,872**

VALUE ENGINEERING DESIGN COMMENT # DC-6

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Validate the $2,500,000 allowance for utility relocations is reasonable for each Item No.

ORIGINAL DESIGN:
The Final Joint Inspection meeting for Item No. 1-115.00 was held on October 22, 2007, and meeting for Item No. 1-115.10 was held on October 23, 2007. The minutes of these meetings indicate that the estimated utility cost for each Item No. is $2.5 million. The VE Team recommends that these numbers be verified.

VALUE ENGINEERING DESIGN COMMENT # DC-7

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Verify the quantity of guardrail specified in the cost estimate for Item No. 1-115.00.

COMMENTARY:
In reviewing the plans for project Item No. 1-115.00, it was noted that the construction estimate showed 8,170 LF of guardrail while the plans show 3,556 LF. The plan quantities calculated are broken down as follows:

Sheet R5 – 372.5 + 362.5 = 735 LF
Sheet R7 – 102.5 + 237.5 = 340 LF
Sheet R9 – 400 + 175 = 575 LF
Sheet R15 – 212.5 + 212.5 = 425 LF
Sheet R17 – 212.5 + 212.5 = 425 LF
Sheet R21 – 408 + 648 = 1,056 LF
TOTAL = 3,556 LF

VALUE ENGINEERING DESIGN COMMENT # DC-8

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Verify the quantity of woven wire fence specified in the cost estimate for Item No. 1-115.10.

COMMENTARY:
In reviewing the plans for project Item No. 1-115.10, it was noted that the construction estimate showed 26,727 LF of woven wire fence while the plan takeoff quantity was determined to be approximately 16,501 LF. The plan quantities calculated are broken down as follows:

Sheet R4 – 2,648 LF
Sheet R6 – 3,587 LF
Sheet R8 – 1,880 LF
Sheet R10 – 4,024 LF
Sheet R12 – 3,672 LF
Sheet R14 – 690 LF
TOTAL = 16,501 LF

VALUE ENGINEERING DESIGN COMMENT # DC-9

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Construct offset left turn lanes in lieu of standard left turn lanes.

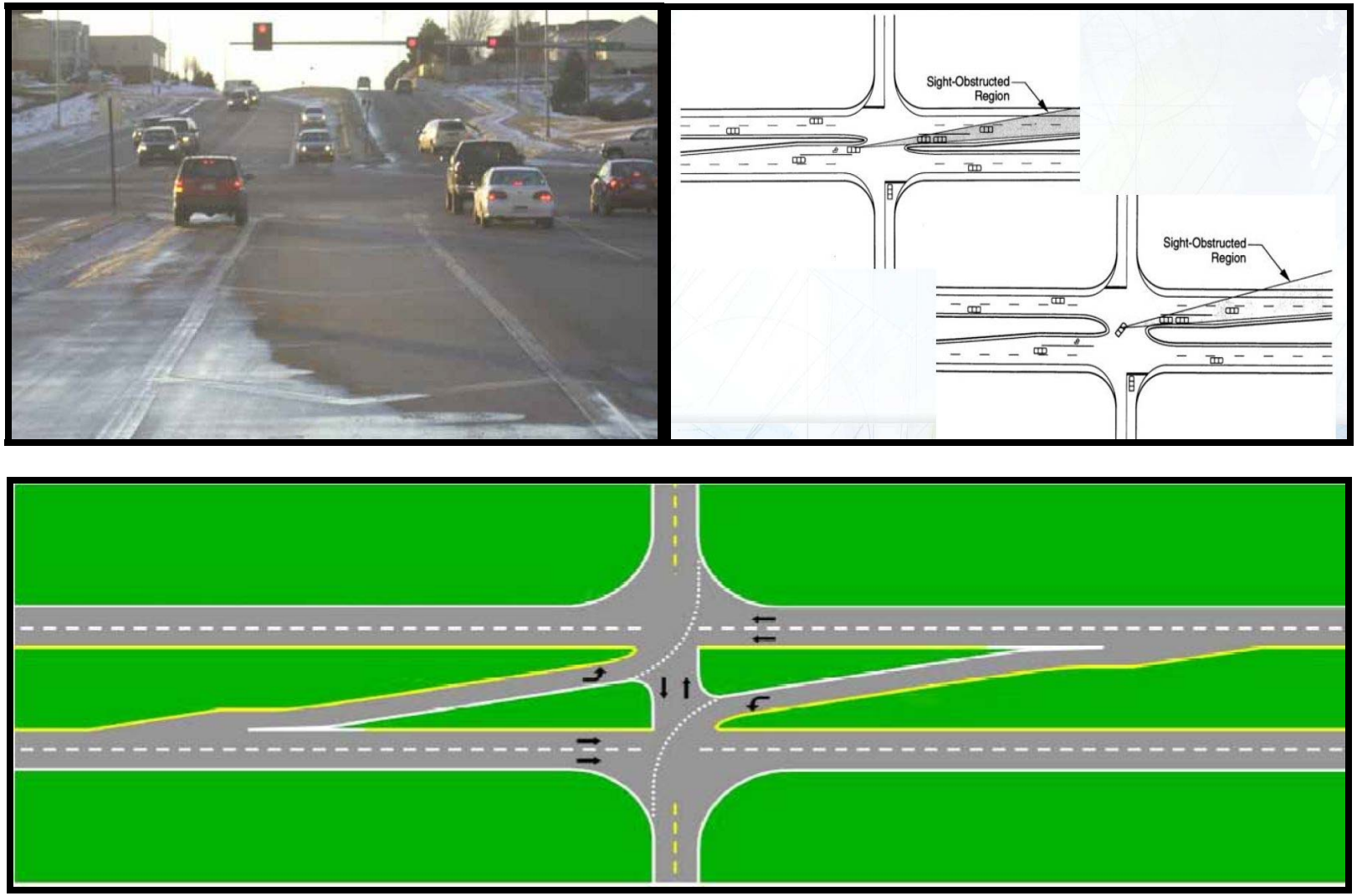
COMMENTARY:

The original design includes left turn lanes at the median opening which are immediately adjacent to the travel way. Recent research has shown that offsetting the left turn lane can provide safety benefits due to improved sight distance. The basis for this is vehicles in the left turn lane at an at-grade intersection can block the view of left-turning vehicles from the opposite direction. The offset turn lane adjusts the alignment of vehicles making left turns from the highway so motorists can better see the vehicles around them, thereby making a safer left turn. Included below are some illustrations which help to visualize this concept.

It should also be noted that KYTC Design Memo 3-09 entitled "Auxiliary Turn Lane Policy" encourages the use of offset turn lanes.

VALUE ENGINEERING DESIGN COMMENT # DC-9

PHOTOGRAPH AND SKETCHS OF RECOMMENDED DESIGN



Examples of Recommended Offset Left Turn Lanes

VALUE ENGINEERING DESIGN COMMENT # DC-10

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize a right turn lane at the industrial park where significant truck turns are expected.

COMMENTARY:
The original design specifies that each right turn at intersections be preceded with a 100 ft deceleration taper along the mainline. Given that trucks decelerate more slowly than most other vehicles, consideration could be given to providing a short right turn lane near the industrial park at locations where trucks would be more prevalent, such as westbound at Veterans Avenue and westbound at County Line Road.

VALUE ENGINEERING DESIGN COMMENT # DC-11

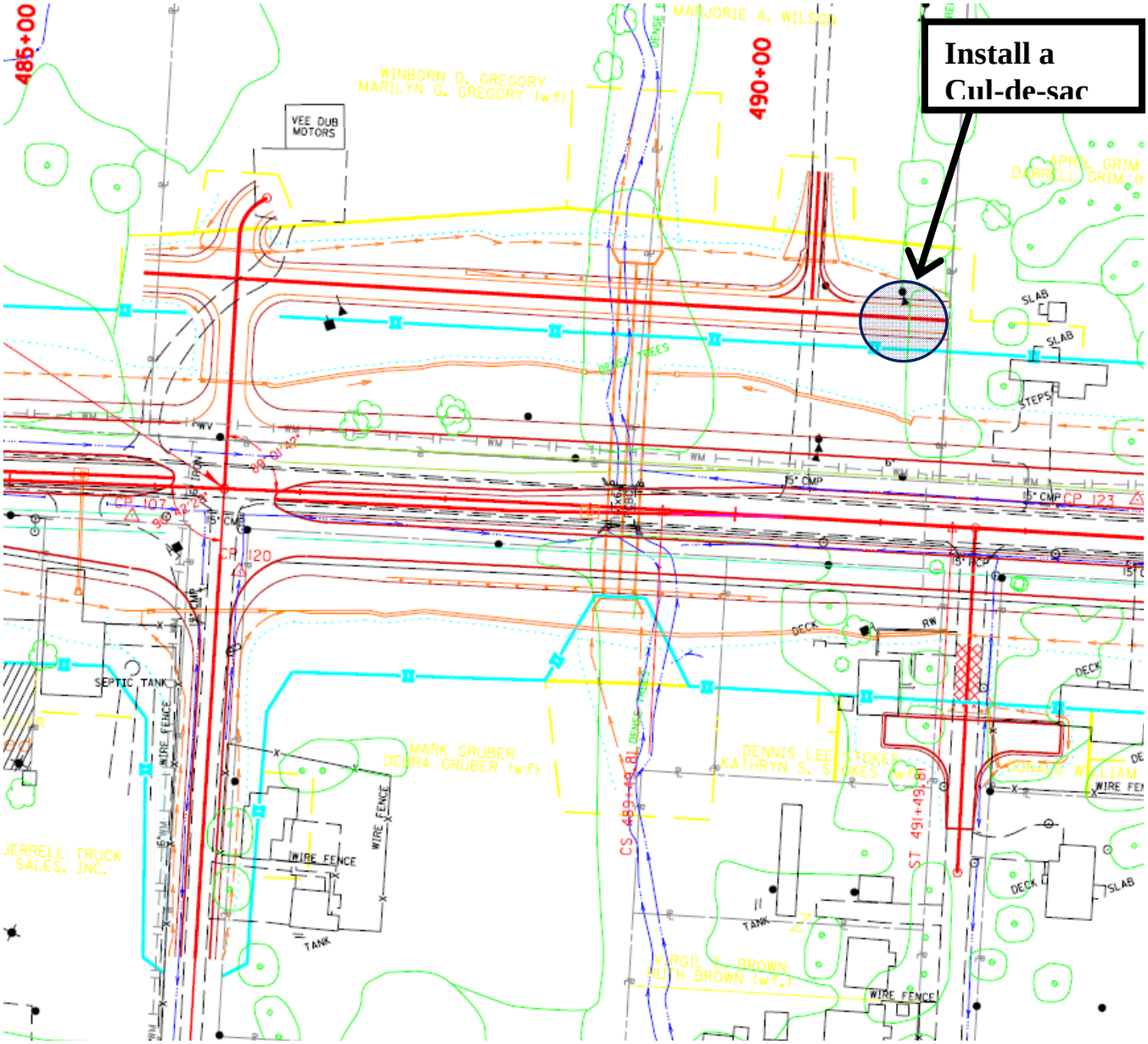
DESCRIPTIVE TITLE OF DESIGN COMMENT:
Investigate the temporary tie-in of US60 to existing US60 at County Line Road if Item No. 1-115.10 is constructed before Item No. 1-115.00.

COMMENTARY:
Proposed Item No. 1-115.10 extends from County Line Road, ~500 ft south of existing US60, eastward 1.5 miles to meet the existing 4-lane section near Lester Harris Road. This Item No. shifts the mainline traffic from the existing two lanes on tangent alignment to proposed four lanes on an alignment having minimum radius of 22,920 ft. If this Item No. is constructed first for an unspecified duration, then a significant incompatibility would occur at County Line Road such that traffic would need to negotiate a 90-degree turn. Safety would be improved if a smoother connection were to be provided to reconnect the west end of the project with existing US60 at County Line Road.

VALUE ENGINEERING DESIGN COMMENT # DC-12

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize a cul-de-sac in lieu of a dead end for the access road north of US60 at Station 491+00.

COMMENTARY:
The original design specifies that the access road on the north side of US60 near Station 491+00 has an abrupt end. Unless significant new development is imminent at this location, provision of a public turn-around or cul-de-sac would improve operation.



VALUE ENGINEERING DESIGN COMMENT # DC-13

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize cement stabilized roadbed for Item No. 1-115.00 in lieu of lime stabilized base as indicated in the cost estimate.

COMMENTARY:
The VE Team noted during the review of the project that the utilization of chemically stabilized roadbed was required given the lack of rock available for rock roadbed. However, based on the construction cost estimate, the Item No. 1-115.00 project is utilizing lime stabilization and the Item No. 1-115.10 is utilizing cement stabilization.

The VE Team recommends the use of one material for the stabilization to gain efficiency and consistency between the two sections. It appears from the Geotechnical Engineering Roadway Report dated 11/5/2007 that the intent was to use cement treated stabilization. Therefore, the VE Team recommends using cement stabilization unless the Project Team wants to bid alternates.

Photograph of Cement Stabilized Roadbed

VALUE ENGINEERING DESIGN COMMENT # DC-14

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Reconcile the unit prices in the cost estimate for both Item Nos. and the Kentucky average unit prices.

COMMENTARY:
The VE Team noted several discrepancies between the unit prices listed in the cost estimates of both Item Nos. These unit prices also differed from the Kentucky average unit prices. The VE Team recommends reconciling these estimates to each other and the Kentucky average unit prices. The following table further illustrates this point.

Element	Unit	Item No. 1-115.00 Unit Price	Item No. 1-115.10 Unit Price	KY Average Unit Price
Roadway Excavation	CY	$8.50	$4.02	$5.08
Embankment In Place	CY	NA	NA	$6.17
Lime Stabilized Roadbed	SY	$3.38	NA	$2.46
Cement Stabilized Roadbed	SY	NA	$1.79	$3.27
DGA Base	TON	$24.72	$12.27	$18.99
Perforated Pipe - 4-inch	LF	NA	NA	$5.99
Drainage Blanket (Type II)	TON	$76.69	$36.79	$36.28
Cl 2 AB 1.00D PG64-22	TON	$60.00	$57.76	$53.91
Cl 2 AB 1.00D PG76-22	TON	NA	NA	NA
Cl 3 AB 1.00D PG64-22	TON	$60.00	$68.35	$49.22
Cl 3 AB 1.00D PG76-22	TON	$60.00	$76.00	$68.96
Cl 2 AS 0.38D PG64-22	TON	$65.00	$99.78	$65.59
Cl 2 AS 0.38D PG76-22	TON	NA	NA	$89.44
Cl 3 AS 0.38D PG64-22	TON	NA	NA	$61.38
Cl 3 AS 0.38D PG76-22	TON	$65.00	$65.00	$88.05

Note: Asphalt descriptions may not match as numerous different types are listed in the estimate and do not necessarily match what is shown on the plan sheets.

APPENDICES

The appendices in this report contain backup information supporting the body of the report, and the mechanics of the workshop. The following appendices are included.

CONTENTS

APPENDIX A
Study Participants

APPENDIX A – Study Participants

Workshop Attendance

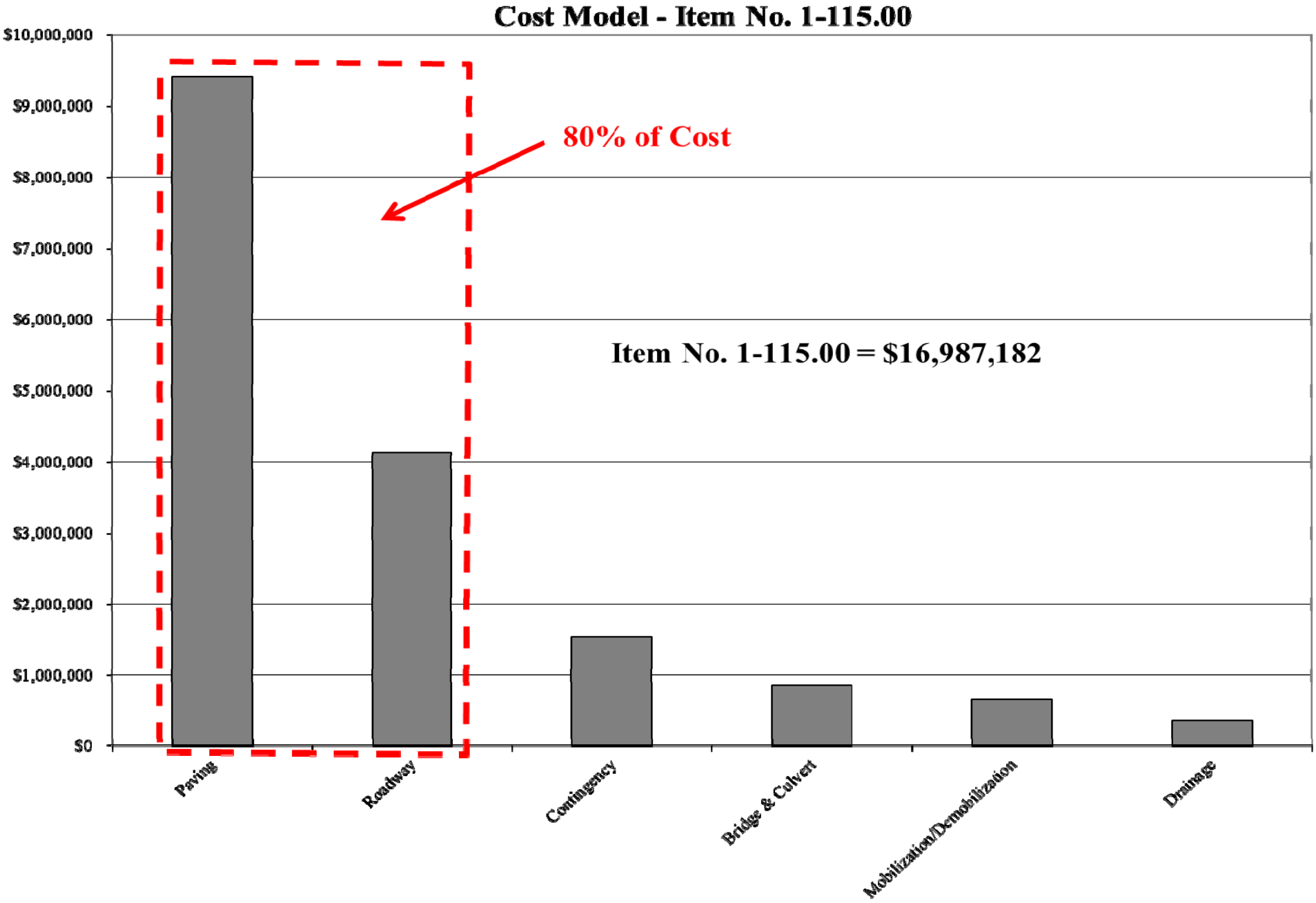
Name	Organization and Address (Organization first, with complete address underneath)	Tel # and Email (Tel first with Email underneath)	Role in Workshop	Participation					
				Meetings		Study Sessions			
				Intro	Out Brief	Day 1	Day 2	Day 3	Day 4
Boday Borres	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Boday.Borres@ky.gov	KYTC Quality Assurance Branch	X	X				
Stephen Curless	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3504 Steve.Curless@urs.com	VE Roadway Designer	X	X	X	X	X	X
Brad Eldridge	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280	KYTC Representative		X				
Greg Groves	URS Corporation 325 W. Main Street, Suite 1200 Louisville, KY 40202	502-569-2301 Greg.Groves@urs.com	VE Highway Engineer	X	X	X	X	X	X
Mike Guter	URS Corporation 3950 Sparks Drive, SE Grand Rapids, MI 49546	616-574-8477 Mike.Guter@urs.com	VE Constructability	X	X	X	X	X	X
Mike McGregor	KYTC, District 1 5501 Kentucky Dam Road Paducah, KY 42003	270-898-2431x273 Mike.McGregor@ky.gov	KYTC Project Manger	Via Video	Via Video				
Susan Oatman	KYTC, District 1 5501 Kentucky Dam Road Paducah, KY 42003	270-898-2431 Susan.Oatman@ky.gov	KYTC Design Engineer		Via Video				
Ben Quinn, Jr.	AEI 2500 Nelson Miller Parkway Louisville, KY 40223	502-245-3813 Benq@aei.cc	Consultant PM	X	X				
Kyle Schafersman	URS Corporation 8300 College Boulevard, Suite 200 Overland Park, KS 66210	913-344-1019 Kyle.Schafersman@urs.com	VE Team Leader	X	X	X	X	X	X
Brent Sweger	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Brent.Sweger@ky.gov	KYTC VE Coordinator	X	X	X	X	X	X

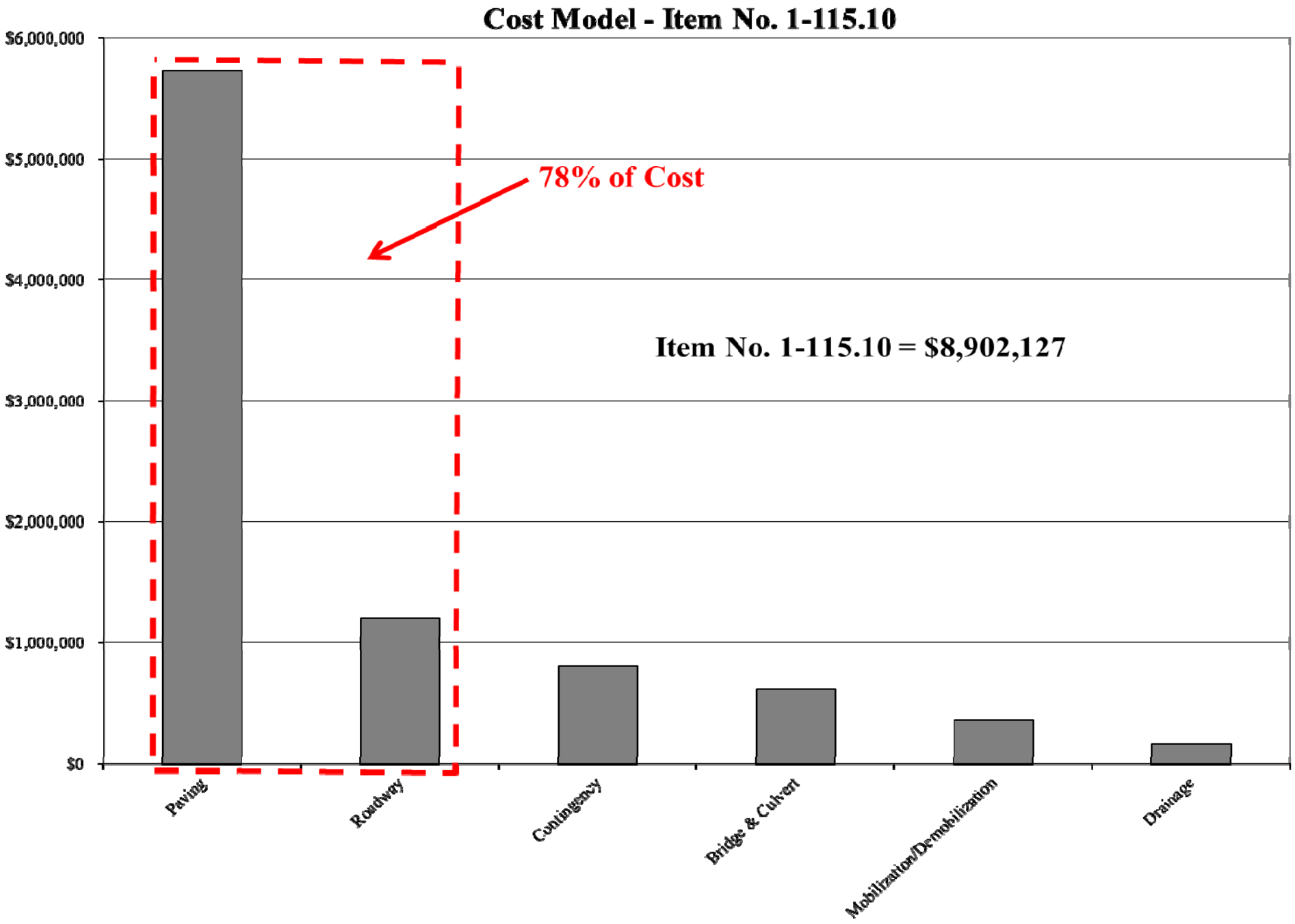
Workshop Attendance

				Participation					
				Meetings		Study Sessions			
Name	**Organization and Address (Organization first, with complete address underneath)**	**Tel # and Email (Tel first with Email underneath)**	**Role in Workshop**	**Intro**	**Out Brief**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Randy Williams	KYTC, District 1 5501 Kentucky Dam Road Paducah, KY 42003	270-898-2431 Randy.Williams@ky.gov	KYTC Project Delivery Branch		Via Video				

APPENDIX B
Cost Information

APPENDIX B - Cost Information


Cost Model - Item No. 1-115.00
$10,000,000
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
80% of Cost
Item No. 1-115.00 = $16,987,182
Paving
Roadway
Contingency
Bridge & Culvert
Mobilization/Demobilization
Drainage


Cost Model - Item No. 1-115.10
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
78% of Cost
Item No. 1-115.10 = $8,902,127
Paving
Roadway
Contingency
Bridge & Culvert
Mobilization/Demobilization
Drainage

APPENDIX C
Function Analysis

APPENDIX C - Function Analysis

Function Model

Item	Cost	Function
Total for Item No. 1-115.00	$16,987,182	Enhance truck route Improve connectivity Support growth Enhance capacity Support Industrial Park Improve safety Improve level of service
Paving	$9,420,443	Support vehicles Reduce maintenance
Roadway	$4,130,836	Create surface Support pavement
-Roadway Excavation	*$2,335,707*	Smooth profile
-Perforated Pipe 4-inch	*$300,500*	Drain subgrade
-Staking	*$200,000*	Mark location Establish line and grade
-Guardrail-Steel W Beam-S Face	*$178,433*	Keep vehicles on road at culverts
-Silt Trap Type B	*$147,945*	Control erosion
Contingency	$1,544,289	Account for unknowns
Bridge & Culvert	$853,536	Convey water
Mobilization/Demobilization	$665,005	Move labor and equipment to site Remove labor and equipment from site
Drainage	$373,072	Convey water
Total for Item No. 1-115.10	$8,902,127	Enhance truck route Improve connectivity Support growth Enhance capacity Support Industrial Park Improve safety Improve level of service
Paving	$5,734,735	Support vehicles Reduce maintenance
Roadway	$1,207,592	Create surface Support pavement
-Roadway Excavation	*$473,657*	Smooth profile
-Fence-Woven Wire Type 1	*$106,106*	Control access

Item	Cost	Function
-Channel Lining Class II	*$146,757*	Prevent erosion
-Maintain & Control Traffic	*$69,000*	Direct traffic Delineate work zone
-Seeding and Protection	*$77,000*	Prevent erosion
Contingency	$809,284	Account for unknowns
Bridge & Culvert	$617,000	Convey water
Mobilization/Demobilization	$363,785	Move labor and equipment to site Remove labor and equipment from site
Drainage	$169,732	Convey water

APPENDIX D
Creative Idea List and Evaluation

APPENDIX D - Creative Idea List and Evaluation

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**TM Resp.**
1	Combine Item Nos. 1-115.00 and 1-115.10 into one project in lieu of two separate projects	DC	G. Groves
2	Utilize the current allocated funds to purchase all right-of-way for Item Nos. 1-115.00 and 1-115.10 in lieu of treating the projects as separate entities	DC	G. Groves
3	Construct initial 2 lanes (ultimate 4 lanes) for Item No. 1-115.00 first before constructing Item No. 1-115. 10	4	
4	Construct Item No. 1-115.00 before constructing Item No. 1-115.10	DC	S. Curless
5	Construct initial 2 lanes (ultimate 4 lanes) for Item No. 1-115.10 in lieu of 4 lanes	1	S. Curless
6	Construct a 2 lane ultimate roadway in lieu of 4 lanes for both Item Nos.	1	B. Sweger
7	Construct a 2 + 1 lane design in lieu of 4 lanes for both Item Nos.	1	B. Sweger
8	Construct offset left turn lanes in lieu of standard left turn lanes	1	G. Groves
9	Adjust the profile grade to improve the balance of earthwork	1	M. Guter
10	Adjust profile grades to reduce the fill at culvert crossings which will eliminate the need for guardrail	2	M. Guter
11	Utilize 90-degree culvert crossings and relocated streams to eliminate the skewed culvert crossings	2	M. Guter
12	Reduce shoulder asphalt section in lieu of full depth shoulders	1	M. Guter
13	Where intersecting roads are to be reconstructed, reduce the asphalt section from 9 inches to 5 inches where applicable	2	M. Guter
14	Combine the two culverts at Stations 470+70 and 474+23 in lieu of two separate culverts	1	S. Curless
15	Utilize 11 ft traffic lanes and 8 ft paved outside shoulders in lieu of 12 ft traffic lanes and 10 ft paved outside shoulders	1	G. Groves
16	Utilize cement stabilized roadbed for Item No. 1-115.00 in lieu of lime stabilized base as indicated in the cost estimate	DC	G. Groves
17	Revise the cost estimates for right-of-way on both Item Nos.	DC	K. Schafersman
18	Verify the quantity of guardrail specified in the cost estimate for Item No. 1-115.00	DC	G. Groves
19	Verify the quantity of woven wire fence specified in the cost estimate for Item No. 1-115.10	DC	G. Groves
20	Utilize a 30 ft depressed grass median in lieu of a 40 ft depressed grass median	3	G. Groves
21	Review access control plan to consolidate and reduce the number of access points and median openings	2	B. Sweger
22	Utilize the existing County Line Road alignment to intersect with US60 in lieu of realigning County Line Road to the east	2	B. Sweger
23	Reduce right-of-way costs by utilize property easements for the cut/fill slopes in lieu of purchasing all the right-of-way	4	

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**TM Resp.**
24	Straighten the right-of-way lines in lieu of jagged right-of-way lines for Item No. 1-115.00	DC	M. Guter
25	Utilize a right turn lane at the industrial park where significant truck turns are expected	DC	S. Curless
26	Investigate the temporary tie-in of US60 to existing US60 at County Line Road if Item No. 1-115.10 is constructed before Item No. 1-115.00	DC	S. Curless
27	Validate the $2,500,000 allowance for utility relocations is appropriate for Item No. 1-115.00	DC	M. Guter
28	Utilize a cul-de-sac in lieu of a dead end for the access road north of US60 at Station 491+00	DC	S. Curless
29	Add a turn lane to the existing US60 in applicable locations in lieu of constructing a new 4 lane US60 bypass around Kevil	3	
30	Reconcile the unit prices in the cost estimate for both Item Nos. and the Kentucky average unit prices	DC	M. Guter

Development Status Legend:

1: Idea is considered by the VE Team to be the best value enhancement possibility and is currently being developed as a VE recommendation

2: Idea is considered by the VE Team to be a good value enhancement possibility and will be developed as a VE recommendation after all the “1s” have been developed

3: Idea is considered by the VE Team to be of marginal value enhancement possibility and may be developed as a VE recommendation after all the “1s” and “2s” have been developed

4: Idea was not considered to enhance the value of the project and has been eliminated from further consideration by the VE Team

DC: Idea is being developed as a Value Engineering Design Comment to the designers with no easily quantifiable cost associated

APPENDIX E
VE Punch List

APPENDIX E – VE Punch List

VALUE ENGINEERING PUNCH LIST

ITEM NOS.: **1-115.00 & 1-115.10** PROJECT COUNTIES: **Ballard-McCracken** DATE OF STUDY: **11/14/2011 to 11/17/2011** **VE # 201109**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y,N,UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
Roadway										
VE-1	✓-2	Utilize a 30 ft depressed grass median in lieu of a 40 ft depressed grass median			$2,921,000	$2,613,000	$308,000	NA	Env	
VE-2		Utilize 11 ft traffic lanes and 8 ft paved outside shoulders in lieu of 12 ft traffic lanes and 10 ft paved outside shoulders			$1,070,000	$0	$1,070,000	NA	Oth	
VE-3	✓-1,2	Reduce shoulder asphalt section in lieu of full depth shoulders			$725,000	$374,000	$351,000	NA	Oth	
VE-4	✓-1,2	Where intersecting roads are to be reconstructed, reduce the asphalt section from 9.25 inches to 5.75 inches where applicable			$288,000	$105,000	$183,000	NA	Oth	
VE-5	✓-1,2	Adjust the profile grade to improve the balance of earthwork			$2,809,000	$1,778,000	$1,031,000	NA	Oth	
VE-6		Adjust profile grades to reduce the fill at culvert crossings which will eliminate the need for guardrail			$2,231,000	$1,593,000	$638,000	NA	Saf	
VE-9	✓-2	Construct initial 2 lanes (ultimate 4 lanes) lieu of 4 lanes for both Item Nos.			$10,193,000	$3,766,000	$6,427,000	NA	Env, Con	
VE-10		Construct a 2 lane ultimate roadway in lieu of 4 lanes for both Item Nos.			$10,680,000	$3,447,000	$7,233,000	NA	Env, Con	
VE-11	✓-1	Construct a 2 + 1 lane design in lieu of 4 lanes for both Item Nos.			$10,568,000	$4,085,000	$6,483,000	NA	Env, Con	
Structures										
VE-7		Utilize 90 degree culvert crossings and relocated streams to eliminate the skewed culvert crossings			$329,000	$338,000	($9,000)	NA	Oth	
VE-8	✓-1,2	Combine the two culverts at Stations 470+68 and 474+24 in lieu of two separate culverts			$109,000	$86,000	$23,000	NA	Con	
Other Design Comments										
DC-1		Review access control plan to consolidate and reduce the number of access points and median openings			NA	NA	NA	NA	Saf, Ops	
DC-2		Construct Item No. 1-115.00 concurrent with Item No. 1-115.10			NA	NA	NA	NA	Con, Ops	

VALUE ENGINEERING PUNCH LIST

ITEM NOS.: **1-115.00 & 1-115.10** PROJECT COUNTIES: **Ballard-McCracken** DATE OF STUDY: **11/14/2011 to 11/17/2011** **VE # 201109**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y,N,UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
DC-3		Utilize the current allocated funds to purchase all right-of-way for Item Nos. 1-115.00 and 1-115.10 in lieu of treating the projects as separate entities			NA	NA	NA	NA	Con, Ops	
DC-4		Straighten the right-of-way lines in lieu of jagged right-of-way lines for Item No. 1-115.00			NA	NA	NA	NA	Con	
DC-5		Revise the cost estimates for right-of-way on both Item Nos.			NA	NA	NA	NA	Oth	
DC-6		Validate the $2,500,000 allowance for utility relocations is reasonable for each Item No.			NA	NA	NA	NA	Oth	
DC-7		Verify the quantity of guardrail specified in the cost estimate for Item No. 1-115.00			NA	NA	NA	NA	Oth	
DC-8		Verify the quantity of woven wire fence specified in the cost estimate for Item No. 1-115.10			NA	NA	NA	NA	Oth	
DC-9		Construct offset left turn lanes in lieu of standard left turn lanes			NA	NA	NA	NA	Saf, Ops	
DC-10		Utilize a right turn lane at the industrial park where significant truck turns are expected			NA	NA	NA	NA	Saf, Ops	
DC-11		Investigate the temporary tie-in of US60 to existing US60 at County Line Road if Item No. 1-115.10 is constructed before Item No. 1-115.00			NA	NA	NA	NA	Ops, Con	
DC-12		Utilize a cul-de-sac in lieu of a dead end for the access road north of US60 at Station 491+00			NA	NA	NA	NA	Ops	
DC-13		Utilize cement stabilized roadbed for Item No. 1-115.00 in lieu of lime stabilized base as indicated in the cost estimate			NA	NA	NA	NA	Oth	
DC-14		Reconcile the unit prices in the cost estimate for both Item Nos. and the Kentucky average unit prices			NA	NA	NA	NA	Oth	
					Saf 4	Ops 7	Env 4	Con 8	Oth 12	

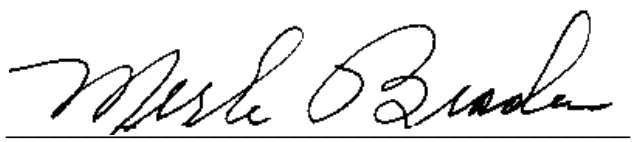
* Y=yes, N=no, UC=under construction

END OF REPORT

This report was compiled and edited by:
Kyle Schafersman, PE, CVS
URS Corporation
8300 College Boulevard, Suite 200
Overland Park, KS 66210
913-344-1019 Tel
913-344-1011 Fax

This report was commissioned by:
Kentucky Transportation Cabinet
200 Mero Street
Frankfort, KY 40622

This report was released for publication by:
Merle Braden, PE, CVS-Life, FSAVE
QA/QC Manager
URS Value Engineering Services
913-432-3140 Tel
merle_braden@urscorp.com



Approved by Merle Braden, PE, CVS-Life (URS)