Value Engineering Study

I-65 TO US-31W CONNECTOR
WARREN COUNTY, KENTUCKY

Item Number 3-16.00
VE Study Number 201108

Kentucky Transportation Cabinet
Frankfort, Kentucky

Study Date: October 31-November 2, 2011

KENTUCKY TRANSPORTATION CABINET

URS

I-65 TO US-31W CONNECTOR
WARREN COUNTY, KENTUCKY

Item Number 3-16.00

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VALUE ENGINEERING STUDY
for
Kentucky Transportation Cabinet
Frankfort, Kentucky

Study Date: October 31– November 2, 2011

Final Report

December 21, 2011

URS

EXECUTIVE SUMMARY

General
URS conducted a Value Engineering (VE) study of the I-65 Interchange in Warren County, Kentucky. The Item Number is 3-16.00. The topic was the 80% design submission prepared by QK4 for the Kentucky Transportation Cabinet (KYTC).

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 $56,096,795 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, 31 creative ideas were identified; fifteen of these ideas were developed into VE recommendations and eight 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 – Maximize Economics represents an estimated potential cost savings of $14,217,000. VE Team Selected Combination #2 – VE Team Preference results in an estimated potential cost savings of $13,022,000. 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 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W	$5,167,000	
VE-2	Utilize 4 ultimate lanes in lieu of 6 ultimate lanes from I-65 to US68/KY80 and utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W	$7,619,000	2
VE-3	Eliminate the section of the project between US68/KY80 and US-31W and create an at-grade intersection at US68/KY80	$10,599,000	
VE-4	Eliminate the section of the project between US68/KY80 and US-31W. Reconfigure an at-grade intersection to "T" the eastern portion of US68/KY80	$10,599,000	1
VE-5	End the widening and reconstruction of US-31W at Commonwealth Boulevard	$1,978,000	1, 2
VE-6	Increase beam spacing to eliminate beam lines, where applicable	$278,000	2*
VE-7	Move the radius of the railroad spur westward to reduce the bridge square footage and variable skew	$925,000	2*
VE-8	Utilize mechanically stabilized earth (MSE) abutments on Bridges No. 1, 3, 4, and 5 in lieu of 2:1 spill through slopes	$1,998,000	1*, 2*
VE-9	Utilize MSE walls with road pavement in lieu of bridge deck and piers from the north side of US68/KY80 to the south side of the railroad spur	$1,330,000	2*
VE-10	Utilize a single span structure over Commonwealth Boulevard in lieu of a 2-span bridge	$153,000	
VE-11	Utilize a single span structure over a reduced width Commonwealth Boulevard in lieu of a 2-span bridge	$465,000	
VE-12	Utilize a three sided culvert structure for a reduced width Commonwealth Boulevard in lieu of a 2-span bridge	$828,000	
VE-13	Utilize an at-grade intersection at the connector and Commonwealth Boulevard in lieu of a grade separation and eliminate the Mizpah Road relocation (frontage road) by consolidating the access points of Mizpah Road and Commonwealth Boulevard	$2,199,000	2*
VE-14	Utilize 40 ft. depressed median in lieu of 60 ft. depressed median	$280,000	1*, 2*

Summary of VE Team Selected Combination # 1 - Maximize Economics: $14,217,000

Summary of VE Team Selected Combination # 2 - VE Team Preference: $13,022,000

* The cost savings available for this recommendation have been reduced to eliminate overlap of potential savings

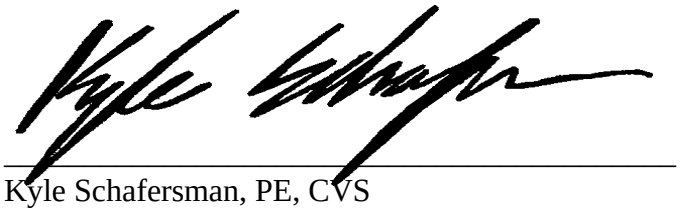
SUMMARY OF VE DESIGN COMMENTS	
DC #	Design Comment Description
DC-1	Revise the cost estimate for bridges, temporary barriers, maintain and control traffic, traffic signal, and sinkhole mitigation
DC-2	Verify the number of asphalt types in the pavement design folder match the number of asphalt types listed in the cost estimate
DC-3	Utilize the minimum vertical clearance for all structures in lieu of excess clearance
DC-4	Reduce the driving lane width to 11 ft. in lieu of 12 ft. lanes
DC-5	Reduce the width of shoulders from 12 ft. to 10 ft.
DC-6	Install cable barrier in the median
DC-7	Utilize acceleration/deceleration lanes for construction access from I-65 to the new connector in lieu of the Phase 1 “T” intersection with I-65
DC-8	Construct the bridge over I-65 in the first phase to facilitate construction traffic access between north and south sides of I-65 in lieu of constructing bridge over I-65 in the second phase

Acknowledgments
A thank you is given to the staff members from the Kentucky Transportation Cabinet and QK4 for their participation. Special thanks are also extended to Mr. Brent Sweger for his assistance with this study.

Value Engineering Study - Core Team

Name	Discipline / Role	Organization	Telephone
Stephen Curless, PE	Roadway Design	URS	513-419-3504
Greg Groves, PE	Roadway Design Engineer	URS	502-569-2301
Mike Guter, PE	Constructability	URS	616-574-8477
Brian Rhodes, PE	Structural Engineer	URS	513-419-3500
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

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Appendices

SECTION 1 - INTRODUCTION

This report documents the results of a Value Engineering study on the I-65 Interchange project in Warren County, Kentucky. The Item Number is 3-16.00. The study was held at the KYTC offices in Frankfort, KY on October 31 – November 2, 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 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. A full listing of the creative ideas that were identified is in Appendix D.

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.

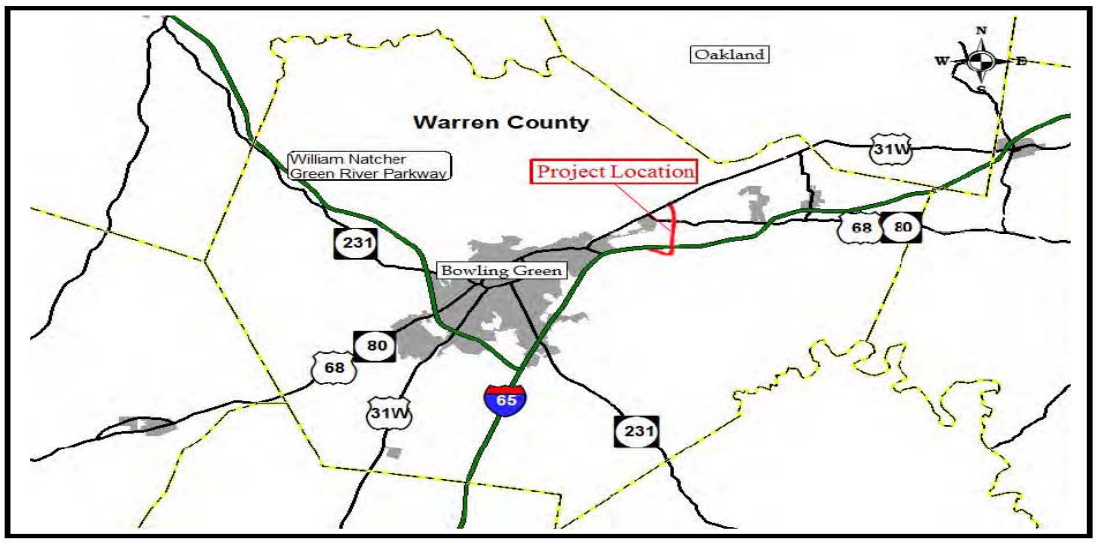
A. Introductory Information
    Section 1- Introduction
    Section 2- Project Description
B. Primary Body of Results
    Section 3- Recommendations and Design Comments
C. Supporting Documentation
    Appendices

SECTION 2 – PROJECT DESCRIPTION

The proposed project will construct a new connector route from Interstate 65 (I-65) to US-31W, on the north side of Bowling Green, Kentucky in Warren County. The project begins with construction of a new "trumpet" style interchange with I-65 near MP 30.6 (just north of the abandoned southbound rest area), then proceeds northeast 2.8 miles to intersect with US-31W. A new half diamond interchange will be constructed on the Connector at US68/KY80, approximately 1.7 miles northeast of the new interchange with I-65.

The project study area is located northeast of the Bowling Green Central Business District (CBD) and includes some of the incorporated limits of Bowling Green, unincorporated portions of Warren County, and incorporated portions of Oakland, a small community northeast of Bowling Green. Specifically, the study area for this project is a pie-shaped area extending from the northeast portion of Bowling Green east to include the US-31W, US68/KY80, and I-65 corridors.

Map of Project Location



PROJECT LOCATION MAP
I-65 to US31W Connector
Item No. 3-16.00
Warren County, KY

The purpose of the project is to meet the existing and future transportation demands including the need for improved access between US-31W and I-65, and improved roadway capacity and safety conditions. Recently this area has experienced a new surge in development, which has contributed to increased congestion and higher crash rates. The needs for the project are based on the following reasons:

- Improve access between US-31W and I-65. The amount, pace, and type of development (i.e., with a regional draw) that has occurred within the study area, and is planned to occur in the near future, there is a need to improve the connection between US-31W and I-65.

- A community's road network functions more efficiently and effectively when the connections and linkages between the major roads adequately meet the travel demands. A well-connected network gives drivers options, which 1) reduces chokepoints and bottlenecks, and the congestion and congestion-induced crashes associated with them, and 2) improves overall efficiency and reduction in fuel consumption and travel time. Within the study area, the type of recent and planned growth, especially within the Kentucky Transpark, has a regional influence and draw, attracting employees and shipping goods through a multi-county and multi-state area via I-65. The existing industrial, commercial, residential, and educational facilities along US-31W, and US68/KY80 are only accessible to and from the interstate via three interchanges within a ten mile stretch: the KY 446 interchange (Exit 28), a half interchange in Oakland (Exit 36) and an interchange in Smiths Grove (Exit 38). Southbound I-65 traffic cannot exit at US68/KY80 in Oakland. Additional interstate access in the study area would improve travel efficiency (i.e., travel time and costs), and improve both the capacity and safety of the existing roads.

- Improve transportation capacity. Existing and proposed development in the area is forecasted to increase traffic congestion on US-31W, US68/KY80 and KY446. In 2006, the average daily traffic (ADT) on I-65 was about 48,700 vehicles per day (VPD). Traffic on US-31W ranged from 7,200 in the rural area to the northeast to 22,900 VPD in the urban area near KY 446. Traffic on US68/KY80 was 4,930 VPD, and traffic on KY 446 was 17,800 VPD. By the year 2030, traffic on I-65 is estimated to increase to 73,220 VPD, on US-31W volumes will range from and 24,130 to 38,580 VPD, traffic on US68/KY80 will be 10,160 VPD, and volumes on KY 446 will reach 46,480 VPD, respectively. These numbers, which assume no highway project will be built (i.e., the No Build option), indicate increases in traffic volumes, increases in congestion, and decreases in Levels of Service (LOS).

- Improve safety. Based on a study of the most recent crash data, sections of each of the major highways have a statistically high crash rate (i.e., a critical rate factor greater than 1.0). One of the more notable high crash areas is along US-31W in the community of Bristow, which has a mix of land uses including apartments, homes, churches, schools and commercial areas. The high volume and mix of traffic in Bristow contribute to the high crash rate and affects the community. Without any improvements to the roadways, safety is expected to decrease as development and congestion increase in the future.

The goals for this project, which are in addition to the purpose and needs, are as follows: Support the community's existing, planned, and approved economic development initiatives identified in the study area while avoiding and minimizing impacts to the natural, cultural, and human environment

During the alternatives screening process, the travel projections indicated the preferred alternative would attract more vehicles and heavy trucks from the high crash and high congestion area of US-31W, which also

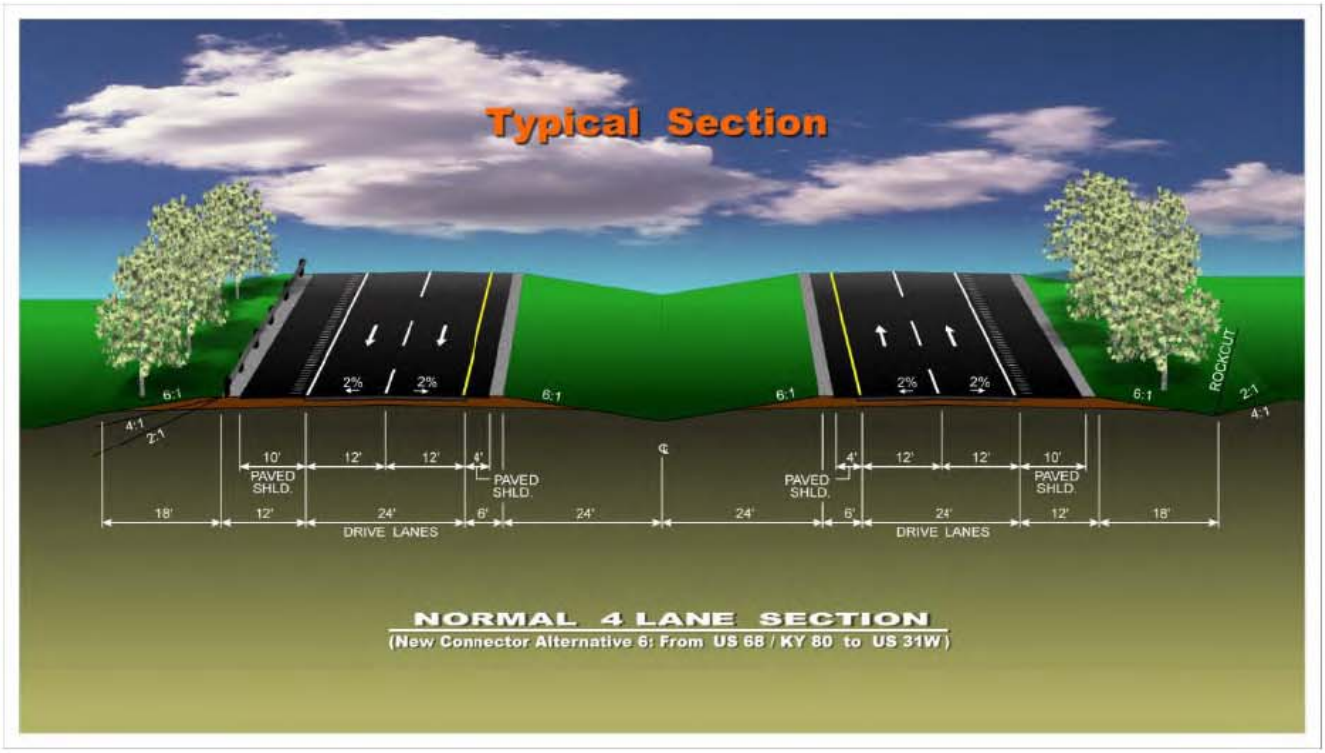
has a mix of land uses that include residential, commercial, churches, and schools that form the community of Bristow. The preferred alternative would therefore improve overall levels of service and safety better than the other build alternatives. Further, the preferred alternative would be the most cost effective in regard to reducing vehicle-hours of travel (VHT) and, it would improve access to I-65 and US-31W, while also providing access to US68/KY80.

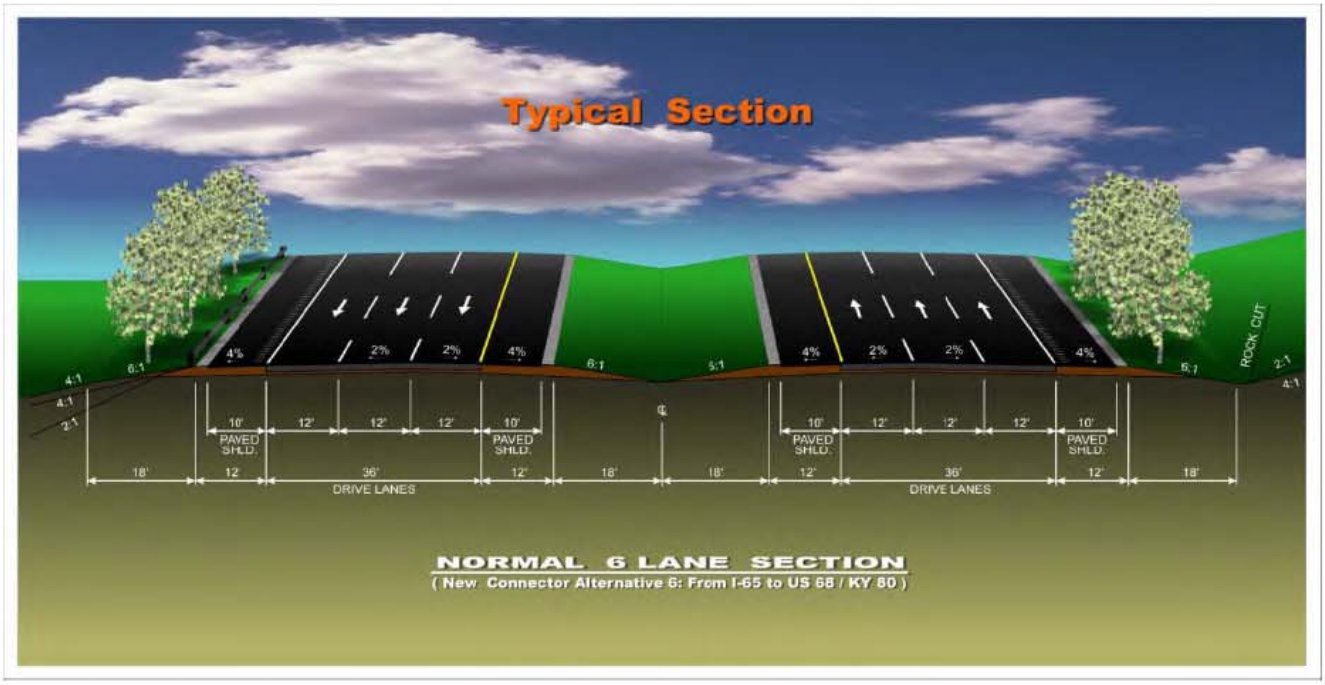
In conclusion, the preferred alternative has been recommended primarily because it would serve traffic needs better than the other alternatives, its alignment is the new corridor option farthest from the Mill Cave entrance, and its alignment is the only alternative option that received a "not likely to adversely affect" determination from U.S. Fish and Wildlife Service (USFWS) for possible impacts to the protected gray bat.

As the project moves into more detailed design, the possibility of phasing construction of the project will be considered. Potentially, the first phase would construct the section of roadway from a new I-65 interchange north to US68/KY80. That section is projected to have a year 2030 ADT of 47,460 VPD (LOS C). The second phase would continue the roadway north to US-31W. That section is projected to have less traffic—a projected (2030) ADT of 6,080 VPD. That section could be constructed at a later date, as traffic volumes dictate. The determination regarding phasing of construction and intersection/interchange configuration at US68/KY80 will be made during the final design stage of this project.

The typical section of the new connector, from US68/KY80 to US-31W, is a 4 lane section with 12 ft. lanes. There are 12 ft. outside shoulder (10 ft. paved) and 6 ft. inside shoulders (4 ft. paved) with a 48 ft. depressed grass median in-between.

The typical section of the new connector, from I-65 to US68/KY80, is a 6 lane section with 12 ft. lanes. There are 12 ft. outside shoulder (10 ft. paved) and 6 ft. inside shoulders (4 ft. paved) with a 48 ft. depressed grass median in-between. The figures on the following page display the typical sections described here.





TYPICAL SECTIONS
I-65 TO US31W CONNECTOR
Item No. 3-16.00
Warren County, Kentucky

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.

VALUE ENGINEERING RECOMMENDATION # VE-1

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W.

ORIGINAL DESIGN:
The original design specifies a total of four travel lanes for the Connector between US68/KY80 to US-31W (northern section).

RECOMMENDED CHANGE:
The VE Team recommends the total number travel lanes to be reduced to two in the northern section. At Ramp 5A, there would be a two lane exit; the rightmost lane on the Connector would be an exit only lane and the center lane would have the option of continuing straight or exiting. The leftmost lane would be straight only. North of Ramp 5A, the two northbound lanes would merge into a single lane. Ramp 7A design would be two lanes and continue without merge along the one lane from the north to form three lanes.

The two lanes would align to cross Commonwealth Boulevard approximately on the location of the northbound bridge of the Original Design.

ADVANTAGES:
- Reduces earthwork
- Reduces pavement
- Reduces right-of-way
- Reduces impervious surface and stormwater runoff
- Right sizes the project for traffic needs
- Reduces bridge widths

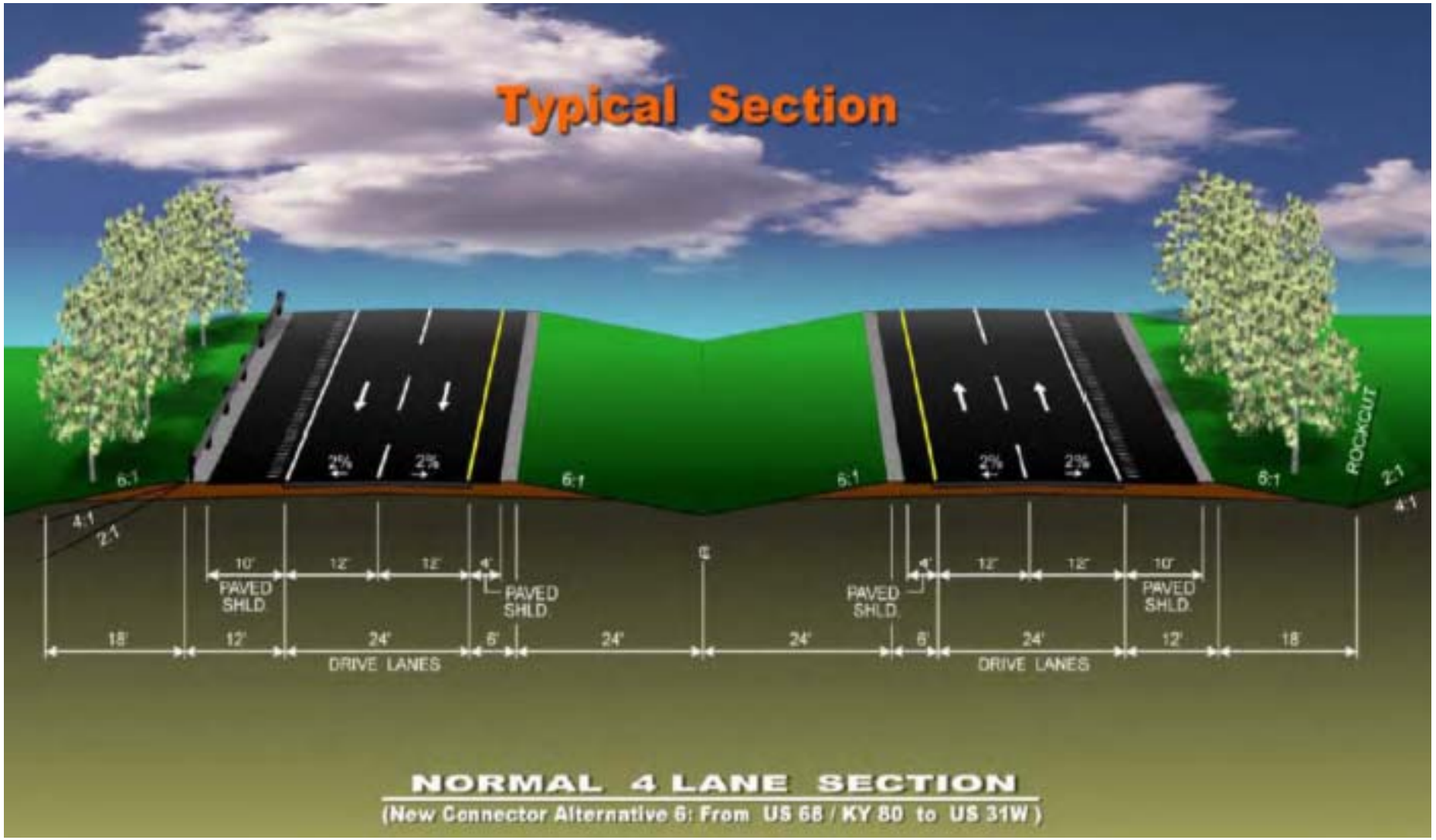
DISADVANTAGES:
- None

JUSTIFICATION:
The projected traffic volumes warrant a smaller number of lanes in the northern section. Preliminary capacity calculations show that two through lanes can accommodate traffic adequately. The costs can be reduced significantly while still meeting the basic needs of the project.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$8,194,000	$0	$8,194,000
RECOMMENDED DESIGN	$3,027,000	$0	$3,027,000
ESTIMATED SAVINGS OR (COST)	$5,167,000	$0	$5,167,000

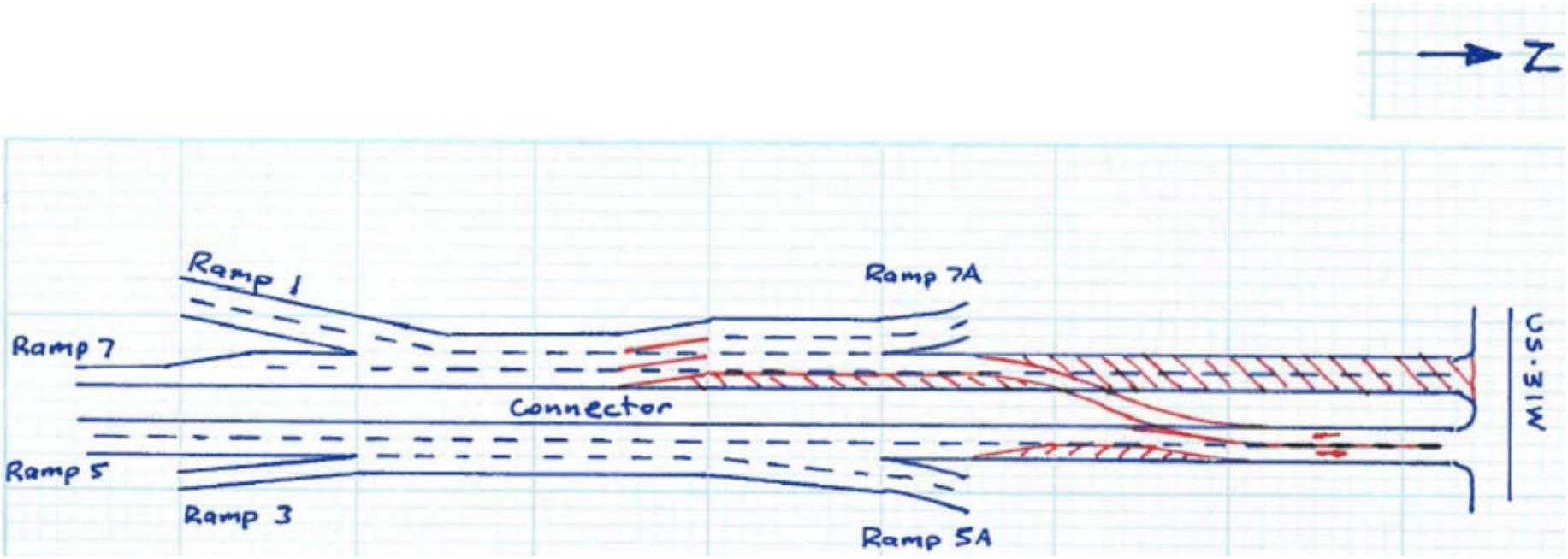
VALUE ENGINEERING RECOMMENDATION # VE-1

SKETCH OF ORIGINAL DESIGN



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 $
Pavement (SB side)	SY	$60.00	1	32,778	$1,966,680		
Pavement (crossover)	SY	$60.00	1			3,667	$220,020
SB Bridge over US68/KY80	SF	$100.00	1	41,844	$4,184,400	18,829	$1,882,900
SB Bridge over Commonwealth	SF	$100.00	1	18,480	$1,848,000	9,240	$924,000
Right-of-way	ac	$15,000	1	13	$195,000		
Earthwork (not calculated)							
Total					$8,194,080		$3,026,920

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-2

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 4 ultimate lanes in lieu of 6 ultimate lanes from I-65 to US68/KY80 and utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W.

ORIGINAL DESIGN:
The original design specifies the road to contain a total of six travel lanes for the Connector between I-65 and US68/KY80 (southern section). It also specifies a total of four travel lanes for the Connector between US68/KY80 to US-31W (northern section).

RECOMMENDED CHANGE:
The VE Team recommends the total number travel lanes to be reduced to four in the southern section and two in the northern section. Ramp 5 traffic would merge with the two lanes on Ramp 7 to form two lanes on the northbound Connector. At Ramp 5A, there would be a two-lane exit; the rightmost lane on the Connector would be an exit only lane and the leftmost lane would have the option of continuing straight or exiting.

Ramp 7A design would remain essentially the same as the Original Design; however, there would only be a single lane coming from the north. At I-65, the rightmost lane of the Connector would exit to Ramp 1 (southbound). The leftmost lane will widen to two lanes; the leftmost will lead to Ramp 7 and the rightmost will lead to Ramp 1.

ADVANTAGES:
- Reduces earthwork
- Reduces pavement
- Reduces right-of-way
- Reduces impervious surface and stormwater runoff
- Right sizes the project for traffic needs
- Reduces bridge widths

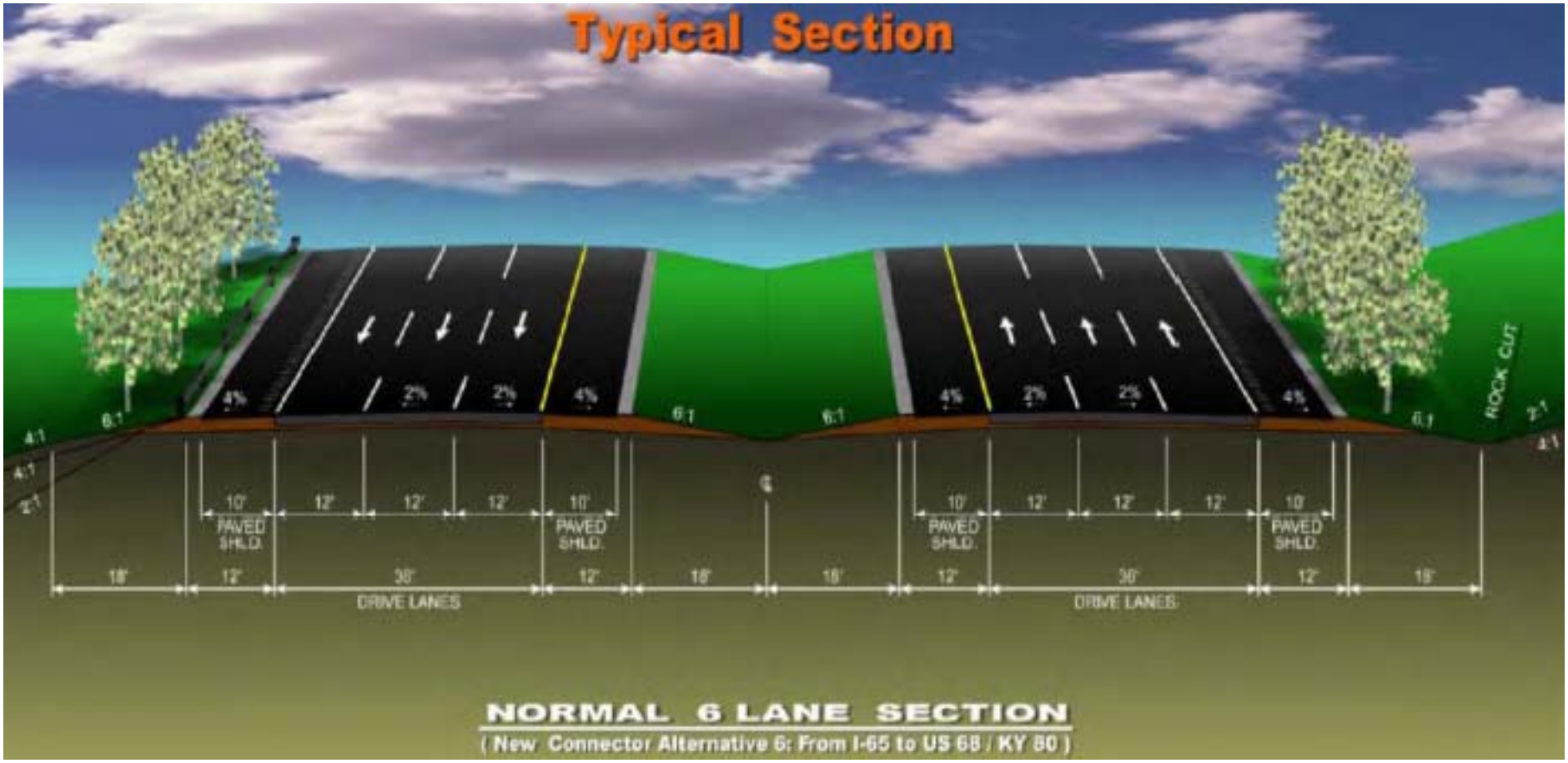
DISADVANTAGES:
- Reduced level of service

JUSTIFICATION:
The projected traffic volumes warrant a smaller number of lanes in both sections. Preliminary capacity calculations show that through lanes can accommodate traffic adequately. The costs can be reduced significantly while still meeting the basic needs of the project.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$18,011,000	$0	$18,011,000
RECOMMENDED DESIGN	$10,392,000	$0	$10,392,000
ESTIMATED SAVINGS OR (COST)	$7,619,000	$0	$7,619,000

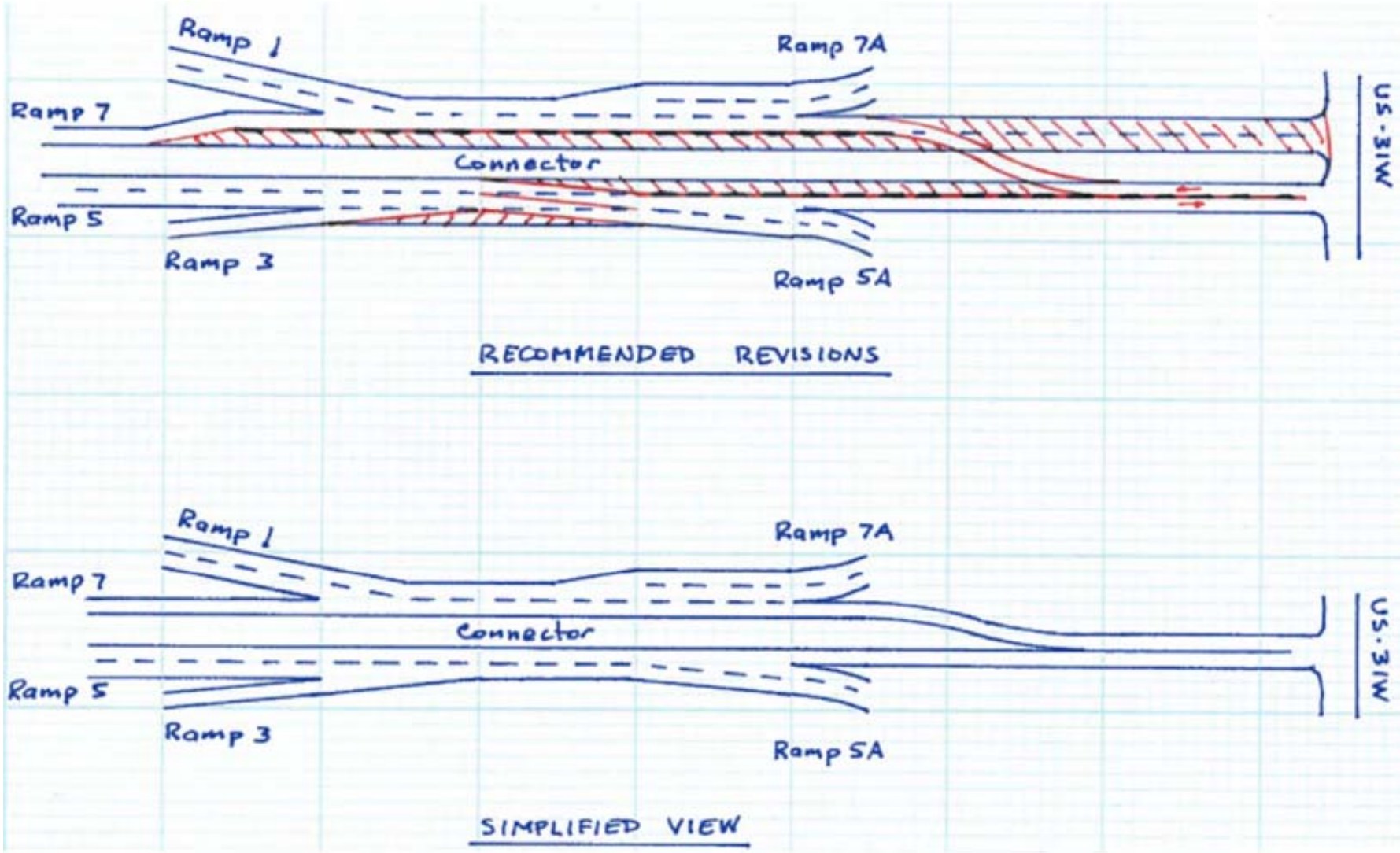
VALUE ENGINEERING RECOMMENDATION # VE-2

SKETCH OF ORIGINAL DESIGN



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 $
Right-of-way	ac	$15,000	1	13	$195,000		
Pavement (mainline)	SY	$60.00	1	47,888	$2,873,280		
Pavement (crossover)	SY	$60.00	1			3,667	$220,020
SB Bridge over US68/KY80	SF	$100.00	1	41,844	$4,184,400	18,829	$1,882,900
SB Bridge over Commonwealth	SF	$100.00	1	18,480	$1,848,000	9,240	$924,000
Bridge over SB I-65	SF	$100.00	1	32,208	$3,220,800	24,156	$2,415,600
Kelly Road Bridge	SF	$100.00	1	14,060	$1,406,000	13,076	$1,307,600
Bridge over CSX RR	SF	$100.00	1	42,840	$4,284,000	36,414	$3,641,400
Earthwork (not calculated)							
Total					$18,011,480		$10,391,520

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-3

DESCRIPTIVE TITLE OF RECOMMENDATION:
Eliminate the section of the project between US68/KY80 and US-31W and create an at-grade intersection at US68/KY80.

ORIGINAL DESIGN:
The original design specifies the Connector contain four travel lanes between US68/KY80 and US-31W (northern section) with a half interchange at US68/KY80.

RECOMMENDED CHANGE:
The VE Team recommends the northern section be eliminated and the interchange be converted to an at-grade intersection with US68/KY80. This can be done using one of two approaches:

a. Build the ramps as designed, forming two intersections at the ramp terminals
b. End the Connector at US68/KY80, forming a single T intersection.

Also, enter into a Memorandum of Understanding (MOU) with the Transpark board to preserve the right-of-way until the need for extending the roadway to the north is warranted.

ADVANTAGES:

- Reduces earthwork, pavement and structures
- Does not divide Transpark
- Minimizes right-of-way impacts to Transpark
- Allows for future construction of the northern section, as needs warrant

DISADVANTAGES:

- Maintenance of Traffic (MOT) at US68/KY80 if the northern section is built in the future

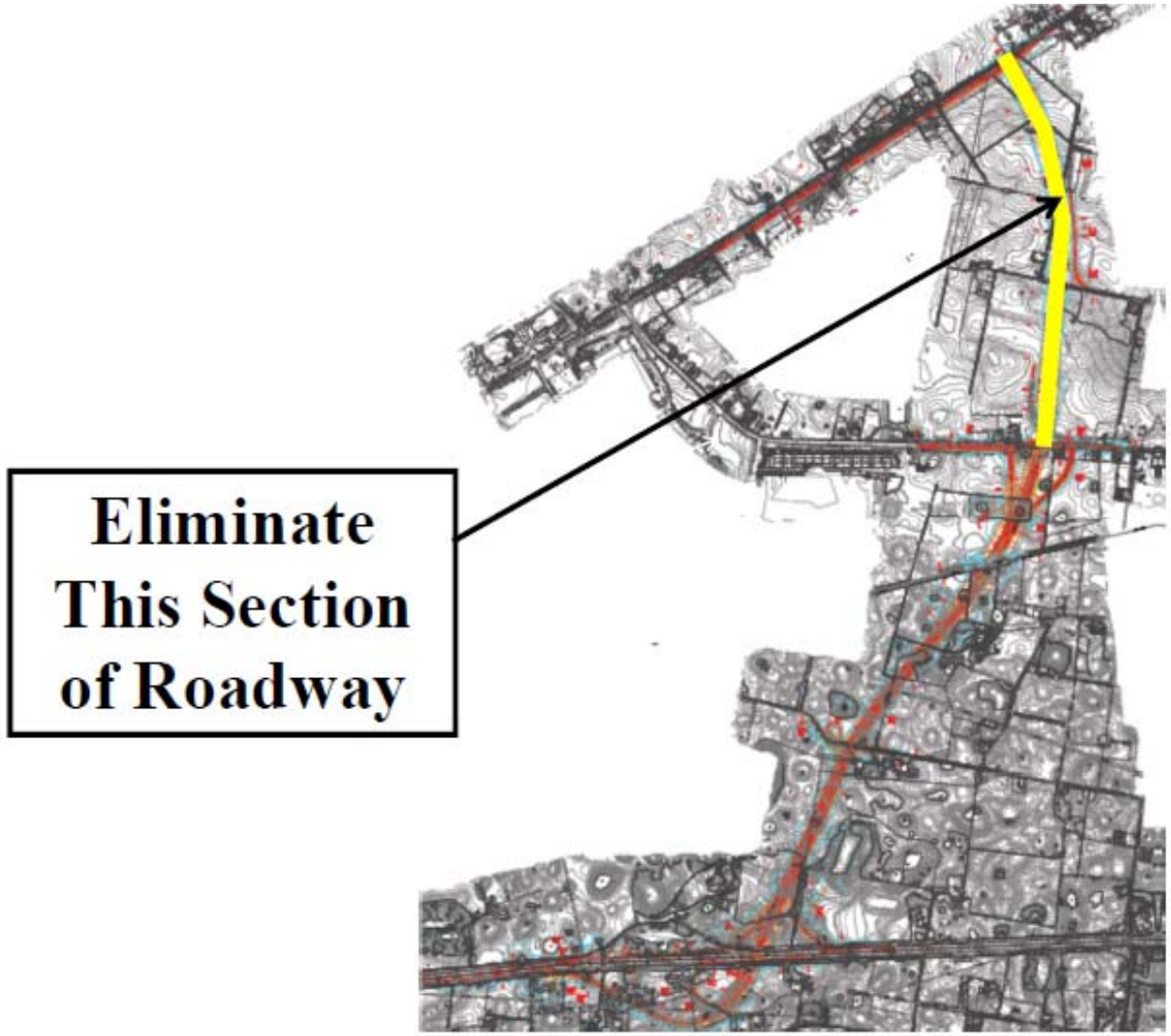
JUSTIFICATION:
One of the documented needs for the project is to improve access between US-31W and I-65. By implementing this VE recommendation, that need is still met by providing the connection between US-31W and I-65 via the Connector and US68/KY80. The projected volumes traveling north of US68/KY80 are relatively small and can be easily accommodated in the intermediate future without the northern section. This will result in significant construction and right-of-way savings. Note that with three lanes entering US68/KY80, no more than two of those lanes will be able to turn right into Transpark. This essentially frees the leftmost lane for vehicles traveling to US-31W.

Creating a MOU will keep building construction out of the future roadway right-of-way limits without expending transportation funds at this time.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$10,599,000	$0	$10,599,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$10,599,000	$0	$10,599,000

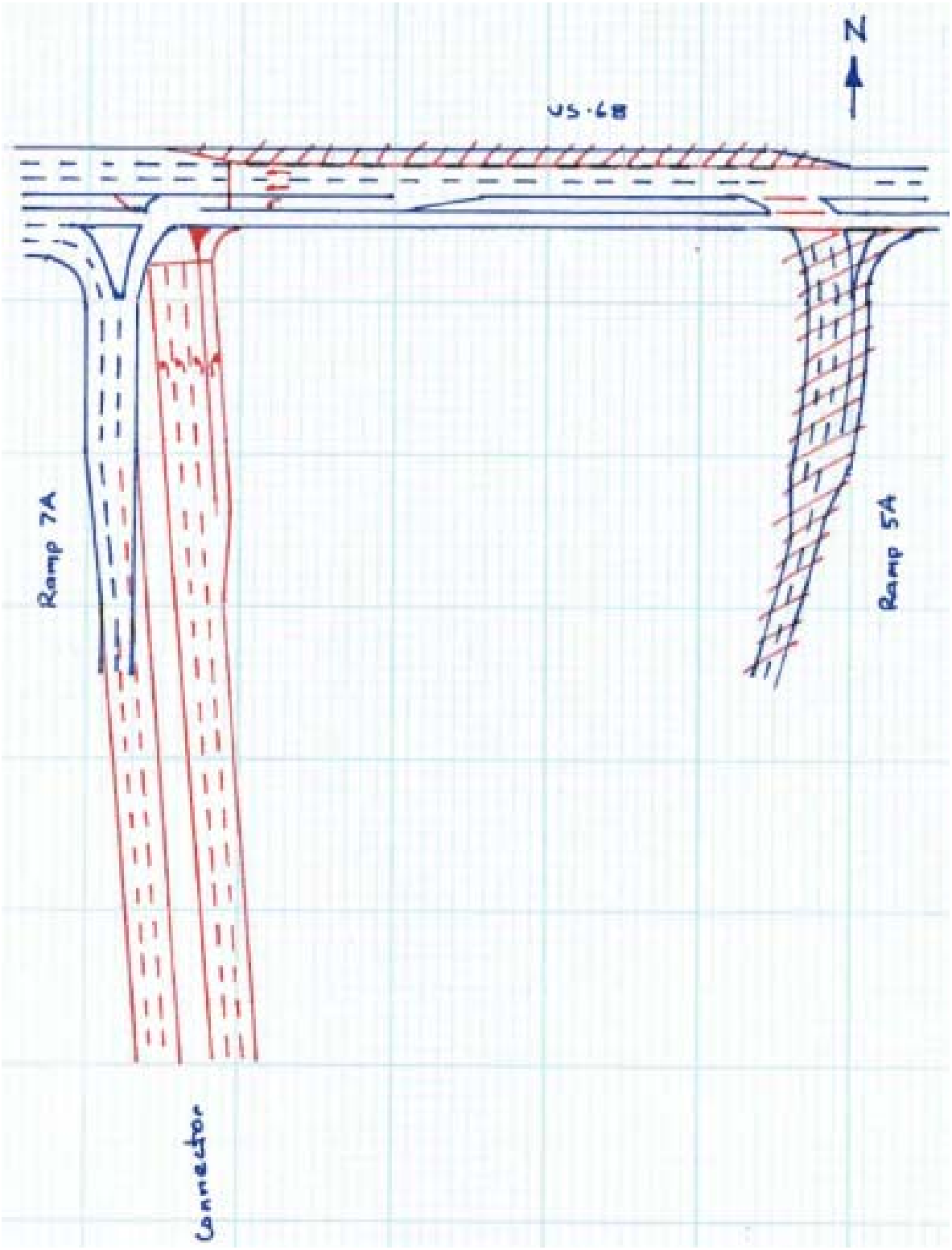
VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF RECOMMENDED DESIGN



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 $
Right-of-way	ac	$15,000	1	60	$900,000		
Pavement (northern section)	SY	$60.00	1	55,777	$3,346,620		
Pavement (Mizpah Road)	SY	$60.00	1	5,333	$319,980		
Bridge over US68/KY80	SF	$100.00	1	41,844	$4,184,400		
Bridge over Commonwealth Boulevard	SF	$100.00	1	18,480	$1,848,000		
Earthwork (not calculated)							
Total					$10,599,000		$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

VALUE ENGINEERING RECOMMENDATION # VE-4

DESCRIPTIVE TITLE OF RECOMMENDATION:
Eliminate the section of the project between US68/KY80 and US-31W. Reconfigure an at-grade intersection to "T" the eastern portion of US68/KY80.

ORIGINAL DESIGN:
The original design specifies the Connector contain four travel lanes between US68/KY80 and US-31W (northern section) with a half interchange at US68/KY80.

RECOMMENDED CHANGE:
The VE Team recommends the northern section be eliminated and the interchange be converted to an at-grade intersection with US68/KY80. US68/KY80 would be reconfigured so the eastern portion would form a T intersection at the Connector and the Connector would flow directly into the western portion of US68/KY80.

ADVANTAGES:
- Eliminates one potential signal and need for coordination
- Better facilitates the main traffic movements
- Better traffic flow
- Reduces earthwork, pavement and structures
- Does not divide Transpark
- Minimizes right-of-way impacts to Transpark
- Allows for future construction of the northern section, as needs warrant

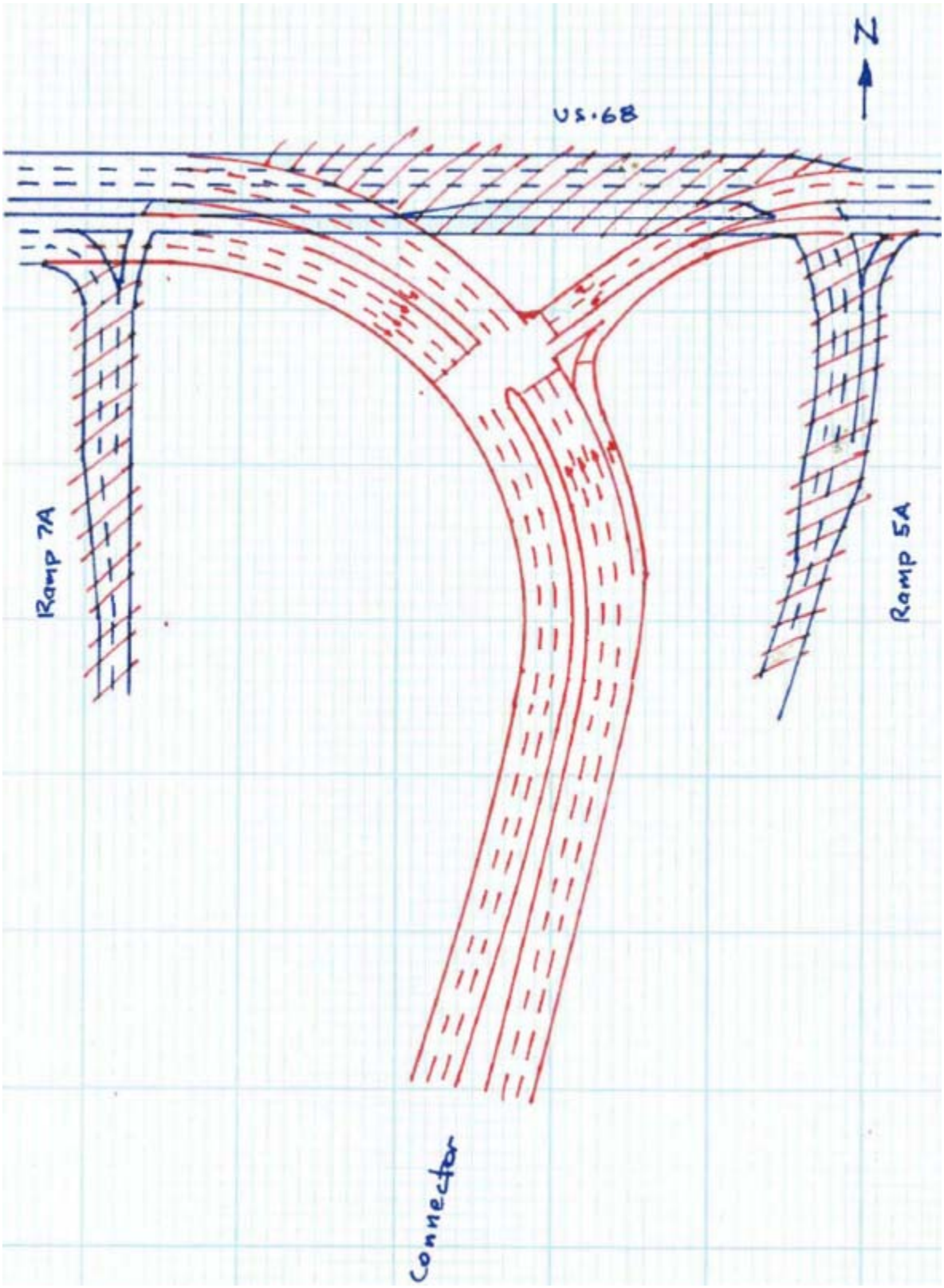
DISADVANTAGES:
- Increases the number of phases for one signal

JUSTIFICATION:
One of the documented needs for the project is to improve access between US-31W and I-65. By implementing this VE recommendation, that need is still met by providing the connection between US-31W and I-65 via the Connector and US68/KY80. The projected volumes traveling north of US68/KY80 are relatively small and can be easily accommodated in the intermediate future without the northern section. This will result in significant construction and right-of-way savings. Note that with three lanes entering US68/KY80, no more than two of those lanes will be able to turn right into Transpark. This essentially frees the leftmost lane for vehicles traveling to US-31W.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$10,599,000	$0	$10,599,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$10,599,000	$0	$10,599,000

VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF RECOMMENDED DESIGN



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 $
Right-of-way	ac	$15,000	1	60	$900,000		
Pavement (northern section)	SY	$60.00	1	55,777	$3,346,620		
Pavement (Mizpah Road)	SY	$60.00	1	5,333	$319,980		
Bridge over US68/KY80	SF	$100.00	1	41,844	$4,184,400		
Bridge over Commonwealth Boulevard	SF	$100.00	1	18,480	$1,848,000		
Earthwork (not calculated)							
Total					$10,599,000		$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-5

DESCRIPTIVE TITLE OF RECOMMENDATION:
End the widening and reconstruction of US-31W at Commonwealth Boulevard.

ORIGINAL DESIGN:
The original design specifies widening to four lanes US-31W from where the current four lanes end to the location of the new Connector.

RECOMMENDED CHANGE:
The VE Team recommends ending the widening of US-31W at Commonwealth Boulevard and then tying into the existing two lane road east of Commonwealth Boulevard. The VE Team also recommends the construction of a roundabout at Commonwealth Boulevard.

ADVANTAGES:

- Reduced earthwork, pavement
- Reduced right-of-way impacts and cost
- Addresses traffic needs to access Transpark
- Eliminates need for signal at Commonwealth Boulevard
- Better traffic operations at intersection
- Traffic calming affects in urbanizing area

DISADVANTAGES:

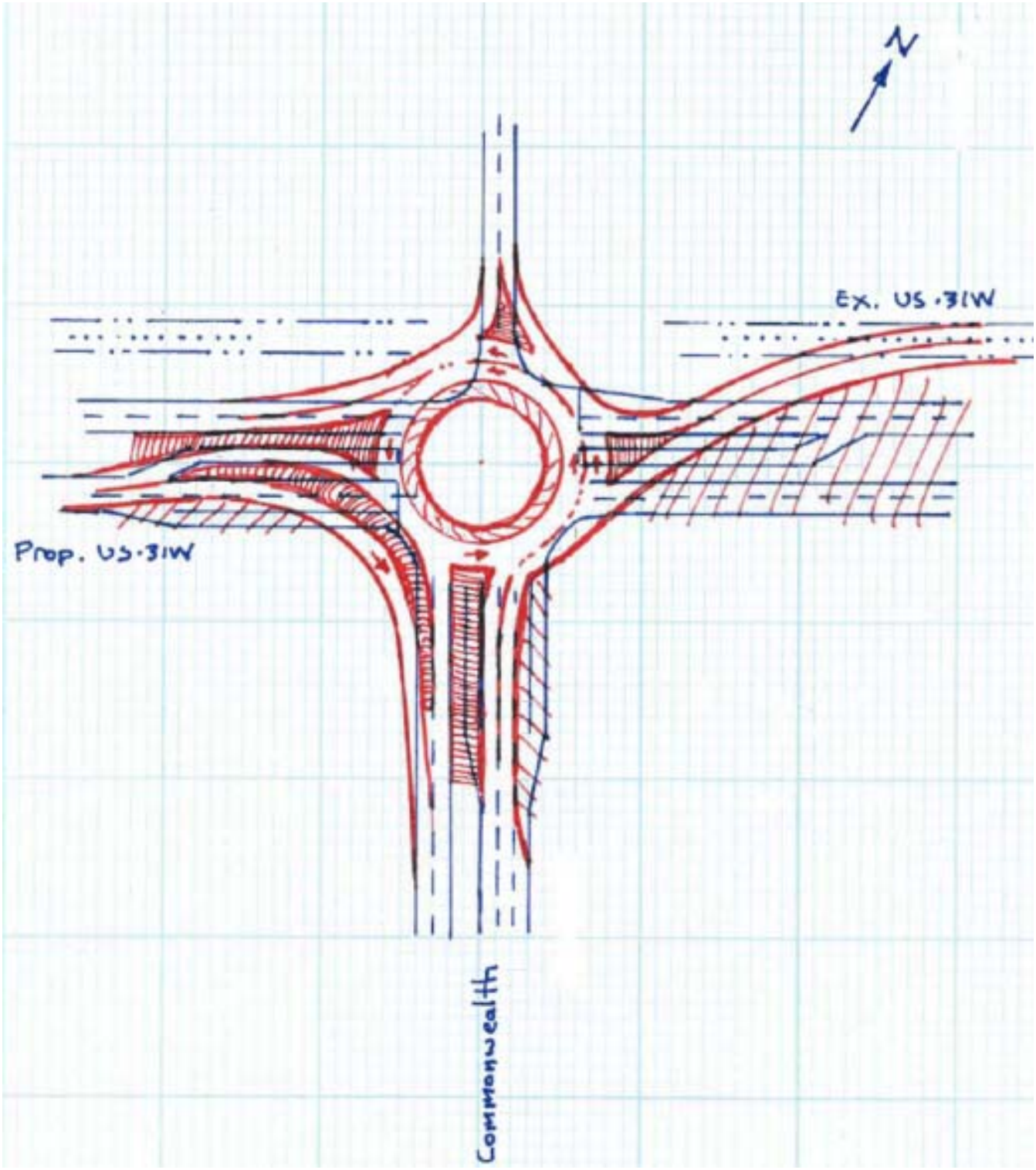
- None

JUSTIFICATION:
The recommendation eliminates the need to reconstruct and widen approximately 4,000 feet of US-31W. Just widening US-31W to the entrance of Transpark at Commonwealth Boulevard allows for higher traffic capacity and traffic flow where it is most needed, meeting the purpose and need identified in the Record of Decision while reducing the cost.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,978,000	$0	$1,978,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$1,978,000	$0	$1,978,000

VALUE ENGINEERING RECOMMENDATION # VE-5

SKETCH OF RECOMMENDED DESIGN



Transition from 4 lane widened section to 2 lanes existing alignment at Commenwealth Boulevard

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 $
Right-of-way	ac	$15,000	1	11	$165,000		
Pavement	SY	$60.00	1	30,222	$1,813,320		
Earthwork (not calculated)							
Total					$1,978,320		$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 #2

VALUE ENGINEERING RECOMMENDATION # VE-6

DESCRIPTIVE TITLE OF RECOMMENDATION:
Increase beam spacing to eliminate beam lines, where applicable.

ORIGINAL DESIGN:
The original design specifies beams spacing on the order of 8'-0" for all of the structures in the project limits with the exception of the Connector Road over CSX that utilizes beam spacing of approximately 9'-10". The structures utilize various beam types including Types 3, 4 and 5. The overhangs on the bridges are generally around 2'-6". All structures show multiple beam lines of 5 or more with the exception of the Kelley Road overpass that has 4 beam lines. The deck thicknesses shown are the KYTC minimum of 8".

RECOMMENDED CHANGE:
The VE Team recommends increasing beam spacing to eliminate beam lines where possible. The VE Team believes this is a practical alternate at all locations with the exception of the Kelly Road overpass. Reduction in beam lines at this structure would result in a superstructure supported by 3-beam lines which is not recommended. For the Connector Road over US68/KY80, the Connector Road over future Commonwealth Boulevard, and for the Connector Road over I-65 twin bridges, implementation of this policy would result in the reduction of one beam line per bridge.

ADVANTAGES:
- Reduction in the number of beam lines
- Takes full advantage of deck capacity
- Minimizes the number of picks required of the contractor
- Takes full advantage of deck capacity
- Reduces overall dead load of the superstructure resulting in less demand on substructures and foundations

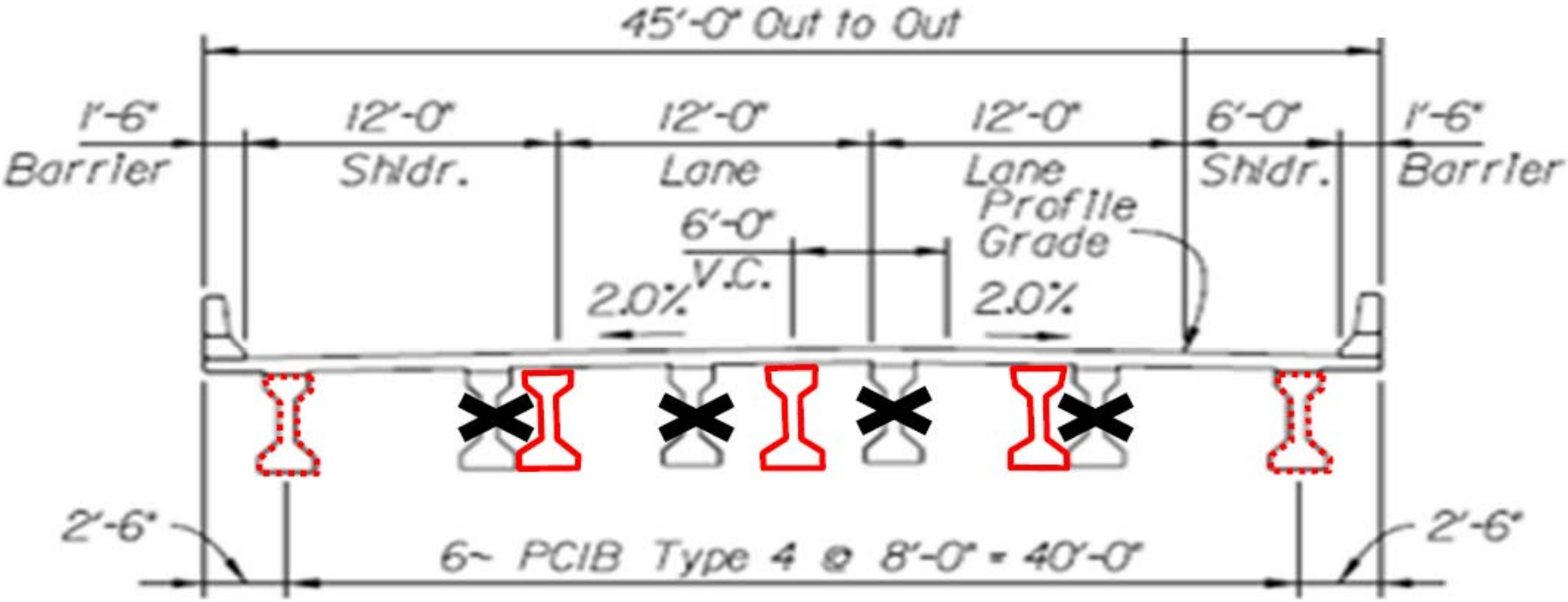
DISADVANTAGES:
- Increases structure depth by utilizing deeper beam sections
- May require thickening of the slab to accommodate greater deck spans

JUSTIFICATION:
Utilizing fewer beam lines minimizes structure cost and superstructure dead load. An increase in girder depth may be required, but that extra depth can be accommodated as most of the structures have excess vertical clearance at their current elevations. The minimum deck thickness required by KYTC is 8". It is likely this deck can be designed to accommodate LRFD design loads.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$3,586,000	$0	$3,586,000
RECOMMENDED DESIGN	$3,308,000	$0	$3,308,000
ESTIMATED SAVINGS OR (COST)	$278,000	$0	$278,000

VALUE ENGINEERING RECOMMENDATION # VE-6

SKETCH OF RECOMMENDED DESIGN



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 $
Connector over US68/KY80							
Prestressed I-Beam, Types 3 & 5	LF	$234.39	1	4,955	$1,161,402		
Prestressed I-Beam Type 5	LF	$255.00	2			3,964	$1,010,820
Reinforced Concrete Deck	CY	$506.49	1	1,101	$557,645	1,136	$575,373
Connector over I-65							
Prestressed I-Beam Type 4	LF	$234.39	1	3,400	$796,926		
Prestressed I-Beam Type 5	LF	$255.00	2			2,720	$693,600
Reinforced Concrete Deck	CY	$506.49	1	756	$382,906	780	$395,062
Connector over Commonwealth Boulevard							
Prestressed I-Beam Type 4	LF	$234.39	1	1,980	$464,092		
Prestressed I-Beam Type 5	LF	$255.00	2			1,584	$403,920
Reinforced Concrete Deck	CY	$506.49	1	440	$222,856	453	$229,440
Note: Assumes an extra 1/4" deck thickness due to greater beam spacing, and assumes an increase of one beam size due to the increased spacing							
Total					$3,585,828		$3,308,215

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-7

DESCRIPTIVE TITLE OF RECOMMENDATION:
Move the radius of the railroad spur westward to reduce the bridge square footage and variable skew.

ORIGINAL DESIGN:
The original design spans both US68/KY80 and the rail spur at approximately the mid-point of Connector Road. The railroad spur radius occurs under the structure at this location. This curvature results in substructure units that vary greatly in skew and increases the total number of spans required. The total structure length including the north and south roadways is approximately 993 feet.

RECOMMENDED CHANGE:
The VE Team recommends moving the radius of the railroad spur outside of the bridge limits. Moving the radius as suggested would result in parallel alignments of US68/KY80 and the railroad under the bridge. The change would result in a four span bridge minimizing bridge length. The change would also result in the northbound and southbound structures being similar, and eliminate the widely varying skews on the existing layout. Finally the change would remove the use of different beam sizes on the same structure, the stepped pier seat, and the deck joint that may be a result of the different beam sizes.

ADVANTAGES:
- Reduces total bridge length
- Eliminates stepped beam seat at pier
- Eliminate widely varying skews
- Eliminate deck joint above change in beam section
- Results in identical left and right bridges, minimizes variable beam lengths within spans
- Eliminate change in beam depths within bridge limits

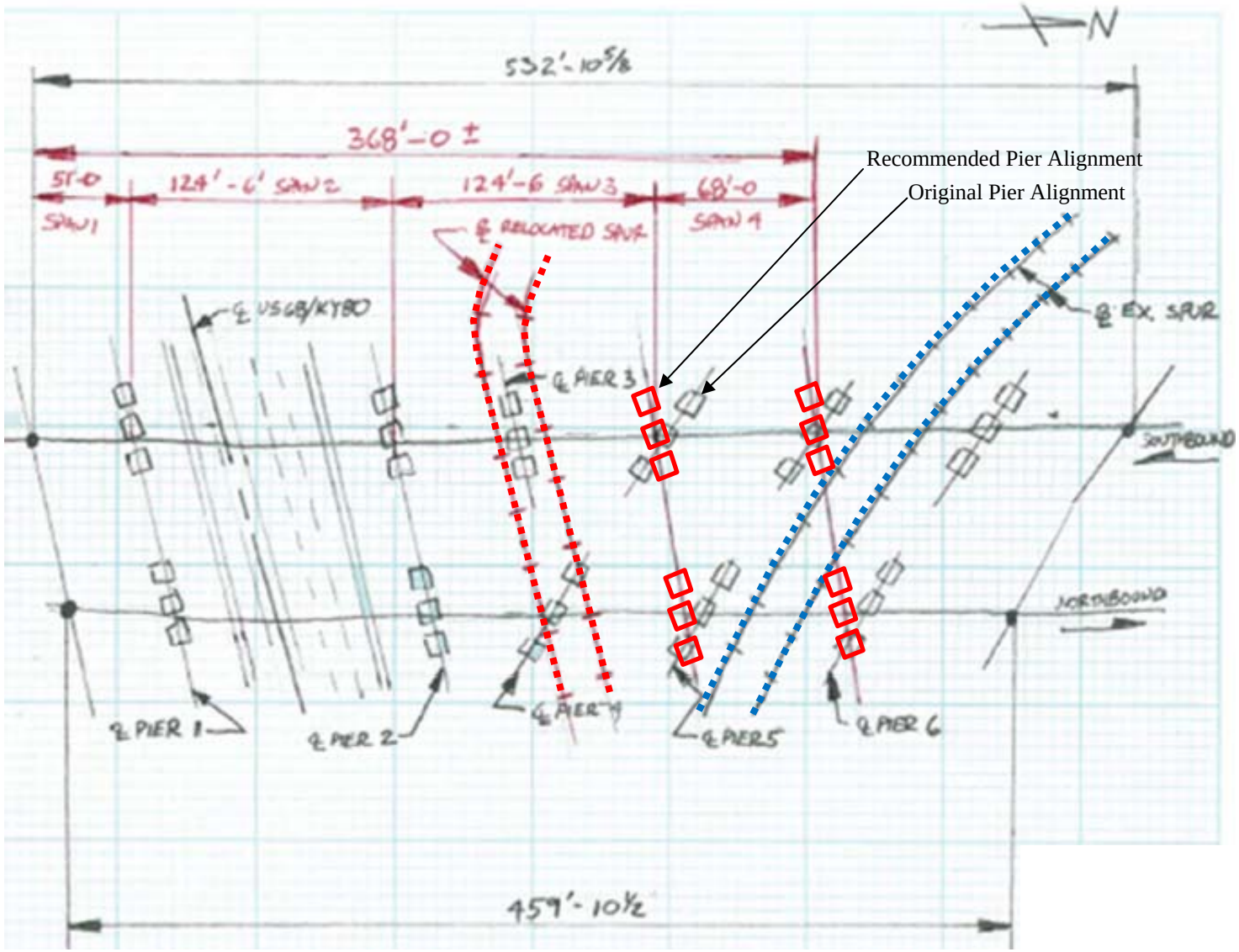
DISADVANTAGES:
- Requires moving a portion of the newly placed spur line
- May not be an accepted change in Transpark's master plan

JUSTIFICATION:
Moving the railroad spur radius outside the bridge limits has multiple benefits. A large reduction of total bridge results from shifting the radius. It also eliminates the variable beam depths within the bridge limits. This eliminates the stepped beam seats. It also would eliminate the joint above the beam step, removing the maintenance required at bridge deck joints. The current layout has variable length beams within the same span, resulting in poor manufacturing economy. The widely varying skews result in acute corners at the deck joint. These corners can cause in-use performance problems and often require extra detail and design effort.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$4,914,000	$0	$4,914,000
RECOMMENDED DESIGN	$3,989,000	$0	$3,989,000
ESTIMATED SAVINGS OR (COST)	$925,000	$0	$925,000

VALUE ENGINEERING RECOMMENDATION # VE-7

SKETCH OF RECOMMENDED DESIGN



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 $
Rail relocation	LF	$260.00	7			1,500	$390,000
Bridge	SF	$110.00	7	44,673	$4,914,030	32,715	$3,598,650
Note: Estimate of average cost per square foot of deck per KYTC Department Division of Structural Design							
Total					$4,914,030		$3,988,650

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:
Utilize mechanically stabilized earth (MSE) abutments on Bridges No. 1, 3, 4, and 5 in lieu of 2:1 spill through slopes.

ORIGINAL DESIGN:
The original design specifies tail spans with 2:1 slopes from approximate road elevation to the end-bent abutments at the Connector over I-65, CSX RR, US68/KY80, and Commonwealth Boulevard. The bridge deck area reductions are not the full length abutment to pier distance because the remaining span lengths over road or railroad needs to increase by six feet to account for the distance from MSE wall face to the proposed integral, semi-integral, or end-bent abutment behind it. The following shows the area of tail span at each of these bridges, minus the six feet just discussed.

Connector over I-65
South tail spans: 90' width x 70.5' span length = 6,345 SF
North tail spans: 90' width x 46.5' span length = 4,185 SF

Connector over CSX Railroad
South tail spans: 138' width x 90.5' span length = 12,489 SF
North tail spans: 138' width x 80.0' span length = 11,040 SF

Connector over US68/KY80 and Railroad Spur
South tail spans: 90' width x 45.0' span length = 4,050 SF
North tails spans: 90' width x 62.0' span length = 5,580 SF

Connector over Commonwealth Boulevard
South tail spans: 90' width x 37' slope length = 3,330 SF
North tail spans: 90' width x 32' slope length = 2,880 SF

RECOMMENDED CHANGE:
The VE Team recommends MSE walls at the location of the piers and/or bottom of slopes with integral, semi-integral, or end-bent abutments behind the MSE walls. This change will replace bridge deck area with pavement, eliminate slope paving, and replace embankment comprising the spill through slope with an estimated equal amount of road embankment behind the MSE wall, and add MSE wall with soil reinforcement and backfill. The abutments are assumed to remain similar in regards to foundation pile and concrete quantities when comparing the original design and recommended design.

The area of MSE wall is determined for Connector over bridges by multiplying northbound fascia to southbound fascia distance and height (low seat minus two feet and road elevation minus 6:1 slope minus frost depth) then adding 3:1 sloped MSE wall at each end. The fascia to fascia perpendicular distance is increased to account for the bridge skew if applicable. The area of MSE wall required at each bridge pier is summarized as follows:

Connector over I-65
South/North abutment: 152' width x (561'–2'–(540'–4'–3')) 26' height and 3:1 slope walls = 6,000 SF each

VALUE ENGINEERING RECOMMENDATION # VE-8

DISCUSSION CONTINUED

RECOMMENDED CHANGE (CONTINUED):

Connector over CSX Railroad

South abutment: 255' width x (576'–2'–(545'–3')) 32' height and 3:1 slope walls = 11,300 SF
North abutment: 255' width x (576'–2'–(548'–3')) 26' height and 3:1 slope walls = 8,700 SF

Connector over US68/KY80 and Railroad Spur

South abutment: 140' width x (569'–2'–(548'–4'–3')) 26' height and 3:1 slope walls = 5,700 SF
North abutment: 160' width x (580'–2'–(555'–4'–3')) 30' height and 3:1 slope walls = 7,400 SF

Connector over Commonwealth Boulevard

South abutment: 135' width x (581'–2'–(560'–3')) 22' height and 3:1 slope walls = 4,500 SF
North abutment: 135' width x (579'–2'–(560'–3')) 20' height and 3:1 slope walls = 3,900 SF

ADVANTAGES:

- Grade separation construction where new grade goes up creates ideal situation for MSE wall implementation
- Eliminates excess bridge
- Potential for simple single span structures at CSX Railroad and Commonwealth Boulevard in lieu of multi-span structures
- Bridge maintenance requirements in the long term is reduced because bridge area is reduced
- Widely used for new bridge overpass construction

DISADVANTAGES:

- If Connector is not built out to full width in the median, abutment widening because of foundation construction through MSE fill is difficult
- The MSE wall will be built along the full width of the Connector cross section, therefore creating a long wall
- MSE walls require protection at the base for train impacts, although this treatment is common for MSE walls
- For Kelly Road over Connector, this recommendation was applied and determined to be close to a wash or costs money therefore is not recommended

JUSTIFICATION:

Excess and unnecessary bridge is eliminated, which reduces construction budget in the short term and bridge maintenance costs and effort in the long term.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$13,787,000	$0	$13,787,000
RECOMMENDED DESIGN	$11,789,000	$0	$11,789,000
ESTIMATED SAVINGS OR (COST)	$1,998,000	$0	$1,998,000

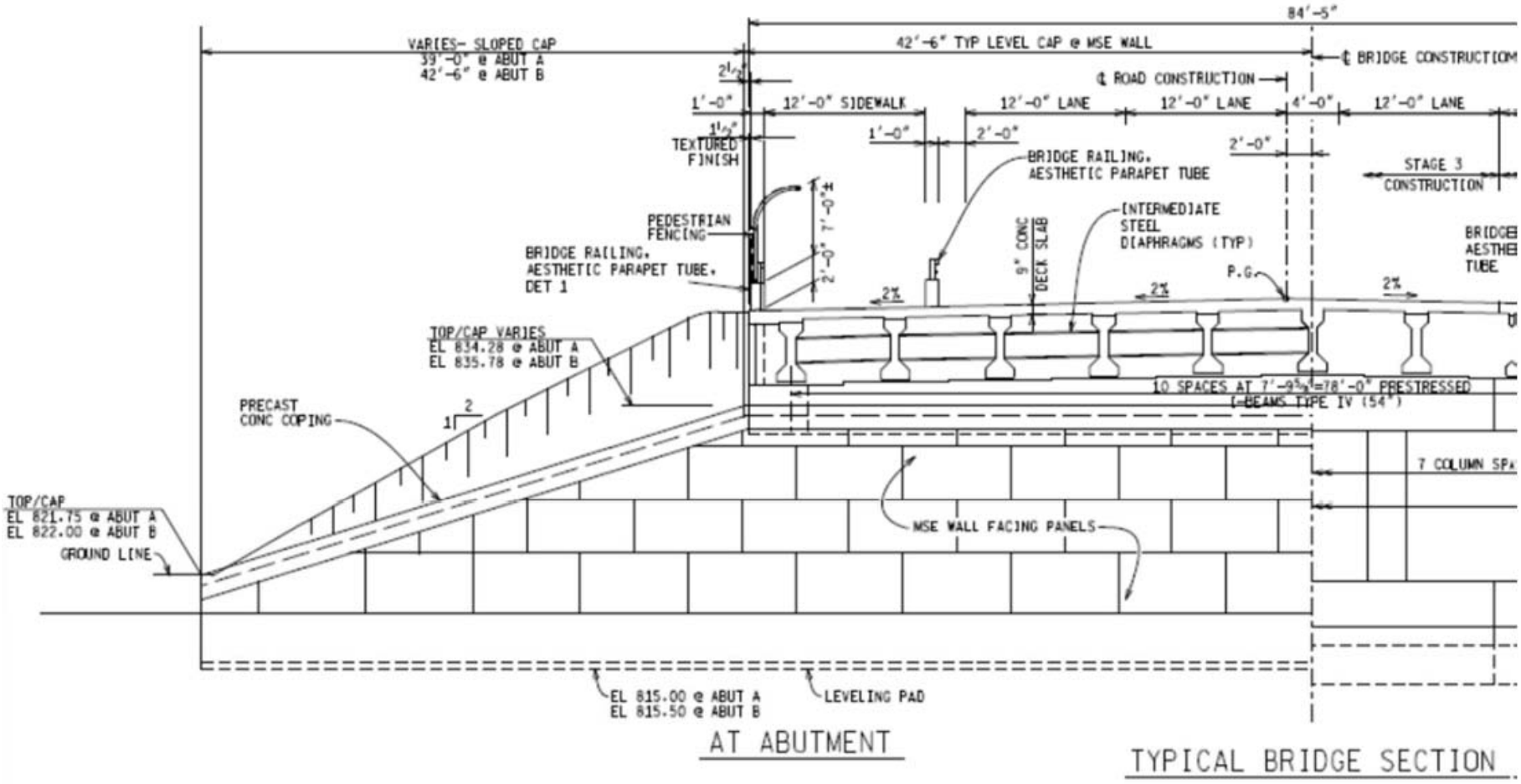
VALUE ENGINEERING RECOMMENDATION # VE-8

PHOTOGRAPHS OF ORIGINAL DESIGN

Typical Overpasses Depicting Original 2:1 Slope Design

VALUE ENGINEERING RECOMMENDATION # VE-8

SKETCH OF RECOMMENDED DESIGN



Example MSE Wall Design at Bridge Ends

VALUE ENGINEERING RECOMMENDATION # VE-8

PHOTOGRAPHS OF RECOMMENDED DESIGN

Typical Overpasses Depicting Recommended MSE Wall Design

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 $
Bridge No. 1 at I-65	SF	$100.00	1	32,208	$3,220,800	21,678	$2,167,800
MSE Wall	SF	$55.00	7			12,000	$660,000
Underbridge Slope Paving	SF	$5.00	7	10,530	$52,650		
Road Pavement	SF	$6.00	7			10,530	$63,180
Bridge No. 3 at CSX Railroad	SF	$100.00	1	42,840	$4,284,000	19,311	$1,931,100
MSE Wall	SF	$55.00	7			20,000	$1,100,000
Underbridge Slope Paving	SF	$5.00	7	23,529	$117,645		
Road Pavement	SF	$6.00	7			23,529	$141,174
Bridge No. 4 at US68/KY80	SF	$100.00	1	41,844	$4,184,400	32,214	$3,221,400
MSE Wall	SF	$55.00	7			13,100	$720,500
Underbridge Slope Paving	SF	$5.00	7	9,630	$48,150		
Road Pavement	SF	$6.00	7			9,630	$57,780
Bridge No. 5 at Commonwealth	SF	$100.00	1	18,480	$1,848,000	12,270	$1,227,000
MSE Wall	SF	$55.00	7			8,400	$462,000
Underbridge Slope Paving	SF	$5.00	7	6,210	$31,050		
Road Pavement	SF	$6.00	7			$6,210	$37,260
Total					$13,786,695		$11,789,194

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:
Utilize MSE walls with road pavement in lieu of bridge deck and piers from the north side of US68/KY80 to the south side of the railroad spur.

ORIGINAL DESIGN:
The original design specifies bridge between US68/KY80 and the railroad spur from a pier immediately north of US68/KY80 to a pier immediately south of the railroad spur. There are two spans of varying lengths on both the northbound and southbound structures within this area. The bridge deck area reductions are not from pier to pier because the remaining span lengths over US68/KY80 and railroad spur need to increase by six feet to account for the distance from MSE wall face to the proposed integral, semi-integral, or end-bent abutment behind it. The reduced bridge deck area is as follows.

Northbound bridge deck area:90’ width x (136’ average length minus 12’ or 124’) = 11,160 SF
Southbound bridge deck area:90’ width x (133’ average length minus 12’ or 121’) = 10,890 SF

RECOMMENDED CHANGE:
The VE Team recommends using MSE walls, road embankment, and road pavement between US68/KY80 and the railroad spur. The following is the area of MSE wall required at each of the piers immediately north of US68/KY80 and immediately south of the railroad spur.

The area of MSE wall is determined by multiplying northbound fascia to southbound fascia distance and height (low seat minus two feet and road elevation minus 6:1 slope minus frost depth) then adding 3:1 sloped MSE wall at each end. The fascia to fascia perpendicular distance is increased to account for the bridge skew. The area of MSE wall required at each pier is summarized as follows.

South pier: 140’ width x (573’–2’–(548’–4’–3’)) 30’ height and 3:1 slope walls = 7,000 SF
North pier: 160’ width x (577’–2’–(555’–4’–3’)) 27’ height and 3:1 slope walls = 6,500 SF

VALUE ENGINEERING RECOMMENDATION # VE-9

DISCUSSION CONTINUED

ADVANTAGES:

- Eliminate excess bridge
- Eliminate variable length spans
- Potential for two simple single span structures in lieu of one complex multi-span structure if abutments on opposite side of road or railroad treated in the same way
- Bridge maintenance requirements in the long term is reduced

DISADVANTAGES:

- If Connector is not built out to full width in the median, abutment widening because of foundation construction through MSE fill is difficult
- The MSE wall will be built along the full width of the Connector cross section, therefore creating a long wall
- MSE walls require protection at the base for train impacts, although this treatment is common for MSE walls

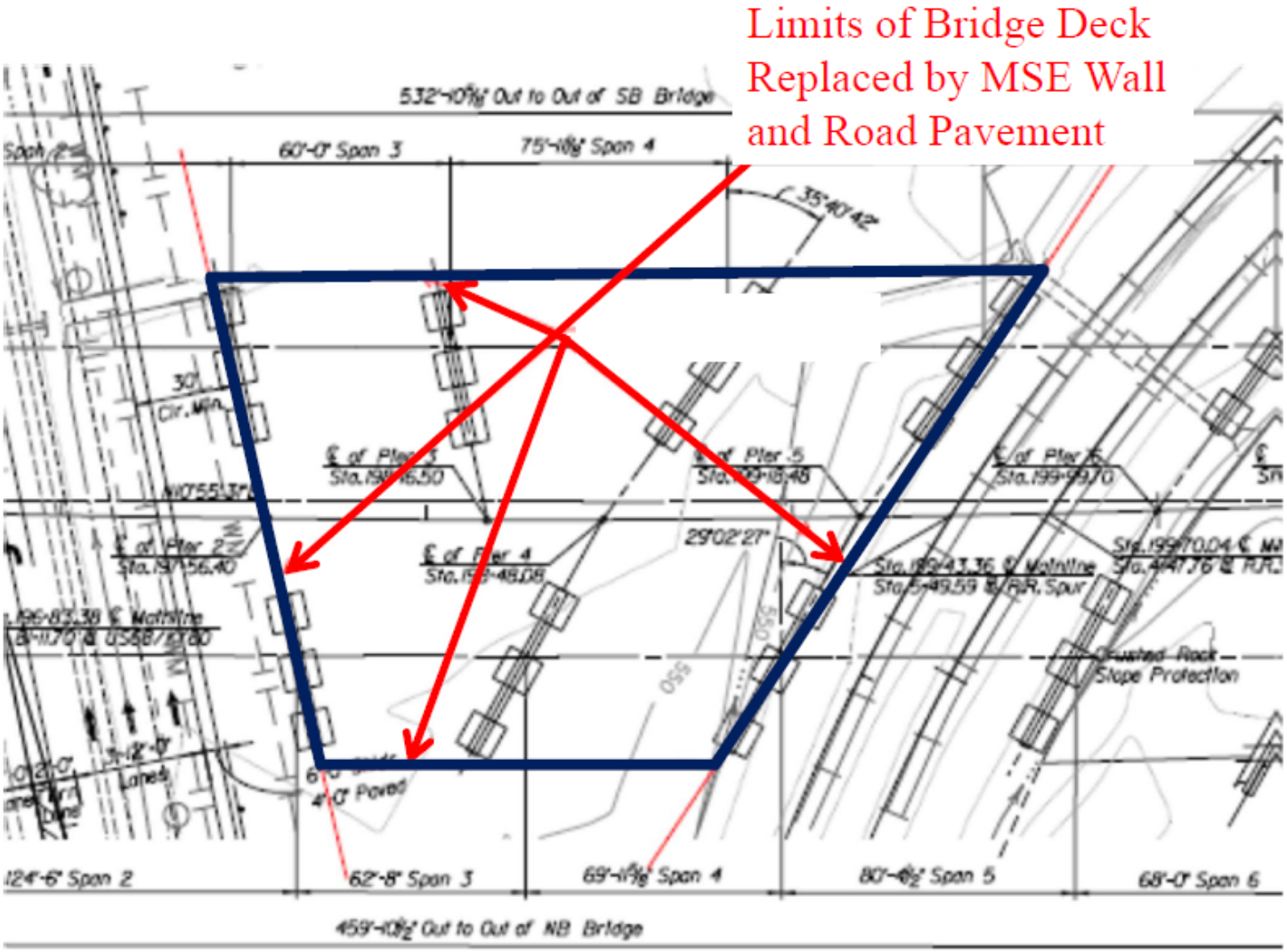
JUSTIFICATION:

Excess or unnecessary bridge is eliminated, which reduces construction budget in the short term and bridge maintenance costs and effort in the long term. A complex multi-span structure can be reduced to two simple span structures.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$4,184,000	$0	$4,184,000
RECOMMENDED DESIGN	$2,854,000	$0	$2,854,000
ESTIMATED SAVINGS OR (COST)	$1,330,000	$0	$1,330,000

VALUE ENGINEERING RECOMMENDATION # VE-9

SKETCH OF RECOMMENDED DESIGN



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 $
Bridge No. 4 at US68/KY80	SF	$100.00	1	41,844	$4,184,400	19,794	$1,979,400
MSE Wall	SF	$55.00	7			13,500	$742,500
Road Pavement	SF	$6.00	7			22,050	$132,300
Total					$4,184,400		$2,854,200

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:
Utilize a single span structure over Commonwealth Boulevard in lieu of a 2-span bridge.

ORIGINAL DESIGN:
The original design specifies a two-span structure over Commonwealth Boulevard, with a pier in the median and 2:1 spill through slopes from approximate road elevation to the end-bent abutments. The bridge deck area reductions caused by this change are not from abutment to pier because the remaining span lengths over the road needs to increase by six feet to account for the distance from MSE wall face to the proposed integral, semi-integral, or end-bent abutment behind it. The following shows the area of tail span at each of these bridges, minus the six feet just discussed.

South tail spans: 90’ width x 37’ slope length = 3,330 SF
North tail spans: 90’ width x 32’ slope length = 2,880 SF

RECOMMENDED CHANGE:
The VE Team recommends a single span structure because excess underclearance allows for deeper beams. As part of this change, MSE walls are added at the bottom of slopes with integral, semi-integral, or end-bent abutments behind the MSE walls. This change will reduce a two span bridge to a single span, replace bridge deck area with pavement, eliminate slope paving, and replace embankment comprising the spill through slope with an estimated equal amount of road embankment behind the MSE wall, and add MSE wall with soil reinforcement and backfill. The abutments are assumed to remain similar in regards to foundation pile and concrete quantities when comparing the original design and recommended design.

The area of MSE wall is determined by multiplying northbound fascia to southbound fascia distance and height (low seat minus two feet and road elevation minus 6:1 slope minus frost depth) then adding 3:1 sloped MSE wall at each end. The area of MSE wall required at each location is summarized as follows.

South abutment: 135’ width x (581’–2’–(560’–3’)) 22’ height and 3:1 slope walls = 4,500 SF
North abutment: 135’ width x (579’–2’–(560’–3’)) 20’ height and 3:1 slope walls = 3,900 SF

VALUE ENGINEERING RECOMMENDATION # VE-10

DISCUSSION CONTINUED

ADVANTAGES:

- Reduce bridge deck area
- Reduce long term bridge maintenance costs
- Eliminate pier in the median
- Change multi-span bridge to single span
- Ease constructability

DISADVANTAGES:

- If Connector is not built out to full width in the median, abutment widening because of foundation construction through MSE fill is difficult
- The MSE wall will be built along the full width of the Connector cross section, therefore creating a long wall

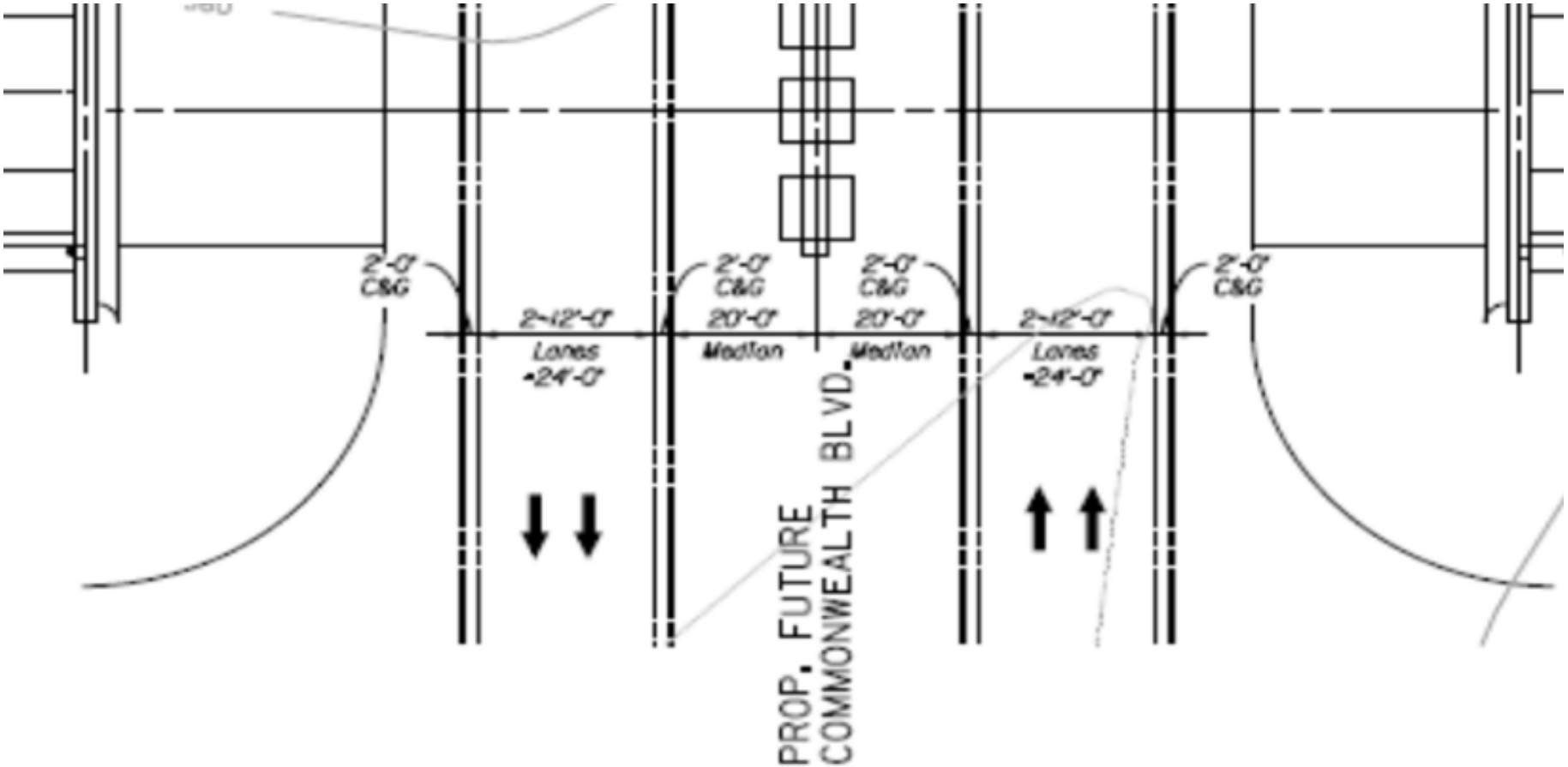
JUSTIFICATION:

The primary purpose of this recommended change is to reduce bridge deck area. One of the primary drivers that make this change possible is that the railroad spur drives the vertical grade up just to the south of Commonwealth Boulevard. This increases in the vertical grade of the connector to provide excess underclearance at Commonwealth Boulevard. Therefore the bridge beam depth can increase and longer spans are feasible.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,879,000	$0	$1,879,000
RECOMMENDED DESIGN	$1,726,000	$0	$1,726,000
ESTIMATED SAVINGS OR (COST)	$153,000	$0	$153,000

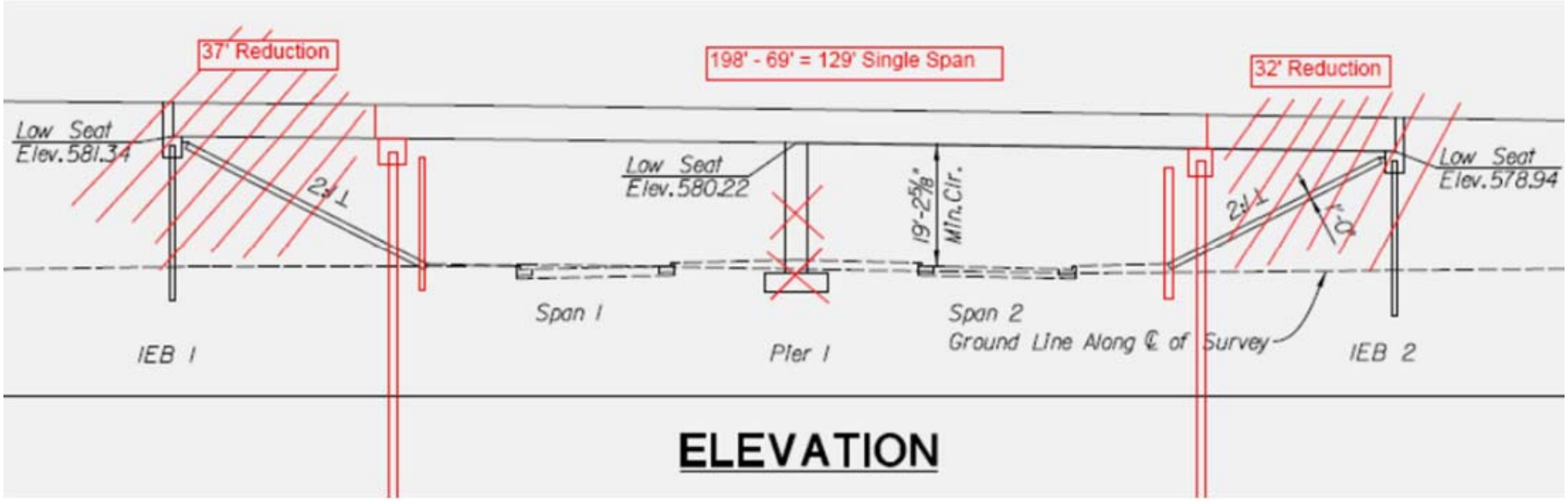
VALUE ENGINEERING RECOMMENDATION # VE-10

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-10

SKETCH OF RECOMMENDED DESIGN



Integral Abutments, MSE Walls, and Single Span at Future Commonwealth Boulevard

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 $
Bridge No. 5 at Commonwealth Boulevard	SF	$100.00	1	18,480	$1,848,000	12,270	$1,227,000
MSE Wall	SF	$55.00	7			8,400	$462,000
Underbridge Slope Paving	SF	$5.00	7	6,210	$31,050		
Road Pavement	SF	$6.00	7			$6,210	$37,260
Note: Recommended bridge design unit cost is similar to the original design unit cost. The added cost for a deeper and a closer spaced beam is offset by eliminating the pier cost.							
Total					$1,879,050		$1,726,260

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-11

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a single span structure over a reduced width Commonwealth Boulevard in lieu of a 2-span bridge.

ORIGINAL DESIGN:
The original design specifies a two-span structure over Commonwealth Boulevard, with a pier in the median and 2:1 spill through slopes from approximate road elevation to the end-bent abutments. Commonwealth Boulevard is proposed as a median separated roadway, with 24' of road in each direction and 40' of median in between. See the attached sketch.

RECOMMENDED CHANGE:
The VE Team recommends a single span structure. The single span structure is possible because Commonwealth Boulevard is reduced in width and because excess underclearance allows for deeper beams. The reduced width Commonwealth Boulevard is achieved by eliminating the median and bringing the 2:1 slopes closer to the edge of road. This means that the Commonwealth Boulevard section includes 48' of road, 2.5' of curb and gutter on each side, and 5' clear zone on each side between back of curb and toe of 2:1 slope. This equals a total of 63' of roadway. The south 2:1 slope requires approximately 40' of length to account for 20' of grade differential. The north 2:1 slope requires approximately 36' of length to account for 18' of grade differential. This means that the total single span of the bridge will equal between 140' to 145'. PCI beams are feasible at these span lengths.

ADVANTAGES:
- Reduce bridge deck area
- Reduce long term bridge maintenance costs
- Eliminate pier in the median
- Change multi-span bridge to single span
- Ease constructability

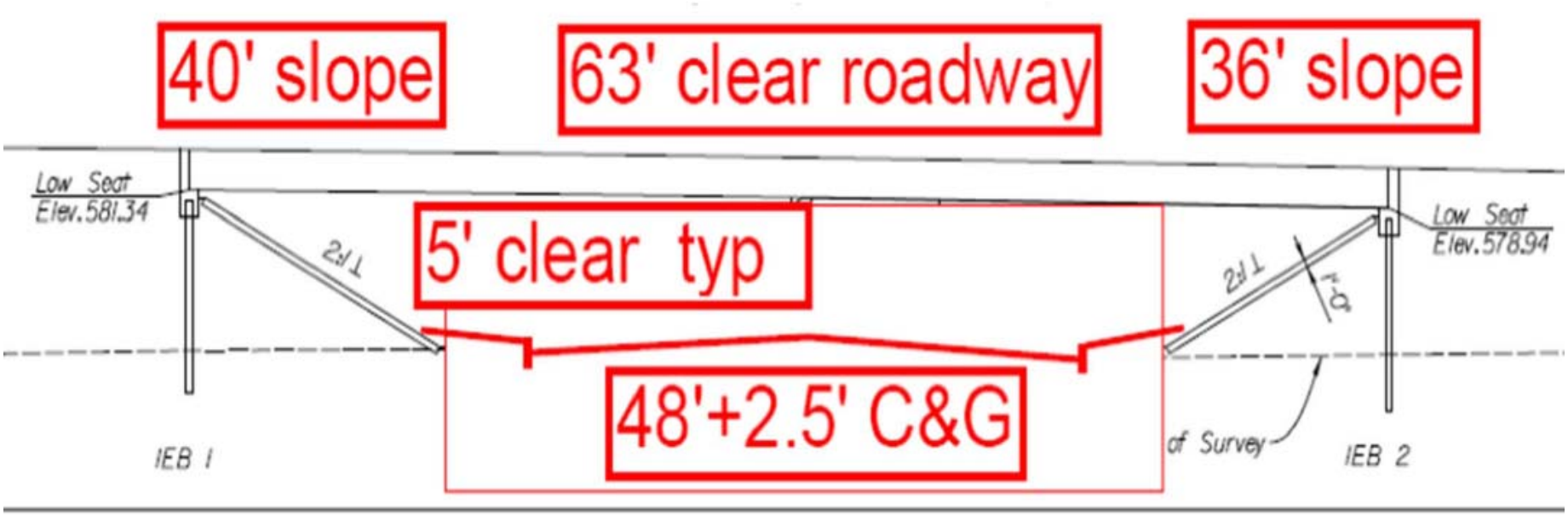
DISADVANTAGES:
- Reducing width and eliminating median of Commonwealth Boulevard changes the character of the road

JUSTIFICATION:
The primary purpose of this recommended change is to reduce bridge deck area. One of the primary drivers that make this change possible is that the railroad spur drives the vertical grade up just to the south of Commonwealth Boulevard. This increase in the vertical grade of the connector provides excess underclearance at Commonwealth Boulevard. Therefore the bridge beam depth can increase and longer spans are feasible

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,848,000	$0	$1,848,000
RECOMMENDED DESIGN	$1,383,000	$0	$1,383,000
ESTIMATED SAVINGS OR (COST)	$465,000	$0	$465,000

VALUE ENGINEERING RECOMMENDATION # VE-11

SKETCH OF RECOMMENDED DESIGN



ELEVATION

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 $
Bridge No. 5 at Commonwealth Boulevard	SF	$100.00	1	18,480	$1,848,000	13,530	$1,353,000
Road pavement	SF	$6.00	7			4,950	$29,700
Note: Recommended bridge design unit cost is similar to the original design unit cost. The added cost for a deeper and a closer spaced beam is offset by eliminating the pier cost.							
Total					$1,848,000		$1,382,700

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-12

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a three sided culvert structure for a reduced width Commonwealth Boulevard in lieu of a 2-span bridge.

ORIGINAL DESIGN:
The original design specifies a two-span structure over Commonwealth Boulevard, with a pier in the median and 2:1 spill through slopes from approximate road elevation to the end-bent abutments. Commonwealth Boulevard is proposed as a median separated roadway, with 24' of road in each direction and 40' of median in between. See below for a sketch of the roadway.

RECOMMENDED CHANGE:
The VE Team recommends a single span three-sided culvert structure. The use of a single span three-sided culvert structure is possible if Commonwealth Boulevard is reduced in width, and the excess underclearance may allow for the arch. The reduced width Commonwealth Boulevard is achieved by eliminating the median, clear distances along the side of the road, and 2:1 slopes. This means that the Commonwealth Boulevard section includes 48' of road and 2' of curb and gutter on each side. This equals a total of 52' of roadway.

ADVANTAGES:
- Eliminate bridge deck
- Eliminate bridge approaches
- Eliminate road-bridge transitions
- Reduce long term bridge maintenance costs
- Ease constructability

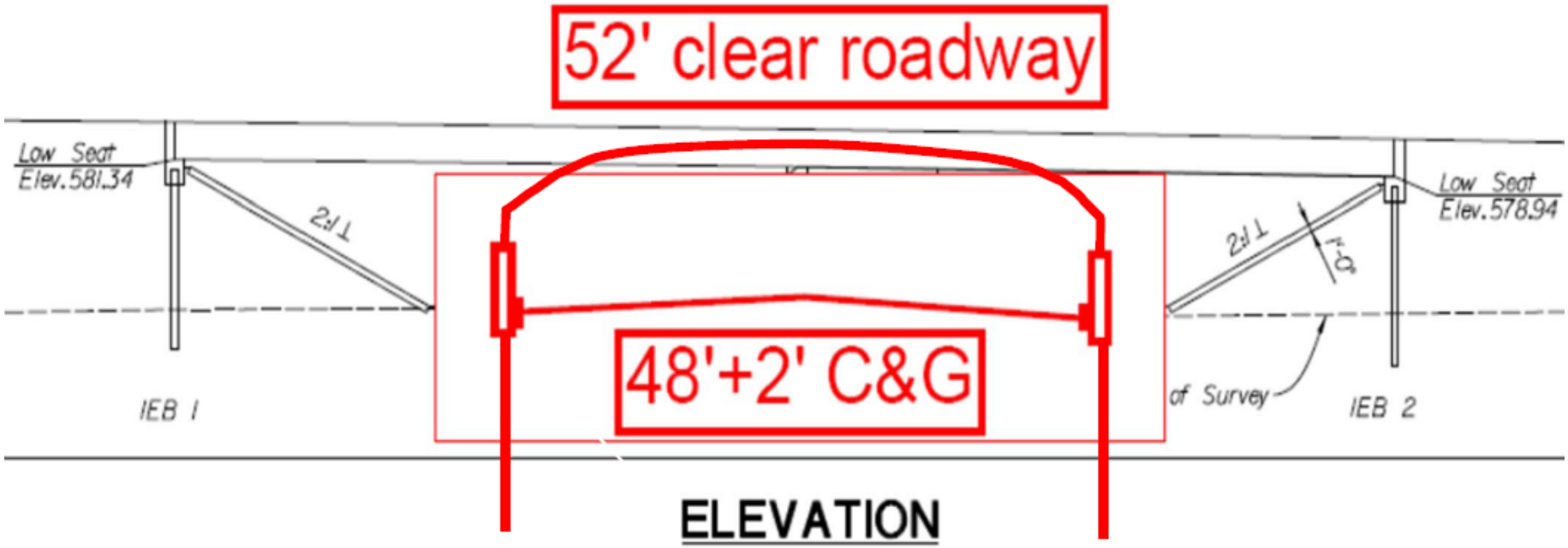
DISADVANTAGES:
- Reducing width and eliminating median of Commonwealth Boulevard changes the character of the road

JUSTIFICATION:
The primary purpose of this recommended change is to eliminate bridge. One of the primary drivers that make this change possible is that the railroad spur drives the vertical grade up just to the south of Commonwealth Boulevard. This increase in the vertical grade of the US-31W Connector provides excess underclearance at Commonwealth Boulevard. Therefore the use of an arched structure with earth cover becomes feasible.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,848,000	$0	$1,848,000
RECOMMENDED DESIGN	$1,020,000	$0	$1,020,000
ESTIMATED SAVINGS OR (COST)	$828,000	$0	$828,000

VALUE ENGINEERING RECOMMENDATION # VE-12

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-12

PHOTOGRAPH OF RECOMMENDED DESIGN

VALUE ENGINEERING RECOMMENDATION # VE-12

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Bridge No. 5 at Commonwealth Boulevard	SF	$100.00	1	18,480	$1,848,000		
Road pavement	SF	$6.00	7			4,950	$29,700
Three-Sided culvert No. 5 at Commonwealth Boulevard	SF	$120.00	7			8,250	$990,000
Total					$1,848,000		$1,019,700

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-13

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize an at-grade intersection at the connector and Commonwealth Boulevard in lieu of a grade separation and eliminate the Mizpah Road relocation (frontage road) by consolidating the access points of Mizpah Road and Commonwealth Boulevard.

ORIGINAL DESIGN:
The original design specifies a grade separation for Commonwealth Boulevard at a location shown on a conceptual master plan for the Transpark development. The original design also calls for Mizpah Road to be realigned parallel to the connector serving as a frontage road.

RECOMMENDED CHANGE:
The VE Team recommends utilizing an at-grade intersection for Commonwealth Boulevard by shifting the intersection north toward US-31W. This would change the access control from full control to partial control and eliminate the need for a bridge. It would also eliminate the need for the relocated Mizpah Road which was being proposed as a frontage road. See the illustrations below for a better understanding of the concept.

ADVANTAGES:
- Elimination of a bridge
- Reduces long term maintenance on bridge
- Elimination of relocated Mizpah Road
- Reduces right-of-way for relocated Mizpah Road

DISADVANTAGES:
- Changes the Transpark Master plan
- Reduces the access control
- Requires roadway plan changes

VALUE ENGINEERING RECOMMENDATION # VE-13

DISCUSSION CONTINUED

JUSTIFICATION:
The VE Team believes this recommendation should be considered by the Project Team since the change will still serve the Transpark development while not requiring the construction of a bridge and Mizpah Road relocation. The VE Team roughly looked at Station 215+00 as an option given the profile grade on the connector closely matches the existing ground elevation. The change from full access control to partial access control will still help preserve the future traffic operation of the corridor especially given the traffic volume drop-off on the connector between US68/KY80 and US-31W.

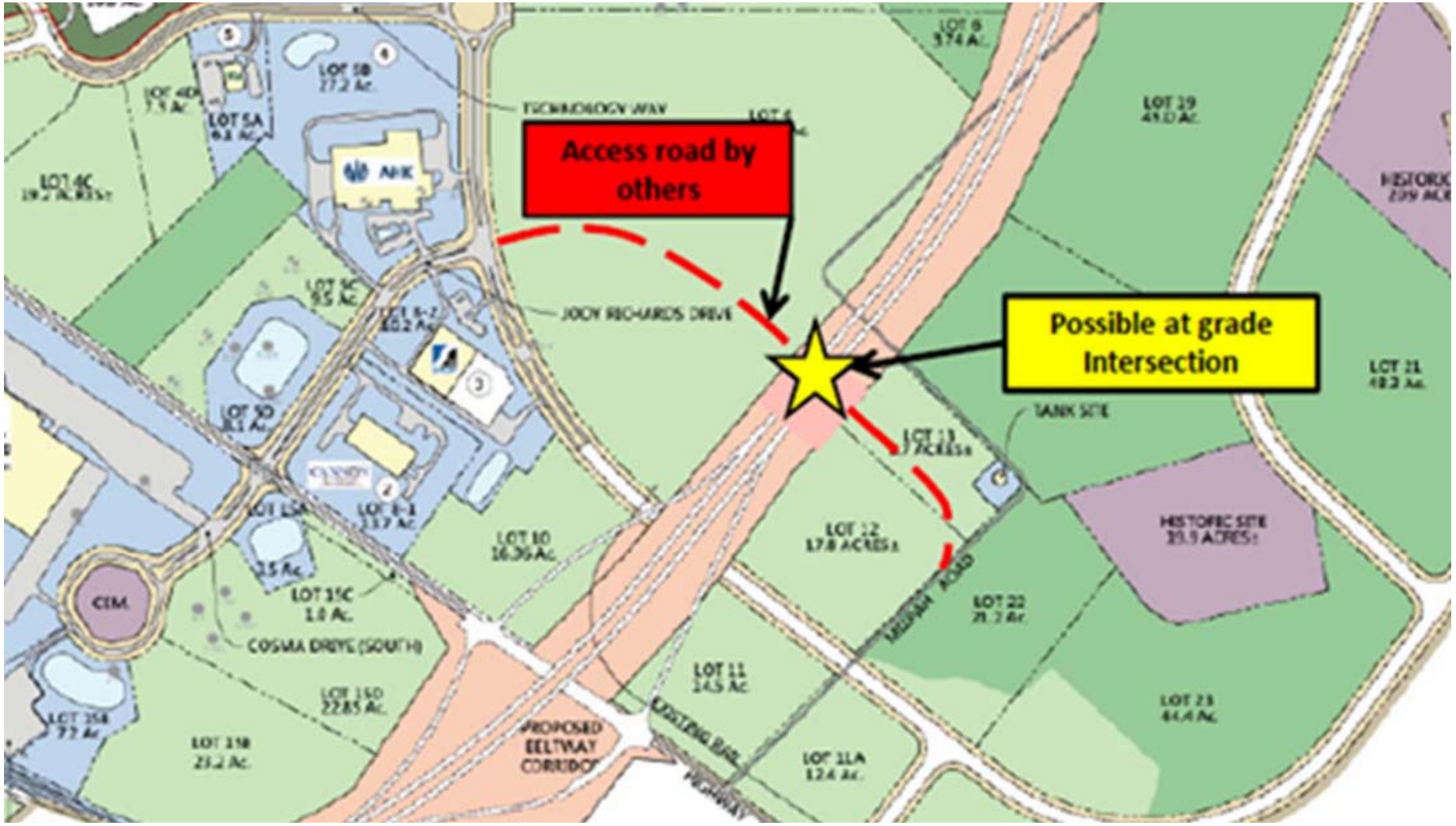
ASSUMPTIONS:
This recommendation is predicated of the belief that the connector will not become part of the I-66 corridor.

- Cost for Commonwealth Boulevard Bridge = $1,848,000
- Right-of-way Estimate for Mizpah Road Relocation: (2,000' length X 70' width) / 43560 = 3.2 ac
  Estimated cost for right-of-way = $15,000 / ac.
  Cost Savings = (3.2)(15000) = $48,000
- Relocated Mizpah Road Cost : (2000' length X 24' width) / 9 = 5,333 SY
  Estimated roadway cost per SY = $60 / SY per the provided cost estimate.
  Cost = 5,333 SY X $60/SY = $319,980

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,216,000	$0	$2,216,000
RECOMMENDED DESIGN	$17,000	$0	$17,000
ESTIMATED SAVINGS OR (COST)	$2,199,000	$0	$2,199,000

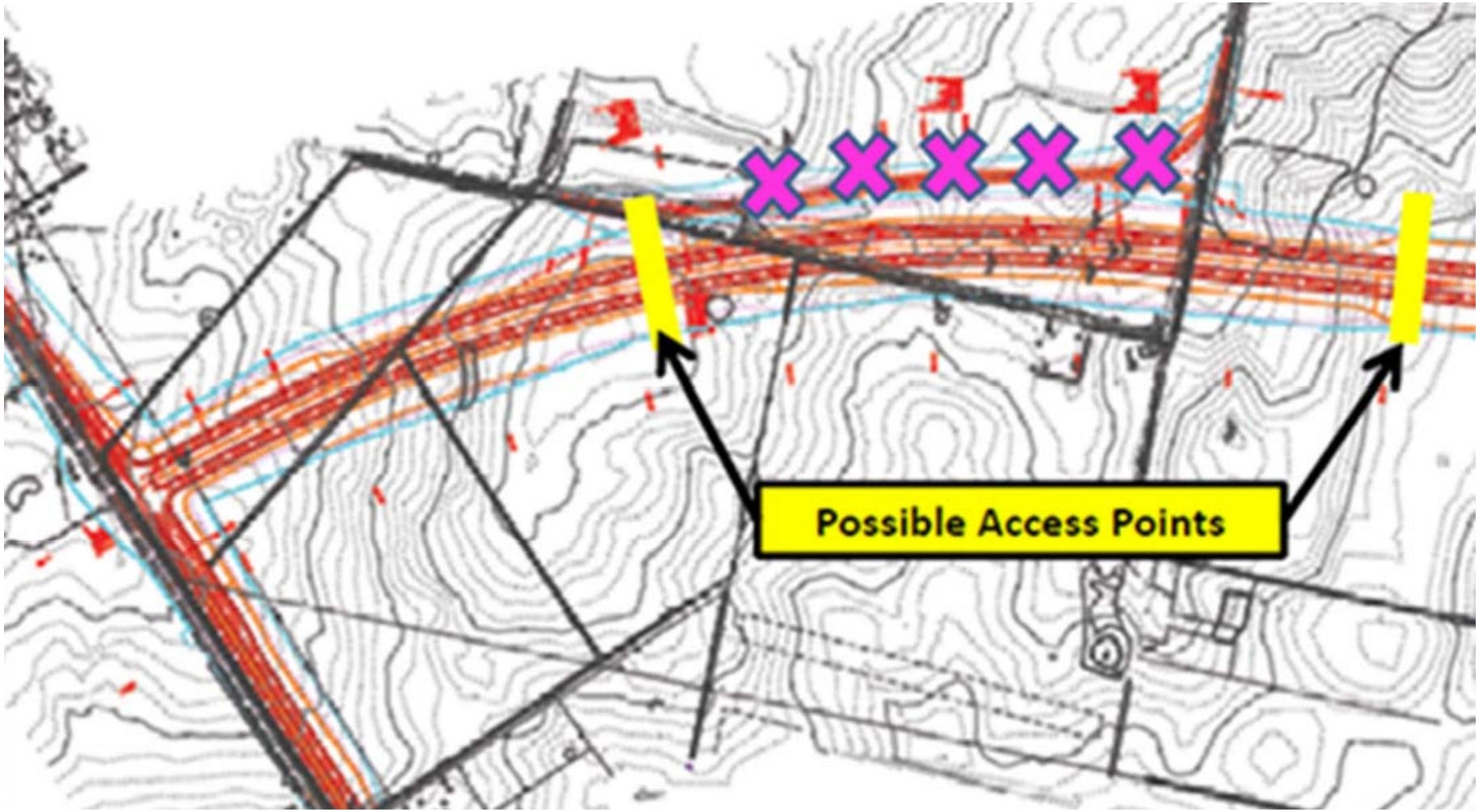
VALUE ENGINEERING RECOMMENDATION # VE-13

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-13

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-13

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Bridge over Commonwealth Boulevard	LS	$1,848,000	1	1	$1,848,000		
Embankment wedge at bridge	CY	$2.84	1			6,140	$17,438
Right-of-way reduction	ac	$15,000	1	3.2	$48,000		
Relocated Mizpah Road	SY	$60.00	1	5,333	$319,980		
Total					$2,215,980		$17,438

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-14

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 40 ft. depressed median in lieu of 60 ft. depressed median.

ORIGINAL DESIGN:
The original design specifies 60 ft. depressed median from I-65 to US-31W.

RECOMMENDED CHANGE:
The VE Team recommends reducing depressed median section from 60 ft. wide to 40 ft. wide throughout mainline section. This 20 ft. reduction in template width will decrease the earthwork volumes and right of way footprint. The Roadside Design Guide allows the use of 40 ft. median width for this type of facility with a barrier being an optional component. Due to current use of cable barrier by the KYTC on selected roadways, it may be decided to install barrier for this proposed project, if the project team deemed appropriate.

ADVANTAGES:
- Reduce roadway excavation
- Reduces roadway embankment
- Reduces right of way requirements
- Reduces length of Kelly Road Bridge

DISADVANTAGES:
- Redesign required
- Reduces green space
- May require median barrier (cable rail)

VALUE ENGINEERING RECOMMENDATION # VE-14

DISCUSSION CONTINUED

JUSTIFICATION:
The recommended change is in compliance with the current edition of the Policy on Geometric Design (Green Book). The change would reduce total earthwork (excavation and embankment) on the project, which includes a quantity decrease in the major bid item of Embankment in Place by approximately 57,000 cubic yards. The narrowing of median will also result in shortening the Kelly Road Bridge over the Connector, decrease the right of way footprint and reduce the quantity for miscellaneous bid items such as culvert cross drains, seeding, clearing and grubbing and long term maintenance cost for mowing.

ASSUMPTIONS:
For Embankment-in-Place:
Station 164+00 to Sta. 176+00, Average fill height = 20': 24,000 SF.
Station 180+00 to Sta. 196+00, Average fill height = 20': 32,000 SF.
Station 201+00 to Sta. 205+00, Average fill height = 30': 12,000 SF.
Station 208+00 to Sta. 214+00, Average fill height = 15': 9,000 SF.
Volume = (24,000 + 32,000 + 12,000 + 9,000) X **20**' / 27 = 57,037 CY → Say 57,000 CY @ $2.84/CY

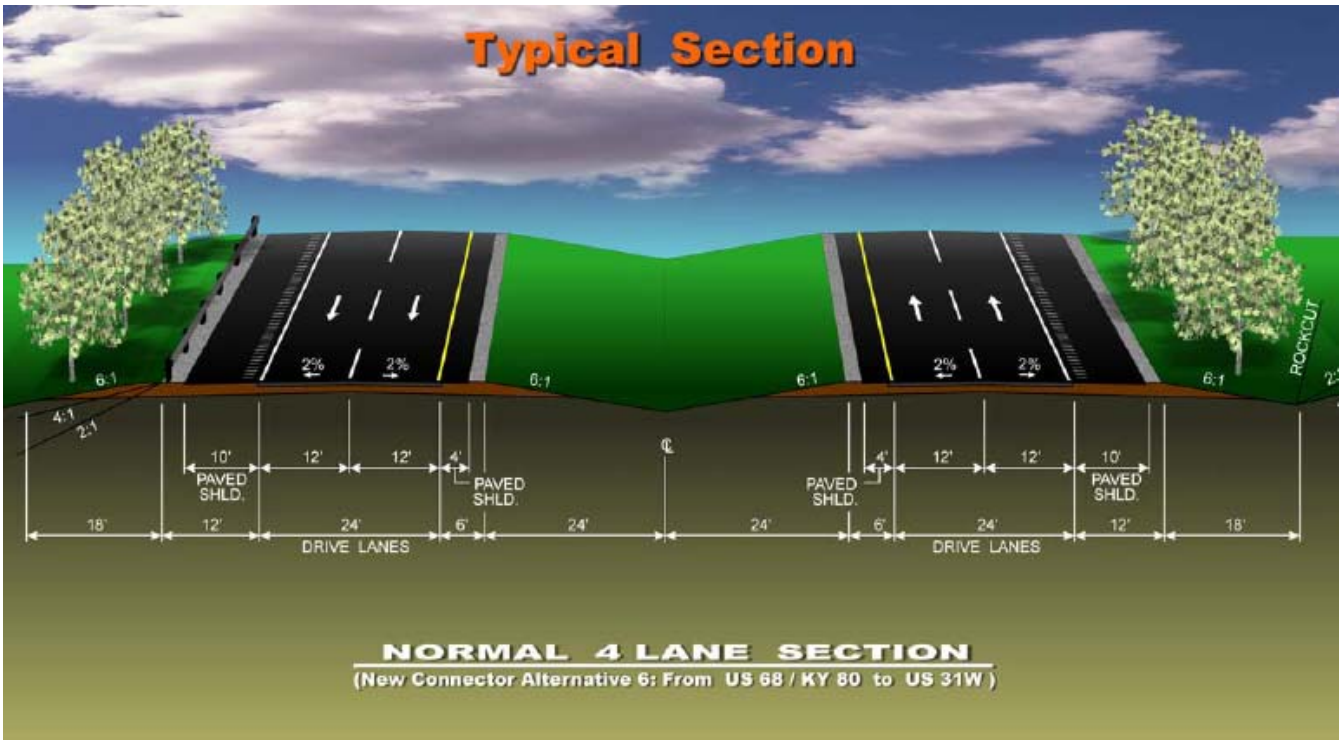
For Kelly Road Bridge:
Bridge length is 307'; width is 27' = 8,289 SF @ $100/SF.
Bridge deck reduction: 27' X **20**' = 540 SF X $100 = $54,000
Revised deck area: 8,289 – 540 = 7,749 SF.

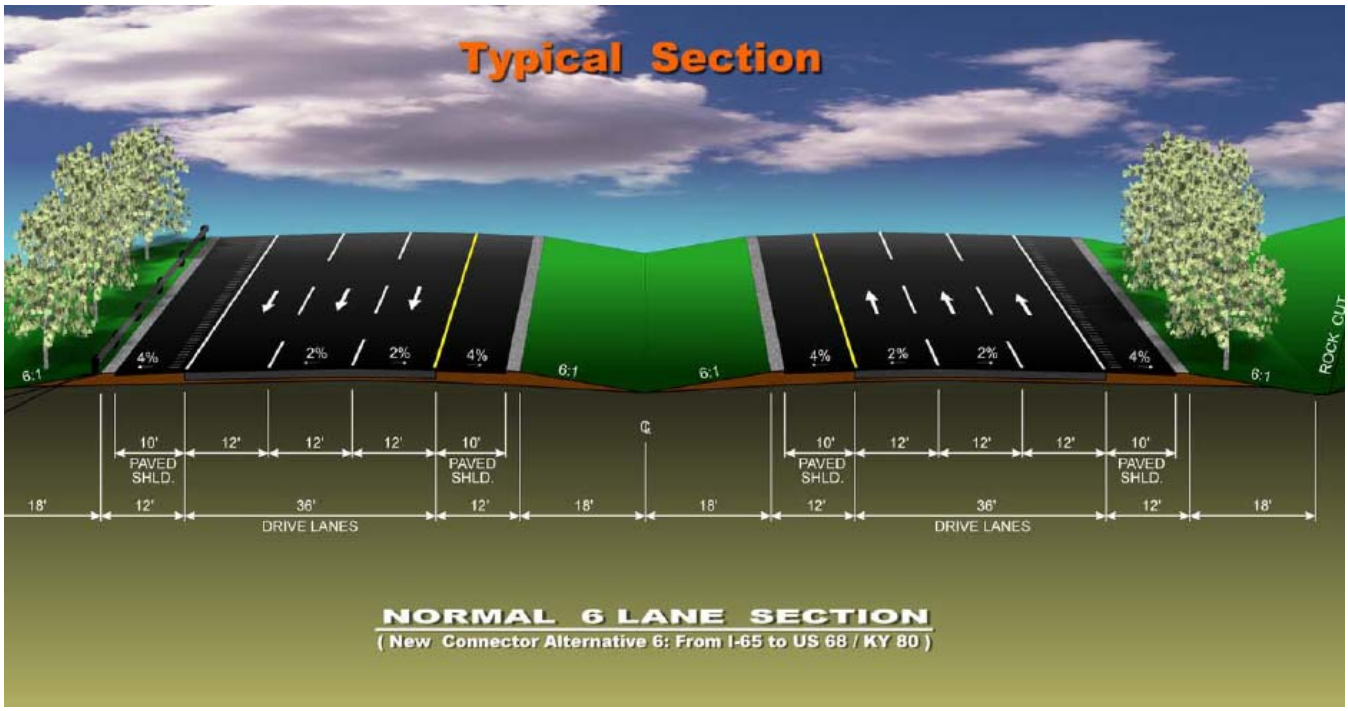
Right of Way Cost:
Station 120+00 to Station 214+00 = 9400' X **20**' = 188,000 SF / 43560 (SF/acre) = 4.3 acres
4.3 acres X $15,000/acre = 64,500 savings

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,055,000	$0	$1,055,000
RECOMMENDED DESIGN	$775,000	$0	$775,000
ESTIMATED SAVINGS OR (COST)	$280,000	$0	$280,000

VALUE ENGINEERING RECOMMENDATION # VE-14

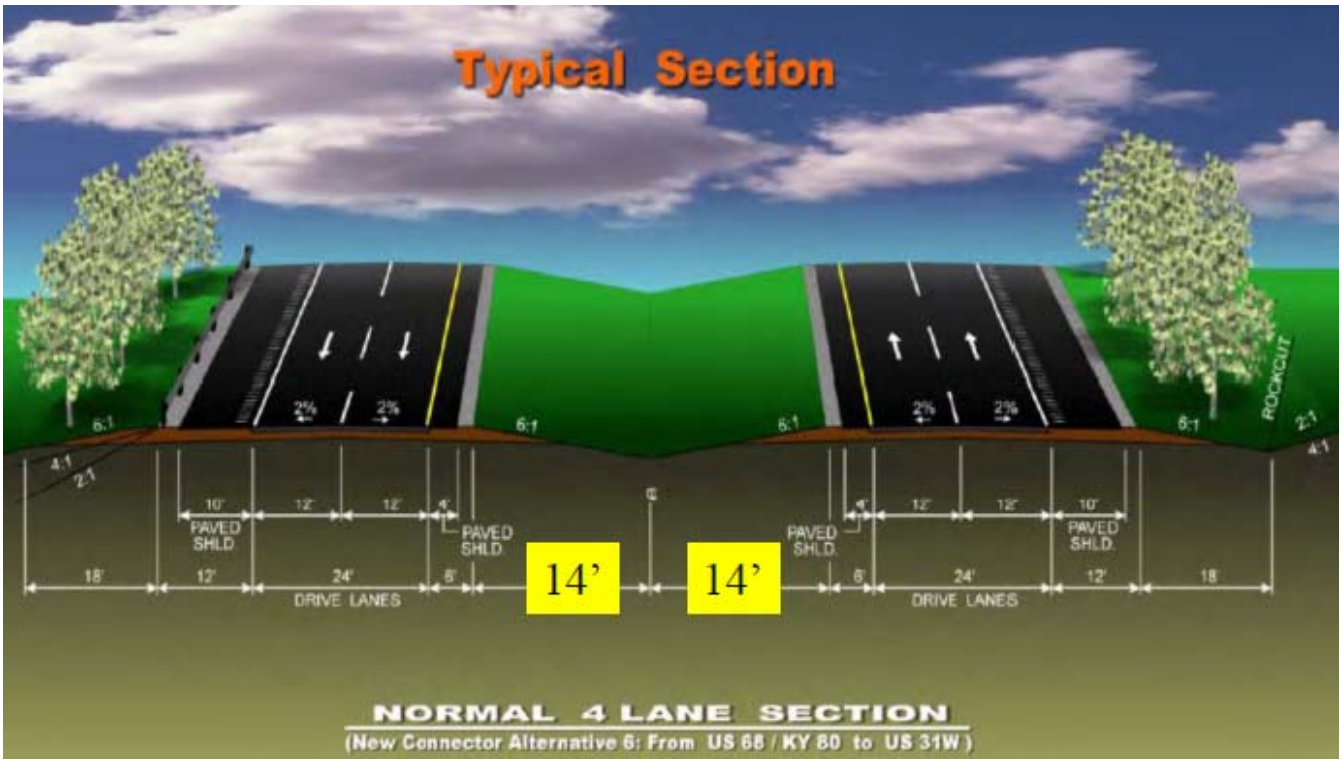
SKETCH OF ORIGINAL DESIGN

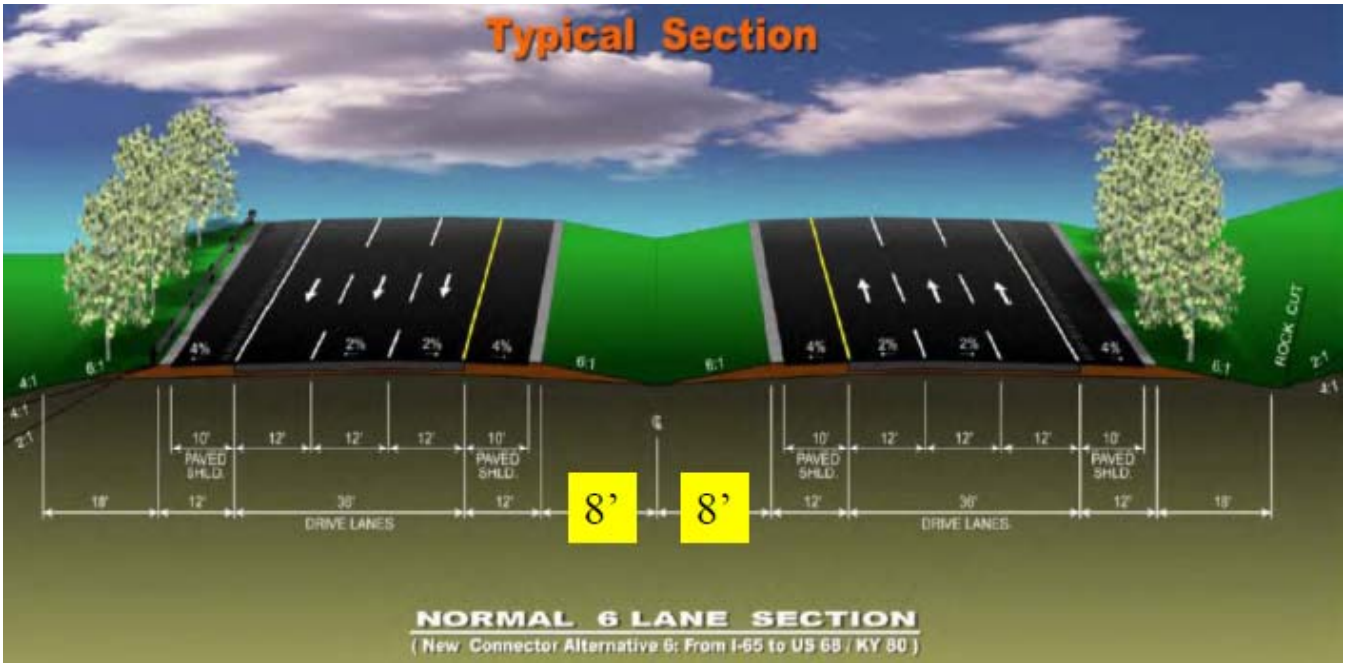




VALUE ENGINEERING RECOMMENDATION # VE-14

SKETCH OF RECOMMENDED DESIGN





VALUE ENGINEERING RECOMMENDATION # VE-14

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Embankment in place	CY	$2.84	1	57,000	$161,880		
Kelly Drive Bridge	SF	$100.00	1	8,289	$828,900	7,749	$774,900
Right-of-way	ac	$15,000	1	4	$64,500		
Total					$1,055,280		$774,900

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:
Revise the cost estimate for bridges, temporary barriers, maintain and control traffic, traffic signal, and sinkhole mitigation.

COMMENTARY:
The VE Team recommends the cost estimate be revised with the following revisions:

- The cost estimate for the five new bridges assumes a total bridge unit cost of $100/SF. KYTC Division of Structural Design uses approximately $110/SF for new bridges. The VE Team assumes the unit price may even be higher than $110/SF and recommends revising this number.

- Concrete Barrier Wall Type 9T is listed in the cost estimate at 18,550 LF at $29.38/LF for a total of $544,936.86. The VE Team assumes this temporary barrier will be located around the pier construction for the new bridge over I-65. There is another line item in the estimate for relocating concrete barrier walls, so the VE Team assume the quantity listed in the estimate is excessive. The VE Team recommends verifying this quantity to improve the accuracy of the estimate.

- Maintain and control traffic is listed in the cost estimate as a $100,000 lump sum. The VE Team recommends increasing this figure to approximately $250,000. There will be considerable traffic control issues associated with the new bridge over I-65 as well as the traffic control issues associated with the at grade tie-in at US-31W. This amount should be further evaluated by the project cost estimator as the design progresses.

- The cost estimate does not contain any line item for traffic signals. The VE Team assumes a traffic signal will be necessary for vehicles exiting the connector at US68/KY80 in the northbound direction. Approximately 41,000 ADT will be using that interchange, so a signal will most likely be warranted and should be included in the cost estimate.

- The cost estimate does not contain any line item for sinkhole mitigation. The project has several sinkholes identified within the right-of-way for the new connector. Sinkholes will require mitigation according to KYTC standards. This mitigation usually involves cleaning out the sinkhole, installing geotextile fabric, filling with granular embankment, installing clay soil cap, and installing a reinforced concrete cap. All of this material and labor should be captured in the cost estimate under a mitigate sinkholes line item with appropriate quantities.

VALUE ENGINEERING DESIGN COMMENT # DC-2

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Verify the number of asphalt types in the pavement design folder match the number of asphalt types listed in the cost estimate.

COMMENTARY:
The following asphalt types are listed in the pavement design folder dated July 28, 2011. The ten asphalt types in the May 3, 2011 estimate provided to the VE Team does not match these types.

Cl3 AB 1.00D PG64-22
Asphalt Base for Connector from I-65 to US68/KY80 and the Ramps Mainline

Cl 3 AS 0.50B PG64-22
Asphalt Surface for Connector from I-65 to US68/KY80 and the Ramps Mainline

Cl 2 AB 1.00D PG64-22
Asphalt Base for Connector from I-65 to US68/KY80 and the Ramps Shoulders
Asphalt Base for Connector from US68/KY80 to US-31W
Asphalt Level and Wedging for the US68/KY80 Overlay
Asphalt Base for US68/KY80 Full Depth Reconstruction
Asphalt Base for US-31W

Cl 2 AS 0.50B PG64-22
Asphalt Surface for Connector from I-65 to US68/KY80 and the Ramps Shoulders
Asphalt Surface for Connector from US68/KY80 to US-31W
Asphalt Surface for US-31W and Shoulders

Cl 2 AS 0.38B PG64-22
Asphalt Surface for the US68/KY80 Overlay and Full Depth Reconstruction

The VE Team recommends uniformity in material provided for ease during construction, and therefore minimizing the number of asphalt types that are designated. The following table shows the asphalt types listed in the May 3, 2011 estimate.

0007	00205 CL3 ASPH BASE 1.50D PG64-22	38,476.000	TON	$52.65000	$2,025,761.40
0008	00208 CL4 ASPH BASE 1.50D PG64-22	82,107.000	TON	$50.85000	$4,175,140.95
0009	00212 CL2 ASPH BASE 1.00D PG64-22	5,807.000	TON	$61.31532	$356,058.06
0010	00214 CL3 ASPH BASE 1.00D PG64-22	40,143.000	TON	$57.18811	$2,295,702.30
0011	00219 CL4 ASPH BASE 1.00D PG76-22	31,671.000	TON	$37.61267	$1,191,230.87
0012	00291 EMULSIFIED ASPHALT RS-2	131.000	TON	$537.19584	$70,372.66
0013	00301 CL2 ASPH SURF 0.38D PG64-22	184.000	TON	$92.11680	$16,949.49
0014	00309 CL2 ASPH SURF 0.50D PG64-22	2,277.000	TON	$56.91000	$129,584.07
0015	00312 CL3 ASPH SURF 0.50D PG64-22	6,413.000	TON	$60.58000	$388,499.54
0016	00324 CL3 ASPH SURF 0.50B PG64-22	4,406.000	TON	$76.43000	$336,750.58
0017	00335 CL4 ASPH SURF 0.50A PG76-22	13,295.000	TON	$69.69000	$926,528.55

VALUE ENGINEERING DESIGN COMMENT # DC-3

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize the minimum vertical clearance for all structures in lieu of excess clearance.

COMMENTARY:

Many of the structures along the Connector have clearance in excess of the required minimums. The VE Team assumed a required minimum vertical clearance of 17'-0" for all roadway overpass structures. This value was assumed as the location is near an industrial park; therefore highway clearances should be maintained. The VE Team assumed a minimum vertical clearance of 23'-0" to comply with CSX overhead bridge requirements. The following vertical clearances were noted in the Advanced Situation folders for the following bridges:

US68/KY80: 23'-0" over the railroad spur, 23'-1 5/8" over I-65
Connector over Commonwealth Boulevard: 19'-2 5/8"
Connector over CSX: 23'-6 5/8"
Kelly Road over Connector: 18'-5"
Connector over I-65: 17'-3"

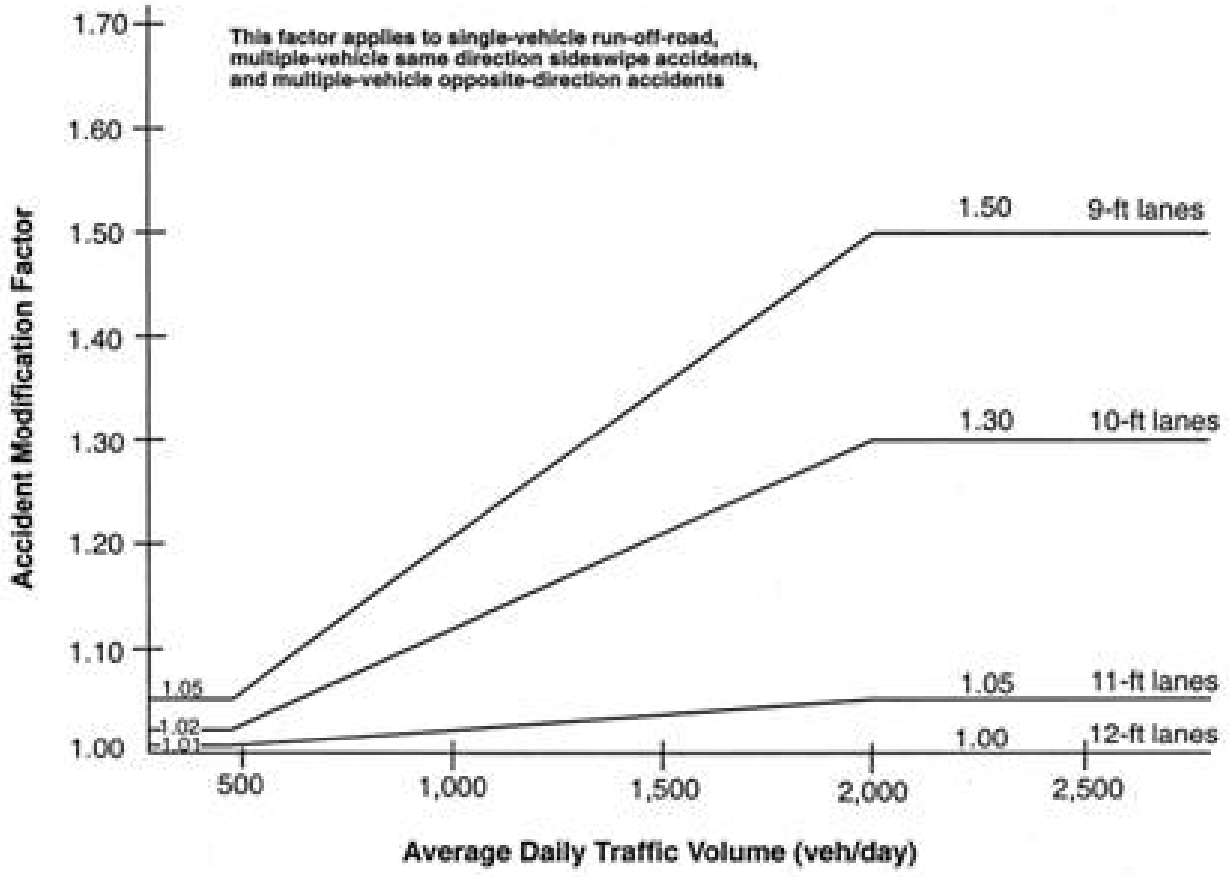
VALUE ENGINEERING DESIGN COMMENT # DC-4

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Reduce the driving lane width to 11 ft. in lieu of 12 ft. lanes.

COMMENTARY:

Utilize an 11 ft. lane in lieu of a 12 ft. lane for the connector. 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. This would be more applicable if the Project Team (or KYTC Administration) decides the connector will not be part of I-66 and the possible of having an initial 2-lane section.

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 DESIGN COMMENT # DC-5

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Reduce the width of shoulders from 12 ft. to 10 ft.

COMMENTARY:
Utilize a 10 ft. shoulder width in lieu of a 12 ft. shoulder width for the connector. Studies have shown that there is not an appreciable change in operation or safety by reducing the shoulder width from 12 ft. to 10 ft. This would be more applicable if the Project Team (or KYTC Administration) decides the connector will not be part of I-66 and the possible of having an initial 2-lane section. Below are some excerpts for consideration.

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 DESIGN COMMENT # DC-6

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Install cable barrier in the median.

COMMENTARY:

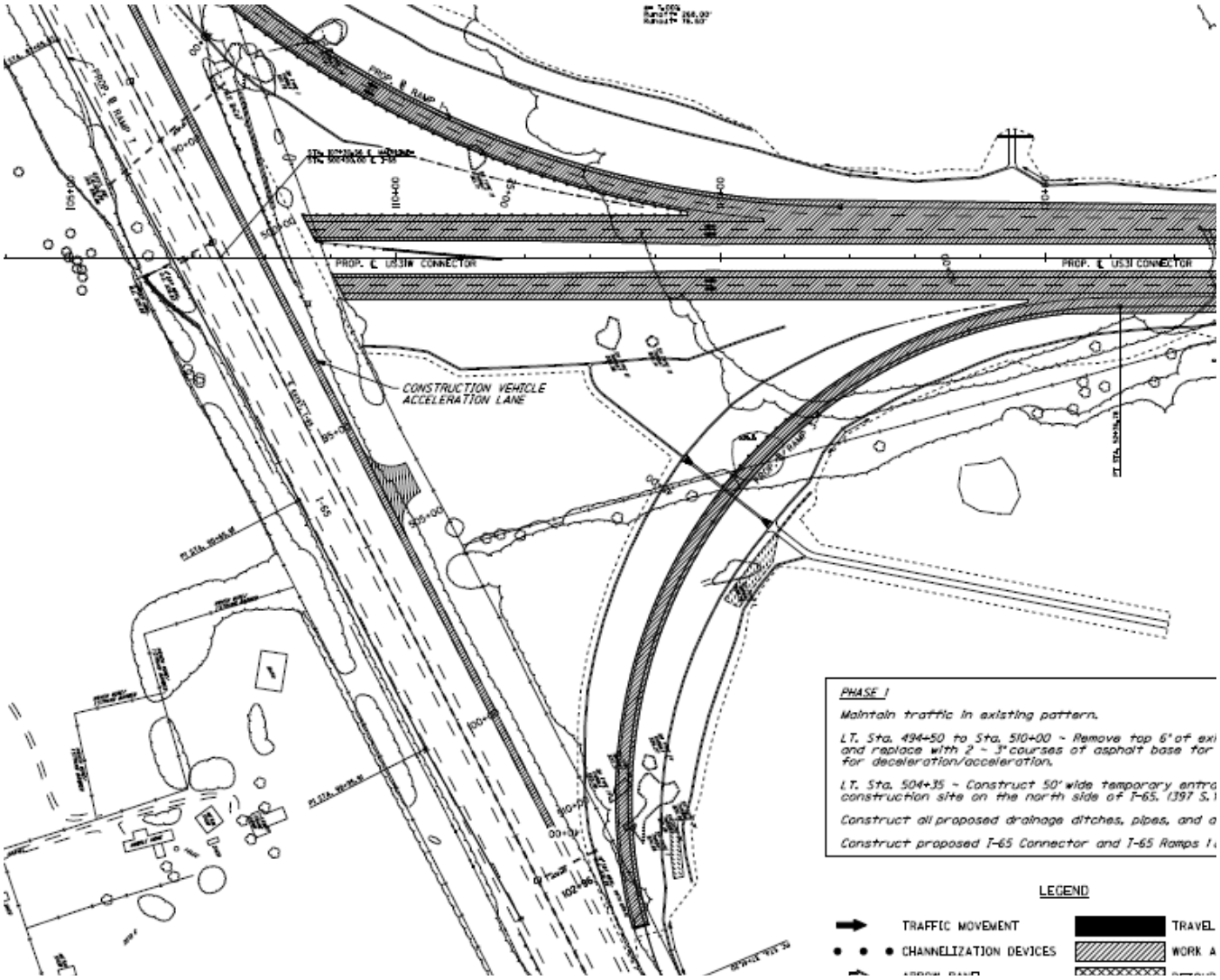
Assuming the Project Team decides to reduce the median width from 60 ft. to 40 ft., the use of median barriers is an optional feature pending the traffic volumes. An option for this barrier system could be cable barrier placed in the median. KYTC has had recent success with this installation to reduce the severity of median cross-over crashes. Given their familiarity with the installation, further information is provided with this comment. If questions arise, the Project Team should contact the Director of the Division of Highway Design.

Photograph of cable barrier in the median of a roadway

VALUE ENGINEERING DESIGN COMMENT # DC-7

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize acceleration/deceleration lanes for construction access from I-65 to the new connector in lieu of the Phase 1 "T" intersection with I-65.

COMMENTARY:
The current phasing plans allow for a "T" intersection directly onto I-65. The VE Team anticipates that this "T" intersection will impact traffic on I-65. In our opinion, impacts to I-65 should be minimized. The VE Team recommends deceleration and acceleration lanes for access along I-65 in order to minimize impacts to the flow of traffic. The VE Team also recommends contract requirements pushing construction traffic entering I-65 away from I-65 (i.e., to adjacent interchanges) if deceleration or acceleration lanes are not provided.

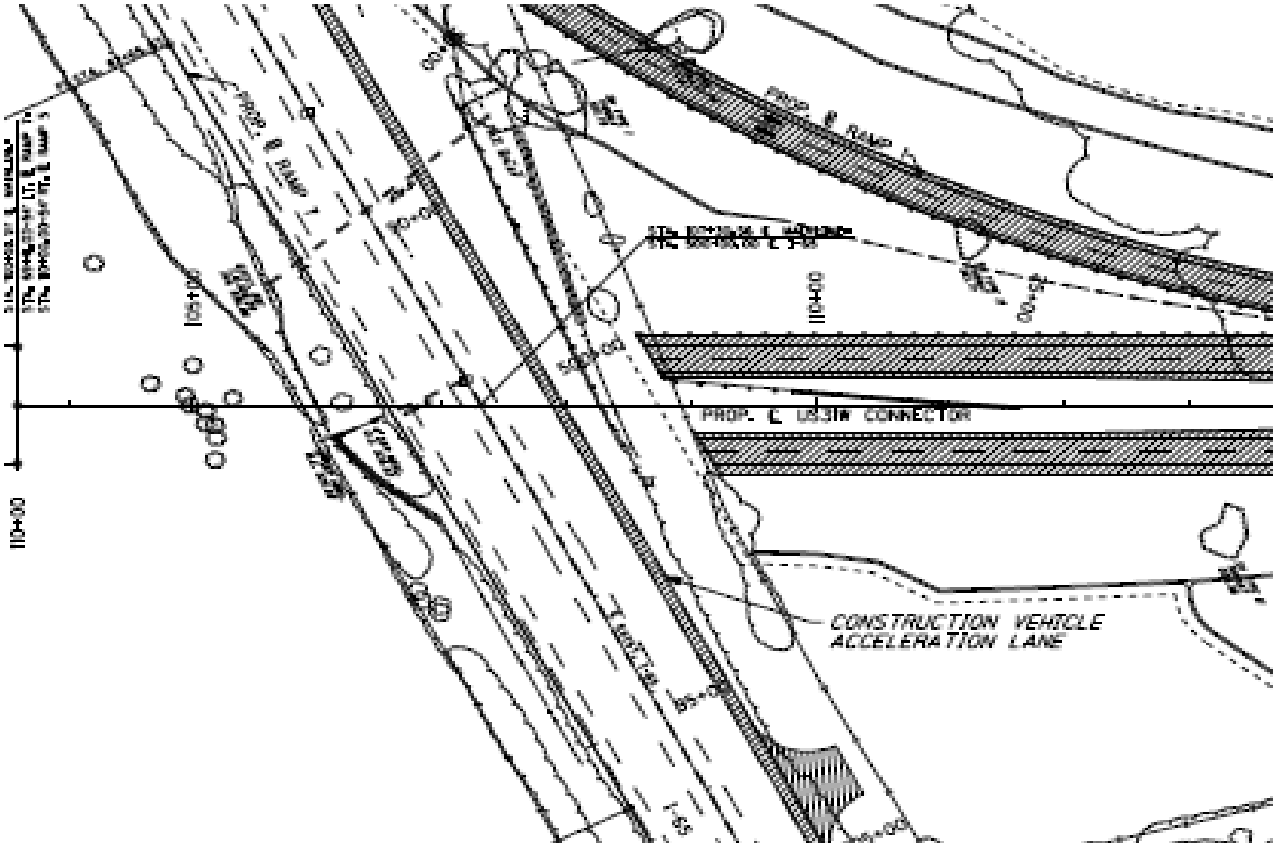


MOT Plan Sheet Phase 1

VALUE ENGINEERING DESIGN COMMENT # DC-8

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Construct the bridge over I-65 in the first phase to facilitate construction traffic access between north and south sides of I-65 in lieu of constructing bridge over I-65 in the second phase.

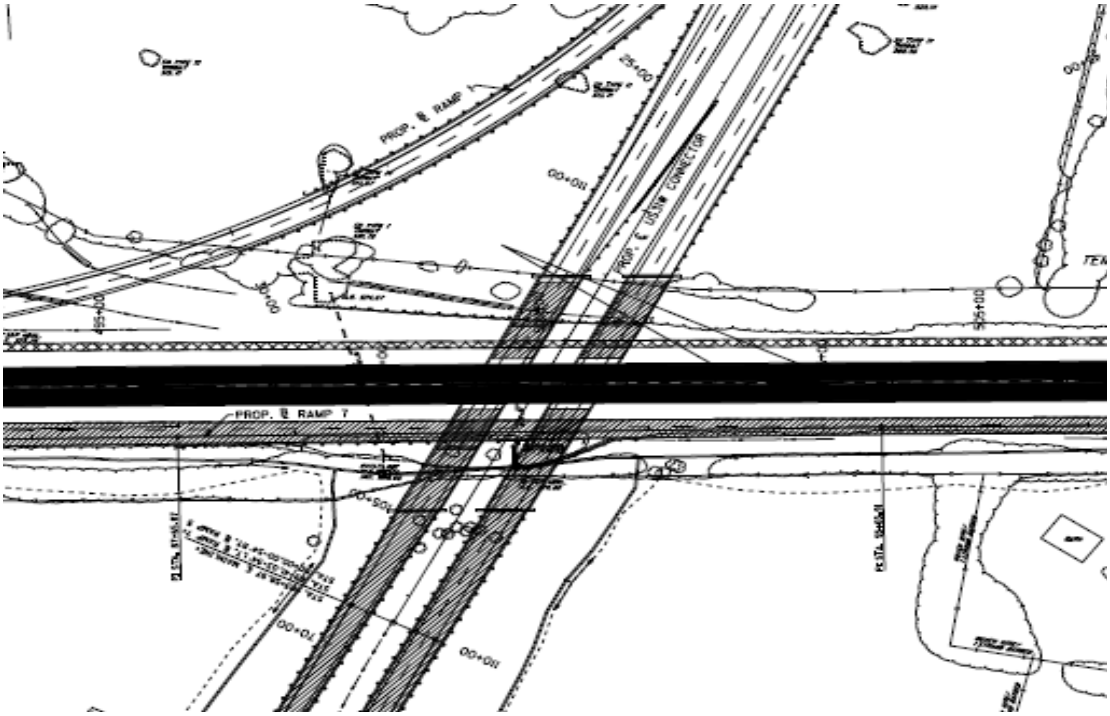
COMMENTARY:
The current phasing plans specify construction of the Connector over I-65 bridges in later phases and appear to promote discontinuity in the construction schedule for these bridges. The VE Team recommends phasing that dictates the construction and completion of these bridges (or at least one of them) in the first phase. The completed bridge can serve as a crossing for construction traffic across I-65. This may alleviate impacts to I-65 traffic. Significant material deliveries are required on this project. The embankment importation quantities are significant and concrete delivery is required. Exit points with deceleration for the construction traffic can be installed along both the westbound or eastbound directions. All I-65 entry can be directed to existing interchanges west and east of the project until the new ramps are constructed to a useable condition with acceleration lanes for construction traffic. The VE Team also recommends continuity in construction schedules in order to maximize the efficiency during construction and therefore reduce construction costs.



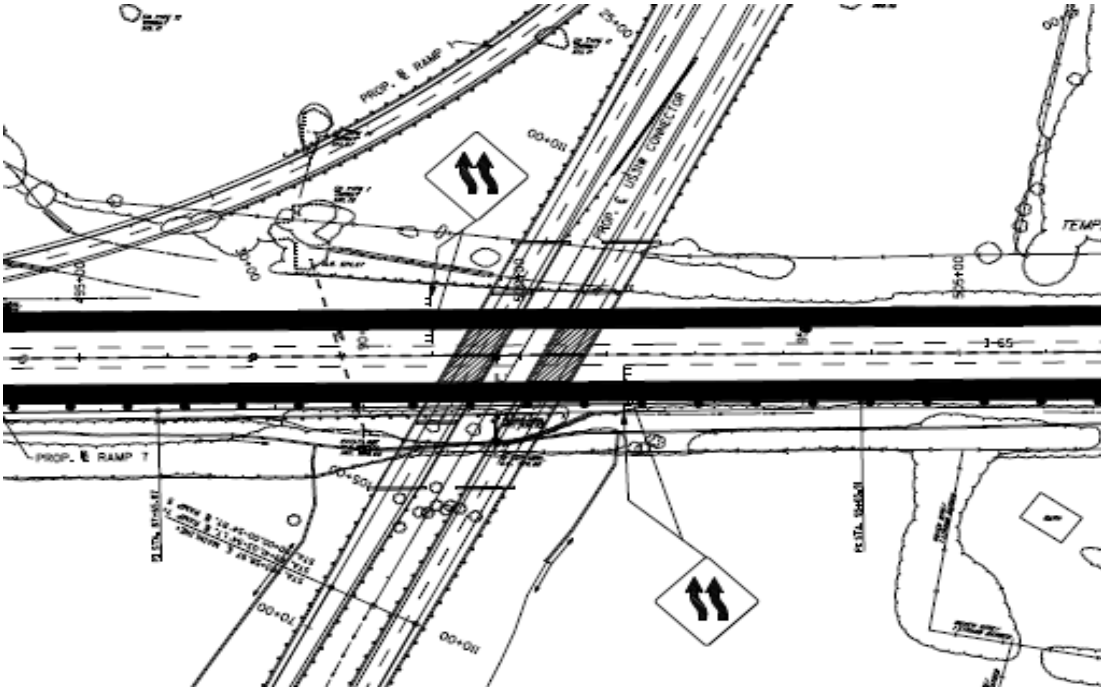
Connector over I-65 Phase 1

VALUE ENGINEERING DESIGN COMMENT # DC-8

ADDITIONAL INFORMATION



Connector over I-65 Phase 2A



Connector over I-65 Phase 2B

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

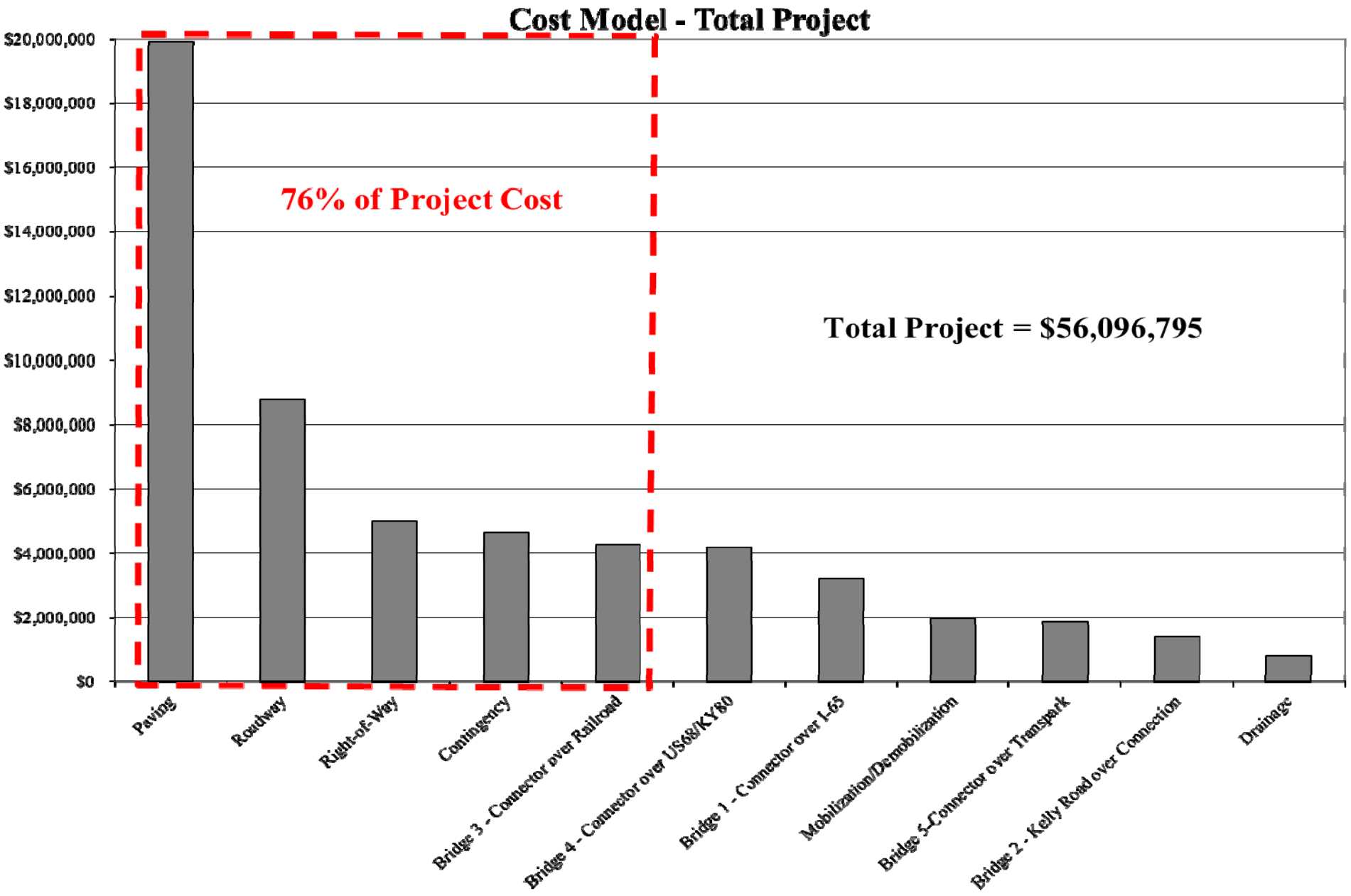
Attendees				Participation				
				Meetings		Study Sessions		
Name	**Organization and Address (Organization first, with complete address underneath)**	**Tel # and Email (Tel first with Email underneath)**	**Role in Workshop**	**Intro**	**Out Brief**	**Day 1**	**Day 2**	**Day 3**
Boday Borres	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Boday.Borres@ky.gov	KYTC Quality Assurance Branch		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
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
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
Glen Kelly	QK4 815 West Market Street, Suite 300 Louisville, KY 40202	502-585-2222 gkelly@qk4@.com	Engineering Design Team	X	X			
Joe Plunk	KYTC, District 3 900 Morgantown Road Bowling Green, KY 42101	270-746-7898 Joseph.Plunk@ky.gov	KYTC District 3 Representative	X	Via Video			
Brian Rhodes	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3500 Brian.Rhodes@urs.com	VE Structural Engineer	X	X	X	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
Renee Slaughter	KYTC, District 3 900 Morgantown Road Bowling Green, KY 42101	270-746-7898 Renee.Slaughter@ky.gov	KYTC District 3 Representative	X				
Roy Sturgill	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Roy.Sturgill@ky.gov	KYTC Quality Assurance Branch		X			

Workshop Attendance

Attendees				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**
Brent Sweger	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Brent.Sweger@ky.gov	KYTC VE Coordinator	X	X	X	X	X
Albert Zimmerman	QK4 815 West Market Street, Suite 300 Louisville, KY 40202	502-585-2222 azimmerman@qk4@.com	Engineering Design Team	X	Via Video			

APPENDIX B
Cost Information

APPENDIX B - Cost Information


Cost Model - Total Project
$20,000,000
$18,000,000
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
76% of Project Cost
Total Project = $56,096,795
Paving
Roadway
Right-of-Way
Contingency
Bridge 3 - Connector over Railroad
Bridge 4 - Connector over US68/KY80
Bridge 1 - Connector over I-65
Mobilization/Demobilization
Bridge 5-Connector over Transpark
Bridge 2 - Kelly Road over Connection
Drainage

APPENDIX C
Function Analysis

APPENDIX C - Function Analysis

Function Model

Item	Cost	Function
Total Project	$56,096,795	Support commitment Access Transpark Improve safety on adjacent roads Improve connectivity Improve future mobility
Paving	$19,922,097	Support traffic Supply long-term capacity
Roadway	$8,777,736	Support construction
-perforated pipe-4 IN	*$553,887*	Drain edge
-granular embankment	*$234,852*	Support drainage
-embankment in place	*$4,001,154*	Establish grade
-fence-woven wire type 1	*$213,121*	Delineate boundary
-guardrail-steel w beam-S face	*$369,531*	Contain errant traffic
-clearing and grubbing	*$879,000*	Eliminate organics Prepare site
-maintain and control traffic	*$100,000*	Control traffic Delineate work zone Tie-in to I-65
-staking	*$331,003*	Establish line and grade
-concrete barrier wall type 9T	*$544,937*	Protect work zone
-temp mulch	*$191,254*	Prevent erosion
-seeding and protection	*$325,071*	Prevent erosion
Right-of-Way	$5,000,000	Accommodate roadway
Contingency	$4,646,072	Account for unknowns
Bridge 3 - Connector over Railroad	$4,284,000	Separate grade Clear CSX facilities
Bridge 4 - Connector over US68/KY80	$4,184,400	Accommodate future beltway Connect to US-31W Clear rail spur
Bridge 1 - Connector over I-65	$3,220,800	Access northbound traffic Clear I-65
Mobilization/Demobilization	$1,986,017	Mobilize labor and equipment
Bridge 5-Connector over Transpark Internal Road	$1,848,000	Support connectivity

Item	Cost	Function
Bridge 2 - Kelly Road over Connection	$1,406,000	Maintain connectivity
Drainage	$821,673	Convey stormwater Control 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***	**Responsible VE Team Member**
1	Utilize 4 ultimate lanes in lieu of 6 ultimate lanes from I-65 to US68/KY80	1	S. Curless & B. Sweger
2	Utilize 2 initial lanes in lieu of 4 initial lanes from I-65 to US68/KY80	3	S. Curless & B. Sweger
3	Eliminate the section of the project between US68/KY80 and US-31W and create an at-grade intersection at US68/KY80	1	S. Curless & B. Sweger
4	Eliminate the section of the project between US68/KY80 and US-31W. Reconfigure an at-grade intersection to "T" the eastern portion of US68/KY80.	1	S. Curless & B. Sweger
5	Utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W	1	S. Curless & B. Sweger
6	Reduce depth of cut between US68/KY80 and US-31W by revising the grade from 1% to 3%	3	
7	Utilize mechanically stabilized earth (MSE) abutments on all five bridges in lieu of 2:1 spill through slopes	1	M. Guter
8	Utilize the minimum vertical clearance for all structures in lieu of excess clearance	DC	B. Rhodes
9	Utilize a roundabout at the Transpark entrance off of US-31W in lieu of making 4 lanes on US-31W	2	S. Curless & B. Sweger
10	Cul-de-sac Kelly Road on both sides of the new connector in lieu of constructing a bridge over the new connector	3	
11	Utilize at-grade intersection at connector/future relocated Commonwealth in lieu of grade separation	2	G. Groves
12	Utilize at-grade railroad crossings in lieu of grade separation	4	
13	Utilize at-grade intersection at Kelly Road in lieu of grade separation	4	
14	Cul-de-sac Mizpah Road in lieu of realignment	3	
15	Consolidate Mizpah Road and Commonwealth Boulevard into a single intersection with the new connector	2 w/ #11	G. Groves
16	Reduce the driving lane width to 11 ft. in lieu of 12 ft. lanes	DC	G. Groves
17	Reduce the width of shoulders from 12 ft. to 10 ft.	DC	G. Groves
18	Utilize a single span structure over a Commonwealth Boulevard in lieu of a 2-span bridge	2	M. Guter
19	Utilize a single span structure over a reduced width Commonwealth Boulevard in lieu of a 2-span bridge	1	M. Guter
20	Utilize a three sided culvert structure for a reduced width Commonwealth Boulevard in lieu of a 2-span bridge	2	M. Guter
21	Utilize 36 ft. depressed median in lieu of 60 ft. depressed median per the Record of Decision (ROD)	1	G. Groves
22	Install cable barrier in the median	DC	G. Groves
23	Revise the cost estimate for bridges, temporary barriers, maintain and control traffic, traffic signal, sinkholes, etcetera	DC	K. Schafersman

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status***	**Responsible VE Team Member**
24	Verify the number of asphalt types in the pavement design folder match the number of asphalt types listed in the cost estimate	DC	M. Guter
25	Utilize a steel structure for the US68/KY80/railroad spur in lieu of a concrete structure to reduce the number of spans and piers	2	B. Rhodes
26	Increase beam spacing to eliminate beam lines, where applicable	1	B. Rhodes
27	Conduct additional investigation of sinkholes throughout the project area	4	
28	Utilize steel beams to reduce embankment quantity in lieu of concrete beams	3	
29	Construct bridge over I-65 in the first phase to facilitate construction traffic access between north and south sides of I-65 in lieu of constructing bridge over I-65 in the second phase	DC	M. Guter
30	Utilize acceleration/deceleration lanes for construction access from I-65 to the new connector in lieu of the Phase 1 “T” intersection with I-65	DC	M. Guter
31	Move the radius of the railroad spur westward to reduce the bridge square footage and variable skew	1	B. Rhodes

*****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 Punchlist

APPENDIX E – VE Punchlist

VALUE ENGINEERING PUNCH LIST

ITEM NO.: **3-16.00** PROJECT COUNTY: **Warren** DATE OF STUDY: **10/31/2011 to 11/2/2011** **VE # 201108**

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		Utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W			$8,194,000	$3,027,000	$5,167,000	NA	Con, Env	
VE-2	✓-2	Utilize 4 ultimate lanes in lieu of 6 ultimate lanes from I-65 to US-68 and utilize 2 ultimate lanes in lieu of 4 ultimate lanes from US68/KY80 to US-31W			$18,011,000	$10,392,000	$7,619,000	NA	Con, Env	
VE-3		Eliminate the section of the project between US68/KY80 and US-31W and create an at-grade intersection at US68/KY80			$10,599,000	$0	$10,599,000	NA	Con, Env	
VE-4	✓-1	Eliminate the section of the project between US68/KY80 and US-31W. Reconfigure an at-grade intersection to "T" the eastern portion of US68/KY80			$10,599,000	$0	$10,599,000	NA	Con, Env	
VE-5	✓-1,2	End the widening and reconstruction of US-31W at Commonwealth Boulevard			$1,978,000	$0	$1,978,000	NA	Con	
VE-13	✓-2	Utilize an at-grade intersection at the connector and Commonwealth Boulevard in lieu of a grade separation and eliminate the Mizpah Road relocation (frontage road) by consolidating the access points of Mizpah Road and Commonwealth Drive			$2,216,000	$17,000	$2,199,000	NA	Con	
VE-14	✓-1,2	Utilize 40 ft. depressed median in lieu of 60 ft. depressed median			$1,055,000	$775,000	$280,000	NA	Env	
Structures										
VE-6	✓-2	Increase beam spacing to eliminate beam lines, where applicable			$3,586,000	$3,308,000	$278,000	NA	Oth	
VE-7	✓-2	Move the radius of the railroad spur westward to reduce the bridge square footage and variable skew			$4,914,000	$3,989,000	$925,000	NA	Con	
VE-8	✓-1,2	Utilize mechanically stabilized earth (MSE) abutments on Bridges No. 1, 3, 4, and 5 in lieu of 2:1 spill through slopes			$13,787,000	$11,789,000	$1,998,000	NA	Oth	
VE-9	✓-2	Utilize MSE walls with road pavement in lieu of bridge deck and piers from the north side of US68/KY80 to the south side of the railroad spur			$4,184,000	$2,854,000	$1,330,000	NA	Oth	

VALUE ENGINEERING PUNCH LIST

ITEM NO.: **3-16.00** PROJECT COUNTY: **Warren** DATE OF STUDY: **10/31/2011 to 11/2/2011** **VE # 201108**

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
VE-10		Utilize a single span structure over Commonwealth Boulevard in lieu of a 2-span bridge			$1,879,000	$1,726,000	$153,000	NA	Oth	
VE-11		Utilize a single span structure over a reduced width Commonwealth Boulevard in lieu of a 2-span bridge			$1,848,000	$1,383,000	$465,000	NA	Oth	
VE-12		Utilize a three sided culvert structure for a reduced width Commonwealth Boulevard in lieu of a 2-span bridge			$1,848,000	$1,020,000	$828,000	NA	Oth	
Other Design Comments										
DC-1		Revise the cost estimate for bridges, temporary barriers, maintain and control traffic, traffic signal, and sinkhole mitigation			NA	NA	NA	NA	Oth	
DC-2		Verify the number of asphalt types in the pavement design folder match the number of asphalt types listed in the cost estimate			NA	NA	NA	NA	Oth	
DC-3		Utilize the minimum vertical clearance for all structures in lieu of excess clearance			NA	NA	NA	NA	Oth	
DC-4		Reduce the driving lane width to 11 ft. in lieu of 12 ft. lanes			NA	NA	NA	NA	Oth	
DC-5		Reduce the width of shoulders from 12 ft. to 10 ft.			NA	NA	NA	NA	Oth	
DC-6		Install cable barrier in the median			NA	NA	NA	NA	Saf	
DC-7		Utilize acceleration/deceleration lanes for construction access from I-65 to the new connector in lieu of the Phase 1 "T" intersection with I-65			NA	NA	NA	NA	Saf, Con	
DC-8		Construct the bridge over I-65 in the first phase to facilitate construction traffic access between north and south sides of I-65 in lieu of constructing bridge over I-65 in the second phase			NA	NA	NA	NA	Saf, Con	
					Saf 3 Ops 0 Env 5 Con 9 Oth 11					

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

END OF REPORT

This report was compiled and edited by:
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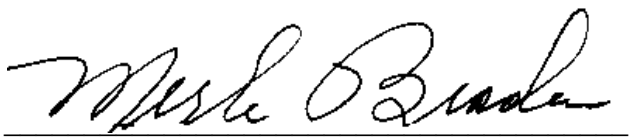

Approved by Merle Braden, PE, CVS-Life (URS)